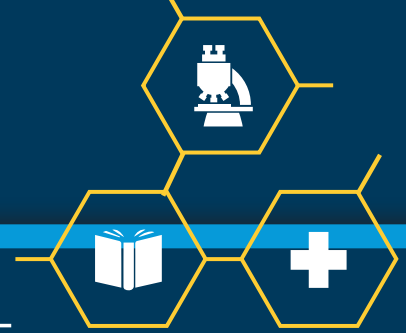


GW RESEARCH DAYS

TUESDAY, APRIL 9, 2019

THE GEORGE WASHINGTON UNIVERSITY

WASHINGTON, DC



GW RESEARCH DAYS

2019

ANNUAL RESEARCH DAY

TUESDAY, APRIL 9, 2019

MARVIN CENTER

800 21ST STREET, NW

- 8:30-10:00 a.m.** **Registration** (*Third Floor Lobby Adjacent to Grand and Continental Ballrooms*)
- 8:30-10:00 a.m.** **Poster Setup** (*First Floor Great Hall, Third Floor Grand and Continental Ballrooms*)
- 10:00 a.m.-1:00 p.m.** **Poster Presentations and Judging** (*First Floor Great Hall, Third Floor Grand and Continental Ballrooms*)
- 1:00-2:00 p.m.** **Poster Retrieval** (*First Floor Great Hall, Third Floor Grand and Continental Ballrooms*)

RESEARCH DAYS WEBSITE

ONLINE - <https://researchdays.gwu.edu>

- 5:00 p.m.** **Poster Winners Announced Online**

MARVIN CENTER

800 21ST STREET, NW

- 6:00-8:00 p.m.** **GW Research Days Celebration hosted by the GW Undergraduate Review**
(*First Floor Presentation Space, Adjacent to Columbian Square*)
- **Presentations by GW Research Days Participants**
 - **Keynote by Catharine Young, PhD, Senior Director of Science Policy, Biden Cancer Initiative**



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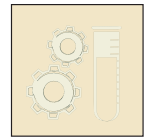
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SCHOOL OF ENGINEERING AND APPLIED SCIENCE

Identifying Blood Vessels in Thermal Breast Images

The initial stages of breast cancer are characterized by an increase in the vascularity of regions where a tumor is present. This results in the affected region being warmer and, when exposed to ambient conditions, cooling more slowly, than the surrounding tissue. Those characteristics allow thermographic analysis of a patient's breasts potentially to be used to detect the early stages of breast cancer. Results to date have been promising, but a confounding factor has been the similarities between tumor regions and blood vessels naturally present in the breasts. Blood vessels are easy for those who have spent time analyzing these images to identify subjectively, but we have not previously had a way of removing the blood vessels computationally. This project aims to develop a reliable method of distinguishing blood vessels in thermal images to increase the diagnostic accuracy of thermographic analysis for breast cancer.

Blood vessels appear on thermal images as long, tubular bright regions. This allows a Frangi vessel enhancement filter set to look for bright structures to be implemented to create a new image that assigns to each point a measure of its "vesselness," or how likely it is that the point is part of a vessel. The Frangi vesselness filter uses the eigenvalues of the Hessian matrix of the image to detect large and small gradients and outputs a vesselness image.

Although the filter has shown promising results in identifying vessels, there are multiple difficulties and shortcomings that we have begun to address. One significant issue is the need for the parameters of the filter (thickness of the tubular structures, overall sensitivity) to be adjusted for each patient. This lack of uniformity requires judgment and input on the user's part that is difficult for someone not well versed in analyzing these images. A way of combatting this is to use CLAHE (Contrast Limited Adaptive Histogram Equalization) before applying the vesselness filter. This improves the contrast in the image and allows for the same parameters to be used for all the patients and volunteers analyzed so far.

Using the Frangi vesselness filter after performing CLAHE on thermal breast images is an effective, but imperfect, method of identifying vessels. We present our results for a set of real thermal breast images, including several measures of performance. Future work will focus on identifying the ideal parameters that can be used across patients and refining what the filter identifies as vessels.

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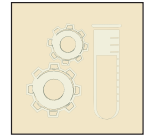
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BIOMEDICAL ENGINEERING



SCHOOL OF ENGINEERING AND APPLIED SCIENCE

Human Organotypic Cardiac Slices: A Platform Studying Long QT Phenotype

Cardiac excitability is controlled by a combination of depolarizing and repolarizing currents, whose dysregulation during heart failure (HF) or myocardial infarction (MI) play a significant role in relevant life-threatening cardiac arrhythmias. Several studies have shown that electrical remodeling of the heart, which can involve a profound decrease in the transient outward K⁺ current (I_{to}), is associated with arrhythmias. Many studies have also shown that specific gene mutations which encode for cardiac potassium channel sub-units are the principal cause of certain arrhythmias resulting from abnormal repolarization, such as in the case of Long QT Syndrome (LQTS). However, the precise relationship between the expression and regulation of these potassium channels and arrhythmias in humans is still not clear, because most studies are conducted in animal models or cell lines.

Human left ventricular slices were prepared from human donor hearts that were rejected for transplant but offered for research. Upon procurement of the human heart, small cubes (1cm²) were cut from the left ventricular tissue and sliced into 400µm thick slices. Slices were cultured under physiological culture conditions for a total of 72 hours, with transfection occurring 24 hours after the slices were cut from the heart. Specific small interfering RNAs (siRNAs) for both I_{to} and I_{ks} proteins were used to silence KCNIP2 and KCNQ1 genes expression, respectively. Positive and negative controls were also carried out to verify the efficiency of the transfection protocol. At each time point (0, 24h, 48h, and 72h), slices were collected for functional, structural, and molecular evaluations. Functional studies were performed using cardiac optical mapping, in which slices were fluorescently stained with a voltage-sensitive dye (Di-4-ANEPPS) and electrophysiological properties measured. Structural studies were carried out with immunohistochemistry and confocal microscopy imaging to assess channel silencing effects on protein localization at the cellular and sub-cellular levels. Finally, the quantitative effects of the silencing protocol were tested with Western Blotting and measuring total protein expressions levels before and after transfection.

Functional studies showed that slices treated with siRNA for KCNIP2 exhibited a prolonged repolarization time compared to the controls, as observed from the action potential duration (APD) recordings in a representative human heart from a 73-year-old female donor. Western Blots and immunohistochemistry results also showed differences in protein levels and expression from the various donor human hearts examined. This project continues to examine the knockdown of I_{to} and I_{ks} in a human organotypic tissue slice model to better understand LQTS.

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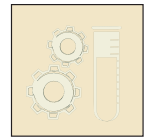
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SCHOOL OF ENGINEERING AND APPLIED SCIENCE

Investigating Pro-Arrhythmic Activity in Arrhythmogenic Right Ventricular Cardiomyopathy Type 5 with Optical Mapping

Arrhythmogenic Ventricular Cardiomyopathies (AVC) are a family of diseases characterized by ventricular tachycardia, heart failure, sudden cardiac death (SCD), and fibrosis. Autosomal dominant right ventricle predominant AVC type 5 (ARVC5) is caused by a missense mutation in transmembrane protein 43 (TMEM43). Earlier onset of symptoms and increased hospitalization in human males compared to females demonstrate that ARVC5 is sex-influenced. While the effects of ARVC5 on cardiac function have been investigated, the specific mechanisms responsible are largely unknown. To study these mechanisms, a mouse model for ARVC5 has been developed that carries the S358L-TMEM43 mutation. Pro-arrhythmic signs in ECG tracings, notably QRS prolongation, predict increased risk of SCD, necessitating advanced electrophysiological studies using optical mapping. The objective of this study is to further characterize the phenotypic sex differences in the progression of ARVC5 and to characterize pro-arrhythmic activity using ECG recordings and optical mapping.

WT and homozygous $Tmem43^{S358L}$ mice were studied at 3 months of age. 5-minute ECG tunnel recordings were collected prior to each optical mapping experiment, in which the mouse heart was excised and perfused on a Langendorff system in physiological conditions. Di-4-ANEPPS (voltage-sensitive dye) was used to measure transmembrane potential. Hearts were paced on the RV lateral surface at 2X threshold. S1-S1, S1-S2, and S1-S2-S3-S4 protocols were executed for arrhythmia induction. RR interval and QRS duration of ECG tunnel recordings were analyzed using MATLAB.

Poincare plots of RR-intervals show that male TMEM43 mutants exhibit irregular heart rate while females do not at 3 months of age, which is supported by clinical findings between sexes. On average, QRS duration was not significantly higher in mutant mice compared to WT (13.87ms vs. 13.34ms). ECG recordings will continue to be recorded as the disease progresses. No arrhythmic activity was observed during optical mapping studies, however pseudo ECG and optical data revealed irregular rhythm and poor tissue viability in mutants compared to WT. The absence of arrhythmia may be due to the fact that electrical disorders are more difficult to detect in animals with fast heart rates. To better elucidate an understanding of the pro-arrhythmic activity in the ARVC5 phenotype, isoproterenol will be administered in future experiments to increase arrhythmia susceptibility. Previous studies show progressive systolic LV and RV dysfunction evident at 6 months of age, so optical mapping and ECG recordings will be performed at 6 months of age to continue investigating pro-arrhythmic activity and associated manifestations in ECG.

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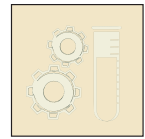
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SCHOOL OF ENGINEERING AND APPLIED SCIENCE

Engineered Live Three-Dimensional “Spark Cell” Structures for Optical Pacing

Prior work on cardiac optogenetics has established the tandem-cell-unit strategy for pacing, i.e. light-sensitive (channelrhodopsin-2) non-myocytes, such as human embryonic kidney cells (ChR2-HEKs), when put in contact with human stem-cell-derived cardiomyocytes (hiPS-CMs), can be used for optical stimulation. We have successfully engineered 3D spheroids of ChR2-HEK “spark cells” and set out to track the earliest emergence of optical pacing after these structures are deposited onto hiPS-CM syncytia.

ChR2-HEKs were seeded at 2×10^4 cells/well onto 96-well microplates chemically designed to promote cellular self-assembly. Cells were cultured over 24 hours. Each resulting “spark-cell” spheroid was then transferred onto an iPS-CM monolayer and monitored in 45-minute increments. Blue light (470 nm) pulsed at a frequency of 0.5 Hz to 1.0 Hz at $<1\text{mW/mm}^2$ was used to probe for responsiveness, while optical measurements with genetically-encoded calcium indicator R-GECO was used for capturing the response. We observed a 1:1 relationship between blue light pulses and calcium transients paced at 0.5 Hz to 1.0 Hz approximately 8 hours after spheroid deposition.

Our results demonstrate a simpler, scalable, and cost-effective method to optically stimulate engineered cardiac tissue compared to traditional stimulation approaches. In particular, we show that 3D “spark cell” spheroids can confer cardiac optical pacing within a much shorter time frame compared to direct optogenetic transformation of cardiomyocytes by plasmid transfection or viral infection, which typically requires more than 48 hours. Our future work involves extension of the method to other “spark cell” types such as cardiac progenitor cells, and robotic automation of the spheroid handling.

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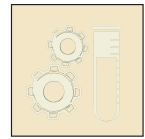
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Chronic Measurement of Stimulated Calcium Transients with Genetically-Encoded Calcium Indicator and All-Optical Cardiac Electrophysiology

Calcium ion fluxes play a crucial role in the rhythmic contraction of cardiomyocytes. Developing a reliable method for chronically monitoring stimulated calcium transients in human cardiomyocytes is valuable for tracking dynamic changes as the cells grow. We combined the red-shifted Genetically-Encoded Calcium Indicator R-GECO with the optogenetic actuator channelrhodopsin-2 (ChR2). By expressing the R-GECO and ChR2 genes into patient-derived induced pluripotent cardiomyocytes (iPS-CMs), we measured optically-paced calcium transients over time.

Cytoplasm-targeting R-GECO was acquired from Addgene as bacteria in agar stab. Purified R-GECO plasmid was introduced to iPS-CM densely-grown samples on 96-well plates using lipofection. Expression of ChR2 was achieved by adeno-viral infection in the same cells. Continuous stimulation and recording were conducted with these spectrally-compatible optogenetic actuator (ChR2) and sensor (R-GECO) using the all-optical methods developed in our laboratory. Spontaneous and optically-paced (0.7Hz and 1Hz) calcium transients were recorded every other day for 13 days in these iPS-CM samples.

Co-expression of R-GECO and ChR2 in iPS-CMs was excellent. We confirm the ability of the sensor and actuator to work in conjunction over an extended length of time (two weeks). Robust calcium transient recordings were obtained, and are currently being analyzed for mapping out electrophysiological changes over time.

The use of R-GECO in conjunction with ChR2 provides a reliable all-optical chronic-monitoring methodology for optically-controlled calcium transients. The stable expression of the calcium sensor significantly eliminates the risk of contamination posed by repetitive use of indicator dyes. Our future work entails leveraging this technology for optimization of the growth and maturity of human iPS-CMs.

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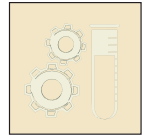
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SCHOOL OF ENGINEERING AND APPLIED SCIENCE

Sex Differences in Ion-Channel Promoter Expression of Healthy Human Heart

Cardiovascular diseases remain the primary cause of death worldwide. Several epidemiologic and investigative studies have shown the evidence of sex hormones effect on cardiac electrophysiology through genomic regulation. However, very little is known about the molecular basis for gender-related discrepancies in cardiac electrophysiology. Due to physiologically distinct functions of atria (electrical impulse initiation) and ventricles (blood pumping) there is a difference in ion-channel expression within a heart that cause different disease susceptibilities between both sexes.

Compare holistic ion-channel gene expression associated with sex differences using Cap Analysis of Gene Expression (CAGE) analysis on left atrial (LA) and left ventricular (LV) human donor hearts.

Total RNA was extracted from left atria (LA) and left ventricle (LV) of human donor hearts n=4 males (mean age = 53.75) and n=3 females (mean age = 58.7), the cause of death was determined to be non-cardiogenic. Samples were analyzed with CAGE, which is a high throughput method for transcriptome analysis that utilizes 'cap-trapping'. The number of tags gives a frequency of usage that provides information about transcription start sites as well as transcript expression levels. Normalization of raw CAGE tag count was performed as counts per million. Statistical significance ($p < 0.05$) was determined with Wilcoxon Rank-Sum and Kruskal-Wallis tests.

57 genes are known to code for ion-channel α - and β -subunits in human hearts. Interestingly, 14 genes were not detectable; 13 genes showed low expression which was insufficient for promoter identification with the threshold of +/-500 bp regions. Male and female ion-channel expression levels were significantly different from each other ($p = 0.0002$). The highest upregulation in both sexes was detected in promoters of I_{Na} (SCN5A and SCN1B), $I_{to,f}$ (KCNIP2), I_{K2P} (KCNK1), and I_{NCX} (SLC8A1). Interestingly, SLC8A1, which is known to be cardioprotective from ischemic injury was significantly upregulated in female atrium ($p = 0.0408$). Other promoter expression that was significantly different across sexes include: $I_{to,f}$ (KCND3) ($p = 0.0186$) and I_{KATP} (KCNJ11) ($p = 0.049$) in atrium and I_{Na} (SCN4B) ($p = 0.028$) in ventricle.

Our study reveals that there are sex-dependent gene expression differences in cardiac ion-channels and that CAGE approach allows high-throughput gene expression profiling which can be beneficial for gender-specific computational model development, drug testing, and personalized medicine overall.

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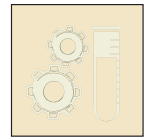
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Can a Convolutional Neural Network (CNN) Implement Histogram Equalization in Image Analysis?

Recently, the Convolutional Neural Network (CNN) as a typical deep learning technique has been widely used in many image processing applications such as classification, recognition, segmentation and image reconstruction and achieved remarkable success. We have applied CNN to segment the breast region from thermal breast images. In that study, an interesting phenomenon showed that: image pre-processing by contrast-limited adaptive histogram equalization (CLAHE) can improve segmentation outcomes. The benefit of pre-processing is natural in traditional image processing, but it is questionable in deep learning. In a CNN, if any pre-processing could improve the final result, it will be automatically learned and implemented by the initial convolutional layers. That is one key feature of CNN. Thus, a likely reason for this phenomenon is: CNN cannot learn and implement histogram equalization (HE) to images. That is likely the case because convolutional operations in CNN are localized, but HE is a global process, and thus a CNN may inherently be unable to perform HE on images.

To test this hypothesis, we firstly designed a simple 3-layer CNN and its input and output are same-size images. Second, the training images for CNN are from A category (thermal breast images) and the supervisors are histogram-equalized images. Third, we tested the trained CNN by different images from A category and some images from B category (portrait and nature images), which has distinct difference from A category. Then, we quantitatively compared the output images from CNN with histogram-equalized testing images via the Cumulative Histogram Similarity (CHS) between two images. Results show that CNN trained on A category performed about 40% lower on average CHS than HE to process B category. Such preliminary conclusion demonstrates CNN does not well learn HE but somewhat image style transformation to a certain category. Because once HE is learned, it should be implemented as needed for any kind of images. Our next studies are to examine the hypothesis on more categories' images and varied CNN architectures. In addition, we will seek a theoretical explanation of such limitations of the CNN. Two major points of significance of this study are: 1) it is a good way to define some of the limitations of CNNs, and thus helps understand them further; 2) if our hypothesis is eventually confirmed, we will examine CNNs in combination with other image pre-processing approaches. Such conclusions could encourage more CNN applications to use image pre-processing to improve their performance.

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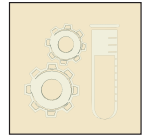
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Automated Detection of Simulated Motion Blur in Digital Mammograms

Motion blur is a known phenomenon in full-field digital mammography that arises during image acquisition. It has been reported to reduce lesion detection performance and mask small microcalcifications, resulting in failure to detect smaller abnormalities until they reach more advanced stages. It is estimated that 20% of screening mammograms show elements of blur. Motion blur has been found to be due mainly to paddle motion (up to 1.5 mm vertically) during the clamping phase of the mammography exam. We propose to detect motion blur automatically using machine learning algorithms, which could support the clinical decision-making process during the mammography exam by allowing for an immediate retake, thereby preventing unnecessary expense, time, and patient anxiety.

We simulated blur mathematically to mimic the blur seen in mammograms. The blur point-spread function mask is generated by displacing an individual pixel by a random vector (within the range of the blur effect) and the pixel contribution to the overall image is then sampled on a regular pixel grid using subpixel linear interpolation. This randomly-generated motion trajectory is constrained by several factors, including tissue elasticity, imaging exposure time, and size of blur effect (motion boundary in millimeters). The blur mask is convolved with a mammogram to create blur. Three motion blur magnitudes (0.5, 1.0, and 1.5 mm) were simulated on 68 mammograms (INbreast Database). Blur was quantified using 17 blur operators for each mammogram and at each blur level (272 images total). Machine learning classifiers, including Linear Support Vector Machine (SVM) and Subspace Discriminant Ensemble (SDE), were trained to distinguish three levels of blurred from unblurred mammograms, using four-way classification.

The average accuracy for classifying unblurred and blurred mammograms at three levels of magnitude was 75.40% and 74.60% for Linear SVM and SDE respectively. The true positive rate was highest for classifying mammograms with no simulated blur, reaching 99% for both classifiers with a false negative rate of 1%. Training the classifiers to distinguish mammograms with no blur from those with the lowest simulated blur level (0.5 mm) had accuracies of 98.5% and 97.8% for the Linear SVM and SDE respectively.

Our preliminary results show the potential to detect simulated blur automatically using machine learning classifiers and blur operators. We are currently fine-tuning our blur model, simulating smaller blur levels, and using larger mammographic datasets to train the classifiers.

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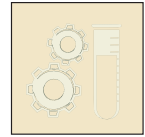
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BIOMEDICAL ENGINEERING



SCHOOL OF ENGINEERING AND APPLIED SCIENCE

Encapsulation of 5-Azacytidine in PEG-PLGA Nanoparticles for Improved Drug Delivery in the Treatment of Ovarian Cancer

Ovarian cancer is a deadly disease with extremely limited options for effective treatment. The development of ascites in the peritoneal cavity of the ID8 mouse model of ovarian cancer closely mimics late-stage ovarian cancer in women, thus making it a useful model. Preclinical research in this model shows that 5-Azacytidine (Aza) is an effective treatment as demonstrated by reduced tumor burden; however, this drug is rapidly metabolized and needs to be administered often. Designing nanoparticles for drug delivery can improve efficacy of a rapidly metabolized drug such as Aza, by increasing its bioavailability through sustained release. We aim to improve drug delivery of 5-Azacytidine by encapsulating it in PEG-PLGA nanoparticles. We investigated two different nanoparticle synthesis methods: emulsion evaporation and nanoprecipitation. Nanoparticles were then characterized for size/polydispersity and surface charge (zeta potential) using dynamic light scattering. UV-vis spectroscopy was additionally used to characterize encapsulation efficiency and drug loading. We observed that both methods of nanoparticle formation produced stable particles that were similar in size and polydispersity, but the nanoprecipitation method proved to be a more efficient process for nanoparticle synthesis. Nanoparticles will be tested in vitro with ID8 mouse ovarian cancer cells to assess release kinetics and validate effective Aza encapsulation. Specifically, we will use the ID8 p53^{-/-} mouse ovarian cancer cell line because p53-inactivating mutations are common for human ovarian cancer; additionally, this syngeneic model will allow us to later test the expected immune effects of Aza treatment within the tumor microenvironment. For in vitro testing using ID8 p53^{-/-} cells, we expect to see increased cell death with increased dosages of the Aza PEG-PLGA nanoparticles, but not with Blank PEG-PLGA nanoparticles. Further studies include assessing DNA Methyltransferase 1 (DNMT1) protein levels and 5-methylcytosine levels using the therapeutic, low-dose equivalent, of Aza PEG-PLGA nanoparticles used in vitro. Over the course of 5 days, we expect to see comparable levels of DNMT1 protein and 5-methylcytosine for cells treated with Aza PEG-PLGA nanoparticles once, in comparison to the standard 500 nM Aza dose for cells treated daily. In the clinic, Aza is also given daily, so sustained release would allow for less frequent injections, thus increasing patient comfort and compliance. Our encapsulation efficiency and drug loading studies demonstrate encapsulation of Aza, as determined by UV-vis spectroscopy. Our studies demonstrating nanoparticle size, polydispersity and stability show optimal values and consistency, as determined by DLS. In vitro studies demonstrating efficacy are currently ongoing.

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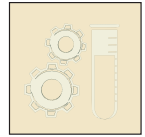
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SCHOOL OF ENGINEERING AND APPLIED SCIENCE

Breast Cancer Segmentation with Saliency Program and CNN

Breast cancer occurs when healthy breast tissue cells are taken over by cancerous cells, and metastatic cancer is cancer that has spread from the original site of the tumor, increasing the mortality rate of the patient. Every 1 out of 8 women will develop metastatic breast cancer in their lifetime, and 39% of women with breast cancer will die from the disease. Breast cancer is the most common cancer in the United States after skin cancer.

In this work, the breast tumor is segmented from the healthy tissue. The tumor is segmented in order to create a clearer image of the breast cancer for treatment. Having a clearer image is important in treatment, so that radiation is directed only at the site of the tumor and healthy tissue isn't damaged unnecessarily.

In order to segment the image, the original MRI images are first passed through a saliency program. Saliency is the extent to which an object or area in an image pops out or catches the eye of the viewer. Previous work has shown that a breast tumor is more salient than other areas of the breast. In this feature-based program, the Gabor function is used to create a map from the original image, which will emphasize the parts of the picture that a simple cell in the mammalian visual system would see. The Mahalanobis distance is then applied to find the pixels that are the most different from the mean of the pixels. These points that are the most different are the salient points, which are also the points most likely to be a breast tumor.

After the images are sent through the saliency program, a convolutional neural network (CNN) creates the final segmentation map. Each convolutional layer is made up of filters whose weights will be updated with every back propagation, determining how heavily each node should be weighted and allowing the FCN to create a more accurate segmentation.

In this program, the saliency program and FCN are combined to create a program that is more accurate at locating breast tumors than either program was alone. In this paper, the average accuracy for the CNN program alone is 0.93 and accuracy for the saliency program with the CNN is 0.99.

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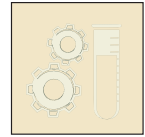
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Syncytium Cell Growth is Required for Mature Phenotype and IK1 Contribution in Human Induced Pluripotent Stem-Cell-Derived Cardiomyocytes (hiPS-CMs)

Human induced pluripotent stem cell-derived cardiomyocytes (hiPS-CMs) enable cardiotoxicity testing, patient-specific disease modelling and cellular therapy. However, their maturity has been of concern, e.g. relatively depolarized resting membrane potential and more spontaneous activity compared to adult ventricular cardiomyocytes, attributed to lack of inward rectifier potassium current (Ik1, Kir2.1 protein). Using Western blotting, here we confirm the presence of Kir2.1 expression in dense hiPS-CM syncytia and find it to be about six times lower than in adult human ventricular tissue. We present evidence that hiPS-CM cell density influences Kir2.1 expression in a direct way. Using all-optical cardiac electrophysiology and pharmacological treatments, we show reduction of spontaneous voltage activity and calcium activity, as well as irregular behavior and reduction in voltage-calcium uncoupling in denser cultures. Treatment with BaCl₂ (a Kir2.1 channel blocker), altered the frequency of spontaneous activity in a dose-dependent manner only in the highest density cultures, with Kir2.1 expression, but had little effect on sparser plated cells. Using optically-paced and optically-acquired action potentials, we also established dose-dependent decrease in the rate of rise of action potentials with BaCl₂ block only in the high-density cell cultures but not in the sparser ones. This result is in line with Ik1's role in resetting the membrane potential and increasing the availability of the Na⁺ channels for the next excitation event. Considering the contribution of Ik1 to the final repolarization phase, we confirmed that the action potential duration in denser cultures was increased with BaCl₂ but in a less dramatic manner. Our results emphasize the importance of syncytial growth with hiPS-CM to obtain more relevant mature phenotype.

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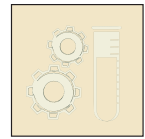
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SCHOOL OF ENGINEERING AND APPLIED SCIENCE

Patient-Based Classification of Clear Cell Renal Cell Carcinoma through Computed Tomography Texture Analysis

Renal cell carcinoma (RCC) is a malignant cortical tumor originating from the renal parenchymal urothelial system. More than half of RCCs are clear cell renal cell carcinoma (CCRCC). Their pathological characteristics can be classified into four grades according to the Fuhrman nuclear grading system. The major requirement to correctly treat tumors is knowledge of their sub-type, location, and aggressiveness. Computed tomography texture analysis (CTTA) can quantify a tumor's heterogeneity, which may contain information about the nature of the tumor. We studied whether CT scans could be categorized into sub-types using a trained classification model, which can be a reference for doctors to define the types of tumors and thus to provide suitable treatment. A reliable CT-based grading method could reduce the number of kidney biopsies required prior to therapy.

We obtained 77 CT scans of CCRCC images from 26 patients. Each tumor had three slices—one each from the superior, mid, and inferior aspects of tumor. (One small tumor had only two slices.) The tumor region was cropped by an experienced radiologist. Each image of a tumor is centered in an image of size 100 by 100 pixels. We extracted 44 texture features (including gray-level co-occurrence, gray-level run-length, and Hu's moments) and histogram-based features from normalized tumor images. The area under the receiver operating characteristic curve (AUC) is a measure of classifier performance. The AUC value for each feature was calculated according to the raw feature values, which was used to rank the features. A random-forest (RF) classification algorithm was developed to classify the grade of CCRCC. To analyze the results on a per-patient basis, we combined slices per patient. The RF classifiers were trained using 80% of the data, and the remaining 20% of patient data were used to test. The final AUC values after classification were calculated in the patient-based case by adjusting the cost matrix in the random-forest algorithm.

Since grades 1 and 4 have only one and two patients respectively, we combined grades 1 and 2 as a "low-grade" group and grades 3 and 4 were combined as a "high-grade" group. The best classification results were observed using random forests with the average accuracy in the patient-based case of 0.83 over 20 trials. And the best AUC value is 0.80 ± 0.06 using 10% of the features, which indicates good classification results. We expect further improvement as more data are acquired and other classification methods are evaluated.

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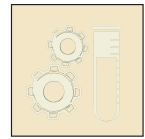
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BIOMEDICAL ENGINEERING



SCHOOL OF ENGINEERING AND APPLIED SCIENCE

Multispectral RTI: An Innovative Imaging Tool for Art Conservation

Reflectance Transformation Imaging (RTI) is a digital photographic technique that utilizes a hemispherical array of focal light emitting diodes (LEDs) that sequentially illuminate an object from multiple angles. A series of photographs of the object are acquired using a stationary camera, with each photograph capturing an image illuminated from a different angle. Software is then used to combine 64 images of the object to render a high-resolution, three-dimensional model of the surface. Additionally, digital filters and enhancements can be utilized to highlight subtle surface and textural features, including microfractures and material degradation.

RTI technology is especially valuable in the field of art restoration and preservation because it is a noninvasive tool that allows conservators to evaluate the condition of objects of art and artifacts and discover surface features that are not normally visible using conventional photography. This research is being conducted in collaboration with the Library of Congress, which is searching for new techniques to analyze a collection of rare French glass flutes from the 19th century. Many of these flutes are composed of potash glass, containing potassium carbonate, which has an unstable crystalline structure. As a result, these flutes are at risk of deterioration, and can develop microfractures, flaking, and material strain. The goal of this research is to develop a portable and economical RTI imaging unit that can identify incipient structural damages in irreplaceable antiquities and facilitate preservation and restoration.

Conventional RTI systems use arrays of LEDs that emit only white light. The novel feature of this project is the use of three types of LED light sources with distinct wavelengths: infrared, ultraviolet, and full-spectrum white light. The benefit of using multispectral illumination is that features that may be inconspicuous when imaged using one wavelength may be obvious using another. For example, minute surface cracks and fractures may be best assessed using white light, but stresses, strains, and flaking of materials may be better visualized using infrared or ultraviolet light. By incorporating LEDs with three distinct wavelengths of light in a single imaging device, the multispectral RTI machine becomes a versatile tool for art conservation.

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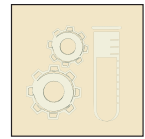
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SCHOOL OF ENGINEERING AND APPLIED SCIENCE

Infrared Breast Region Segmentation by U-Nets

Thermal infrared images of the breast are being investigated to determine if they can be used to detect breast cancer in its early stage by analyzing its vessels and masses, which are visible because of the heat they generate. It is important to limit the examined area by finding the breast boundary. Some standard segmentation algorithms, however, work poorly for patients with small breasts. In addition, the raw infrared images contain background and noise that will reduce the segmentation accuracy. So, we designed a new algorithm to eliminate those interferences and used a neural network to perform segmentation.

From 11 patients, we obtained 165 infrared images; all contained background and noise. To use U-Nets, we transformed those 16-bit images to 8-bits and eliminated the interferences at the same time. We applied an averaging filter with kernel size 101 by 101 to smooth the raw images, and used the Otsu algorithm to find the thresholds. Those thresholds were modified by adding a compensation value. We removed the interferences by using this new threshold and remapped the raw images to 8-bits.

After transforming the raw images, we built U-Nets to perform segmentation. The network contains two parts: a contracting path and an expansive path. The contracting path follows the typical architecture of a convolution network, and the expansive path is the deconvolution network. In the expansive path, we combined the feature map which is cropped correspondingly from the contracting path. After training the model, the networks can generate the segmentation result. For patients 1, 3, and 9—those with small breasts—the average Intersection over Union (IoU) measures of accuracy were 0.82 ± 0.015 . For other large-breast patients, the average IoU accuracies are 0.92 ± 0.01 .

Image enhancement can improve the accuracy of segmentation. Contrast-limited adaptive histogram equalization (CLAHE) is a useful way to improve the contrast of images. For different patients, however, the optimal parameters of CLAHE are different; using a fixed value of clip limit would yield unsatisfactory results. We therefore designed an algorithm, based on image entropy, to determine the clip limit values independently for each image. After using CLAHE to improve the contrast, the average IoU accuracy of patients 1, 3, and 9 are improved to 0.87 ± 0.015 .

Combining U-Nets and image enhancement can improve segmentation accuracy substantially. Also, the CLAHE was useful in finding the vessels in breast areas, which will help to reduce errors as the method is developed further.

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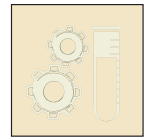
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SCHOOL OF ENGINEERING AND APPLIED SCIENCE

“Snakes” Versus “ConnectPixels:” Segmentation of IR Images for Breast Cancer Detection

Current diagnosis techniques of breast cancer have various drawbacks, including the expenses incurred and time it takes to image patients as well as the exposure to harmful radiation. A potential solution to this is using thermographic images of breasts and locating warm regions in the images to detect tumors, as an adjunct to mammography. Thermographic imaging is not currently a commercially used tumor detection method due to the lack of evidentiary literature and difficulty standardizing segmentation. This study aims to create an automated method of segmenting the breast regions from the captured images to allow for an efficient, uniform segmentation with minimal manual input. This method could potentially replace manually segmented regions used for cluster analysis, thus making analysis more efficient and user-friendly. Increasing the precision and efficiency of the breast region segmentation is necessary for the future implementation of cluster analysis on the region of interest to minimize noise and the number of pixels to be processed.

Thermal images of fifteen patients and twenty-six normal volunteers were acquired over a fifteen minute imaging period and analyzed with MATLAB. Edge pixels, or pixels that could potentially be the boundary of the breast, were determined by processing the images through multiple edge detection algorithms. After locating the edge pixels, two pixel connection methods, ‘connectPixels’ and ‘snakes’, were compared to determine which one formed connections that more closely approximated the breast’s natural outline.

Success was calculated for each method with the Jaccard Similarity Index (JSI), using manual segmentation as truth. The accuracy of the manual segmentation was improved upon by registering the infrared images to regular “visible” images, containing more apparent borders, before manually segmenting. The resulting JSI values for each image indicated how similar the automated segmentations were to the manual truth, with JSI values closer to 100% indicating a closer match to the truth. Averaging all the JSI values, ‘connectPixels’ had a JSI value of 0.8343 for patients and 0.8147 for volunteers and ‘snakes’ had a JSI value of 0.9499 for patients and 0.9273 for volunteers. The ‘snakes’ method proved to be a closer match to the truth than ‘connectPixels’. Future studies will focus on automating the segmentation further by reducing the manual input required. The ‘connectPixels’ method could be developed further to be more accommodating of different breast sizes and ultimately, help develop a more uniform segmentation method.

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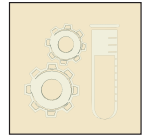
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SCHOOL OF ENGINEERING AND APPLIED SCIENCE

Functional Response of Perfused Hearts to Optogenetic Activation of Intrinsic Cholinergic Neurons

Parasympathetic cholinergic neurons produce acetylcholine and are found in the central and peripheral nervous system. The structure and function of parasympathetic cholinergic neurons that innervate the heart remains incompletely understood. It was hypothesized that cardiac cholinergic neurons have a significant influence on ventricular function by reducing heart rate (HR) and increasing coronary vasodilation, measured by increased coronary flow rate (CFR). The response of optogenetic activation of cholinergic neurons in the right atrium was studied using Langendorff perfused mice hearts followed by periods of optical stimulation. Hearts were subsequently CUBIC-cleared to further study the structure of cardiac cholinergic neurons. Results of a paired t-test indicated significant drops in HR when cholinergic neurons were activated, as hypothesized. Significant drops in CFR during stimulation were also observed (paired t-test), contrary to our hypothesis. However, HR was a confounding variable in the experiments, which may have contributed to reductions in CFR. Next steps include isolating CFR measurements from HR influence to determine if, independently, CFR increases in the presence of exogenous acetylcholine. This correlation should provide more evidence for cholinergic neurons as the mechanism for parasympathetic control on the heart, leading to a decreased HR and changes in CFR. A better understanding of the anatomy of cholinergic neurons and their functionality will provide an overall better understanding of the human heart and its abnormalities, thereby also improving targets for disease treatment.

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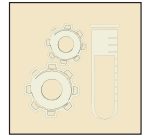
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SCHOOL OF ENGINEERING AND APPLIED SCIENCE

Development and Characterization of Bovine Milk Ultrasound Responsive Exosomes

Exosomes are naturally secreted bilayer vesicles ranging in size from 40 to 130 nm that play a critical role in cell-to-cell communications and protein and RNA delivery. Here, for the first time, bovine milk derived exosomes have been modified to be acoustically responsive as potential ultrasound contrast agents. The echogenic exosomes were formed through a freeze-drying process in the presence of mannitol. The size and morphology of the particles were assessed with Dynamic Light Scattering, a qNano™, and atomic force microscopy (AFM). The ultrasound response of these particles was characterized through linear and non-linear scattering behavior. The presence of the echogenic exosomes enhances the scattered signal by 11.4 ± 6.3 dB. The stability of these particles under constant ultrasound exposure were assessed to be similar to echogenic polymersomes. The variation of mannitol concentration was assessed. To assess the imaging improvement of ultrasound imaging, the exosomes were injected through a tail vein and synovial fluid in mice. The brightness within the images was significantly higher when the echogenic exosomes were injected than before. The modification of the echogenic exosomes shows to have great promise as potential ultrasound contrast agents or ultrasound responsive drug delivery system.

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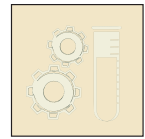
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In Vitro Evaluation of Cardiotoxicity on Human Induced Pluripotent Stem Cell-Derived Cardiomyocytes After Treatment with Histone Deacetylase Inhibitors

The development of histone deacetylase inhibitors (HDACi) as anti-cancer therapy is an active research area with almost 500 ongoing clinical trials at various stages. Negative cardiac effects of HDACi indicated in trials suggest the need for a high-throughput method for preclinical cardiotoxicity testing. In this study, we apply an all-optical drug screening methodology to a panel of four relevant HDACi: panobinostat which shows clear warnings for adverse cardiac events including arrhythmias, entinostat which is in phase III of clinical trials, tubastatinA, and 4-phenylbutyrate which has been shown to act as a counter-measure for hypertrophy and heart failure. Human induced pluripotent stem cell-derived cardiomyocytes (hiPSC-CMs) are used as a model for the cardiac effects of treatment, both cardiotoxic and beneficial.

Human iPSC-CMs were dosed in 96-well plates with three concentrations of each compound for one hour. HDAC Class I/II enzyme activity was quantified using a SpectraMax i3x™ (Molecular Devices) to characterize relative inhibition levels of each compound. Sample cell toxicity following treatment, including cytotoxicity, cell viability and apoptosis was also assessed. hiPSC-CMs were treated with the panel of HDACi for 24 hours and modulation of histone 3 and tubulin acetylation was assessed by Western immunoblotting technique. For functional assessment, hiPS-CMs were optogenetically transformed by viral infection with Channelrhodopsin-2 with a YFP marker for optical pacing, dosed for 48 hours, and labeled with calcium and voltage sensitive dyes. OptoDyCE, an all-optical electrophysiology interrogation platform, was used to collect spontaneous and optically-paced action potentials (APs) and calcium transients (CTs). Each condition was optically-paced at 0.5 Hz for 25 second recordings.

Treatment with panobinostat resulted in a dramatic increase in cytotoxicity and apoptosis while treatment with other compounds had a lesser effect. Cell viability decreased for all compounds in a dose-dependent manner. Inhibition of HDAC I/II enzyme activity was detected in a dose-dependent manner for all compounds. Panobinostat and 4-phenylbutyrate inhibited activity greater than other compounds. All compounds increased H3 acetylation in a dose-dependent manner, while only tubastatin A treatment significantly increased tubulin acetylation. Panobinostat and tubastatin A completely suppressed spontaneous activity and induced dramatic AP and CT shortening at highest concentration. 4PB increased CT duration by 15-20% while entinostat induced no significant changes in electrophysiology. No overt arrhythmias were observed with any of the compounds. We demonstrate the automated investigation of *in vitro* models, giving initial indications of cardiotoxic and potentially beneficial effects of HDACi early in the development process.

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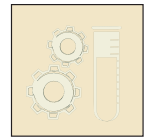
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SCHOOL OF ENGINEERING AND APPLIED SCIENCE

Tumor Heterogeneity and Genomics to Predict Radiation Therapy Outcome for Head-and-Neck Cancer: A Machine Learning Approach

This study was inspired by the observation that a tumor is not a homogeneous organ-like system. Variations in the imaging features within a single tumor have been observed. Tumor heterogeneity arises from two causes: variations in blood flow to the different regions of the tumor, leading to radiologic heterogeneity; and variations in gene mutations, leading to genomic heterogeneity. The heterogeneous nature of the tumor leads to failure in establishing a uniform therapy system for all patients. Establishing a relationship between tumor heterogeneity and the treatment outcome can be instrumental in developing a therapy system unique to the patient.

The purpose of our study was to determine whether the information present in the heterogeneity of tumor regions in the pre-treatment PET-CT scans of Head-and-Neck Squamous Cell Carcinoma patients can be a useful measure of the efficacy of radiation therapy in their treatment. For this purpose, the patients were divided into two categories based on the recurrence status of the tumor post-treatment, and texture analysis was performed for the quantification of intra-tumor heterogeneity. Texture features are used in the Classification Learner Application in MATLAB, which uses several classification methods including Weighted K Nearest Neighbors, Linear Support Vector Machine, and Bagged Trees. Slice-wise classification results are computed for 2D and 3D cases using 50-fold cross-validation for HNSCC and Head-Neck databases separately, and by combining them. For the computation of patient-wise classification results, we assign the class label possessed by more than half of a subject's slices.

To investigate this phenomenon further, we performed a combined study of the textural and the gene mutation information of a group of patients to see if the gene data can be used as additional features in the determination of treatment efficacy. Initial results indicate that a combination of the heterogeneity and gene expression information can be used to effectively design personalized treatment regimens for patients.

We are currently working on analyzing images of patients of lung adenocarcinoma and squamous carcinoma for extension of our work towards development of a more comprehensive method of therapy personalization in cancer patients.

Prediction of the response to radiation therapy can be used to reduce the number of patients who are unnecessarily exposed to radiation. Tumor texture measures provide a measure of tumor heterogeneity, which can be used to predict tumor recurrence status.

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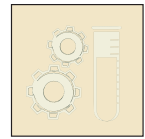
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SCHOOL OF ENGINEERING AND APPLIED SCIENCE

Electrocardiographic Response to Doxorubicin Treatment in Mouse is Modulated by Conscious and Anesthetized State

Doxorubicin (DOX) is an anthracycline antibiotic, currently used in anti-cancer chemotherapy. DOX causes DNA fragmentation and generates free radicals that can result in cancer cell apoptosis. However, DOX has also been shown to deteriorate cardiac function in cancer patients. This study investigates the effects of DOX on cardiac function from Electrocardiograms (ECGs) of mice treated with varying DOX doses, in conscious and anesthetized state.

Mice at ~15 weeks of age were injected with saline, 20 or 30 mg/kg DOX and ECGs were recorded 5 days post-injection. Conscious ECG was recorded using the emka Technologies ECG tunnel device. Then, the mouse was anesthetized using isoflurane (1 and 2.5%) and anesthetized ECG was recorded using a Vevo Visualsonics ultrasound machine mouse platform. P, PR, QRS, QTc, and RR intervals/durations were measured using a custom Matlab program.

Preliminary results indicate that there are significant differences between the conscious and anesthetized ECGs recorded from the same mouse. For example, P wave intervals were shortened by approximately ~31% while PR and RR intervals were prolonged by ~30% and ~42%, respectively, in mice in anesthetized state relative to conscious state. No change in QRS durations were observed while the QTc response was more complex.

Furthermore, ECG response to DOX treatment showed some important differences in the conscious state relative to the anesthetized state. More specifically, while no ECG parameters were different between saline and DOX-treated mice in the conscious state, several parameters were significantly modulated in the anesthetized state. Briefly, the P wave duration was significantly reduced by ~28% in female mice treated with DOX, irrespective of dose, relative to saline-treated controls. Additionally, QTc and RR interval prolongation (~82% and ~40%, respectively) were observed in female mice treated with 30 mg/kg DOX. These effects could be a combinatorial effect of isoflurane and DOX or it could be a result of other factors that are altered between the two states such as the contribution of the autonomic nervous system.

To summarize, these data indicate that 1) significant differences were observed between conscious and anesthetized ECGs recorded from the same mouse and 2) the effect of DOX treatment produced differing responses in the conscious versus anesthetized state. While the former suggests that ECG differences due to anesthesia extends beyond the slowing down of the heart rate as previously reported, the latter could have important implications in the diagnosis and treatment of DOX-induced cardiotoxic effects.

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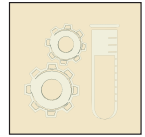
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SCHOOL OF ENGINEERING AND APPLIED SCIENCE

Physiological Analysis and Modeling of Stress during Human UAV Interaction

This study presents a stress evaluation method during the interaction between a human and an unmanned aerial vehicle (UAV). A virtual reality (VR) based UAV stress simulation and monitoring system are developed for the experiment. The heart-rate variability (HRV) is used for building the model. The stress is treated as a set of continuous states in this study because HRV could exhibit rapid changes when the human is experiencing acute stress during the interaction. The results show that human stress is induced in the experiment and the time domain features show a consistent pattern. Unsupervised learning algorithms are applied to characterize the dynamic patterns and cluster the different stress levels with feature mapping on a 2D plane associated with the position and velocity of the UAV. The proposed method is validated by modeling the stress during Human-UAV interaction. The stress is induced by changing the distance and velocity in this experiment. Then, the HRV time domain features are extracted to build the model to estimate stress. A PCA-based clustering method is used in this study; several physiological data including the time domain features are combined to find the correlation between these signals and the movements of UAV. Finally, the results show that the HRV parameters, SDNN, SDSD, and RMSSD, have a decreased pattern among the clusters which could reflect on the Distance vs. Velocity plane. The stress level can be continuously defined based on those parameters.

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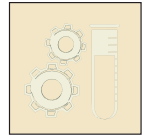
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SCHOOL OF ENGINEERING AND APPLIED SCIENCE

Fully Implantable Battery-Free Pacemakers for Optoelectric Stimulation of the Rodent Heart

Heart failure, or the condition where the heart becomes less efficient at pumping blood, affects 5.7 million adults and contributes to nearly 300,000 deaths per year in the United States. To better understand heart failure, large animal models of heart failure have been developed by rapid pacing of the heart using implantable pacemakers. Small animals, such as rodents, are a more versatile, affordable model to investigate heart failure across a range of genotypes and phenotypes. However, few miniaturized tools suitable for chronic pacing in small animals exist. Here, we present a fully implantable, battery-free optoelectric pacemaker for rats and mice which is powered by wireless inductive power transfer. To validate our miniature pacemakers, the electrical pacing abilities of the device were confirmed by *ex vivo* optical mapping of the membrane potential activation of mouse hearts. Optical pacing abilities were verified by far-field ECG during illumination of *ex vivo* optically depolarizable transgenic mouse hearts which express channelrhodopsin-2 (ChR2). For chronic *in vivo* electrical pacing, the miniaturized pacemaker was implanted into rats where the electrode was sutured onto the anterior epicardial surface of the left ventricle, and the device receiver was placed into the subcutaneous space. Successful pacing for capture of the heart was verified by ECG before incisions were closed and rats were allowed to recover. Pacing and capture of the heart was monitored daily by ECG. Our results show that ChR2-expressing mouse hearts were able to be paced optically, and the heart rate was captured at a range of frequencies. Electrically, the heart was captured, and the time course of pacing activation during electrical stimulation was tracked using the membrane potential to show anisotropic conduction. Chronic *in vivo* electrical pacing of the rat heart showed capture of the heart rate for up to 6 days. We have demonstrated that fully implantable battery-free optoelectronic pacemakers can acutely and chronically capture the heart.

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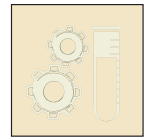
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SCHOOL OF ENGINEERING AND APPLIED SCIENCE

A Powerful Approach to Understanding Cardiac Structure and Function

Today, scientists have a poor understanding of protein localization within cardiomyocytes due to adherence to outdated experimental assays, such as diffraction-limited microscopy and western blotting. With advances in electron microscopy and data science, there is now no excuse to visualize proteins within their native structural context. This visualization leads to a precise inference into the protein's function.

Data science is a burgeoning field that many scientists forgo. The wealth of structural data within a single electron micrograph can be mined to pinpoint protein location to push scientists toward a true understanding of cardiomyocyte structure and function. We propose that scientists embrace this new perspective in their hypothesis-driven research. For example, hypotheses supported by western blot analysis of protein levels can now be validated through a direct visualization of proteins within cells. Accurate correlative analysis can then be performed, such that visualized structural morphology and extreme resolution protein localization leads to proper structure-function inference.

We investigated the distribution of a common gap junctional protein complex (connexin 43) in cardiac tissue to prove that this structure-function visualization rapidly enables hypothesis-driven research. We harnessed unique aspects of scanning electron microscopy to obtain data structures that allow precise localization of connexin 43 within a cardiomyocyte family. Chiefly, we performed large-area overview scanning electron microscopy of post-embedded immunolabeled connexin 43 in cardiac tissue. Cardiac tissue slices were frozen in a high-pressure freezer and subsequently freeze-substituted in Lowicryl resin. This allows protein antigen preservation for post-embed immunolabeling of connexin 43 using a 10nm gold nanoparticle immunolabel. Connexin 43 localization around gap junctions was analyzed at extreme resolution to obtain a spatial distribution of connexin 43. Two-dimensional epitope probability density was applied to predict the location of connexin 43 relative to the gold immunolabel.

We identified prolific labeling of connexin 43 at gap junctions in cardiac tissue and quantified their distribution around gap junctions. These basic visualizations aided in new discoveries of connexin 43 distribution throughout the cardiomyocyte, such as outer-mitochondrial membrane-bound connexin 43.

Many current biochemical and imaging methods to understand protein levels within cardiac tissue are inadequate due to the extremely limited interpretation of protein localization within the cardiomyocyte. Over-interpretation of these data leads to a waste of valuable biomedical-research funding. We advocate for a clear understanding of cardiac protein localization that intrinsically yields structure-function insight.

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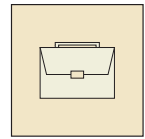
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BUSINESS



SCHOOL OF BUSINESS

The Effectiveness of Continuance Assurance and its Application in Modern World through Case Study on WorldCom

WorldCom accounting scandal and its substantial bankruptcy may be considered one of the largest scandals and bankruptcies in the US history. This report firstly is focused on revisiting the WorldCom scandal and designing a continuance insurance model for WorldCom. Secondly, this report will discuss the feasibility of implementing a continuance insurance model in companies conducting business in today's modern world. This report will also discuss how continuance insurance is implemented and how it works in today's world and if a continuance insurance scheme is beneficial, harmful, or costly to a company . We will study this topic through reading papers, online articles, and doing research using online sources.

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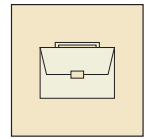
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SCHOOL OF BUSINESS

The Atlantic Coast Pipeline: The Abuse of Power from Capitalist Companies and Politicians

Private property has served as a foundation of an American's independence. The constitutional right to private property is based on the principle that government should not unreasonably interfere with the use of one's property. In 2014, energy giant Dominion Energy announced a new energy project, the Atlantic Coast Pipeline (ACP). In this paper, we analyze the ACP from multiple factors: Abuse of power from capitalist companies that are politically intertwined, that disrupt community cohesion, landowners' financial security, sensitive ecological areas, and how it harms the ethics of eminent domain. We examine a family farm that has experienced seven eminent domain cases in the past three decades, with the current case resulting in a federal lawsuit. We examine the abuse of power with eminent domains between state and federal laws, including unethical business practices made by corporate companies through mergers and acquisitions, lobbying, and political ties. For now, the ACP will pass through five states, two national forests, private property, an African American community, and Native American lands, creating a unique set of environmental and demographical injustices. A governmental preservation approach with its attention to procedural power was used to analyze how capitalist companies can disrupt community unity and sensitive ecological areas despite strong opposition. Supporting references for this research was collected by one-on-one interviews, a family's legal documentation including mention of endangered plants and wildlife, and document data of social media, family paperwork, public documents, and news sources to answer my research questions. The argument focuses on a broad assortment of concerns that this project has kindled, such as abuse of power for eminent domain, land ownership, financial insurance woes, fabricated economic growth, environmental harm, and social justice issues. These concerns will negatively impact thousands of other people and their families if passed and for the next 50 years.

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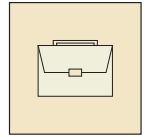
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SCHOOL OF BUSINESS

Innovation Leadership: Best-Practice Recommendations for Promoting Employee Creativity, Voice, and Knowledge Sharing

Innovation—the implementation of creative ideas—is one of the most important factors of competitive advantage in 21st century organizations. Yet, leaders do not always encourage employee behaviors that are critical for innovation. We integrate existing literature on the critical factors that serve as antecedents of innovation, including employee voice and knowledge sharing, which in turn lead to creativity and innovation. Based on existing empirical research, we offer evidence-based recommendations for managers to become innovation leaders by: (1) developing the right group norms, (2) designing teams strategically, (3) managing interactions with those outside the team, (4) showing support as a leader, (5) displaying organizational support, and (6) using performance management effectively.

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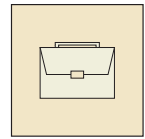
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BUSINESS



SCHOOL OF BUSINESS

A Pluralist Conceptualization of Scholarly Impact in Management Education: Students as Stakeholders

Scholarly impact is typically conceptualized and measured as an internal exchange that occurs among researchers in the form of citations in journal articles. We offer an expanded conceptualization and measurement of scholarly impact by investigating knowledge transfer to a critical management education constituency: students. To do so, we investigated which sources (e.g., peer-reviewed journals, business periodicals), individual items (e.g., journal articles, book chapters), and authors are most frequently cited in 38 widely-used organizational behavior, human resource management, strategic management, and general management undergraduate-level textbooks. By extracting all endnotes and references, we created a database including 7,445 sources, 33,719 articles and book chapters, and 32,981 authors cited at least once. Results showed a weak relationship between journals, articles, and authors cited most frequently in journals and those most frequently cited in textbooks. We also found that students are exposed to knowledge and content originating both in academic and non-academic outlets. Results have implications for theory and practice regarding the science-practice gap and a consideration of students as stakeholders, the conceptualization and measurement of scholarly impact and the design of academic performance management and reward systems, and choices regarding what knowledge academics create and disseminate.

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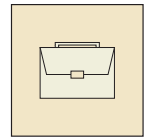
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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Dynamics of Industry Stock Price Movements

This project explores the dynamics of industry stock price movements and their correlation with financial news headlines. Understanding price movement of industries is important from a practical perspective because investors seek to optimize their investment decisions and asset allocation in the real world and from an academic perspective as related to the study of asset pricing in Finance.

We investigate correlations of stock market price movements between industries using a dataset of daily industry index prices in the New York Stock Exchange for 2017. Then using natural language processing techniques to determine topics and sentiment, we explore correlations between news headlines and the stock market price movements for each industry. The news headline data is comprised of Thomson Reuters newswire headlines for each day of 2017.

We represent industries and price movements using a complex network model that visually represents correlations inter-industry. Then we evolve the network in response to the impact of news events on industry price movements. We characterize the distribution of price movements in response to news events and provide insight on how quickly markets absorb and respond to news.

Our model also enables exploration of possible power-law forms of the various distributions, which in turn would suggest that the price movement system behavior is dominated by large fluctuations or extreme news events.

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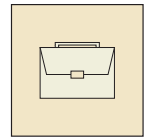
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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Early Modern Money Laundering

Early Modern Iberian financial history is a puzzle. Of course, much of Early Modern finance need not leave a trace. Even so, until, around 1500 AD, Northern Italians, such as those from Florence, Genoa or Venice, knit together the Mediterranean with their commerce, and in so doing dominated European finance. After around 1500, the low countries, centered around Antwerp and then Amsterdam dominated European finance. Curiously, many of the characters who influenced financial development in the low countries were refugees, or the children of refugees from Iberia. Surely, there must have been significant financial expertise in Iberia before the refugees left. If so, why weren't nearby Iberian centers like Barcelona and Valencia more prominent earlier? What was happening in Iberia during this era?

The Early Modern period in Iberia was shaped by the culmination of the "reconquista" - the reconquest of Iberia from Muslim rulers. Increasingly, Jews and Muslims were pressured to convert. The last Muslim kingdom of Granada surrendered in 1492. That same year, Jews were ordered: convert, leave, or die—but leave your money. Muslims were forcibly converted in the 1520s, and expelled in 1609-1614 under similar terms. Even after conversion, both groups, called "New Christians", were persecuted by the majority "Old Christians". Is it understandable that many would eventually leave Iberia even before the final expulsions?

Finance in the Early Modern era was built around the "bill of exchange". By it, a merchant/banker might invest Spanish currency in Spain, by buying a contract to be paid back with French or Italian currency in France or Italy. Often, these bills were notarized and records were required to be kept indefinitely. Some of these records may still exist. We are conducting archival research in order to sort through the notary records of Iberia and the lower countries such as Belgium. Increasingly, these archives are being put online, so we have better access to them. We are exploring the uses of these "bills of exchange." Were Jews, Muslims and "New Christians" able to use "bills of exchange" to escape persecution and take their resources with them?

We have been exploring Iberian history to understand how this history shaped the finance, and whether surviving financial records can tell us if the victims of Iberian history were able to at least partly frustrate their Iberian persecutors, and incidentally seed the rise of Northern European finance.

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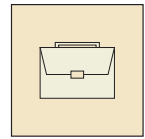
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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Investment Opportunity between Traditional versus Renewables Energy Sector in the United States: Future Outlook

This paper analyzes the future and profitability of the energy sectors in the United States. As pressure from climate change, sustainability initiatives, and dwindling fossil fuel reserves make eventual divestment from the fossil fuel industry in favor of renewable energy inevitable, understanding the comparative profitability and financial health of companies in the fossil fuel industry versus the renewable energy industry is critically important. By analyzing the various financial records and accounting ratios of companies in each industry and through quantitative analysis and qualitative analysis using macro and microeconomic trends, growth strategy, risk factors, etc using company 10-K reports and expert primary and secondary sources a current and future outlook is established. A sample of six companies in the fossil fuel industry and six companies in the renewable energy industry of mid to large market caps were chosen and analyzed from 2001 (or IPO date if later than 2001) to 2017. Research is still ongoing and in the quantitative analysis stage, but I hope to determine if it is currently better to invest in the fossil fuel or renewables energy sector, whether the future looks more profitable in a particular energy industry, and if companies of similar size are a better investment in the traditional or renewable energy sector. This report will establish if current renewable energy companies are better financial investments than traditional energy companies.

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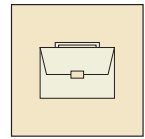
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SCHOOL OF BUSINESS

Effect of Temperature on MNC Sub-National Provincial Location Choice in China

How do changes in average temperature effect MNC sub-national provincial location choice? Past research on the relationship between temperature on MNC location choice has indicated that MNCs tend to enter warmer locations. Following new internationalization theory and the Ownership-Location-Internationalization (OLI) paradigm, we instead hypothesize that firms aim to minimize the negative impact that differences in average temperature has on location-bound firm specific advantages such as labor efficiency and productivity, energy efficiency and costs, and material costs. To do this, MNCs enter locations with more mild average temperatures instead of locations with colder or warmer average temperatures. We test our sample of 1,921,627 company-city-year observations with non-missing values, where 242 Fortune Global 500 companies from 23 home countries and 36 2-digit industries chose to enter 340 cities of 30 provinces in China between 1976 and 2012 with a multi-level mixed-effects complementary log-log regression model. Our study finds and inverted U-shaped relationship between average temperature and MNC sub-national provincial location choice. Our findings indicate that MNCs will enter sub-national provincial locations that have more mild average temperatures, rather than higher or lower average temperatures, and contrary to past findings that indicate that warmer average temperature will increase MNC entry.

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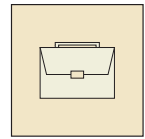
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ELLIOTT SCHOOL OF INTERNATIONAL AFFAIRS

Plant-Based Solutions in an Omnivorous World

It is estimated that by 2050 the world's population will increase to nearly 10 billion people. The question remains: how will we feed these people while also ensuring the future of our planet? Recent studies have shown that a shift to a more plant-based diet will be crucial for the health of humans and of our planet. Fortunately, recent studies also show that more and more people have been consuming diets richer in plant foods. In addition to environmental and health concerns motivating people to eat more plant-based foods, these foods are becoming increasingly accessible. That said, veganism remains seen by many as 'elite' and/or 'trendy.' More and more vegan and vegetarian restaurants open every year, but few are accessible for lower-income populations.

The purpose of this research is to arrive at a feasible business plan for a vegan restaurant with a sliding-pay-scale policy and a focus on education. This research will utilize primary sources such as news articles, interviews and recent studies as well as secondary sources such as scholarly articles, documentaries and opinion pieces. These sources will be used in order to examine a number of issues including the merits of a plant-based diet for human health and the environment as well as to examine existing businesses with similar missions and/or models. Research will also be used to examine the feasibility of creating a restaurant with a focus on local, sustainable, and seasonal plant-based food while also trying to keep costs at a minimum.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

An African American Art Therapy Student’s Emotional Discovery in a Predominately White Institution: Arts-Based/ Heuristic

Within educational settings, racial minorities face a different microclimate than their white counterparts due to the lack of same ethnicity faculty, microaggressions, and racism. These issues are particularly salient for African American students in Predominately White Institution preparing for their careers. Art making, especially when informed by art therapy, offers an opportunity to elucidate, symbols, imagery, and narrative to uncover and share emotions further self-awareness and identity development.

An African American woman undertook an arts-based and heuristic study to explore underlining emotions as a student in the GW Art Therapy Program. The overwhelming majority of art therapy practitioners, supervisors, and educators in the U.S. are White. Supporting data consisted of sixty-seven drawings and painting of the researcher’s artwork that she created as part of class assignments and independently over the duration of a year and half attending art therapy graduate courses. Artwork was categorized into themes based on the Nigrescence model of identity development; (pre-encounter, involvement, immersion, dissociation, internalization, self-actualization, and acceptance.)

All of the stages of Nigrescence model were identified. The involvements and internalization stages were the most prevalent as they reoccurred repeatedly. Unlike the model, the themes did not occur sequentially but instead emerged and reemerged as new academic and social experiences presented themselves.

The significance of the findings indicated lack of awareness to racism dynamics punctuated with moments of being made aware. This project is a valuable way to give a voice to and become aware of these themes. Although this study offers a unique perspective for further understanding the impact on an African American student’s identity when studying art therapy, it may have transferable ideas for others while furthering their education in other disciplines. By creating art around particular moments and sharing the results, the emotions that emerged could provide an environment for conversations on racial diversity and inclusion. Intentional art making can offer African American students pursuing professional careers a process for heightening self-awareness and reclaiming their identity.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Where are the Women Artists? A Qualitative Look at On-View Collections

In 2019, about fifty years after the Feminist art movement, women’s art work in major museums is still minimal at best. For years groups like the Guerrilla Girls publicly protested and relied on quantitative data to call attention to the disparity that plagues most fine art spaces. Despite an opportunity for a more inclusive art scene for women in the 21st century—more than thirty years after the Guerrillas began their work, in the wake of another women’s movement resurgence, and a time when diversity has become important in non-art institutions—data shows that museums have not followed cultural trends. While non-art institutions are compelled to consider their lasting exclusionary practices, the need for museums to consider the diversity of their own collections is much less clear. Instead these large institutions maintain collections true to their original purpose, a purpose upholding a canonical view of valuable art. Completed research includes data on the Metropolitan Museum of Art, The Museum of Modern Art, the Whitney Museum of American Art, the National Gallery of Art, and the Smithsonian American Art Museum. The five museums together have an average of 85.8% male artists in their permanent on view collections, pointing to an extreme gender gap. This research quantifies diversity in museums, using artwork by women to understand one area of diversity. Ongoing research includes continued data collection and analysis of two more museums, the Guggenheim Museum and the Hirshhorn Museum and Sculpture Garden. Furthermore ongoing research focuses on qualitative data analysis of museum histories, their current financial support, and visual analysis of women’s art work that has made it into collections. Art museums have several roles in society, most importantly a role to educate visitors about the art in their mission statement. Without representing artists of all genders and races in their collections, museums deny visitors more complete histories of artistic production. These findings allow for an opportunity to understand the relationship between fine art museums and artist representation.

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The Use of Art Therapy Trauma Protocol (ATTP) for the Elderly with Trauma: A Case Study

Bilateral art therapy has been shown to promote sensory awareness, which may contribute to emotional regulation. By activating and integrating both right and left brain processes through bilateral stimulation, it is possible to acknowledge internal disturbance, process traumatic memory, integrate polarized self-representation, and regulate sensory imprints. Those who are aging and struggling with trauma might benefit from the bilateral art intervention as it provides an opportunity to integrate past experiences and facilitate the culmination of psychological growth, which is a primary psychosocial task for the elderly.

This qualitative case study explored the therapeutic potential of an Art Therapy Trauma Protocol (ATTP) on an elderly who has endured trauma. The ATTP was used to provide a structured bilateral art therapy protocol. The participant was offered tempera paints to complete the protocol. Over four sessions, the participant created images based on her emotions and self-perception by using both her dominant and non-dominant hands. A pre- and post-intervention using the Difficulties in Emotion Regulation Scale was performed to measure the participants' level of emotional regulation.

The participant showed an enhanced level of emotional regulation as she accessed her traumatic memories, acknowledged unidentified internal disturbance, and shifted her self-perception from a victim to a survivor. The result of pre-and-post DERS subscale scores showed that the participant was more able to aware and clarify, control impulsive behaviors, engage in goal-directive behavior, accept negative emotional experience, and access to emotion regulation strategies after four sessions of ATTP intervention. Thematic analysis revealed four themes: the exploration of repressed emotions, reminiscent of traumatic experience, polarization and integration, and internal resiliency. Symbolized expression of colors and figures helped the participant to process her somatic memory on the affective and emotional levels.

This case study demonstrates the therapeutic implication of ATTP on a traumatized elderly. In this study, the participant displayed emotional breakthrough and consolidation of a sense of self through engaging in bilateral sensorimotor experience, which is understood to activate both analytic and sensory regions of the brain. The findings indicate that the ATTP may be effective in lowering internal distress, strengthening internal self-representation, and developing self-confidence through emotional regulation within the traumatized elderly population. The result may be corroborated by future research that implements quantitative methods.

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CREATIVE ARTS



CORCORAN SCHOOL OF THE ARTS & DESIGN

The Salon to the Stage: Women in the Western Canon

Not a single opera in the Metropolitan Opera's 2018-2019 season is a work by a female artist. The National Symphony Orchestra will not play a female composed work in their 2018-2019 season. Across the board it is a magnificent triumph for female composers to be represented in the Western Canon. This disparity extends past the reaches of classical music to popular music, where approximately 2% of studio producers are female and 12% of songwriter credits belong to women. This study examines the history of female representation in music throughout time and across genres, with an emphasis on 19th Century German Lieder.

To determine the disparity, we conducted historical review of gender politics and the lives of female composers. Within 19th century German Lieder, I focused my research on Fanny Hensel, sister of Felix Mendelssohn who was discouraged from composing due to social norms but is a well-documented female composer in 19th century Germany. I performed a musical analysis comparing pieces by male composers to pieces by female contemporaries in the same field, to find differences in compositional styles. Historical and musical research was accompanied by a literature review of research concerning the gender gap in music.

My research culminates in a one-hour performance of music by female composers, highlighting female musicians presented during the Corcoran NEXT Exhibition. The program presents songs by female composers from France, Germany performed alongside songs by male composers. The performance showcases compositions by women while presenting an artistic perspective of the persistent gender gap in music.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

How a Postmodern Feminist Approach to Doll Making in Art Therapy can Empower a Female Trauma Survivor: A Case Study

Art therapy has shown to build autonomy and empowerment with consideration of postmodern, intersectional feminism. Through the decision making process and skills building implemented through the art therapy process, it may be possible to instill feelings of empowerment in a client who has survived trauma. The purpose of this project is to explore participant feelings of empowerment and autonomy through a feminist approach to art therapy.

A qualitative case study explored the use of doll making with a female who has experienced sexual trauma. Over six sessions, the participant experienced and described feelings of autonomy and empowerment, as shown by her ability to make decisions in regards to her artwork and freely express herself. The participant was provided instruction on a range of approaches to doll making and was given a choice of materials including fabric, thread, and needles. The participant was offered different sewing options as well as an educational session to learn the chosen stitch. Providing choice-making opportunities facilitated feelings of autonomy, demonstrated through her choice of stitch, and empowerment, demonstrated in her risk taking to learn a new stitch.

The findings were analyzed through thematic coding and comparing Likert Scale based questionnaires, filled out at the end of each session. The participant was able to make her own decisions during doll making as well as in other aspects of life as indicated by her self report measures. Throughout the data analysis, several themes emerged: Perfection versus imperfection, independent decision making, women in society, and self-trust were all observed in session. The participant affirmed these themes through feelings of acceptance towards the doll and an emerging sense of self. The doll provided a metaphor within which the participant was able to explore aspects of self.

With historical trauma emerging through the #metoo movement, it may be valuable for art therapists to approach their clients with a postmodern, intersectional feminist approach in order to understand and validate client experience. Art therapy can enhance decision-making abilities for a female who has experienced sexual traumas indicated by the themes that emerged in session and results from the questionnaire. This model allowed for macro and micro levels of conversation regarding women in society and aspects of self. The findings indicate people who have experienced trauma would benefit from self-trust art making through a postmodern, intersectional feminist approach, demonstrating the need for additional research and art therapy.

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Deconstructing the Art of Austro-Bohemian Horn Playing: The Intersections Between Musicological History and Performance Practice

Post-medieval Western music can be defined by three major eras of horn playing: baroque horn (1550-1700), classical horn (1700-1850), and modern horn (1850-present). These periods of Western music and the techniques utilized to play each of these instruments have both been thoroughly analyzed, however the intersections between shifting performance practices in horn playing and historical shifts in musical thinking have long been neglected in existing musicological literature. Thus, the aim of this study is to bridge the gap between the technical aspects of Austro-Bohemian horn playing and the Western musical eras in which they existed. These intersections were studied using extensive analysis of primary resources from horn players and composers across the three major eras of Western music, in conjunction with musical scholars addressing major historical developments. The baroque horn, for instance, was originally played with the bell pointed straight upwards, implying that baroque players favored volume over timbre, and lending credence to the theory that these horns were strictly used for hunting or signaling purposes. The classical horn was a more complex instrument; the bell was lowered to hand level to allow for hand-stopping technique, and crooks were added to allow for key changes. This aligns with the pre-romantic and romantic philosophies of the 18th and early 19th centuries, and the incorporation of the horn into symphonic literature suggests a shift away from the purely utilitarian ideals of the baroque era. The modern horn incorporated rotary valves for pitch as well as a second set of tubing to aid in upper register timbre, which was perhaps a harbinger of the great shift towards experimentalism in Western music. Further analysis of neglected early music literature is needed in order to fully understand how the rich tradition of Austro-Bohemian Horn Playing worked in conjunction with major historical shifts in Western Music. The current findings suggest that the three major eras of horn playing may not only have acted in accordance with shifts in Western Music, but acted upon them, strengthening existing philosophies and sparking the rise of new ones.

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EDUCATION



GRADUATE SCHOOL OF EDUCATION AND HUMAN DEVELOPMENT

English as a Foreign Language: Innovations in Learning and Teaching in Cuba

Cuba's education system has grown successfully over the years. It is considered to be one of the top-performing education systems in the Latin American and Caribbean context. Cuba has made a significant effort in this initiative through quality teacher training. There is a growing economy in the tourism sector of Cuba and English has become a high commodity. Due to this growth, teacher training in English as a foreign language has grown to be most popular. This research paper has five objectives. It begins with an overview of Cuban education and its impact in Cuba followed by a section on the overall topic of English language learning in Cuba. Furthermore, a section on English language teacher training and conveying the impressive innovations that Cuba has incorporated in order to excel in this endeavour along with its education sector overall. Lastly, the authors aim to inform the reader of Cuba's place in the world of education.

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EDUCATION



COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Telenovelas, Subtitles and Spanish Language Acquisition: The Linguistic Benefits of Watching Television Programs with Inter-Linguistic Subtitles

There are already several studies that highlight the linguistic benefits of watching foreign language television programs as an L2 learner. Prior research, as an example, has concluded that the subtitling, and in particular reversed subtitling, of such programs can positively aid the second language acquisition process. Given these findings, this study investigates whether or not looking at a telenovela with intralingual (untranslated) captioning can serve as an effective way to acquire new words in Spanish. The first ten minutes of a Colombian telenovela were presented to two experimental groups of students from an American university. One group looked at the video clip with Spanish subtitles while the other group looked at the clip without any captioning. The results were collected through three assessments: a pre-test, immediate post-test and delayed post-test. At the end of the study, the participants who watched the telenovela with intralingual captioning recorded the highest scores. Having said that, there was evidence of some amount of vocabulary acquisition by the other experimental group as well. In short, this research reaffirms the benefits of watching television programs in other languages and provides a basis for further research on the incidental learning of foreign languages.

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English as a Foreign Language: Innovations in Learning and Teaching in Cuba

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EDUCATION



ELLIOTT SCHOOL OF INTERNATIONAL AFFAIRS

A Study to Determine if the Difficulty in Learning the General Theory of Relativity Could Be Lessened by Creating a New Educational Method through Comparing the Different Teaching Styles of Englert and Feynman

The theory of relativity, created by Albert Einstein, is widely known to be one of the most difficult theories to teach. Consequently, there have been a lot of studies to better understand how to teach this complex theory, particularly to undergraduate students. In France, the ministry of education is constantly trying to increase the success rate among Physics students by exploring different methods.

Therefore, the major purpose of this research is to find the best method for teaching the theory of general relativity.

The most effective method may be found by analyzing two different lectures by Nobel Prize winners Englert and Feynman. Both have wildly different approaches to teaching this particular theory. The fundamental factor taken into consideration was whether or not the methods created by Feynman and Englert would be effective in long-term or short-term.

The research determined that the two key differentiators in the teaching methods were the presentation of the basic components and the classroom structure. By combining the most effective parts of each method, the research showed a new way of teaching general relativity could be created. This new method would represent an illustration of the learning strategy of Feynman and the more traditional strategy of Englert which could further be used for teaching other concepts and theories in physics. This is extremely exciting as this new method could assist future Physics professors in teaching the theory of general relativity. This clearer understanding of the theory may also inspire more interests in the field of Physics. As a result, physics could become more accessible to everyone.

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GRADUATE SCHOOL OF EDUCATION AND HUMAN DEVELOPMENT

Practice-Based Teacher Education Programs at Independent Schools: A Cross-Case Analysis

Teachers' knowledge and skills are the most important influences on the learning and development of young children. It is imperative that teachers entering the classroom are prepared with the knowledge, expertise, and experience necessary to promote student learning. This qualitative, instrumental, multiple case study with cross-case analysis explores practice-based teacher education programs at independent schools and provides a thick, rich description of the essential components of each program and novice educators' experience of each program. Practice-based teacher education programs are experience oriented programs that emphasize the connection between theory and practice through daily engagement with schools.

This study outlines the essential components of practice-based teacher education programs at independent schools and provides valuable insight and information to practitioners seeking to establish programs or strengthen existing programs, and researchers committed to innovative teacher education and interested in the independent school context. A product of this study was a proposition for characterizing the essential components of practice-based teacher education programs at independent schools. The components identified by this analysis include a clear, well-defined mission; coherent and integrated core curriculum, coursework, practice, and theory; extended immersive field experience in a supportive school context; response to school specific culture; commitment to diversity and inclusion practices; exemplar modeling of pedagogical and instructional practices; ongoing supervision, observation, and feedback; educative mentoring; support for a cohort of novice educators; opportunities to develop self-awareness and self-reflective practices; commitment to preparing teachers to effectively teach, increasing teacher effectiveness, improving teacher self-efficacy, promoting teacher retention, and advancing school specific goals.

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GRADUATE SCHOOL OF EDUCATION AND HUMAN DEVELOPMENT

The Cultural Development of Moral Repair in U.S. Military Veterans: A Hermeneutic Phenomenological Study

Military and political leaders report the U.S. military is experiencing a suicide epidemic. Despite efforts to thwart it, recent evidence shows the suicide rate among military personnel is at its highest since 2012. An emerging area of academic and clinical interest, the study of moral injury and moral repair, offers a fresh and welcomed view into this problem. Moral injury is perhaps best thought of as a spiritual wound or scarring of the soul where deeply held personal beliefs or truths about humanity become undone leading to feelings of guilt, shame, self-condemnation, anger, and betrayal. Left unattended, these feelings lead individuals to lives disconnected and isolated from the social world. Some, perhaps most, never learn how to heal from this type of injury. Instead, they suffer in silence, or worse. Moral injury resulting from combat-related trauma has been suggested as having a mediating role in military service member suicidal behavior, although evidence is just emerging. How veterans heal from moral injury, otherwise known as moral repair, is even less understood and is the focus of this study.

Specifically, this qualitative research study seeks to explore the lived experience of moral repair among US military veterans in order to elicit moral repair's cultural form. The study is conducted through a cultural psychological lens rooted in Vygotskian socio-historical theory using Heidegger hermeneutic phenomenology methods providing a means of uncovering the cultural character imbued in the psychological phenomenon.

Veterans from the Vietnam War to present combat operations in Iraq and Afghanistan have been interviewed. Preliminary results indicate moral repair is developed by reconnecting with the social world through culturally mediated constructive, holistic and integrative activity using one's military identity as a launching point.

From a theoretical perspective, examination of moral repair through a cultural psychological lens, one that captures the socio-historical nature of human development, may serve to advance our fundamental understanding of it and assist in developing an operational definition of moral repair for use in further studies.

From a practitioner perspective, further insight into the cultural character (e.g. social activities, artifacts, and concepts) elucidated through the lived experience of moral repair among U.S. military veterans may inform military, clinical, religious, and community leaders in developing or updating policies, programs, interventions, and treatments aimed at healing our wounded warriors and in so doing ideally reduce the risk of suicidal behaviors within the military community.

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Engaging Girls of Color in Out-of-School Programming: A Community-Based Research Agenda

High quality out-of-school time (OST) programming provides children and adolescents with supervised learning, quality teaching, mentorship, extracurricular activities, and socioemotional development during after school and summer hours (Dawes, 2018; Sanders, Lewis-Watkins, and Cochrane, 2018). In 2014, the Afterschool Alliance reported that 10.2 million youth participated in OST programs; however, just one-third of these were adolescents of color. Unfortunately, youth from low-income families and low-resourced urban neighborhoods are particularly affected by not having access to summer learning or enrichment programs (Alexander, Entwisle, and Olson, 2007). Scholars found that summer learning loss is cumulative and harmful (Alexander, Entwisle, and Olson, 2007), and when schools close for the summer, low income students lose access to books, meals, technology, and structured enrichment (Pitcock, 2018).

Participation in OST programs positively influence students' test scores in readings and mathematics (Lauer et al., 2006) and can also provide students of color with opportunities to learn from more diverse, high-quality role models, teaching, and mentoring staff (Sanders, Lewis-Watkins, and Cochrane, 2018). OST participation is also associated with positive identity development (Sanders, et al. 2018; Nieto, 1998), which is associated with improved school and post-school outcomes (Lerner, Almerigi, Theokas, & Lerner, 2005). Despite the promising benefits of OST programming, there remains a gap in access to and participation in these programs. Specifically, we do not know how limited access to OST programming impacts low income girls and girls of color. While research has indicated that a variety of structural and institutional factors (e.g. fees, transportation, and family demands) limit access to OST programs, we submit that further identifying youth and community perspectives on program access, value, and effectiveness can aid in strengthening the ability to reach and improve OST experiences for girls of color.

To explore this, we propose a mixed methods youth participatory action research study with the intention to design appropriate survey instruments to measure the effectiveness of OST programs for girls. We will employ community based research methods to identify youth and community perceptions on current OST offerings, needs, and solutions to improve girls specific programming. Utilizing the findings from the qualitative data collection phase of the study, and the current literature and best practices for OST in under resourced communities, we plan to develop a quantitative instrument to further investigate, on a larger scale, what needs exist and which programs are effective based on community input.

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GRADUATE SCHOOL OF EDUCATION AND HUMAN DEVELOPMENT

School Leadership within India

To help achieve Sustainable Development Goal 4, “Quality Education,” this study examines school leadership within the education system in India. UNICEF and UNESCO described quality education as: “quality of learning [that] should be assessed by the capacity of individuals in their childhood, their youth and throughout life to acquire knowledge, skills, understanding, and values to live and participate in society” (2012, p. 4). In essence, all school systems should strive to achieve quality education—school leadership can impact this quality. School leadership is defined as leadership that influences and empowers others for school reform and better learning outcomes (OECD, 2006).

First and foremost, research has highlighted the importance of school leadership and the impact on increased student learning. Scholars Leithwood, Louis, Anderson, and Wahlstrom, noted that school leaders are the second most important actor in achieving student learning as teachers are the first (2004). The major problem with school leadership and training in India is that the school leaders do not receive any formal training for developing their knowledge and skills to be able to implement effective leadership (School Leadership Development, 2014). The lack of formal training is highly concerning given the fact that school leaders are often responsible for teacher training and school transformation.

For this study, a qualitative, semi-structured interview process was conducted to speak with teachers and school leaders from both public and low-income private schools in India. The interviews will be coded, to see emergent themes from which the results will be interpreted. This study intends to better understand the effectiveness of school leaders and the style of leadership implemented to produce quality education.

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Advancing Research in Chronic Absenteeism in Among Low Income and Minority Students Through Application of the Systemic Questioning Framework

An estimated 5 million to 7.5 million students are chronically absent within the US. Chronic absenteeism (CA) is highly correlated with academic success, achievement, grade retention, and dropout rates. Further, low income and minority students are more likely to be chronically absent, contributing to academic achievement gaps. Few studies have explored the differential impacts of CA on low income and minority students due to the lack of universal reporting systems for attendance. My purpose was to identify the primary drivers and effects of CA among low income and minority students. The Systemic Questioning Framework was used to critically examine CA and its assumptions to inform the design of effective evidence-based interventions to reduce CA and narrow academic achievement gaps.

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A Dual Mediation Model to Describe the Effects of Digital Practice with Feedback

This research focuses on a dual mediation model designed to describe the learning process of 6th grade students practicing fractions operations questions while using various forms of feedback. The variables of interest in this study are the predictor variable, feedback, the mediator variables, cognitive and overall affective engagement, which are measured via survey, and fractions learning outcomes which is measured via gain scores from a 24 item fractions pretest and posttest. Cognitive Load Theory, Cognitive Information Processing Theory, Engagement, and the Bangert-Drowns cognitive model of the effects of feedback were used to explain the effects the dual mediation model created. To investigate this model and the relationships, first, a series of three T-Tests will be used to see if feedback led to significant differences in overall cognitive engagement, overall affective engagement, and fractions learning outcomes, second, Structural Equation Modeling (SEM) was used to measure the fit of the model to the data and to evaluate the strength or existence of mediation for each of the two mediator variables.

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GRADUATE SCHOOL OF EDUCATION AND HUMAN DEVELOPMENT

Prepare Students for the Future of Work: Policy Coherence for Inclusive School-to-Work Transition

The Education and Inequality Cross-Disciplinary Team (CRT), Graduate School of Education and Human Development is exploring the issue of education and inequality in a cross-disciplinary approach. Education provides us with the opportunity for social and economic mobility whereas it also can reproduce and strengthen social stratification. As part of CRT lab activities, the team is studying multiple research problems located at the intersection of access and identity as two key areas informing consideration of education and inequality. Education policy is one of these research problems.

In the domain of school-to-work transition, post-secondary education has been considered as the main source of high-level cognitive skills that are rewarded in the labor market. In the era of the fourth industrial revolution, however, it is not education but artificial intelligence and automation-related technologies that frame qualifications. Additionally, it has been established that women are underrepresented in STEM fields; therefore, the existing labor market segmentation might generate a serious gender inequality issue surrounding the future of work. Hence, education policy addressing the quality enhancement of education (i.e. improving the level of cognitive skills) should be coupled with associated policies in order to integrate economic, social and technological dimensions of education and employment. This integration enables relevant governmental institutions to formulate and implement responsible education policies. Therefore, this study attempts to create a conceptual model to assess the relevance of education policy that aims to mitigate educational inequality by exploring a concept of “policy coherence.”

The United Nations’ 2030 Agenda for Sustainable Development calls upon all countries to “pursue policy coherence and an enabling environment for sustainable development at all levels”. Specifically, the United Nations’ Sustainable Development Goal 17. 14 aims to “enhance policy coherence for sustainable development” (PCSD) while respecting each country’s leadership to establish and implement policies for poverty eradication and sustainable development.

The Organisation for Economic Co-operation and Development (OECD) defines PCSD as an approach and policy tool to integrate economic, social, environmental, and governance dimensions of sustainable and inclusive growth at all stages of domestic and international policy making. Especially, PCSD aims to increase governmental capacities to strengthen synergies across economic, social and environmental policy areas.

Thus, OECD proposes eight building blocks for PCSD and a conceptual “coherence monitor” to track progress on policy coherence. Both good practices and challenges in nine OECD countries provide implications for education policy making and implementation, potentially informing education policy.

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GRADUATE SCHOOL OF EDUCATION AND HUMAN DEVELOPMENT

Framing of Refugees and Immigrants in the U.S. Media

Research has shown in many instances, both in the US as well as globally, the influence of mass media on the generation of public opinion. Therefore it is important to understand and consider the way refugees and immigrants are framed in the media and discern how these frames influence the refugee and immigrant Representations. The relationship between these frames have a direct effect on how refugees and immigrants are perceived and accepted by members of society. These frames have also been found to both influence and be influenced by the sociocultural and sociopolitical discourses here in the US.

Research that has been conducted in Australia and Europe point to mass media's role in the current framing of asylum seekers as frauds, victims or dangers to national culture and safety. This proposed study acknowledges the importance of understanding and accounting for this under researched contributor to the Discourse on Immigration and Refugee Integration. To this end, we propose conducting a Discourse/Narrative analysis on material collected from some of the top Social Networking sites as well as the leading News outlets in the past five years to identify the current framing of refugees and immigrants in the US.

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Young Children of Refugee Mothers in the United States: Integration Successes and Challenges

The United States has been a major leader of refugee resettlement in the world for several decades, providing refugees of conflict and natural disasters with services and resources to rebuild their lives. However, what many refugees find when they arrive is far from an easy life. Many barriers upon arrival—including linguistic isolation, cultural unfamiliarity, poverty, and unemployment—can have a lasting impact on their access to necessary resources and support, as well as their enrollment in important systems such as healthcare and education.

Of the barriers refugees face, linguistic isolation seems to be the biggest factor in creating issues with childhood education. Linguistic isolation for mothers is not only a leading cause of their difficulties in accessing health, social, and other services but also a major impediment to the well-being and development of their children. Children of refugee parents have a low preschool enrollment rate, about 42%; this figure may not be surprising considering how linguistic isolation hinders parents' ability to engage in school programs and meetings, as well as advocate for their student(s).

Therefore, we seek to answer the following questions, with a focus on mothers of children ages 5 and under: What is being done to alleviate the prevalence of linguistic isolation in households with children of refugees? What resources are available to refugee mothers to assist in their engagement with their students' education while in the United States? How are district and state education policies working to bridge the linguistic gaps that deter refugee parents away from involvement in their students' education? In what ways/areas do relief organizations and refugee resettlement programs in the United States need to improve in order to better engage refugee parents? Through our research, we hope that lessons learned will not only improve and fill gaps in the US' own resettlement practices for vulnerable sub-populations such as refugee mothers and young children, but also serve as an example for other countries who are working to develop their own refugee resettlement programs and policies.

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Parents and Educators of a Special School: Their Perspectives on Inclusive Education for People with Down Syndrome in Navi Mumbai, India

The topic of this study is centered on students with intellectual disabilities; in particular, its focus is on those individuals who have Down syndrome. One of the primary debates revolving around the treatment of people with intellectual disabilities is whether or not they should be educated in separate, special schools. According to the current academic consensus, and the government of India's new policies, inclusion within mainstream schools is the most beneficial practice for students with Down syndrome to grow socially and academically; however, the perspectives of parents and staff are often left out of the equation when determining the impact of such schemes on local communities. Thus, this study utilizes these perspectives through a three week period of interviews and observations at a special school located in Navi Mumbai, India. A total of eleven parents and five staff members were consulted. The results point toward aspects of special education that make it necessary in India's current climate of integration and less specialization. Simultaneously, the findings also indicate how inclusive education needs to change in order to become beneficial for families, who are typically not part of these policy discussions.

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GRADUATE SCHOOL OF EDUCATION AND HUMAN DEVELOPMENT

Understanding How Callings Develop: A Phenomenological Study of Millennials' Lived Experiences of Discerning a Calling through Meaning-Making

This phenomenological study seeks to explore the lived experiences that have led Millennials through a meaning-making process to discover their callings. The primary research question addresses what the relationship is between Millennials' meaning-making process and the discovery of their calling. Secondary questions address how Millennials, who have found their calling, define and conceptualize the concept and sources of calling, what are the lived experiences that have led Millennials to discover their calling, and how do Millennials make meaning of the experiences and influences that have led them to discover their calling.

Perceiving and living a calling is associated with various life/work outcomes such as life satisfaction/meaning, job satisfaction, and meaningful work. However, little is known about how callings develop, and there are conflicting views on how they are conceptualized. The existing research on calling is focused primarily on previous generations, university students, and individuals of religious-based backgrounds. However, it is important for researchers and practitioners to understand how the Millennial generation develops a calling, because they are currently in the workforce and are reported to be the biggest U.S. generation yet. While there is significant research on the career expectations of Millennials and how they value meaning in their work, there is little known about what experiences lead them to develop their callings and how they make meaning of those experiences to discern their callings. Thus, this study extends the body of research beyond these groups to Millennials who are currently in the workforce and living their callings in order to ensure that their perspectives and experiences of calling are incorporated into the literature.

Eight Millennials who are currently living their calling were selected for participation in this interview-based study. The findings of the study are presented within the following three main themes: the conceptualization of calling, the lived experiences in developing a calling, and the meaning-making process. Three main conclusions were set forth, based on these findings: 1) participants conceptualized calling as a life philosophy, purpose, or goal, but which often includes career as a means to fulfill one's calling, 2) participants' lived experiences in developing a calling reinforce the themes of adversity/trying times, professional/educational experiences, receiving messages, and unplanned/unspecific opportunities, and 3) participants' meaning-making experiences are based on an ongoing process of development, reflection, and self-discovery. This study also offers relevant implications for research and the field of human and organizational learning (HOL) and recommendations for future research.

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GRADUATE SCHOOL OF EDUCATION AND HUMAN DEVELOPMENT

Addressing Universities' Historic Ties to Slavery

Over the past twenty years, there has been a growing movement of universities in the United States acknowledging and addressing their historic ties to slavery. Evidence presented by these universities and by outside researchers irrefutably demonstrates that higher education institutions in the United States permitted, protracted, and profited from the African slave trade. Slaves constructed buildings, cleaned students' rooms, and prepared meals; slave labor on adjoining plantations funded endowments and scholarships; slaves were sold for profit and to repay debts; and even outside of the direct exploitation and selling of slave labor, both northern and southern universities benefited greatly from the antebellum slave economy. Higher education institutions in the United States are revered worldwide for their academic achievements; however, what has been overlooked until recently is how these universities touted Enlightenment values while simultaneously benefiting directly and indirectly from the enslavement of human beings. Using research gathered through a review of the literature on the topic, this project begins with a study of the history of slavery at three colonial-era American universities, as well as the apologies and initiatives that have been issued by these universities in response. This project also includes the challenges that have been made by both supporters and critics of institutional apologies. Rather than definitively conclude if and in what way universities should make amends for their historic ties to slavery, the goal of this project is to more broadly consider how universities can authentically address their past while making intentional efforts to ensure a just and equitable future.

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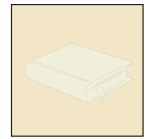
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GRADUATE SCHOOL OF EDUCATION AND HUMAN DEVELOPMENT

The Effects of Gender Role Norms and Perceptions of Masculinity on Leadership Style Development in College Men

The purpose of this study was to explore perceptions college men have regarding gender role norms and the effect those perceptions have on their leadership style development. This qualitative study utilized a questionnaire and two semi-structured interviews with 14 former Interfraternity Council and/or North American Interfraternity Conference fraternity chapter presidents at one of two site institutions near a Mid-Atlantic metropolitan area. Bandura's (1971) social learning theory was used as a framework in this study. A post-intentional phenomenological approach was used to gather reflections from participants on their perceptions of gender role norms and how those perceptions influenced their leadership style development in college.

Nine themes emerged to answer the two research questions of how perceptions of gender role norms informed leadership styles in college men, including what messages of masculinity and gender role norms college men receive and from where those messages are received, and how leadership styles of college men are reflections of their learned masculinities. The themes that emerged in this study contributed to four overall findings. First, participants engaged in authoritarian approaches to leadership to hide a lack of confidence in their knowledge and abilities of leading a group. Second, in caring for others, participants saw themselves as their organization's savior. Third, the participants had difficulty navigating conflicting expectations of gender and perceived unprovoked attacks on campus and chose to disengage entirely from community discourse on privilege. Finally, participants isolated themselves from their organization in order to maintain moral authority and power over their members. These findings are significant in adding to the knowledge of college men's perceptions on masculinity and how those perceptions affect their leadership style development.

Five recommendations for practice are outlined based on the findings of the study. First, developing materials to help students decide to run for a position and facilitate transition into that decision prior to their fraternity elections. Second, to provide ongoing training and debriefing for fraternity chapter presidents. Third, to incorporate concepts of healthy masculinity into new member programming. Fourth, to encourage and facilitate relationships between chapter presidents. Finally, to develop a campus or fraternity Good Samaritan policy.

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GRADUATE SCHOOL OF EDUCATION AND HUMAN DEVELOPMENT

The Nexus of Education and Transformation through Vision 2030: A Case Study in Saudi Arabia

Saudi Arabia has been at the nexus of global trade, politics, and religion for thousands of years. The Saudi Monarchy have both recognized and elevated education's role in Saudi society from antiquity to the present time. In 2016, due partly to a crash in oil prices, the Saudi Monarchy released Vision 2030. Vision 2030 is a broad plan to wean Saudi Arabia off its dependence on oil and rebuild its human capital in order to make the domestic economy more globally competitive. This paper is a case study of Saudi Arabia's stated plans to transform the education sector under Vision 2030 to the present implementation of the policy. The paper aims to identify the gaps between the stated goals and the plan's implementation; the potential gaps can help to explain the difficulty of transforming an education sector, and, on a larger scale, the growth of the domestic human capital in a relatively brief period of time. In addition, the findings can help shed light on how foreign actors (higher education institutions, non-profits, and private companies) can engage with the Saudi Monarchy at a time when the perception of increased engagement with the country is generally accepted as negative. The paper is grounded in human capital theory and international political economy approaches to development.

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GRADUATE SCHOOL OF EDUCATION AND HUMAN DEVELOPMENT

How Does Social-Emotional Learning Look Like in China?

Overwhelming evidence has shown that well-delivered Social-Emotional Learning (SEL) programs are essential to the short-term and long-term improvements in academic achievement, social skills, and mental health of students across ages and abilities. SEL has become a growing priority for educational investment at both the federal and the state level in the US. Since SEL was introduced and defined by Collaborative for Academic, Social, and Emotional Learning (CASEL) two decades ago, it has captured the interest of researchers, educators, and policy-makers around the world. In 2012, the Ministry of Education of China partnered with UNICEF and officially introduced SEL to the Chinese educational system. The purpose of this research is to investigate the ways SEL has been integrated into the educational system in China, especially in early childhood school settings. Data was gathered through a literature review to understand SEL for young children in Chinese educational context. The research is ongoing. Findings and implications of the research will be reported and discussed at the poster session. The research will lead to further investigation of the effects of SEL programs in different cultural contexts and the cultural sensitivity of SEL practices.

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SCHOOL OF ENGINEERING AND APPLIED SCIENCE

Primary Sludge Fermentation: Sustainable and Economical Process of Supplementing Carbon for Short Cut Nitrogen Removal

Mainstream shortcut nitrogen removal offers vast opportunities for energy and treatment cost savings, making these processes sustainable and cost-effective for biological nutrient removal (BNR) systems within modern wastewater treatment plants. DC Water operates a 384 mgd (1400 MLD) advanced wastewater treatment plant to meet stringent nutrient limits (Total phosphorous (TP) < 0.17 mg P/L and Total nitrogen (TN) < 3.7 mg TN/L). The operating costs of the nitrogen removal facility are significant and include \$8M per year for methanol, \$0.6M per year for alkalinity supplementation, and \$1.5M in energy demand for aeration. This notable cost for methanol addition as an external carbon source for BNR process is a clear driver for evaluation of short-cut nitrogen removal technologies. Nitrite oxidizing bacteria (NOB) out-selection, using aeration control strategies, proved to be tricky considering the stringent nutrient permit. Therefore, an alternative route selecting for partial denitrification (PdN) of NO₃-N to NO₂-N using acetate coupled with anammox (AnAOB) was explored to achieve higher removal of nitrogen. In contrast to the NOB out-selection based approach, the PdN coupled with anammox approach requires an external carbon source either in the form of acetate or glycerol. Because the cost of commercially available acetate and glycerol in the USA are respectively, more expensive than (factor ≥ 3) or comparable to the currently used methanol, alternative sources should be explored to increase economic viability.

The overall objective of this research was to explore the viability of primary sludge fermentate as the recycled carbon source for selecting PdN in order to reduce chemical costs. In addition, the solids retention time needed to reach required soluble COD yields as well as the concurrent nutrient release during fermentation were evaluated to estimate the potential of PdN-AnAOB under mainstream conditions.

Laboratory scale continuously stirred tank reactors (CSTR) with working volume of 4L were operated with equal solids retention time and hydraulic retention time (SRT=HRT) at room temperature (20-23°C). The reactors were seeded and wasted with primary sludge influent (PS) to maintain 0.5 day, 1 day, 2 day and 4 day SRT.

This study showed that incorporating primary sludge fermentation within the short-cut nitrogen removal scheme has a huge potential for AnAOB contribution in the mainstream system. Overall, this approach should allow to save 25-67% of operational cost for BNR at Blue Plains, almost \$6.2M out of \$10M currently spent.

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SCHOOL OF ENGINEERING AND APPLIED SCIENCE

0.52 V·mm ITO-based Mach-Zehnder Modulator in Silicon-on-Insulator Platform

Electro-optic modulators transform electronic signals into the optical domain and are critical components in modern telecommunication networks, RF photonics, and emerging applications in quantum photonics, neuromorphic photonics, and beam steering. All these applications require integrated and voltage-efficient modulator solutions with compact form factors that are seamlessly integrable with Silicon photonics platforms and feature near-CMOS material processing synergies. However, existing integrated modulators are challenged to meet these requirements. Conversely, emerging electro-optic materials heterogeneously and monolithically integrated with Si photonics open up a new avenue for device engineering. Indium tin oxide (ITO) is one such compelling material for heterogeneous integration in Si exhibiting formidable electro-optic effect characterized by unity-order index change at telecommunication frequencies. Here we overcome these limitations and demonstrate a monolithically integrated ITO electro-optic modulator based on a Mach Zehnder interferometer (MZI) featuring a high-performance half-wave voltage and active device length product of $V_{\pi}L = 0.52 \text{ V}\cdot\text{mm}$. We show, that the unity-strong index change enables a 30 micrometer-short π -phase shifter operating ITO in the index-dominated region away from the epsilon-near-zero (ENZ) point for reduced losses. The material index change in ITO, Δn_{ITO} shows near unity order change as demonstrated and denotes the potential of this emerging material, which is significantly higher as compared to its Si counterpart while both (ITO and Si) operate with the free carrier modulation mechanism. The estimated efficiency-loss product of the device, $\alpha V_{\pi}L$ is about 80 dB·V at the ON state. This device experimentally confirms electrical phase shifting in ITO enabling its use in applications such as compact phase shifters, nonlinear activation functions in photonic neural networks, and phased array applications in light detection and ranging (LiDAR) for terrestrial and areal localization and mapping. In this work, we have demonstrated the first ITO-based Mach Zehnder modulator on a Silicon photonics platform which can enable compact modulator footprint, ease of fabrication and potentially attain CMOS compatibility. This work provides pathways for future optimization schemes facilitating improved device performances including high-speed operation, enhanced modulation depth, and reduced insertion loss. to avail dense on-chip integration for data communication.

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SCHOOL OF ENGINEERING AND APPLIED SCIENCE

The Wake of a Bluff Body in Highly Pulsatile Flow: Effects of Freestream Inflow Frequency

Bluff body wake dynamics are widely studied due to their diversity of rich flow physics when subjected to various inflow conditions and perturbations. Highly pulsatile inflow has proven in our prior studies to generate interesting and unexpected wake dynamics. High-amplitude fluctuations in freestream velocity, or pulsations, occur in biological, geophysical, and engineering flows, e.g. blood flow, coastal flows, and gusting winds. In this study we examine the effect of the frequency of the large freestream fluctuations, ranging from vortex lock-in frequencies on the high end to quasi-steady wake configurations on the low end. The bluff body studied is a surface-mounted hemisphere, the radius of which is several times greater than the local thickness of the boundary layer on the mounting surface. A series of direct numerical simulations (DNS) supplement experimental studies performed using planar particle image velocimetry and hot-wire anemometry in a low-speed, pulsatile wind tunnel. Characterizations of wake structure, turbulence, and various wake regimes through a sweep of frequencies will be presented and compared. A framework for understanding external flow forcing extending from a typical steady flow wake to generation of a single vortex at high pulsation frequencies akin to vortex ring production will be introduced.

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SCHOOL OF ENGINEERING AND APPLIED SCIENCE

DEC-NoC: An Approximate Framework Based on Dynamic Error Control with Applications to Energy-efficient NoCs

Network-on-Chips (NoCs) have emerged as the standard on-chip communication fabrics for multi/many core systems and system on chips. However, as the number of cores on chip increases, so does power consumption. Recent studies have shown that NoC power consumption can reach up to 40% of the overall chip power. Considerable research efforts have been deployed to significantly reduce NoC power consumption. In this paper, we build on approximate computing techniques and propose an approximate communication methodology called DEC-NoC for reducing NoC power consumption. The proposed DEC-NoC leverages applications' error tolerance and dynamically reduces the amount of error checking and correction in packet transmission, which results in a significant reduction in the number of retransmitted packets. The reduction in packet retransmission results in reduced power consumption. Our cycle accurate simulation using PARSEC benchmark suites shows that DEC-NoC achieves up to 56% latency reduction and up to 58% dynamic power reduction compared to NoC architectures with conventional error control techniques.

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Development of a Solar Photocatalytic Reactor for Sustainable Water Purification

As lack of access to clean drinking water continues to be a problem, especially in rural areas and developing countries, the challenge of finding innovative ways to treat drinking water in secluded areas with few resources must be met. Additionally, the presence of persistent and emerging organic micropollutants and pathogens further challenges the safety of treated water. A potential solution is the solar-energy-enabled photocatalysis, a sustainable advanced oxidation process that can destruct organic micropollutants and inactive pathogens. Because operating a photocatalytic reactor can be solely dependent on renewable solar energy, the process is sustainable and can be used in areas where electricity and chemicals are not readily accessible.

The purpose of this research project is to develop a solar photocatalytic reactor for sustainable water purification. Among various types of photoreactor designs, the compound parabolic collector (CPC) design was chosen due to its capability to collect high solar radiation at any angle of acceptance, its ability to operate either on pilot-scale or industrial-scale applications, and its low fabrication, operation, and maintenance costs. Graphitic carbon nitride ($g-C_3N_4$) was used as the photocatalyst for contaminant removal. With the optimized CPC reactor design, chitosan beads were applied as the support to immobilize the photocatalyst ($g-C_3N_4$). The photocatalytic reactivity was then evaluated in a 3D printed CPC reactor under simulated sunlight (xenon lamp, AM 1.5 G optical filter) for the removal of a model contaminant and emerging persistent micropollutants in buffer solutions. The $g-C_3N_4$ chitosan beads with an optimized size and $g-C_3N_4$ loading showed a promising photocatalytic activity toward contaminants degradation.

Meanwhile, the $g-C_3N_4$ chitosan beads exhibited selective contaminants degradation that could be attributed to the different interactions between chitosan with contaminants. Overall, the optimum CPC reactor design with the immobilization of photocatalyst on chitosan beads will promote the practical application of solar photocatalytic water treatment technology for rural areas and developing countries.

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Deep Learning Tools to Support Eating Disorder Recovery

Eating disorders (ED) are serious medical conditions that can have disastrous effects on an individual's mental and physical health. ED are often a lifelong struggle, with approximately 2/3 of patients never achieving a full and sustained remission.

One major setback to recovery from an ED is exposure to triggering images or content that can bring back disordered thoughts and behaviors. This content poses a serious threat to patients, yet can be found anywhere online—individuals with ED have created pro-ED communities where they support one another in the dangerous pursuit of being “thin enough.” Hence, it is essential that clinicians and family members be able to identify pro-ED webpages to prevent exposure to these triggers. Unfortunately, it is challenging for them to find and stay up-to-date with pro-ED communities online. This research aims to automatically identify such triggering images, with the ultimate goal of designing tools to support ED patients in recovery.

Though platforms have attempted to detect pro-ED content through community-specific hashtags, members either stop using hashtags or use variations of old hashtags to avoid moderation. Hashtags may change—but, fundamentally, as ED are body image disorders, images are central to this community. Therefore, image-based detection is more reliable. We use deep learning to identify pro-ED images, dividing images into two classes for training: pro-ED and not-pro-ED. For the first class, we used images posted to known pro-ED hashtags. For the second, we chose hashtags that yielded visually similar image content, such as #ootd (outfit of the day), #selfie, and #ballet. Ultimately, we accumulated over 100,000 images to train the ResNet convolutional neural network, achieving 79% accuracy on validation data.

We used this classifier to create two software tools to support ED patient recovery: one for patients that filters pro-ED images and one for clinicians that analyzes the pro-ED content of websites. The patient tool lets ED patients browse the internet without fear of triggers, because each image is run through our classifier before it is displayed; if it is classified as pro-ED, it is blocked. The clinician tool analyzes websites and classifies them as pro-ED based on the statistics of their content, so clinicians can quickly identify pro-ED communities online, allowing them to better treat their patients. These tools leverage state-of-the-art deep learning technology to enable clinicians, guardians, and those suffering from ED to identify and understand sources of pro-ED content to improve health outcomes for ED patients.

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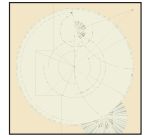
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Application of Thermoelectric Power Generation to a Modern Wood Stove

The purpose of this project is to create a thermoelectric wood stove and compete in the 2018 Wood Stove Design Challenge, created by the Alliance for Green Energy. This competition seeks to draw on the knowledge and skills of students, back-yard inventors, and wood stove manufacturers to re-invent a still widely used technology and bring it into the modern era. Wood stoves are used by millions of households in rural communities across the country, yet the technology revolution that swept household appliances in the last twenty years completely by-passed wood stove technology.

This project will utilize an Englander NC-30 wood stove, donated by England's Stove Works. Three thermoelectric generators will be added to the wood stove, one 100W and two 50W which will utilize the residual heat emitted by the wood stove and convert it to electricity. This electricity can be used to power electronics in the house; or alternatively, power batteries to be used during periods of low sunlight. The thermoelectric generators will be cooled by a dual flow system; comprising of, circulating hot water through coiled pipes, and cold air through a baseboard heat exchanger. A fan will be used to facilitate forced convection and increase the mass flow rate of surrounding air and ensure a more efficient heat exchange. With the current set up of the thermoelectric wood stove a total power output of 57W will be achieved, with 60W being put towards charging a 12V lead-acid battery, and the other 3W powering the pump.

At the competition we competed against five other teams in the thermoelectric category. All other teams were wood stove or thermoelectrics companies, or industry professionals. At competition we used two 50W TEGs and not the 100W TEG as a result of cross-flow in the cooling system preventing water from getting to the 100W TEG, which would have resulted in the thermoelectric modules burning out. Utilizing load-matching we were able to achieve a power output of 32W with only half of our TEGs active. Moving forward with the project the cooling system has been redesigned to allow for the incorporation of the 100W TEG, a clamping system to decrease the contact resistance between the TEGs and the stove's surface, and a thermal medium of thin copper sheeting will be placed between the wood stove and TEGs for greater heat transfer. The expected total power output after modifications are made is 65W.

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Gamma-Aminobutyric Acid (GABA) Supplementation Enhances Neural Stem Cell Proliferation and Differentiation on 3D Printed Gelatin-Methacrylate Scaffolds

The cortical regions of the brain, including the neocortex and the cerebellar cortex are primarily comprised of excitatory glutamatergic neurons and inhibitory gamma-aminobutyric acid (GABA) producing neurons. *In vitro* modeling of these cortical tissues for drug discovery and organ-on-a-chip purposes is heavily contingent on true-to-nature patterning of these neurons. Three-dimensional (3D) printing of neural scaffolds is an emerging approach by which to control the differentiation of neural stem cells (NSCs) *in situ* into a variety of neurogenic fates. However, current approaches to *in situ* differentiation are largely non-specific and yield undesirably heterogeneous populations of cell-fates not suitable for *in vitro* modeling of discrete cortical tissues. As such, we explore the potential for neurotransmitter doped 3D printed scaffolds and neurotransmitter supplemented media to bias NSCs towards assuming either a GABAergic or Glutamatergic fate. Specifically, the bioinks used to construct the 3D printed scaffolds were formulated by adding GABA to gelatin-methacrylate (GelMA) mixtures, a well-characterized hydrogel which is known to enhance cell adhesion. NSC growth and maturation on unmodified GelMA scaffolds is also enhanced by the supplementation of GABA in culturing media. Through the addition of a photoinitiation agent to the GelMA-GABA solutions, the neurotransmitter bearing ink can be printed layer by layer using a stereolithography printer into complex, porous matrices. Results indicate that the addition of GABA enhances NSC proliferation on the 3D printed scaffolds and increases the expression of Glutamate decarboxylase (GAD67), an enzyme which catalyzes the decarboxylation of Glutamate to GABA in GABAergic neurons.

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Creating Transparency: Using An Application to Connect the Inefficiency of Coal Fired Power Plants to Higher Electricity Prices for Consumers

Informed consumers could accelerate the transition away from using coal to generate electricity. The use of coal fired power plants to produce electricity occurs in the United States primarily during “high peak” demand times. This is due to the higher operational costs of coal fired power plants in comparison with more efficient natural gas, renewable, or nuclear power plants. These higher production costs then increase electricity prices for consumers. The focus of this study is whether or not this relationship between the demand for electricity and the use of coal could be brought to the attention of residential consumers. Furthermore, it investigates if consumers would then change their energy consumption habits after associating the reliance on coal during “peak” demand hours and the higher costs of electricity. The course of this study began with researching the energy supply chain and consumer habits, which led to research on smart grids, distributed generation, and the current infrastructure of the United States’ electrical grids. The research showed that residential consumers will conserve energy under specific criteria and that transparency between the production, retail, and consumption of electricity can directly impact consumer habits. Upon the realization that an application could fill this void of transparency, fifteen existing applications were analyzed, of which over half used smart meter technology to track real-time energy consumption. However, none of the applications monitored what energy sources were contributing to the electric grid, and none had features which connected energy sources with the current cost of electricity consumed. Thus, this study invented an application which will accomplish three key tasks. First, the application will monitor in real-time all power plants that are actively contributing to a user’s electrical grid. Second, the application will monitor electricity consumption in real-time via residents’ smart meter. Finally, the application will quantify the collected data and display to the user the current demand level (low, mid, or high peak), the energy sources contributing to their electrical grid, and real-time analysis of current electricity costs. The aim of this application is to show the direct relationship between the inefficiency of coal fired plants and higher electricity prices. This in turn could cause better consumption habits leading to energy conservation, reduced carbon output, and lower electricity prices. Further studies should look into how this application could accommodate the expansion of distributed generation, smart grid integration, and real-time pricing of electricity.

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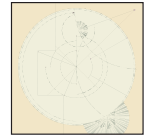
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Characterization of Contact Forces on Synthetic Vocal Folds Using Two-Dimensional Digital Image Correlation

From the cry of an infant to the Gettysburg address, the human voice is a powerful instrument in society. However, abnormal functioning of the phonatory system can lead to vocal fold disorders that impair voiced speech, such as polyps, nodules, and tissue bowing. Approximately one-third of the population will experience a vocal impairment at some point in their lifetime. Because this oral communication is such a fundamental tool for humans, it is important to understand the development of voice disorders and how they affect speech.

This study specifically aims to measure the contact forces experienced by vocal folds during self-sustained oscillation. Excessively high contact forces are believed to lead to formation of nodules. To accomplish the objective, an open source, two-dimensional digital image correlation (2D DIC) software package called "Ncorr" (<http://www.ncorr.com/>) will be applied to analyze synthetic vocal fold models tested using an *in vitro* vocal tract with interchangeable supraglottal tract inserts that replicate the effects of throat and mouth shape for different vowel sounds.

To validate the software, a computer simulation as well as an experimental assessment of the software were completed. The computer simulation used Photoshop to impose known displacements on a synthetically developed image created in MATLAB. To experimentally validate the software, a tensile coupon representative of human vocal folds (Material: Ecoflex™ 00-30) was fabricated, and a random speckle pattern was airbrushed onto its surface using Krylon Leather Brown Gloss. Known strains were imposed on the coupon using a custom-made tensile testing setup. Imaging was performed using an IDT NX4 camera and Motion Studio software. Post-processing was completed using the Ncorr-software to generate displacement and strain fields for both validation tests, which resulted in simulation and experimental strain errors of 8.3% and 10.3%, respectively.

Synthetic vocal fold models are being prepared for additional experiments and 2D DIC strain analysis. These models are fabricated using a standardized "M5" geometry and materials that match the physiological properties of the different vocal fold layers. The vocal fold models will be tested using an *in vitro* vocal tract where compressed air is introduced using an adjustable volume, acoustically-treated, constant pressure chamber that simulates the pressure developed in the lungs during phonation.

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A Three Field Mixed Finite Element Method for Large Deformations of Solids

Nonlinear deformations of solids occur in many modern engineering applications including electro-active/magneto-active materials such as magneto-rheological elastomers and electro-active polymers used in arterial muscles and variable response dampers, flexible electronic systems such as ultra-thin chips, and biological membranes and tissues such as cell membranes, blood vessels, and cardiac muscles. Stable computational methods that can accommodate system nonlinearities and complex geometries of components are vital to accurately model these applications. Designing such computational methods is a challenging task due to the non-linearity of the underlying governing equations.

We introduce a new class of three-field mixed finite element methods for nonlinear elasticity called CSFEM. CSFEMs are conformal finite element methods and the independent unknowns include displacement, displacement gradient, and the first Piola-Kirchhoff stress. The so-called edge finite elements of the curl operator are used to discretize the trial space of displacement gradients. This choice guarantees that the Hadamard jump condition for the strain compatibility will be satisfied on the discrete level as well. The convergence of CSFEMs near regular solutions is studied by using suitable inf-sup conditions. By considering several combinations of first-order and second-order elements, we study the validity of these inf-sup conditions by employing singular values associated to the matrix form of the inf-sup conditions. Some benchmark problems are solved to study the performance of CSFEMs. The results suggest that CSFEMs have optimal convergence rates and can accurately approximate strains and stresses.

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The Self-inspired Artificial Intelligence Device for Toxic Gas Detection and 'Murderers' Prediction

Emission of toxic pollutants into the ambient air present a serious threat to public health and the environment. Toxic, or hazardous, air pollutants cause or are suspected of causing cancer, birth defects, or other serious harms. Among them, toxic gas such as NO_2 is one of the harshest aspects triggering the exacerbation of respiratory system for asthma patients.

Monitoring, recording high-risk gases and predicting the location of gas leakage are highly important for tracking disease and alerting public. Current detectors are lack of portability and cannot provide daily real-time detection. At the same time, predicting the location of gas leakage by few measurements is challenging because the measurements from the sensors would be limited; the speed of the wind could vary; more importantly, the leakage rate is generally unknown. The modeling approach by differential equation might be a solution, however, by considering the complex behavior of fluids (gas) in the different speeds of the wind and the unknown leakage rate, the model might be very complicated and difficult to solve. Moreover, modeling is helpful for simulating the gas plume, but is not capable to predict the location of the leakage point.

As a combination of portable device with the ability of monitoring and predicting toxic gas, we develop a wearable gas sensor based on ultra-large MoSe_2 nanosheets. We obtained MoSe_2 nanosheets with a gold-assist exfoliation method and characterized the electrical and optical properties of the film. The high-performance gas sensor was fabricated to be intimate integrated in a smart watch for daily carry-ons. In particular, the device is decorated with silver nanoparticles and is able to detect toxic gas with high sensitivity and short response time. The system is effective in providing timely warnings and the sensing data are uploaded to cloud-based terminal so that the medical institute can easily access and provide a more accurate diagnosis. Furthermore, we propose a machine learning approach that generalizes the knowledge from the data and accurately predicates the gas leakage location. To our best knowledge, our proposed approach is the first attempt that is capable to predict the leakage location based on one local measurement of an array with limited number of sensors in the macroscopic scale without knowing the leakage rate.

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BugGraph: Graph-Based Vulnerability Analysis for Binary Code with Syntax Similarity

Similarity detection, which answers whether two codes are similar or not, has been widely used for binary vulnerability detection. Existing approaches face two challenges to achieve high accuracy and coverage: compiler and source code induced syntax similarity. Compiler induced syntax similarity appears when the source code is compiled with different toolchain configurations (e.g., compiler family, compiler version, and optimization level). Source code induced syntax similarity comes from the fact that the same vulnerability exists not only in the equivalent or highly similar code, but also in the less similar code. In this work, we design BugGraph to use several graph-based machine learning methods for accurately detecting similar binary codes. Specifically, we identify the compilation configuration (provenance) of a binary code for similarity detection by constructing the function call graph from the binary, and leveraging a graph attention network to highlight the functions that are more representative for the correct provenance. Further, we develop a generalized code similarity model, which employs a graph-based triplet network to learn from a broad range of ranked similar codes instead of polarized ones falling into either similar or different. The experiments have shown that BugGraph achieves up to 95% true positive rate (TPR) for binaries with both source code and compiler induced variance. Our provenance identifier is able to improve up to 39% TPR for compared works. In addition, we have applied BugGraph on real-world vulnerability detection. Specifically, we are able to achieve 84% TPR on OpenSSL and find 41 unpatched vulnerabilities on three firmware.

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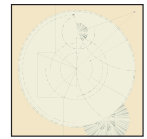
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Accelerator-Rich Heterogeneous Architectures

In the dark silicon era, only a fraction of transistors on a chip can be switched simultaneously due to constrained power budget. To improve energy-efficiency, general-purpose cores are augmented with specialized accelerators. These accelerators can improve energy efficiency by orders of magnitude due to their specialized optimizations. The integration of general-purpose cores with accelerators on the same chip in a heterogeneous design environment is putting stringent demands on the network-on-chip (NoC) communication fabric. Due to vastly different architectures and programming models, different types of cores have distinct traffic patterns as well as sensitivities to latency and bandwidth.

In this research project, we address this NoC design challenge by fully exploring the traffic patterns of diverse types of cores and then designing NoC which can be configured to adapt to specific workloads. Additionally, we consider heterogeneous technologies for the implementation of these accelerator-rich architectures. Recent 3-D integration and packaging techniques have enabled multiple logic dies, and memory dies of different technologies (SRAM, DRAM, NVM etc.) to be integrated on the same chip. It complicates NoC design by incorporating new vertical channels and enabling more flexible memory access schemes. We are exploring 3-D NoC design and heterogeneous technologies for fast and high-bandwidth inter-core communication and on-chip memory access.

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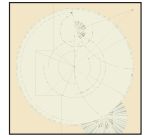
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Energy Storage Planning for Enhanced Seismic Resilience of Power Systems

Power grids are traditionally designed and planned to operate reliably under normal operating conditions. In the last decade, large-scale power outages become more commonplace with the growth in frequency and strength of natural disasters such as floods, windstorms, tsunamis, hurricanes, and earthquakes, which pose a direct threat to the successful operation of electrical energy delivery infrastructure. Among different classes of natural disasters, earthquakes are the one most unpredictable disasters, usually leading to widespread disruptions in the electrical power grid and its critical infrastructures. While such hazards that may hit the grid anytime and anywhere are difficult to predict, modeling and characterization of HILP events, assessing their impacts on power system infrastructures as well as the mitigation strategies that can proactively help in an agile response and recovery and improved resilience are urgently in need.

We introduce a comprehensive framework for modeling and characterization of seismic hazards, vulnerability assessment of electric systems to earthquakes, and corrective mitigation strategies ensuring operational resilience. Subsequently, we investigate the feasibility of employing battery energy storage systems (BESS) to swiftly recover the system critical loads during emergencies. A new index is defined to quantify the resilience of power distribution networks taking into account the uncertain nature of HILP events. This index is then involved in a linear programming (LP) optimization problem to find the optimal size and site of BESS for enhanced resilience against earthquakes. Efficacy of the proposed algorithm is numerically analyzed and verified on a real-world power distribution system. Our preliminary results verify that employing BESS results in improving power system resilience by significantly recovering the electricity outages in a timely manner, when facing seismic HILP emergencies.

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Monitoring Hydrolytic Degradation in Polymeric Scaffolds for Bone Regeneration Applications

3D-printed polymeric scaffolds are being used for allografting in applications such as bone regeneration, particularly in treatment of maxillofacial and craniofacial defects. Osseous tissue growth and extracellular matrix formation is the desired outcome of the scaffold implants. However, the success and efficacy of this treatment modality is limited by the mechanical structure failure due to pulsatile neo-vascular flow conditions and mechanical stresses.

The research question addressed in this study concerns the mechanical structure changes and the fate of material diffusion and transport in these scaffolds. The main goal of this study that is seldom addressed in literature is to ascertain the time-scales of scaffold degradation that are essential to achieve osseous tissue growth and vascular formation.

The experimental protocols included indirect measurements using rheometry and dynamic light scattering techniques. The research question was addressed by monitoring hydrolytic degradation of polyvinyl alcohol (PVA) scaffolds, which are soluble in deionized (DI) water and cell medium (CMPVA) solution used in mesenchymal stem cell (MSC) and human umbilical vein endothelial cell (HuVEC) cultures. Measurements were made with a rheometer (Discovery HR-2,TA instruments) wherein the variation of viscosity of the medium was assessed due to an increase in PVA concentration. Since the degraded solute (PVA) diffuses into the medium (DI water and CMPVA) and is transported into the flow stream, diffusivity was measured using a dynamic light scattering apparatus.

This study is built on previous experiments wherein direct monitoring of the macroscopic mechanical structure of the PVA-scaffolds was achieved using a simple digital microscope camera. Subsequently, mechanical structure changes were also observed under constant flow rate conditions. In order to establish a benchmark for future perfusion experiments, we report measurements pertaining to PVA-scaffold degradation without cellular crosslinking in this study. The results project the PVA-scaffold degradation time to be between 1 to 4 hours depending on the design, diffusivity and solvent used. Extended measurements using MSC cultures are planned in the near future using cell counting methods and spectrophotometry. These experiments have tremendous potential to impact our understanding of scaffold-degradation for applications such as maxillofacial and craniofacial repair.

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Analyzing Chemical Substitution Decisions Among Chemical and Product Manufacturers

Chemical and product manufacturers, spurred by recent environmental and sustainability initiatives, are seeking to embrace alternatives assessment to identify suitable alternative chemicals that are safer and more sustainable for use in consumer and/or specialty products. In this process, it is important to understand potential tradeoffs concerning final product design and re-design decisions. The objective of the present study is to characterize such tradeoffs using a set of six factors affecting product design: business strategy, economic considerations, functionality and performance, health/environmental endpoints, public perception, and regulatory factors. These factors were further disaggregated into 33 attributes distributed across the six factors. We assessed i.) tradeoff weights for each factor and ii.) the degree of influence of factors and attributes on a recent product design or re-design using a survey targeted at chemical and product manufacturers. Results from 33 completed surveys show that two factors are statistically different from equal weighting across the six factors: health/environmental endpoints and regulatory factors. Important attributes (and their factors) include: product price (economic considerations), product performance (functionality and performance), meets desired specifications (functionality and performance), and company reputation (public perception). Principal component analysis yields 9 principal components explaining 79% of the variance in the attribute scores data set. These components load heavily on attributes such as public awareness of human and environmental health concerns, company reputation, product performance, and product price. The broader implications of our study include a realization that the context of the decision may dictate how business and economic concerns may be addressed differently than health and environmental endpoint concerns with the goal of navigating decision tradeoffs among manufacturers.

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Nanomechanics and Electronic Structure of Organic Photovoltaics in Real Application Conditions by Advanced Scanning Probe Microscopy

Organics photovoltaic systems (OPVs) containing semiconducting polymers and fullerene derivatives have received significant attention over traditional crystalline semiconductor materials from the scientific community as a very attractive alternative, potentially offering very low cost, ease of manufacturing, very light weight and mechanical flexibility. This scanning probe microscopy (SPM)-based project seeks to acquire new fundamental understanding into the evolution of the electronic structure, electrical transport and nanomechanical properties of single polymer chains and bulk organic photovoltaic (OPV) devices under practical working conditions, where uncontrollable static and dynamic stresses exist due to thermal or mechanical perturbations. In this case, the relative geometrical arrangement of the PCDTBT:PCBM based OPV device is subject to applied external perturbations and the electrical and mechanical properties of the structure are investigated with different advanced SPM techniques like- Kelvin probe force microscopy (KPFM), conductive atomic force microscopy (C-AFM) and contact-resonance force microscopy (CRFM). We speculated that these external stresses can lead to very significant changes in electromechanical properties and device performance due to the exponential decay of the conductive molecular orbital wavefunctions as a function of intermolecular separation. Our results suggest that the electrical properties of OPVs can dramatically change under such applied external variations.

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Dynamic Deployment of Heterogeneous Mobile Base Stations in Public Safety Networks

As new mobile base stations (mBSs) have been constantly developed with various capacities, mobile coverage, and mobility models, the level of heterogeneity in public safety networks (PSNs) has been increasing. Since disasters and emergencies require the ad hoc PSN deployments, dynamic mBS placement and movement algorithm is one of the most important decisions to provide the critical communication channels for first responders (FRs). We propose a dynamic heterogeneous mBS placement algorithm in an ad hoc public safety network. We define different classes of mobile base stations that have varying performance characteristics and consider three different FRs mobility models. Our proposed algorithm applies the modern clustering technique to deal with the characteristics of different kinds of mBSs.

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Visible-Light-Responsive Photocatalyst of Graphitic Carbon Nitride for Biofilm Control

Access to safe drinking water is defined as a basic human right by the World Health Organization (WHO). Waterborne pathogens, however, have raised significant health concerns and economic losses worldwide. Compared with conventional water disinfection strategies, e.g. the chemical disinfectant, photocatalysis holds promise for the inactivation of waterborne pathogens because of broad spectrum effectiveness under ambient conditions, low cost, easy operation and maintenance. Herein, we developed graphitic carbon nitride ($g-C_3N_4$), an emerging visible-light-responsive photocatalyst and interrogated its anti-biofilm potential in water. $g-C_3N_4$ powder was synthesized through thermal polycondensation of melamine, cyanuric acid, and barbituric acid and $g-C_3N_4$ coupons were fabricated via hydraulic press of the powder. *Staphylococcus epidermidis* (*S. epidermidis*), a Gram-positive bacterium, was selected as a model pathogen to grow biofilms on the coupons. Biofilms were grown in the dark and under visible light irradiation to understand biofilm inhibition by photocatalysis, and mature biofilms were also explored for eradication under visible light exposure. Optical coherent topography (OCT), confocal laser scanning microscopy (CLSM), and scanning electron microscopy (SEM) were used to characterize the thickness, coverage, morphology, and viability of the biofilms. Atomic force microscopy (AFM) was used to characterize the mechanical properties of the biofilms. In addition, a fluorescent lectin, polysaccharide intercellular adhesin (PIA), was utilized to evaluate the presence and content of extracellular polymeric substances (EPS) of the biofilms.

OCT and CLSM suggested that $g-C_3N_4$ coupons inhibited biofilm development and eradicated mature biofilms under the irradiation of white LED light. Compared with mature biofilms developed in the dark, photocatalysis reduced the EPS content based on SEM and PIA staining. In addition, biofilms after photocatalysis became stiffer, which could also be explained with the loss of EPS. H_2O_2 and singlet oxygen were identified as the main reactive oxygen species that control biofilm development and eradication, not only inactivated bacterial cells but also weakened chemical bonds within the EPS matrix.

Our research has demonstrated $g-C_3N_4$ could inhibit and eradicate biofilms under visible light irradiation. Next step we will investigate the antimicrobial potential of $g-C_3N_4$ against other waterborne pathogens, such viruses and protozoans.

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Experimental and Analytical Studies of Tumor Growth

Most biological phenomena commonly involve with mechanics. In this work, we propose an innovative model that tumor is modeled as a poroelastic medium consisting of two parts: solid and fluid. The variation of solid part depends on whether the drug has been effectively delivered to the tumor site. We derive the governing equations of the tumor and incorporate it with the large deformation to improve the accuracy and efficiency of the simulation. Meanwhile, the dynamic finite element equations (DFE) for coupled displacement field and pressure field are formulated. Moreover, the porosity and growth tensor are generalized to be functions of displacement and pressure fields. We introduce a specific porosity and growth tensor. In both cases the formalism of continuum mechanics and DFE accompanied by accurate numerical simulations. To verify the feasibility of the model, we established a epithelial human breast cancer (BrCa) cell line known as MDA-MB-231, which was cultured into small ($<400\ \mu\text{m}$) tumorspheres in order to observe their growth patterns in both constrained growth environment (microwells) and unconstrained growth environment (Ultra-Low Adherence plates). Moreover, the tumorspheres used in the experiment were grown with and without the FDA approved anti-breast cancer anthracycline, Doxorubicin (Dox), in order to observe the influence it has on tumor-growth mechanics.

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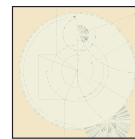
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SCHOOL OF ENGINEERING AND APPLIED SCIENCE

CUBIC as an Alternative “Clearing” Method for Creating Hydrogel-Based Structure in Organs

Cardiovascular disease is the cause of 1 in 4 deaths in the nation and cardiac nerves have a major influence on cardiac health, heart failure, and sudden cardiac death. Understanding the impact of the cardiac nervous system requires in depth cell-specific analysis of the heart, which can be done using tissue clearing followed by 3D microscopic imaging. “Clearing” is the creation of hydrogel-based structures of organs where the lipids are removed without damaging the proteins of the organ. We are interested in using clearing to analyze cardiac neural anatomic pathways with high accuracy.

Recently the CUBIC clearing method has gained momentum since it uses less reagents and can clear tissue quicker than other methods. While previous research has shown qualitative images and descriptions to describe CUBIC efficacy, quantification of the clearing performance is lacking.

The purpose of this study was to compare sequential images of cardiac tissue immersed in CUBIC solution alongside tissue absorbance spectra to measure the efficiency of the CUBIC method.

To visualize cardiac neurons, we selectively expressed a fluorescent probe: an enhanced yellow fluorescent protein (EYFP) conjugated with the light-activated channel channelrhodopsin (ChR2). Mice were crossbred to express EYFP+ChR2 in parasympathetic cardiac neurons which was driven by a choline acetyltransferase (ChAT) promoter using the Cre-Lox system. Hearts from these mice were excised and perfused with PFA as a fixative and perfused with the CUBIC solution. The tissue then was immersed in CUBIC solution and kept in an insulated shaker at 37°C. Absorbance spectra were acquired using a 3D-printed chamber that held the cardiac tissue without shifting the orientation between longitudinal measurements. Each day, the tissue holder was taken out of the CUBIC solution and a white light from an LED was directed through the heart and the light intensity was recorded by the spectrometer. Beer-Lambert’s Law related light intensity and transmittance to absorbance to measure daily changes in the spectrum. Finally, we imaged the right atria of a cleared heart to capture the parasympathetic neural anatomic pathways using 2-photon confocal microscopy. Visualization of the complex 3D anatomic structure revealed that CUBIC processing did not dramatically diminish EYFP fluorescence.

We found that, that over the course of 14 days, the absorbance spectrum of the heart sample decreased over time, with the greatest reduction occurring between days 1 and 4. Future work would include decreasing environmental factors when measuring light intensity to increase the accuracy of absorbance measurements.

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Viscoelastic Drop Deformation and Breakup in a Potential Vortex

In many natural and industrial multiphase flows, the suspended phase often disperses into drops of varied sizes and shapes. The drops deform along with the flow and at the same time influence the background flow. In the case of a dilute emulsion with negligible drop-drop interactions, a single drop provides complete information about the rheology. Here, deformation and breakup of a viscoelastic drop (FENE-MCR) suspended in a potential vortex is numerically investigated using a front tracking method. The nondimensional parameters that determine the problem in this case are capillary number (Ca), Reynolds number (Re), Strouhal number (St) and Weissenberg number (Wi). The shape of a viscoelastic drop is determined by a dynamic balance between inertial forces, interfacial tension and polymeric stresses. Viscoelasticity plays an important role in determining the critical capillary number, above which the drop breaks up. The study shows that viscoelasticity inhibits drop break up and thereby increases the critical capillary number. At lower inertia a viscoelastic drop deforms to a long slender shape before break-up, whereas at higher inertia a dumbbell shape is formed before breaking up. Effect of viscoelasticity on critical capillary number and drop deformation, just before breakup, is complex with different trends emerging at small and large limits of inertia. At lower inertia viscoelasticity has a significant effect on the drop break-up. At higher inertia strong dynamics pressure inside the drop dominates the drop breakup. The underlying reasons for the observed responses are discussed and explained using a damped spring mass model that contains all the essential physics of the drop-matrix system. Results from the simple model match qualitatively with the numerical simulations and provide a physical basis for the observed results.

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High-Performance Deep Learning Classification for Radio Signals

The ability to classify different types of signal modulations in radio transmissions is an important task with applications in defense, networking, and communications. This process has traditionally done manually by human analysts. Recent advances have shown that applying machine learning methods to this task is feasible. But existing recognition networks are complex, with heavy computational requirements, and poor accuracy on some modulation types and noisy environments.

We have built a robust radio frequency signal classifier using a hybrid system that combines images derived from constellation and spectrum data, as well as an efficient convolutional neural network. Our system obtains similar accuracy to the state-of-the-art deep learning classifier, using less training data, and with lower computational requirements.

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IntelliNoC: A Holistic Framework for Energy-Efficient and Reliable On-chip Communication for Manycores

As technology scales, Network-on-Chips (NoCs), currently being used for on-chip communication in manycore architectures, face several problems, including high network latency, excessive power consumption, and low reliability. Simultaneously addressing these problems is proving to be difficult due to the explosion of the design space and the complexity of handling many trade-offs. In this paper, we propose IntelliNoC, an intelligent NoC design framework which introduces architectural innovations and uses reinforcement learning to manage the design complexity and simultaneously optimize performance, energy-efficiency, and reliability in a holistic manner. IntelliNoC integrates three NoC architectural techniques, namely (1) multi-function adaptive channels (MFCs) to improve energy-efficiency, (2) adaptive error detection/correction and re-transmission control to enhance reliability, and (3) a stress-relaxing bypass feature which dynamically powers off NoC components to prevent overheating and fatigue. To handle the complex dynamic interactions induced by these techniques, we train a dynamic control policy using Q-learning, with the goal of providing improved fault-tolerance and performance while reducing power consumption and area overhead. Full system simulation using PARSEC benchmarks shows that our proposed design decreases end-to-end packet latency by 32%, improves energy efficiency by 67%, lowers power consumption (26% for static power and 33% for dynamic power), improves Mean Time to Failure (MTTF) by 77% and reduces area requirements by 25% over baseline NoC architecture.

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Geomagnetic Induced Currents Detection in Power System Using Machine Learning Technology

Solar wind is caused by charged particles erupted from solar flares and associated coronal mass ejections into space during the intensity peak the sun's cycle. The shock wave and/or cloud of magnetic field generated by the solar wind interacts with the Earth's magnetic field. A major disturbance of Earth's magnetosphere and ionosphere leads to geomagnetic disturbances (GMD). Consequently, geomagnetically induced currents (GICs) will appear in the conductor surface of the Earth. The flow of these currents into transmission lines can cause saturation of high-voltage transformers. This phenomenon can lead to increased consumption of reactive power and create disruptive harmonics that could cause very severe consequences, e.g., aging or malfunction of the electric power devices, and even a total collapse of the grid.

Northern North America is especially susceptible to problems resulting from GIC. March 13, 1989, an exceptionally strong GMD caused major damage to electrical power equipment in Canada and the United States. Hydro-Quebec extra high voltage (EHV) transmission system experienced instability and tripping of lines carrying power resulting in total blackout of the Hydro-Quebec system. In the United States, a voltage fluctuation of up to 4% was recorded on the EHV systems in Pennsylvania, New Jersey, and Maryland. September 19, 1989, at the Salem Unit 2 nuclear power plant, a second solar storm damaged the step-up transformers.

In order to limit the potential for damage driven by a GMD, it is crucial to monitor the GICs in power systems and mitigate the impacts before GIC rises to a certain level. However the GMD doesn't indicate the GIC's impact on power system. Meanwhile direct access to GICs, reflected as a DC component in EHV transmission lines, is quite dangerous and a challenge. Conventional approaches of monitoring transmission lines relies only on measurements of AC components through voltage transformer and current transformers. Additionally, the harmonics generated by nonlinear loads or overloading transformers within the grid and will also interfere with those generated by GICs when GMD level is low; such interference will make it difficult to detect GICs. Thus, an efficient and effective GIC detection mechanism is quite demanding.

This project aims to develop a GIC detection mechanism enabling a structural and operational resilience to such disasters. Among various types of GIC detection methods, two major time-frequency analysis techniques, i.e., wavelet transforms and short-time Fourier transforms, are applied and their performance are evaluated. Accordingly, a framework is developed which consists a hybrid GIC detection algorithm combined with advanced machine learning technologies, promising to swiftly detect, estimate, and block the GICs in power grids during a variety of operating conditions when facing a GMD natural disaster.

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Deep Randomized Ensembles for Image Retrieval

Learning embedding functions, which map semantically related images to nearby locations in a feature space supports a variety of image retrieval tasks. In this work, we propose a novel, generalizable and fast method to define a family of embedding functions that can be used as an ensemble to give improved retrieval performance.

Each embedding function is learned by randomly bagging the training labels into small subsets. We show experimentally that these embedding ensembles create effective embedding functions.

The ensemble output defines a metric space that improves the state of the art performance for image retrieval on various retrieval tasks: Birds species retrieval, Similar cars image searching, Fashion clothes matching, etc.

Code is available at: <https://github.com/littleredhx/DREML>

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Power and Performance-Efficient Manycore Architectures

Moore's Law has slowed, while Dennard Scaling has ended. The end of voltage scaling has made power dissipation the fundamental barrier to scaling computing performance across all platforms—from hand-held, embedded systems, to laptops, to servers, to datacenters. This challenge, often called the power wall, is seen across the board. To meet power challenges, we proposed a novel router architecture design and explored machine learning based control policies.

First, we designed a power and performance-efficient router architecture for parallel computing chips. The main idea is inspired by the fact that during low traffic, it is more energy efficient to route packets through a simple switching technique rather than through a complex pipelined router. The proposed design can speed up communication while consuming very little energy.

Second, we extended the design space for power-efficient NoC design by simultaneously applying a number of techniques. However, the simultaneous application of these techniques to yield maximum power efficiency requires the monitoring of a large number of system parameters which often results in substantial engineering efforts and complicated control policies. This motivates us to explore the use of reinforcement learning approach that automatically learns an optimal control policy to improve NoC power efficiency.

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Sustainable Hydrogen Peroxide Production from Water and Oxygen by Sunlight Driven Photocatalysis

Hydrogen peroxide (H_2O_2) is an important chemical that finds worldwide applications in disinfection, medical care/hygiene practices, water purification, industrial processes, and energy production; however, current H_2O_2 production at the industrial scale is not sustainable because of significant energy consumption and waste generation, and the high cost of anthraquinone as the catalyst. Photocatalysis is a promising alternative sustainable approach to generate H_2O_2 from earth abundant H_2O and O_2 by utilizing renewable solar energy. Recently, polymeric photocatalyst graphitic carbon nitride ($g-C_3N_4$) has been demonstrated to generate H_2O_2 under the irradiation of simulated sunlight, and the material has several advantages for practical applications, including capability to absorb a broad solar spectrum, low cost, great stability, and high biocompatibility. In our study, we discovered chlorine (Cl) doped $g-C_3N_4$ (denoted as MCC), which was synthesized from melamine and cyanuric chloride via a solvothermal method, generated H_2O_2 of notable concentrations (up to ca. $650 \mu M$ in 6 h, with a rate of $1.19 \pm 0.06 \mu M/min$) without any organic electron donors under visible light irradiation ($\lambda > 400 \text{ nm}$). This result is promising because the bulk $g-C_3N_4$ that was synthesized by thermal polycondensation of urea or melamine only produced $2-5 \mu M$ of H_2O_2 in 6 h under the same experimental conditions. Experimental conditions were tailored to improve H_2O_2 production. With the addition of $5 \mu M$ of urea as the hole scavenger, the rate constant of H_2O_2 generation was enhanced by 1.5 fold ($1.76 \pm 0.10 \mu M/min$). With the decrease of pH from 7 to 3, the rate constant of H_2O_2 generation increased by 2.5 fold ($2.51 \pm 0.20 \mu M/min$), likely due to the proton-coupled electron transfer (PCET) mechanism and proton dependence of H_2O_2 production. In the future, we will identify the role of Cl on H_2O_2 generation by molecular simulations, advanced material characterizations, and performance evaluation. Antimicrobial performance of photogenerated H_2O_2 will be evaluated for the inactivation of *E. coli*, *S. epidermidis* biofilms, and adenovirus. To sum up, this work sheds light on the development of an innovative effective photocatalyst for sustainable H_2O_2 production from H_2O and O_2 under sunlight irradiation, and it will pave a new avenue for onsite H_2O_2 generation and its applications of disinfection, medical care, hygiene, and water purification for remote areas, developing countries, and regions after natural disasters.

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Defining How Sex-Specific Signaling Complexes Lead to Sex Bias in Autism and Intellectual Disability

Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by atypical social perception and communication, atypical visual attention, and rigid thinking and behavior. Although the genetic basis of ASD remains poorly understood, it has been determined that mutation of the coiled-coil and C2 domain-containing 1A (*CC2D1A*) gene causes a range of neurodevelopmental disorders, including ASD and intellectual disability: *CC2D1A* knockout (cKO) mice have altered neural morphology such as decreased dendritic length and synapse formation. Interestingly, behavioral tests determined that male cKO mice showed cognitive and social behavioral impairments, while female cKO mice displayed far fewer impairments. On a molecular level, we found that only male cKO mice have reduced cAMP signaling. cAMP signaling is well-known to affect cognitive function, in particular, spatial learning. We are interested in determining the mechanism behind this sex-specific signaling in *CC2D1A* knock-out mice, and hypothesized that *CC2D1A* may form distinct protein complexes in male and female mice controlling different signaling pathways. In this research, we explored the composition of the *CC2D1A* signaling complex via immunoprecipitation and mass spectrometry. We also determined protein targets that were differentially phosphorylated between male and female WT and cKO mice, giving insight into *CC2D1A*'s sex-specific roles. These results will increase our understanding of sex bias in neurodevelopmental disorder, and will uncover new avenues for future research.

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Role of p53 in Epigenetic Regulation of Repetitive Elements

Cancer is a disease in which cells become abnormal and start growing uncontrollably due to alterations in the DNA of these cells. Normal cells are generally subject to signals which indicate to the cell whether it should differentiate, divide or die. However, cancer cells develop autonomy by not responding to these signals anymore leading to uncontrolled proliferation. Proteins encoded by genes known as tumor suppressor genes help to prevent the cells from becoming cancer cells. These proteins do so by ensuring controlled cell division, repairing mistakes occurring during DNA synthesis and directing old or cells-gone-wrong to undergo cell death. One of the most important tumor suppressors is p53, which is also the most frequently mutated gene in human cancers.

The human genome is, to a large extent, composed of repetitive elements, which include endogenous retroviruses (ERVs). ERVs are viral elements in the human genome that have integrated over millions of years of human evolution. Most ERVs are generally silenced by DNA methylation and histone modifications. However, Dr. Chiappinelli along with other researchers were able to identify that certain drugs known as DNA methyltransferase inhibitors (DNMTis), like 5-azacitidine (AZA), can cause ERVs to lose DNA methylation and be expressed again. ERV activation stimulates an immune response that causes cancer cell death and recruits host immune cells to kill cancer cells.

90-98% of all the High Grade Serous Carcinoma have mutations in the TP53 gene. Our goal is to characterize the epigenetic regulation of ERVs with a focus on the role of p53 by using HGSC as our cancer model. By assessing and validating the mutational status of p53 and treating with DNMTis, we can see how the expression of ERVs and Interferon Stimulated Genes (ISGs) is affected by the mutational status of p53. We have also assessed this in a mouse ovarian cancer model with two different p53 mutational statuses, one being p53 wildtype and the other p53 null. Treating these mice with 5-azacytidine (AZA) helps us see how DNA demethylation affects the expression of ERVs and ISGs and how this relates to the p53 mutational status. It also enables us to see how AZA affects the mice physiologically. We hypothesize that the p53 mutational status influences the epigenetic regulation and the ERV-induced immune signaling in solid tumors after treatment with DNMTis.

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Effect of Upregulation of Antioxidants in Mesenchymal Stem Cells Under Adipogenic Conditions

Mesenchymal stem cells (MSCs) are multipotent cells capable of “homing-in” to the sites of inflammation. MSCs overexpressing antioxidants can be used as a potential tool to reduce oxidative stress and resultant inflammation in presence of obesinogenic environment and treat associated cardio-metabolic disease.

Antioxidant-upregulated MSCs reduce inflammation and improve cell metabolic function such as cellular respiration in human and mouse MSCs.

Two different sources of MSCs (human adipose-derived and mouse bone marrow-derived) were transduced with adenovirus constructs to upregulate the antioxidants Sod2 and Catalase and subsequently cultured in adipogenic media (Lonza). The upregulation of Sod2, Catalase, and Null (control) were performed individually as well as a combination of Sod2 and Catalase. Gene expression analyses were performed using RT-qPCR and genes related to adipogenesis, apoptosis, and inflammation were investigated. Additionally, oxygen consumption rate (OCR) was analyzed using a mitochondrial stress test (Seahorse).

The inflammatory markers, TNF α and IL6, were downregulated in human MSCs only for Sod2+ Catalase MSCs sample (by what fold?). For UCP1, a gene involved in the browning of white fat, was upregulated in human MSC overexpressing the antioxidants individually and when combination of Sod2+Cat was upregulated. Similar results were observed for Ucp1 in mouse MSCs. However, in mouse MSCs, inflammatory marker, Il6 was not downregulated while Tnf showed a downregulation for all genetically upregulated MSCs. No differences were noted for genes related to adipogenesis and apoptosis in both human and mouse MSCs. OCR did not change in either human or mouse MSCs.

Our results suggest that there is a reduction of inflammation in MSCs overexpressing antioxidants but adipogenesis is not reduced and no improvement in the mitochondrial function was noted as evidenced by OCR values. Further experiments are being carried out to evaluate the differentiation and metabolic changes of MSCs when transplanted in obese diabetic/obese mouse models using individual or combination antioxidants.

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ATR Inhibitor VE-821 and Its Effects on *T. brucei* Biology and Pathogenesis

ATR, or ataxia telangiectasia and Rad3-related (ATR) kinase, a DNA damage signaling protein kinase, is involved with repairing double strand breaks in Eukaryotes. By interfering with cell cycle regulation, ATR coordinates the repair of replication induced DNA damage before cell cycle progresses. *Trypanosoma brucei* is a unicellular human parasite whose pathogenic process of antigenic variation might be coordinated with the formation of DNA replication dependent DNA break formation. However, to date, the relationship between replication induced DNA break formation and specific DNA recombination events associated with antigenic variation remains speculative. Inhibition studies of these normal circuits of ATR, for DSB repair, which may activate antigenic variation, have been done through RNAi knock-down. An alternative to genetic manipulation of ATR function could be chemical inhibition. Small molecule inhibitors against ATR have been developed to control human cancers, thus providing new tools for the analysis of ATR function. Here, we investigated the effects of the ATR inhibitor VE-821 on *T. brucei* biology and pathogenesis.

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Utilizing Affirmative Counseling Practices to Create Recommendations for Counseling Clients with Intersectional Identities in the Autism Spectrum Disorder and LGBTQI+ Communities

The latest estimates of the Center for Disease Control, collected in 2014, reported that 1 in 59 eight-year-old children in the U.S. had been diagnosed with Autism Spectrum Disorder (ASD) (CDC, 2018). Whereas research has shown that individuals with ASD report higher instances of same-sex attraction and gender dysphoria than their neuro-typical counterparts (George and Stokes, 2018; Dewinter, de Graaf, & Begeer, 2017; Jacobs et al., 2014), as these children reach adolescence and adulthood, they are subject to face the multiple minority stressors of their ASD and LGBTQI+ community affiliation in a predominantly hetero- and neurotypical-normative society. Currently, the counseling field has no recommendations for working with clients with ASD who also may be in the LGBTQI+ community. This research begins to bridge that gap by presenting recommendations through the lens of affirmative counseling for work with this population.

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Changes in Oxidative Metabolism Gene Expression In Vastus Lateralis of Type 2 Diabetic Women 1-Year Follow Bariatric Weight Loss

Bariatric weight-loss surgery can treat or improve type 2 diabetes, but the cellular and molecular processes driving this change are not well understood. We assessed skeletal muscle gene expression prior to and 1 year post bariatric surgery. We hypothesized that changes in genes involved in aerobic metabolism would be significantly increased in post-surgery samples. Global gene expression (N=12; black adult females; 6 diabetics/6 non-diabetics; Affymetrix arrays) was generated from vastus lateralis biopsies prior to and 1 year following RYGB. Clinical markers (insulin, glucose, and HOMA) were also measured in blood at these points in time. ANCOVA (group*time with age covariate) was performed using Partek Genomic Suite. Resultant mRNA lists were filtered at $P < 0.01$ and uploaded into DAVID bioinformatics database for functional annotation analysis. RYGB reduced BMI ($P < 0.01$; $-62.6\% \pm 28.3$) and HOMA ($p = 0.01$; -1.9 ± 2.4) 1 yr following surgery; with no differences between groups. ANCOVA identified 292 probes that were significant - (group*time $p < 0.01$). Post-hoc analysis of diabetic group identified 54 probes that were differentially expressed from pre to post-surgery. Functional annotation analysis identified Mitochondria (16/52, $p=2.7 \times 10^{-8}$), tricarboxylic acid cycle (3/52, $p=1.5 \times 10^{-3}$), Mitochondrial inner membrane (8/52, $p=3.3 \times 10^{-6}$). Genes identified include Cytochrome C oxidase subunit VIIIb (COX7B, $p=0.004$, fold change=1.4), Cytochrome C oxidase subunit VIa (COX6A2, $p=0.003$, FC=1.2), Malate dehydrogenase 2 (MDH2, $p=0.001$, FC=1.3), and Succinate dehydrogenase complex, subunit C (SDHC, $p=0.008$, FC=1.2). Gastric bypass surgery resulted in significant weight loss, improved BMI, and improved insulin sensitivity. Our analysis of skeletal muscle gene expression in diabetics identified increases in genes associated with oxidative metabolism indicating a role for these genes in improved insulin sensitivity following weight loss surgery.

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Role of Epigenetic Bromodomain Protein in Metastatic Melanoma

Metastatic melanoma is the most aggressive skin cancer and is the sixth most common cancer, of all age groups in the USA. Introduction of BRAF inhibitors and cancer immunotherapy has greatly improved treatment of melanoma, however, the problem of tumour relapse and therapy resistance persists. A better understanding of the mechanism of development of the diseases is urgently needed to help devise an improved therapeutic intervention. Bromodomain and extra-terminal domain BET family is represented by three members in humans BRD2, BRD3, BRD4 and play key mediators of transcriptional activation. Specific BET inhibitors have been developed and are already in dose escalation clinical trials to investigate safety, tolerability and pharmacokinetics.

Goal of this study is to identify the role of BET proteins in melanoma cells. We, therefore examined the effect of BET pharmacological inhibitor JQ1 on the proliferation and survival of the three melanoma cell lines (A375, A2058 and WM164). Melanoma cells were grown and maintained in the RPMI media supplemented with 15% fetal bovine serum and 1% antibiotic mixture. 70-80% confluent melanoma cells were plated overnight, then treated with JQ1 inhibitor.

MTT: Melanoma cells were treated with various concentrations of JQ1 (1, 5.0 and 10.0 μ M) for 72 hours in the humidified 37°C CO² chamber. MTT 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium was added, followed by incubation at 37°C for 4 hours. After addition of isopropanol containing 0.04N HCL, absorbance readings were taken at a wavelength of 570nm using spectrophotometer. MTT results showed a dose-dependent decrease in the cell proliferation in all the three melanoma cell lines tested, suggesting anti-proliferative role of BET inhibitor in the melanoma cells.

Invasion and migration: In order to understand the role of BET inhibitors in the metastasis, we performed Invasion and migration assays in the melanoma cells. We used uncoated (for migration) and matrigel coated (for invasion) trans-well assays to detect the migratory potential of A375, and A2058 WM164 cells, with or without JQ1 in concentration of 5.0 and 10. μ M. Interestingly, both migration and invasion were found to be reduced in JQ treated cells relative to the control cells in all the cell lines examined.

In summary, our results suggest that BET proteins play an important role in the growth and progression of melanoma cells. Further studies are ongoing to delineate the mechanistic role of BRD proteins in the metastatic melanoma.

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Cerebellar Posterior Lobe Morphology and Symptom Load in the Female Autism Spectrum Disorder

According to recent CDC statistics, Autism Spectrum Disorder (ASD) affects 1 in 59 children and diagnostic rates are about four times higher in boys than girls. This difference in diagnostic rates may be due in part to the female protective effect (FPE). The FPE is related to factors that make girls more resistant to developing ASD. Social pressures may have a role in FPE, but research suggests biological sex differences as a main factor involved. We have less data on girls with ASD, and therefore generally know less about the biology of girls with ASD. There may be differences in brain structure that we have yet to see in data sets, due to the uneven presence of boys represented in ASD studies. One of the distinctive features of ASD involves deficits in social perception. It has been previously determined that the cerebellar posterior lobe (CPL) is involved with social perception. We predict that for girls with ASD, impacts to CPL structure may be a key segment in understanding the FPE as well as a mode of recognizing key biological differences amongst girls with ASD.

Using MRI and behavioral data collected from wave one of a sex-balanced, age and IQ matched longitudinal cohort, we are investigating CPL morphology in 10 girls with ASD between the ages of 8 and 17 years. We will test the correlation between CPL morphology and social symptom load for the individuals. Symptom load will be quantified via scores on the Autism Diagnostic Interview-Revised (ADI-R) and the Social Responsiveness Scale, Second Edition (SRS-2). Discovering such a correlation has the potential to allow us to better understand the FPE as well as how cerebellar morphology relates to behavior in girls with ASD.

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Magnitude of Art in the Aftermath of the Lombok Earthquake: Program Evaluation

Indonesia, the world's largest archipelagic state, is prone to natural disasters because of its position within the Ring of Fire. As a nation of islands seemingly always vulnerable to natural disasters, there is a dire need for effective mental health and psychosocial interventions, including art therapy, to be developed and integrated into disaster response programs. The purpose of this program evaluation is to understand how art therapy supported children survivors of the 2018 Lombok earthquakes during the early phases of a disaster response program.

A qualitative case study research design was utilized to gain an understanding of safe and practical approaches amidst unstable environmental conditions. A one-time portable open studio program was implemented for seven participants. Observations and analyses of participants' artwork, creative process, interactions, and behaviors served as data to understand what art therapy can provide children after experiencing a natural disaster.

Thematic analysis of the participants' artwork found evidence for the value of art therapy during the early phases of a disaster response program. Three themes emerged among them: 1) Reverie (a need to escape from their current situation), 2) Isolation (a degree of detachment and needing additional boundaries), and 3) Transition (acceptance of reality and need to move forward).

The portable open studio was an effective approach for the children at Lombok to relieve their stress and facilitate the expression of their needs when long-term mental health and psychosocial interventions were not yet available. The participants' artwork served as indicators of the children's different responses in coping with the disaster and could be utilized as a base for subsequent interventions. The limited available research demonstrates the need for further studies on the best theories and practices of mental health interventions such as art therapy in disaster response programs.

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Activity of Benzotriazin Derivatives as STAT SUMOylation Inhibitors Across Species

Signal Transducer and Activators of Transcription (STATs) are a family of 7 proteins highly conserved in mammals. They function to signal the presence of cytokines in the environment and transmit the information to the nucleus and activate the transcription of specific genes. In immune cells, STATs are essential for survival, proliferation, interferon production, and effector function. The localization and function of STATs are regulated at the posttranslational level by phosphorylation, acetylation and SUMOylation. The benzotriazine compound, 3-Hydroxy-1,2,3-benzotriazin-4(3H)-one (HODHBt), has been previously identified to block SUMOylation of STAT5 in human T cells, increasing STAT5 nuclear presence and transcriptional activity (Bosque, Cell Reports, 2017). However, whether this mechanism of regulation is observed in the other human STATs, in different immune cell types, and also shared among different species is unknown. We first examined whether HODHBt can increase STAT phosphorylation of human STATs by transfecting the 7 human STATs into 293FT cells, a human embryonal kidney cell line. Second, we compared whether HODHBt increased phosphorylation of STATs in mice splenocytes, a human 293FT cell line that overexpress STAT5 (293-B7), human NK cells, and the African Green Monkey VERO cell line using Western Blot. HODHBt increased phosphorylation of the 7 STATs in the human cell line 293FT. On the other hand, HODHBt did not increase the levels of STAT phosphorylation in VERO cells. Primary mice splenocytes were treated with IL-15, HODHBt or a combination of both. IL-15 induced an increase of total STAT5 as well as phosphorylated STAT5. Contrarily, in human NK cells HODHBt did not increase the levels of STAT phosphorylation. Further analysis by Western Blot of the activity of HODHBt on other STATs is under evaluation. These results suggest that the mechanism of regulation of STAT activity by HODHBt is not conserved across species. Further studies are underway to identify the potential target of HODHBt and how this target differs among species.

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In-Vitro Activity of CUDC-907 (PI3K/HDAC Class I and HDAC10 Dual Inhibitor) in Cutaneous T-Cell Lymphoma

Non-Hodgkin's Lymphoma (NHL) is an aggressive form of cancer affecting the lymphatic system, which plays a vital role in the body's immune function. T-cell lymphoma is a type of NHL that occurs in T lymphocytes, which play an important role in immune responses. TCL is a heterogeneous group categorized into several subtypes, including cutaneous T-cell lymphoma (CTCL). In many cases, CTCL only presents skin symptoms, which are often mistaken for skin conditions.

CTCL develops slowly and consequently responds to treatment slowly. Current treatment plans can take patients several months and even up to a year to respond. Therefore, new treatment options are needed to decrease response time and improve effectiveness. In this regard, PI3K signaling has been shown to have potential significance as a treatment target. PI3K is a part of the AKT (protein kinase B) pathway, which leads to uncontrolled protein synthesis and cancer growth. As a result, the inhibition of PI3K inactivates AKT, which suppresses the cancer. Recent studies show promise in treating some types of leukemia with the use of CUDC-907, a PI3K inhibitor.

The drug's effectiveness was examined with several CTCL cell lines: HH, H9, HuT 78, and SeAx. The CTCL cells were grown in RPMI media supplemented with 10% fetal bovine serum and 1% antibiotic mixture. 70-80% confluent cells were treated with CUDC-907 inhibitor in a tissue culture plate. 50mM stock solutions of CUDC-907 were purchased and stored at -20°C until use. CTCL cells were treated with various concentrations of the drug (10nM, 100nM, 500nM, and 1uM) for 72 hours in a humidified 37°C CO2 chamber. MTT 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium was added, followed by incubation for 4 hours. After the addition of isopropanol containing 0.04N HCL, absorbance readings were taken at a wavelength of 570nm using a spectrophotometer. MTT assay results showed a dose-dependent decrease in cell proliferation in all four CTCL cell lines tested, suggesting an anti-proliferative role of CUDC-907 in the lymphoma cells.

To confirm that CUDC-907 was targeting PI3K, Western Blotting techniques were also performed on the cells, following treatment with the inhibitor. 100nM and 500nM concentrations were used to treat the cell lines for a 24-hour incubation period before the cells were lysed to extract proteins. Gel electrophoresis techniques were used to separate the proteins and AKT levels were compared with a control group, which received no drug treatment. Results showed a dose-dependent reduction in AKT, suggesting the inhibitor's targeting of PI3K.

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Objective Metrics and the Future of Telemedicine

My research team and I have been collaborating with one of the biggest telemedicine companies in the country to develop the first program to provide objective metrics for telemedicine consultations. Telemedicine is a growing medical field that has taken large steps in improving access to healthcare for individuals around the world. Telemedicine consults attempt to bridge the gap between specialized physicians and patients in need of care. With the help of a medical assistant/nurse, a physician can interact with a patient hundreds of miles away and deliver the care they need in a timely manner, through a webcam. However, training physicians to effectively use the technology to improve quality of the overall consult comes with its various challenges. Current measurements regarding consult quality are largely subjective. These measurements rely on basic 1-5 scales to measure certain parameters that attempt to quantify the quality of interactions between the patient and physician. Subjective metrics ultimately impede physicians from understanding the true nature of their consultation and pose a challenge to training physicians in telemedical practices. Thus, our research team has employed CMU's OpenPose algorithm to analyze consultation videos. We have also devised measurements, using natural language processing, to translate existing best practices into objective metrics. Finally, our program will serve as a tool to augment telemedical care and training practices by finally providing physicians with, impartial, quantifiable results of their consultations.

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Effect of TNF Inhibitors in Conjunction with Methotrexate on Hidradenitis Suppurativa Disease Activity

Hidradenitis suppurativa (HS) is a chronic, recurrent, inflammatory disease of the apocrine sweat glands, characterized by recurrent abscessing inflammation. The disease affects approximately 1-4% of the population and there is currently no known cure. The pathogenesis of HS is poorly understood, and various genetic and environmental factors play a key role in disease activity. Tumor necrosis factor- α (TNF- α) is a cytokine that regulates immune responses in multiple inflammatory diseases, and TNF inhibitors (TNFi) are now approved as treatment of HS. In other rheumatic and skin diseases, Methotrexate (MTX) is sometimes used as an adjunctive therapy to increase the efficacy of TNF inhibitors and to minimize development of drug neutralizing antibodies. The purpose of this study was to compare disease control in patients with HS receiving TNFi alone and TNFi in conjunction with MTX.

This research was conducted through the Wound Etiology and Healing Study (WE-HEAL Study), a biospecimen and data repository approved by The George Washington University IRB (041408). All subjects gave written informed consent for longitudinal collection of their data while they receive treatment according to standard of care.

At datalock, there were 132 patients observed in the HS cohort. Subjects were divided by therapy into TNFi alone, TNFi/MTX and No immunosuppression. Disease activity was assessed by comparing Hurley Stage and Hidradenitis Sartorius Score (HSS). Remission rates were assessed using the Hidradenitis Suppurativa Clinical Response (HiSCR).

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Evaluating the Effects of G Protein-Coupled Kinase 4 and Sodium Bicarbonate Cotransporters Interaction on Essential Hypertension

Few researchers have addressed the question of genetic contributions nor gene-gene interactions influencing salt-sensitive hypertension. In fact, the genome-wide association studies (GWAS) has only identified 2% of the genetic factors believed to affect blood pressure (BP). The paracrine interactions of the renal dopamine and renin-angiotensin system are among the forefront of sodium and BP regulation and are essential for proper kidney function. While stimulation of dopamine receptors, D_1R and D_3R , engender natriuretic effects via inhibition of Na^+ transport, stimulation of renin-angiotensin II type 1 receptors (AT_1R) downregulate dopamine receptor expression and engender anti-natriuretic effects. Salt-sensitive individuals are associated with impaired dopamine receptor function which, in part, is due to desensitization by constitutively active G protein-coupled kinase 4- γ (GRK4 γ). While GRK4 is essential for the normal desensitization and resensitization of dopamine receptors, certain GRK4 polymorphisms desensitize and internalize D_1R and D_3R , thus impairing its natriuretic function. There is evidence that the variants GRK4-486V and GRK4-142V influence salt-sensitivity on high and normal salt diets, respectively. However, the influence of the variant GRK4-65L on salt-sensitivity is likely to involve gene-gene interaction. Preliminary work investigating the relationship between GRK4-65L and sodium bicarbonate cotransporter, SLC4A5, indicate that salt-sensitivity of human GRK4-65L transgenic mice are magnified by increased renal tubular SLC4A5.

The aim of this study is to validate the relationship between GRK4-65L and SLC4A5 expression as well as to elucidate the mechanism of their interactions that influence salt-sensitive hypertension. Preliminary data using qPCR support that the expression of SLC4A5 is significantly increased in GRK4 variant cells compared to the GRK4-WT (4.73 ± 0.02 vs. 1.00 ± 0.00 , $P < 0.05$). However, it seems that SLC4A5 variant downregulates the expression of GRK4 in cells expressing both the GRK4-65L and SLC4A5 variant when compared to cells expressing GRK4-65L cells alone (1.75 ± 0.13 vs. 3.29 ± 0.04 , $P < 0.05$). The mechanism of this interaction is unclear and it is uncertain if it is a complication of the cell line used. Future studies will investigate these results in additional cell lines carrying the same polymorphisms. Additionally, protein expression will be quantified using immunoblotting, activity using cyclic AMP and Na^+K^+ ATPase, and colocalization using confocal microscopy to determine the mechanism of interaction between GRK4-65L and SLC4A5.

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Anemia Reduction in India: A Social Factors Approach through the Lens of Fatigue

Reducing anemia in women in the developing world remains a significant public health challenge. We hypothesize that in Odisha, India, the persistent anemia prevalence of 50% among women points to the need to adopt a social factors-based, rather than just a biomedical, approach to address the problem. We ask questions about how fatigue, the primary symptom of anemia, serves as a conceptual repository of gender-, power-, and identity-based issues among women in rural India to draw implications for more comprehensive interventions. to reduce anemia.

We used mixed-methods to understand how perceptions of fatigue may contribute to anemia rates in Odisha, India. We created perceptual maps to understand the conceptualization of fatigue among women, husbands, and mothers-in-law (N=90). Participants were asked to rate how similar 12 items related to anemia were to each other. Similarity scores were converted into a *dissimilarity* matrix and plotted onto 2 dimensions using multidimensional scaling. Participants were then asked to rate each item on importance to health, likability, and ease of acquisition. We also conducted 25 key informant interviews and 16 focus group discussions with women of reproductive age, husbands and mothers-in-law (n = 148). We analyzed the data using applied thematic analysis and triangulated the quantitative and qualitative results.

Men and women had starkly different perceptions of the importance of fatigue on health. Cognitive maps and card sorting revealed that fatigue was not conceptualized as illness in women; women and mothers-in-law reported that fatigue was not important to health and difficult to get. However, husbands thought of fatigue as both important and easy to get. Women in the focus group discussions also reported that fatigue is a part of everyday life for women and that their family's well being takes precedence over any feelings of fatigue they may have.

The results indicate that the social role of women manifests through conceptualizations of fatigue, which has been normalized. If women do not perceive that fatigue represents a sign of illness, or prioritize it, they may not seek treatment. Therefore, future public health interventions should consider the role social structures play on health behavior.

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Differential Expression of NMDA Receptors in Multiple Sclerosis

Multiple Sclerosis (MS) is an inflammatory disease of the central nervous system (CNS) characterized by focal demyelinating plaques. In addition to demyelinating plaques, there is mounting evidence that periplaque lesions (PPL) and normal appearing white matter (NAWM) undergo distinct pathological changes, including early or incomplete demyelination. Glutamate levels increase to excitotoxic levels in individuals with MS, and it has been shown that over-activation of glutamate receptors acutely produces well-circumscribed areas of demyelination reminiscent of MS plaques. N-Methyl D-Aspartate (NMDA) receptors mediate glutamate responses in the CNS, and are present in both white and gray matter. Analogous to the molecular heterogeneity of NMDA receptors in developing human brains, which are likely to play a role in increased vulnerability to glutamate mediated hypoxic-ischemic injury, we expect that similar changes occur in MS.

We wanted to test the hypothesis that NMDA receptor expression increases in PPL and NAWM, which in turn become more susceptible to glutamate-induced excitotoxicity, including myelin damage and axonal injury. For this study we have used fresh frozen human MS brain samples acquired from the Rocky Mountain MS Center tissue bank and conducted: 1. Histological analysis using Solochrome cyanine colorimetric stains and myelin basic protein (MBP) stains; and 2. Fluorescent in situ hybridization using RNAscope to detect and localize the expression of Glutamate Ionotropic Receptor NMDA Type Subunit 1 (Grin1) mRNA.

Our results show that there was increased expression of Grin1 mRNA in PPL and NAWM in MS samples compared to control white matter from non-MS samples. This indicates that a distinct heterogeneous glutamate response exists in the vicinity of an MS plaque. Future work will include analyzing other NMDA receptor subunits, namely Grin2C, Grin2D, and Grin3, as well as combining in situ hybridization with antibody immunofluorescence for NMDA receptor subunits and for cellular markers to further analyze this observed change in NMDA receptor expression in MS lesions.

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Levels of Intrinsic Motivation as a Function of Physical Activity Goals in a Primary Care Setting

Physical activity (PA) goals have been classified as internal (i.e., inwardly focused) or external (i.e., outwardly focused). Internal goals may foster higher levels of PA than external goals. This is because internal goals promote intrinsic motivation (IM) whereas external goals dampen IM. Health management goals (e.g., cardiovascular fitness, energy) are classified as internal goals whereas tone/body shape goals (e.g., appearance, weight maintenance) are classified as external. A limitation of this research is that the internal and external categories were established predominantly with samples recruited from the university setting. The extent to which the internal/external distinction is relevant in the primary care setting is not well understood.

One objective was to test whether the PA goals most commonly endorsed by patients in a primary care setting (i.e., weight maintenance, weight loss, overall health, body shape, stress reduction, well-being, energy, cardiovascular fitness) differed as a function of IM. A second objective was to identify which of the goals were reported as most important to participants.

Participants (N = 531; 39.4% male; 36.3% White) were recruited from a primary care clinic. Participants selected PA goals 0 (*not selected*) and 1 (*selected*). IM was assessed on a scale ranging from 0 (*not at all true*) to 6 (*very true*). Goal importance was assessed on a scale ranging from 0 (*not at all*) to 4 (*extremely*). Eight ANOVAs were run testing whether scores on IM differed as a function of whether or not a PA goal was endorsed. A repeated measures ANCOVA compared the importance of the eight most commonly listed PA goals.

Patients who held an overall health goal reported higher IM ($M = 5.23, SD = 1.20$) than those who did not ($M = 4.96, SD = 1.44; F = 4.95, p < .05$). Those who held cardiovascular goals reported higher IM ($M = 5.31, SD = 1.19$) than those who did not ($M = 5.02, SD = 1.37; F = 4.16, p < .05$). There were no other statistically significant differences. Patients rated overall health the most important PA goal ($M = 3.58, SE = 0.03$) and weight loss as the least important ($M = 2.65, SD = 0.67$).

Results suggest that the internal and external categorization of PA goals may not reflect the way the goals are experienced by those in the primary care setting. This is particularly the case of goals related to weight.

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Optimizing Methodology for Characterizing Microbiome Diversity in Breast Milk Using Metagenomic Data

The breast milk microbiome has not been well characterized and may have many health-related consequences, especially for infants. In order to analyze the microbiome of breast milk, an effective DNA extraction method is necessary. However, breast milk is a unique biological substance which does not yet have a standard for DNA extraction methodology. This project sought to examine variations in DNA extraction methodology in order to determine the optimal method for a microbiome analysis of breastmilk. We tested four DNA extraction kit chemistries—MoBio PowerFood Microbial DNA Isolation Kit, Norgen Food DNA Isolation Kit, ZymoBIOMICS DNA Miniprep Kit and Norgen Milk Bacterial DNA Isolation Kit. In addition, we manipulated other extraction variables including length of time from pumping to extraction, temperature of stored breast milk, use of preservation solution, concentration of sample prior to extraction, and the use of a lysostaphin solution. DNA extraction was performed using each of the four kits and followed by shotgun sequencing. This sequencing technique allowed for analysis of the microbiome through bioinformatic tools including PathoScope 2.0. PathoScope 2.0 was used to map the DNA sequences obtained from breast milk samples against reference sequence databases for a wide variety of bacterial DNA and human DNA to determine the microbiome of breast milk. Low mapping rates and variability between extraction methodologies indicate that further optimization is necessary to capture the full diversity of the breast milk microbiome.

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Longitudinal Follow-Up of Patients Enrolled in the STOP Scleroderma Biorepository

Scleroderma is an autoimmune disease characterized by inflammation, vasculopathy, and fibrosis. The purpose of this study was to investigate longitudinal outcomes and assess clinical differences in a cohort of patients with limited and diffuse scleroderma.

This research was conducted via the STOP Scleroderma Study, a biospecimen and data repository approved by The George Washington University IRB (051427). All subjects gave written informed consent for longitudinal collection of their data.

Of the 84 scleroderma patients enrolled in the STOP scleroderma study at the time of data lock, 37 fulfilled criteria for limited and 19 fulfilled criteria for diffuse scleroderma. Data were collected on demographics and baseline disease activity including skin score, scleroderma health assessment questionnaire disability index (SHAQ-DI), gastrointestinal (GI) score, physician global assessment, and the Medsger severity score. Data were analyzed using GraphPad Prism (version 7.0).

There was no significant difference in age or gender in the diffuse and limited scleroderma cohorts (52.40 ± 12.72 years and 84% female) compared to (57.36 ± 14.48 years and 78% female), respectively ($p = 0.21$) and ($p = 0.27$); or in race ($p = 0.41$). Gastrointestinal involvement was similar in diffuse (0.48 ± 0.38) and limited scleroderma (0.50 ± 0.55 , $p = 0.90$).

As expected, the diffuse patients had higher Medsger Severity Score, (5.68 ± 2.58 compared to 3.20 ± 1.98 in limited, $p = 0.0002$); and SHAQ-DI, (0.87 ± 0.74 in diffuse compared 0.40 ± 0.51 in limited, $p = 0.013$). Physician reported assessments also demonstrated a significant difference in the two cohorts including physician global assessment diffuse (3.63 ± 1.46) and limited (2.08 ± 1.25) ($p=0.0001$); and skin score for diffuse (4.89 ± 1.73) and limited (2.03 ± 1.31) ($p=0.0045$).

In this cohort of patients with diffuse and limited scleroderma, there were a number of quantifiable patient outcomes that correlated with disease activity. Ongoing longitudinal follow up of this cohort is planned.

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Investigating How DNA Methylation Shapes the Immune Response to Epigenetic Cancer Therapies

Epigenetic abnormalities in cancer such as genome-wide hypomethylation and focal hypermethylation alter gene expression. Epigenetic changes targeting proto-oncogenes and tumor suppressor genes can contribute to the development of cancer. DNA methyltransferase inhibitors (DNMTi) such as 5-azacytidine (AZA) and histone deacetylase inhibitors (HDACi) such as ITF2357 (ITF, Givinostat) have been developed to combat these adverse epigenetic events and activate endogenous retroviruses (ERVs) to upregulate an interferon response to stimulate immune signaling. The purpose of this study is to understand the DNA methylation alterations made by these therapies and its effect on the immune system. We collected DNA methylation data from the A549 cancer cell line given three different cancer therapies ITF, AZA, and a combination of ITF and AZA. I used Methylation-sensitive Restriction Enzyme digestion (MRE-seq) and Methylation Dependent ImmunoPrecipitation (MeDIP-seq) to measure DNA methylation. The sequence data were integrated by the methylCRF program to predict DNA methylation levels genome-wide at single CpG resolution, and by the methylMnM program to detect differentially methylated regions (DMRs) between mock and treated samples. We created a python script to identify the DMRs of greatest average methylation difference. From our results, we chose four regions and one control due to their significant changes in gene expression and difference in methylation. These regions are being analyzed using COmbined Bisulfite Restriction Analysis (COBRA) and bisulfite sequencing to investigate the changes in methylation and immune response to the epigenetic therapies.

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Temporal Regulation of Cytokine Mediated Gene Expression Changes Upon the Genetic Intervention of Histone Deacetylase 6 in Melanoma

Previous gene expression studies in melanoma have revealed that several signaling pathways are modulated by specific histone deacetylases (HDAC). Among them, HDAC6 has been shown to tightly control antigen presentation and other immunomodulatory functions. We aim to investigate the effect of HDAC6 on the expression pattern of genes in melanoma cells through a time point dependent manner with the generation of gene clusters, which can then be mapped to specific signaling pathways. WM164 Non-target (NT) and WM164 HDAC6 Knock-down (HDAC6 KD) melanoma cells were used to generate RNA sequencing data. RNA was collected at different time points (0, 1, 2, 4, 6, 8, 12, and 24hrs) after being stimulated with interferon gamma (IFN γ) or interleukin-6 (IL-6). RNA samples were sequenced, followed by a HISAT2-StringTie pipeline processing to give the Fragments per Kilobase of transcript per Million (FPKM) values at different time points. The FPKM values were then inputted to a cluster generating software Graphia Professional, which determines the similarities between individual expression profiles by building a correlation matrix for both gene-to-gene and sample-to-sample comparisons. This matrix was then filtered to remove all correlations below a certain threshold (for the gene-to-gene comparison in the RNA-seq atlas, Pearson's $r < 0.8$). Markov clustering (MCL) algorithm was used to construct a network graph with an inflation value of 2.2, generating 537 clusters in total. The clusters obtained were then used for pathway analysis studies using the online software MetaCore, an integrated software suite for functional analysis of Next Generation Sequencing, gene expression, microRNA, and screening data. Upon stimulation of WM164 NT with IL-6, 12 clusters showed patterns of upregulation, 8 clusters showed patterns of downregulation and the remaining 109 clusters showed cyclic patterns of gene expression. Initial analysis of NT showed up and downregulation of multiple pathways such as HIF-1, TGF- β , and IL-12, IL-4, IL-16 and IL-18 upon stimulation with IL-6 at very defined time windows. In the case of IFN γ stimulation, there was a progressive upregulation of pathways such as Hippo, Notch, IL-23 and WNT while OX40L, IL-8, HIF-1 and VEGF pathways were downregulated at specific intervals of time. Since most immune-related genes are transiently modulated by external stimuli, and in most cases in very defined time windows, we propose that studying the expression of genes at multiple time points after cytokine stimulation would be more significant to build accurate ontology maps of cellular pathways modulated by specific HDACs.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Molecular and Structural Preservation in Guanidinium Supplemented Ethanol-Based Fixative

For the past century, formalin has remained the most commonly used and widely accepted tissue fixative for preserving both histological and molecular characteristics of cells. However, as the field of biomolecular science continues to develop and grow, the need for a fixative that offers improved biomolecular integrity increases. Though neutral buffered formalin, which contains 10% formalin, provides exceptional histology due to the cross-linkage of proteins that preserves cellular architecture, its mechanism of action also leads to the degradation of protein, DNA, and RNA content present in the tissue. Previous research has established that buffered ethanol 70% offers improved DNA, RNA, and protein quantity and quality as compared to NBF. As recent research has well-characterized the histological and molecular properties of BE70, this study focused on how these properties are modified or changed by the addition of guanidine thiocyanate to the solution. Guanidine is often used in RNA and protein extraction due to its chemical propensity to bind to and denature protein. The BE70G fixative demonstrated higher quantities of RNA and DNA, and increased quality of DNA. Additionally, though protein yield was not increased between each of the fixatives, a marked difference was observed in the protein quality of BE70G. Immunohistochemical and H&E staining indicated BE70G provides poor nuclear detail and definition of cellular architecture. Overall, data suggests that guanidine thiocyanate confers improved biomolecular integrity to BE70, but much is left to be desired in its histological properties. Further studies are needed to replicate quantity and quality data, as well as characterize the histomorphological features of the addition of guanidine.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Rate of Recovery of Professional Athletes after Anterior Cruciate Ligament (ACL) Surgery

The incidence of ACL injuries is currently estimated at approximately 200,000 annually, with 100,000 ACL reconstructions performed each year. In general, the incidence of ACL injury is higher in people who participate in high-risk sports, such as basketball, football, skiing, and soccer. Approximately 50 percent of ACL injuries occur in combination with damage to the meniscus, articular cartilage, or other ligaments. In this study we will be looking at those athletes who undergo ACL surgery. We are looking to support the fact that those athletes who undergo bone tendon bone autograft will experience a quicker rate of recovery and the overall performance of the athlete after the surgery will be greater than the hamstring grafts. This is due to results found in prior studies, comparing outcomes of patellar tendon and hamstring autograft ACL reconstruction, the rate of graft failure was lower in the patellar tendon group. If our results supports our hypothesis this will, in turn, will provide supports for the BTB autograft surgery as a more successful surgery with better results for athletes.

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Is Using Food as Reward in Children with Autism Associated with Increased Food Responsiveness?

Children with Autism Spectrum Disorder (ASD) are at elevated risk of being overweight and obese (Curtin et al., 2014). Parents use food commonly as a reward for their children's behavior; however, this is particularly common practice among children with ASD, through approaches such as applied behavior analysis. Research has found a correlation between parents who use food as a reward for their typically developing (TD) children and responsiveness to food and emotional eating (Farrow, 2016). This study seeks to be the first to examine this relationship in children with ASD and whether this relationship is modulated by picky eating status.

The objective was to determine if parents of children with ASD use food as reward more often than parents of TD children and if food reward usage is correlated with food approach behaviors.

Parents of children with ASD ($n=153$; M age = 8.9; 109 males) and TD children ($n=78$; M age = 8.3; 36 males) filled out online questionnaires about their children's eating habits and health. Parent utilization of foods as rewards was assessed using the Child Feeding Questionnaire (Birch et al., 2001) while food approach behavior was assessed using the Child Eating Behavior Questionnaire (CEBQ; Wardle et al., 2001). The CEBQ provides measures of three relevant appetitive traits: food responsiveness, emotional overeating, and enjoyment of food. Picky eating was assessed using an item from the Eating Habits Survey (Wilde et al., 2012).

Parents of children with ASD reported greater usage of foods as rewards than parents of TD children ($t=2.15, p<.05$). Food reward utilization was positively correlated with two of the three food approach appetitive traits among all children with ASD: food responsiveness ($r=.26, p=.001$) and emotional overeating ($r=.36, p<.001$). However, when splitting the ASD group into picky eaters vs. non-picky eaters, the association with using food as reward and food responsiveness was accentuated in non-picky eaters ($n=65; r=.37, p=.003$) and disappears among picky eaters ($r=.07, p=.54$).

Parents of children with ASD rated themselves as more likely to use food as a reward than parents of TD children, and the frequency of this food reward utilization was positively associated with food approach appetitive traits (i.e., food responsiveness and emotional overeating). Importantly, the link between using food as reward and food responsiveness was not found among picky eaters with ASD suggesting modulatory effects. Given the risks for overweight and obesity in ASD and its health consequences (e.g., cardiovascular health, diabetes, etc.), it is critically important to strive to use non-food-related methods of rewarding children with ASD, so as to try to lower the risk for developing appetitive traits that place children at risk for becoming overweight/obese.

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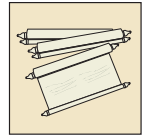
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HUMANITIES



COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Ecocritical Shakespeare, From the Thames to the Rialto

Ecocentrism is the amalgamation of demonstrated attitudes and actions toward environmental sustainability, as well as toward equitable interspecies relationships between humans and other living things. Ecocentrism is a subjective and optional ideology which a society may adopt, as is religion, and the two converge wherein the essence of human spirituality is not only analogous for environmentalism. Rather, spirituality is the tangible basis of ecocentric values in the Renaissance, because physical world-building in the period was a result of religious sense-making.

In the Early Modern period, religion affected the type and degree to which people felt theoretically responsible for dominating, protecting, or collaborating with their world. As a result, I argue the attitudes of Christians toward Jews in Shakespeare's *The Merchant of Venice* supply various implicit and overt linkages between ecocentric attitudes and interhuman division in the Early Modern period. Ultimately, the collusion between religious belief and environmental interaction informed Christians' understanding of whether non-human species deserve equity, and this extended to the degree of humanity assigned to religious Others. At the same time, Shakespeare does not mention the Jewish Ghetto anywhere in his canon, but both his and other literary accounts describing the physical world of Early Modern Venice suggest the Jews were prosperous because of their simultaneous use of physical land and ability to adapt to restrictive religious spaces. Therefore, the larger importance of critical inquiry into Shakespeare's Venice is defining how his theatrical representations of Venice comment on the intersecting social complexities of Early Modern ecocritical thought.

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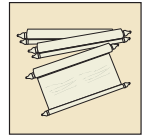
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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Intentionality of Consciousness in Advaita Vedānta, Yogācāra Buddhism and Contemporary Philosophies

As social animals, humans spend most of their lives trying to understand themselves and others around them. There can be difficulty in understanding each individual's own subjective thought processes, and that can be partly reconciled if a common aspect related to each individual's subjective thought process can be found and studied. One such commonality amongst each individual is consciousness, a function of the human mind receiving, processing, storing or rejecting information with the help of different entities (the five senses, emotion, mind, and memory). Understanding intentionality—directing thoughts or actions towards a specific object—helps one create boundaries between the mind and the self, provides clarity on the role of consciousness, and defines whether or not intentionality has significance in relation to consciousness and the discussion of it. The study of ancient and contemporary philosophies can be beneficial and give insight into consciousness due to their extensive research and philosophical basis for wide groups of people. Specifically, the Advaita Vedānta and Yogācāra Buddhism schools of philosophy have studied phenomenological concepts such as consciousness very closely, yet both take distinct approaches in understanding consciousness. In addition to studying these two traditions, analyzing contemporary philosophies—including theories of virtual reality and neural networks—can help better understand the evolving changes in the perception of consciousness being intentional from ancient to modern times. Through using the support of a comparative analysis between Advaita Vedānta, Yogācāra Buddhism, and contemporary philosophies, it is argued that consciousness is inherently intentional in nature because (1) consciousness results from the process of inferences made through coordinated and calculated actions, and (2) consciousness is actively working to create and maintain a sense of self for individuals to allow their existence in the world.

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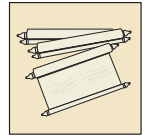
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CORCORAN SCHOOL OF THE ARTS & DESIGN

The Integration of LEED v4 and WELL v2

Since 1993, Leadership in Energy and Environment Design (LEED) has been at the forefront of building sustainability and has reshaped the way that buildings are built. LEED is focused on the actual building and the methods and materials used to build the building, as well as the site. In 2014, a new focus came to light addressing occupants of the built environment. The introduction of WELL Building Standards is the current direction that practice is moving to incorporate into both design and education. The mapping of WELL Features and LEED Standards is something that has not been previously documented. This research will aid as a document to guide a new way of thinking about the occupants and the building, with WELL and LEED, becoming a common entity. The object of this research was to find if there a correlation between the International WELL Building Institute Version 2 and Leadership in Energy and Environment Design (LEED) Version 4 Building Standards, and if so could it be applied to an airport terminal/concourse? Data for the microanalysis was collected from the current versions of LEED and WELL from USGBC (U.S. Green Building Council) and Delos. The information found from each standard was organized into charts, coding the information line by line. Once complete, the data was compiled, and the selective coding organized into a color-coded format. The data was applied to a senior design thesis project of an airport concourse. The data drove the design in order to have a space that was conscious of human mental and physical well being and sustainability of the building fabric. The founded connections between both WELL and LEED will be important to those trying to understand and apply both LEED and WELL standards to an architectural project.

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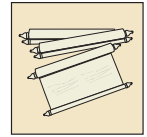
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HUMANITIES



COLUMBIAN COLLEGE OF ARTS AND SCIENCES

The Aging Cicero: Aristotle’s Evolving Influence Over Ciceronian Oratory and Philosophy

The availability of Aristotle’s works from his death in 322 BC to the fall of the Roman Republic has eluded classical scholars. Informed by the historical accounts of Strabo and Plutarch, most believed that Sulla held all the copies of Aristotle’s works when he seized Appellicon’s library from 87-86 BC. However, this formalist approach has been rejected in recent years. Jonathan Barnes posits that there were multiple copies of Aristotle’s treatises in the first century BC. For Barnes, it is clear that Strabo and Plutarch are talking about a specific library of Aristotle—not all of Aristotelian manuscripts in existence.

Still, this new generation of scholars is faced with a few problems of their own. If there were multiple copies of Aristotle’s works, why did orators like Cicero refrain from directly quoting them? To answer this question, the nature of Cicero’s relationship with Aristotle must be explored. While the historical accounts by Strabo and Plutarch are informative, I argue that the significant answer lies in Cicero’s own writings and his engagement with the overarching rhetorical tradition.

Following Cicero’s treatises in a chronological order, this study tracks the progression of his thought and dependence on Aristotle’s rhetorical theory. While it is tempting to treat Cicero’s knowledge of Aristotle as constant throughout his lifetime, it must not be forgotten that Cicero was always growing as a scholar. For this reason, it is necessary to view Cicero’s engagement with Aristotle at various stages of his career. Thus, this study started in the Fall of 2018 with an examination of Cicero’s youthful treatise, *De Inventione* (88 BC), and ended with his more mature works *De Oratore* (55-50 BC), *Brutus* (46-44 BC), and *Orator* (46-44 BC).

Supplying some useful textual analysis for a question that has primarily been approached from a historical perspective, this study exposes the nature of Cicero’s chosen relationship with Aristotle. Although Cicero integrates Aristotle more extensively in his earlier treatises, this does not mean that he had more access to the philosopher. Instead, it reflects a shift in his reliance on Aristotle’s rhetorical theory. Examining the use of Aristotle throughout Cicero’s works, this study has determined that Aristotle’s Rhetoric initially served as a foundation for Cicero’s own rhetorical theory and then as an educational resource for later Roman orators.

For my undergraduate senior thesis in Spring 2019, I am determining whether a similar relationship is present in Cicero’s philosophical works. Thus far, I have seen a parallel in Cicero’s use of Aristotle in his philosophical and rhetorical writings.

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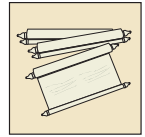
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HUMANITIES



COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Marginalized Peoples in the Ancient Near East

The world of the ancient Near East (i.e., the ancient Middle East) was a diverse and sophisticated world, but it was certainly not egalitarian. Among the most important evidence for this is the rich and abundant corpus of ancient Near Eastern legal literature. The primary foci of this research paper are two major corpora of laws: The Code of Hammurabi and the Covenant Code of the Hebrew Bible (Exodus 20-23). This material is representative of much of the totality of ancient Near Eastern legal literature. The former is written in Akkadian, was produced during the 18th century BCE, and hails from ancient Babylon. The latter is written in Hebrew, is arguably the oldest legal corpus of the Hebrew Bible (ca. 9th or 10th century BCE), and hails from ancient Israel. Within both of these corpora, there are numerous laws about women, children, and slaves. Moreover, within this ancient textual material under consideration, the marginalization of women, children, and slaves was severe. In order to demonstrate this, my research paper will analyze especially the following: marital practices (including the bride price, dowry, infidelity, and divorce), rape laws, inheritance practices (for sons and daughters), adoption, debt slavery, and violence in the home. This research paper foregrounds the primary sources, while also carefully integrating the most convincing and authoritative of the secondary sources (e.g., scholarly books, refereed journal articles, and reputable online sources such as the websites of learned societies and trained scholars). Ultimately, the conclusion of my research demonstrates that the legal practices of the Ancient Near East severely marginalized the most vulnerable of society.

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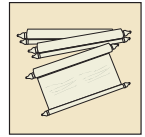
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HUMANITIES



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Path to Modernity: The Novels of Pio Baroja and the Modernization of Spain in the Early 20th Century

The definitive collapse of the Spanish Empire at the turn of the 20th century, when Spain lost Cuba, Puerto Rico, and the Philippines, led to a nationwide identity crisis. A generation of Spanish writers, known as the Generation of '98, published novels and essays that critically questioned Spain's place in the modern world. Pio Baroja, a member of this generation of writers, was a doctor by trade, but decided to look deeper into sociological issues surrounding the need to modernize Spain. While looking at the world through the lens of modernity, his novels focused on how enlightened thinkers, from Kant and Schopenhauer, influenced the evolution of modern thought in early twentieth-century Spain. Spanish culture was going through a period of decline that began with citizens questioning the validity of the traditional ideas that governed the society, but Baroja believed that Spain could be enlightened and modernized. Through characters such as Andres Hurtado from *El árbol de la ciencia* or Fernando Ossorio from *El camino de perfección*, Baroja studies the Spanish man and his relationship with the nation, while they travel and discover more about the modern world and themselves. Baroja had a penchant for using protagonists as allegories for the Spanish nation and its evolving struggles for modern identity. Each novel shows the divisions in Spanish identity, but uses modern rationality and philosophy as the basis for reversing the decline of Spanish culture and modernizing it. This thesis uses the close reading of three novels by Baroja—*El árbol de la ciencia*, *El camino de perfección*, and *La busca*—along with a vast range of philosophical, historical, and cultural texts from Spain and Europe from that time, to show how Baroja successfully shaped the conversation about modern national identity in Spain.

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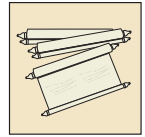
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HUMANITIES



COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Where Gallup Falls Short: What Social Media Reveals About Online LGBTQ+ Communities

In the past decade, there have been large, national, population-based surveys which gathered information about lesbian, gay, bisexual, and transgender (LGBT) populations, such as the 2014 Gallup Daily Tracking Survey and the 2015 National Health Interview Survey (NHIS). These surveys, however, measured only the category of sexual minorities (gay, lesbian, bisexual) and do not include direct measurement of gender identity. Of the 232,324 respondents for the NHIS, 5,640 identified as LGB, and of the 88,687 respondents for Gallup, 2,964 identified as LGBT. The difficulty with national surveys that do not specifically focus on LGBTQ+ populations is that it is impossible to separate the results for the different gender and sexuality minorities and consider differences amongst them.

In contrast, there are online ethnographic studies that cover a much broader variety of sexualities, gender, and sex identities. Via the method of convenience samples that were acquired through snowballing sampling techniques, modern surveys are able to utilize the internet to reach normally underrepresented minorities. For example, the 2014 Ace Community Census received a total of 14,210 responses—of which only 886 identified as straight—and the 2017 Queer Experience Survey received a total of 10,000 responses. This greater diversity in identity information can provide valuable insight into the characteristics of online LGBTQ+ communities and will be used to report online population parameter estimates for a variety of demographic and social variables.

In this report, we examine the demographic information included—the current age of the respondents, coming out age, their racial identities, their religions/beliefs, their employment status, their educational status, etc—in these datasets. The results are presented using these new complex-systems tools of networks, ANOVA, chi-squared χ^2 , k-means clustering, as well as power-law testing. We expect that the respondents will skew young, have some college education, have sufficient contact with English-speaking internet communities where these surveys were dispersed, more likely to be white, trend towards being politically left, and to not be highly religious. We seek to challenge the preconceptions that non-LGBTQ+ individuals may have concerning the queer community, and, further, to analyze the composition of queer populations in a way that surveys such as the Gallup poll fail to take into consideration by their very design.

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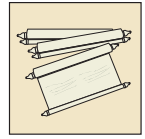
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HUMANITIES



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Epistemic Credibility and Social Identity: An Analysis of the Credibility Bias Held against Women during Testimonial Exchange

In many settings where women make assertions, their ability to transmit knowledge via testimony is impaired due to the hearer denying women epistemic credibility solely due to her social identity. During testimonial exchange, the hearer may automatically assign a credibility deficit to the woman testifying based on negative stereotypes of her identity. This leads to a variety of negative consequences that can greatly devalue the knowledge held by women and make it more difficult for them to get their point across, and it also excludes those on the receiving end of the testimonial exchange from accessing the knowledge that would have been imparted by the women. In this project, the structures by which women are deemed less credible are investigated, and some of the situations in which this phenomenon plays out in are explored. This is accomplished by using the framework of Miranda Fricker's concept of epistemic injustice, in which someone is wronged in their capacity as a knower. This research aims to show that since social identity is considered when accepting testimony, the level of credibility afforded women should be brought up to that afforded men in order to correct the effects of bias, so women have equal opportunities to transmit knowledge.

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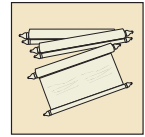
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HUMANITIES



COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Black Women, Radical Love, and the Black Radical Imagination

Throughout my undergraduate tenure I grew increasingly interested in what I have now begun to call the “pedagogy of disposability” - the belief that the messages from society, that make up the fabric of our institutions only teach people that they are disposable. Moreover, I am deeply concerned with how “imperialist white-supremacist capitalist patriarchy” (hooks 2010) vehemently attacks the self-confidence and self-actualization of some Black people.

Instead of focusing on those institutions and those messages that reinforce themes of disposability, in this essay I am more concerned with how my community rejects and reframes those messages. I am more concerned with how we use art as a source of knowledge production and write ourselves into being. I am more concerned with how the use of the Black radical imagination has kept the spirit of the Black community alive during the most egregious times. This imagination was where liberation was made possible and where the idea of freedom was materialized. It is the revolutionary consciousness that separates this art from other Black art, the recurring themes of freedom and truth telling make this art radical. I also believe that this art is where we have continued to reject disposability, a feature that is necessary for “imperialist white-supremacist capitalist patriarchy” (hooks 2010) to function.

Black radical art is a force and a tool that can be utilized for consciousness raising. It is in this art and in the making of this art where we can do and be anything. I argue that by using Black radical art which is essentially the Black radical imagination, we can reimagine our entire world and painstakingly bring them into our lived realities/experiences. This essay will explore the relationship between the Black Radical Imagination and love-politics to freedom making.

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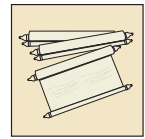
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Physical Activity Goals and Motivation among Patients in a Primary Care Setting

An approach to increasing physical activity (PA) among adults is to develop interventions for primary care settings (PCS). PA goals have been linked to PA whereby internal goals (e.g., interest) are associated with higher levels of sustained PA than external goals (e.g., appearance). According to Self-Determination Theory (SDT) the effect of goals on PA are mediated by one's motivation i.e., external motivation (EM) and internal motivation (IM). However, links between PA goals, motivation, and PA have been not been examined among racially heterogeneous samples in a PCS. The present study addressed these limitations by testing 1) which PA goals were related to PA and 2) testing whether the effect of goals was mediated by EM and IM.

Patients (N = 659; 39.6% male; 47.8% Black, 34.6% White, 5.2% Hispanic, 6.8% Other, 3.2% Asian) were recruited from the waiting room of a PCS during summer 2018. Participation involved completing a 1-page survey assessing PA, race, gender, weight perception, highest level of education, EM, IM, and importance of the following PA goals: weight maintenance, weight loss, overall health benefits, tone/body shape, stress, well-being, energy, cardiovascular benefits. Mediation analyses were used to test study objectives. Covariates in all analyses were race, gender, age and weight perception.

With regards to weight loss, analyses provided results inconsistent with mediation as well-being remained a significant predictor of PA even after controlling for EM (Exp β = .37, 95% CI = .11 to .63). IM was unrelated to PA (Exp β = .17, 95% CI = -.01 to .35) whereas EM was a significant predictor of PA (Exp β = -.30, 95% CI = -.50 to -.10). Regarding weight loss goals, consistent with mediation, weight loss became a statistically non-significant predictor of PA after controlling for EM (Exp β = -.13, 95% CI = -.31 to .05). Here, weight loss was unrelated to IM (Exp β = .09, 95% CI = -.02 to .19) and IM (Exp β = .17, 95% CI = -.01 to .35) and EM (Exp β = -.30, 95% CI = -.50 to -.10). significantly predicted PA.

Contributions of the study include documenting that many of the commonly endorsed PA goals studied in prior work with more homogenous samples were unrelated to whether patients met aerobic PA guidelines. Findings imply that clinical interactions that foster well-being and weight loss goals may not necessarily lead to higher levels of aerobic PA.

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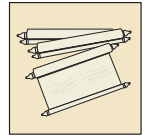
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HUMANITIES



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Ptolemaic Alexandria: The Rise and Fall of an Egypto-Hellenistic Dynasty

This paper is an analysis and comparison of the archaeology being done in the Bay of Alexandria by French archaeologist Franck Goddio and the literary materials in classical sources of Diodorus Siculus, Curtius Rufus, Plutarch, Strabo, Arrian, and Pliny. Since the mid-1990s, Franck Goddio and his team have been mapping and excavating the seafloor of the Bay of Alexandria and uncovering well-preserved statues and structures that have been long been submerged by the Mediterranean Sea. Goddio and his team utilize the typical terrestrial excavation equipment, for example trowels, small shovels, and sieves, but adapt them to the salty underwater environment. More importantly, Goddio and his team utilize magnetometry, Differential Global Positioning System (DGPS), satellite imagery, dredging hoses and sifters, and underwater casting membranes in order to identify the submerged structures and objects. In the field of underwater archaeology, a casting membrane is a liquid polymer that covers the surface and solidifies to make an imprint of an underwater inscription that is too large to be retrieved. The team included two epigraphers, Andre and Etienne Bernand, who studied the molded inscriptions acquired from the submerged colossal buildings and artifacts. Their translations yielded clues to the function of the buildings and helped paint a picture of the lavish lifestyle and layout of the city. This project analyzes the archaeology and ancient literary references to illustrate the Ptolemaic Alexandrian lifestyle. This evaluation of the ancient sources and the archaeology will show the establishment of Alexander the Great's Greek hegemony over the known world and how the diverse Egypto-Hellenistic society developed and flourished under the Ptolemaic Dynasty, which inevitably fell with Cleopatra VII.

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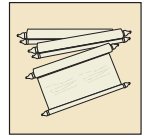
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HUMANITIES



COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Heinrich Schliemann's Colonialism: The Catalyst for the Development of Ottoman Antiquities Policy

This project uses Ottoman sources to study the legislative developments made in antiquities policy in response to Heinrich Schliemann's excavations at the archaeological site of Troy and his subsequent smuggling of Priam's Treasure. The study offers a necessary perspective on how Schliemann's preconceived colonialist attitudes inherently affected his interactions with Ottoman officials and his archaeological work in Ottoman territory, encouraging the implementation of regulatory legislation.

Most of Schliemann's associations with the Ottomans during his excavations at Troy were contentious at best. Some of his most famous accomplishments were only possible due to illicit behavior, like the smuggling of antiquities from Ottoman territories, which directly broke provisions in his permit to excavate at Troy. Ottoman laws regarding antiquities and heritage protection during the mid to late 19th century were a recent development, as previous Ottoman policies towards antiquities have often been framed as those of apathy or indifference. A period of cultural and bureaucratic reforms, known as the Tanzimat, inspired increased interest in protecting and acquiring cultural heritage within Ottoman territories—just in time for the arrival of Heinrich Schliemann in Anatolia.

Heinrich Schliemann's excavations at Troy succeeded in testing the parameters of newly implemented antiquities laws, therefore shaping both contemporary and future Ottoman policies regarding archaeology, excavations, and antiquities protection.

PRIMARY PRESENTER

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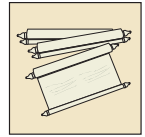
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HUMANITIES



COLUMBIAN COLLEGE OF ARTS AND SCIENCES

In the Cradle of Commerce: Credit, Kinship, and Trust-Based Exchange in the Upper Arkansas River Valley, 1828–1846

Using the Bent-St. Vrain Company and Southern Cheyenne trade partnership as a case study, this thesis explores trust, accountability, non-monetary incentive, and other abstract institutions that dramatically transformed and influenced the North American fur trade. In order to decipher how these institutions and behaviors facilitated profitability and cooperation, this research closely examines interpersonal relationships between individual historical actors and their communities, emphasizing specifically the influence of Native American persons, interests, and standards upon trust-based relationships between suppliers and consumers. Native influences proved particularly powerful in the upper Arkansas River Valley, where, during the 1830s and 40s, the Bent-St. Vrain Company and the Southern Cheyenne established a politically and economically formidable partnership that dominated the local economy for over a decade. This thesis argues that two mutually reinforcing systems of exchange bound the Bent-St. Vrain Company and the Southern Cheyenne together: credit and kinship. The extension of credit—a potentially risky yet lucrative practice implemented throughout the North American fur trade more generally—allowed both the Bent-St. Vrain Company and the Southern Cheyenne to maximize profitability and protect community wealth. Kinship networking—another common fur trade tradition—between non-Native men and Native women allowed individuals from the Bent-St. Vrain and Southern Cheyenne communities access to social capital that often translated into economic and financial capital. This thesis focuses on how and why the institutions of credit extension and kinship networking worked so effectively, and how these institutions established and reinforced a reliably profitable socioeconomic infrastructure of Anglo-Native trade in the upper Arkansas River Valley during the early to mid-nineteenth century. When placed in conversation with the work of Native American and economic historians, this thesis highlights the inextricability of the sociocultural norms and economic institutions that served as the foundations of the fur trade throughout the seventeenth, eighteenth, and nineteenth centuries in North America. In particular, the construction of trust and accountability between historical actors with divergent interests, means of exchanges, and economic standards highlights the influence of social and cultural factors on practices assumed as strictly economic. These intersections of social, cultural, and economic dynamics significantly inform our understanding of the North American fur trade and how sociocultural trends, behaviors, and motivations influenced economic activity in the international fur market.

PRIMARY PRESENTER

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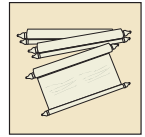
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HUMANITIES



ELLIOTT SCHOOL OF INTERNATIONAL AFFAIRS

“3s. Worth a Day”: First Hand Accounts from the Chinese Community in Sydney

The 1890s saw Australians becoming “among the richest people on the earth,” with comparatively high wages, relatively large houses, and water heating. Yet, this came with strong degrees of economic and social inequality, especially for unmarried women and non-European immigrants. The object of this study is to examine if, why, and how white women in Sydney, Australia protested their place in society via unofficially marrying Chinese men. This study uses three interviews from The Report of the Royal Commission on Alleged Chinese Gambling and Immorality and Charges of Bribery Against Members of the Police Force, written in 1892, as a window into the lives of Sydney’s marginalized communities, especially lower-class women and Chinese immigrants. Three testimonies in particular—by European women Hannah, Adelaide, and Ellen—tell a personal story of marginalized women in Sydney society. Women who chose to go against societal expectations and live with Chinese men of their own “free will,” who are not victims of some myth of Chinese deception, but as people with their own agency and purpose, and should be treated by history as such. Too often, historians rely on telling the stories of marginalized populations solely through media content produced at the time. This form of historiography tends to portray marginalized communities as victims, rather than actors. This study attempts to show the ways in which European women who had been limited by structural boundaries, went around these boundaries to create lives for themselves. By marrying Chinese men and involving themselves in the smoking of opium, these women were fighting back against a society that largely lacked protections for women who were abused by or left by their European husbands and fiancées. Furthermore, the results from this study show the importance of using first-hand accounts of marginalized communities to build a more complete understanding of their lives.

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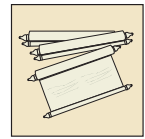
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HUMANITIES



COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Two Roads Converge in a Yellow Wood: The Merging of Ecofeminism and Ecological Economics in Land Management Practices of the Pacific Northwest

This project explores the uses of a new method of research in the field of ecological economics. It was developed by Friend. She developed what she calls a 'policy compass', and adapted it to ecological economics. The data from a table is represented in a completely aggregated form as one arrow on a compass with three general qualities: harmony, suppression and excitement. We then get a very general picture of where an institution finds itself with respect to the three qualities. Institutional policy can then address problems by looking at the compass and reflecting on the table of data.

This project explores an adaptation of the policy compass for ecofeminism. The institution being investigated through the lens of the compass is the land management practices of Washington State and British Columbia, two ecologically similar locations managed under different governmental structures. The policy compass is used to measure the success of land-preservation institutions from an ecological economics perspective and from the perspective of ecofeminism. The central goal of this project is to advocate for ecological land management practices and land conservation, by adapting the compass to reflect both perspectives.

For ecofeminists it is crucial that natural environments should be maintained in something like a natural state and that all people should have access to it without changing it too much. My ecofeminist framework is built upon the ideas that one's organic identity is unhealthily distorted and challenged within the context of society, and the built-up urban environment. I use the term 'organic identity' to refer to the gender identity that is naturally occurring. From a modern perspective that ignores ecofeminism and ecological economics, we ignore the fact that society exists within, and is subject to, the natural world. In contrast, from an ecofeminist and ecological economics perspective, we should live in harmony with nature, and not over regulate it.

To support my position, I construct two policy compasses, one is the adaptation to ecofeminism and the other is the adaptation to ecological economics. This research serves as an example of a way to apply ecofeminism to the field of ecological economics. It also explores the uses of a new methodology that can be adopted in many forms of interdisciplinary research.

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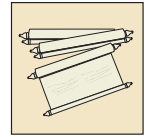
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HUMANITIES



COLUMBIAN COLLEGE OF ARTS AND SCIENCES

By Wheel and Hand: Examining the Forming of Classical Greek Ceramics Through an Experimental Archaeological Lens

The study of classical Greek pottery has long been a cornerstone in the fields of classical archaeology and art history, but much past scholarship has focused on surface decoration of vessels, studying the iconography, styles, techniques, and processes that produced the elaborately painted decorations on classical Greek ceramics. Comparatively less attention has been devoted to examining the craft of producing the vessels themselves. Little scholarship has provided detailed discussion of the structure and operation of classical Greek pottery wheels, nor has there been detailed analysis of vessel formation techniques beyond brief descriptions of vessels being thrown on the wheel.

Combining my experience as a trained potter with an experimental archaeological perspective and building on earlier research analyzing wheel technology and forming techniques in the Greek Bronze Age, my research examines pottery wheel technology and vessel forming techniques employed by classical Greek potters. In light of evidence from recent studies of Greek Bronze Age pottery production that suggest that coil formation and wheel-coiling techniques were used well into the Late Bronze Age, the object of this project is to question traditional interpretations that all classical Greek pottery was formed on the wheel exclusively through throwing. My work seeks to determine whether there is evidence to suggest a continuity of wheel-coiling techniques into the classical period. The central goal of this project will be to understand exactly how the vessels were physically formed and to determine if the capabilities of the classical period wheel would have allowed “true” wheel throwing. In the absence of surviving archaeological evidence, this project analyzes iconographic representations of pottery wheels and potters working on wheels shown on classical vessels. In addition, I consider references and descriptions in ancient literature that discuss the design and manner of operation of wheels as well as forming techniques employed by potters. This project also analyzes secondary literature and experimental archaeological programs, comparing conclusions regarding the formation of Bronze Age ceramics with those for classical pottery.

Preliminary results indicate that for the largest of classical vessel forms, it is likely that the wheel-coiling technique used in the Late Bronze Age continued at least in some regions for the classical period. This research highlights the importance of the relationship between the capabilities of the wheel and vessel forming techniques, which impose technological limitations upon the potters themselves, influence the types of vessels produced, and thus affect what is preserved in the archaeological record.

PRIMARY PRESENTER

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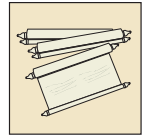
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HUMANITIES



COLUMBIAN COLLEGE OF ARTS AND SCIENCES

The Atlantic Border: A Study of Leon Trotsky's Immigration to Mexico

The Mexican Revolution, like its contemporary European counterparts, resulted in the alteration of social and political structures. Indeed, it was post-1920—a time during which Europeans fled from the turmoil of the first World War and accompanying events—that the search to redefine Mexican values through statehood took shape in immigration laws and attitudes. The rise of the Nazi party in Germany, the civil war in Spain, and the Russian Revolution all contributed to this rise of immigration. Next to the U.S., Latin America collectively hosted the largest number of European refugees during the 1930s and 1940s. Currently, there is a gap in the way scholarship pertaining to the era concentrates on American immigration thus largely overlooking Mexican agency and contribution to early twentieth-century events; it is within that gap that this study is situated. This paper seeks to examine the role of exiled Russian revolutionary Leon Trotsky's asylum in articulating the physical and ideological movement across the Atlantic Ocean and its reconceptualization as a border. Trotsky's unlikely asylum in Mexico emphasized the inconsistencies in Mexican immigration that sought to influence the development of the nation in the post-revolutionary era. Correspondingly, international migration highlighted the way in which Trotsky's role as a revolutionary allowed him to transcend the era's immigration procedures in order to cross the Atlantic and continue his work.

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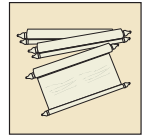
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HUMANITIES



COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Where Monsters Are Made: Generative Processes and the Failure of Beauty in *Frankenstein* and *Dracula*

The gothic horror stories of Mary Shelley's *Frankenstein* and Bram Stoker's *Dracula* have generated remarkable cultural legacies in the form of monsters that extend from their creation in the imagination of the nineteenth century to the present. Both novels absorb the preoccupations and possibilities of science at the time, especially regarding the advancement or corruption of humans in their biological bodies. I demonstrate how *Frankenstein* and *Dracula* grapple with "unnatural" reproductions, the generation of beings outside of the accepted forms of heterosexual reproduction, and the failure of beauty in physical bodies as an indicator of the monstrous. *Dracula* features clear morality distinctions that emphasizes the moral imperative to kill the women that Count Dracula has transformed into dangerously beautiful vampires. The text writes the beauty of these women as corrupted by excessive sensuality and morally reprehensible for straying outside the accepted manifestations of beauty for Christian Englishwoman. However, Mary Shelley's *Frankenstein* presents a more complicated tale in which Victor Frankenstein's attempt to create a beautiful, ideal human body results in Frankenstein's condemnation of his lab-created humanoid. In this work, Shelley lends us the opportunity to be critical of Frankenstein's strict, compassionless relegation of his creation to the realms of monster simply due to his failure to meet Frankenstein's initial intention of beauty and his guilt at having acted outside heterosexual reproduction processes to independently create life.

PRIMARY PRESENTER

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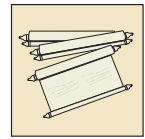
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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Milton's *Areopagitica* and the Non-Issue of Abortion

"Books are not absolutely dead things, but do contain a potency of life in them to be as active as the soul whose progeny they are... Till [the Licensing Act] Books were ever as freely admitted into the World as any other birth; the issue of the brain was no more stiff'd then the issue of the womb..." –John Milton, *Areopagitica* (1644)

"Sit still and drink Pennyroyal Tea/Distill the life that's inside of me." –Nirvana, "Pennyroyal Tea" (1993)

At first glance, one might reasonably assume John Milton's *Areopagitica* (1644) to be entirely unrelated to Nirvana's 1993 hit, "Pennyroyal Tea." What such readers may not realize is that the *Areopagitica* contains several passages which might safely be interpreted as comparisons of the licensing of books and other literature—or more accurately, the prevention of a work's passage to publication justified by the Licensing Act of 1643—to the abortion of a fetus. At the time, pennyroyal was a fairly well-known and widely-used abortifacient, and had been for centuries, even gaining mention in a more temporally relevant smash hit than Nirvana's: Aristophanes' *Peace* (421 B.C.E.). In this paper, I will show that Milton's condemnation of abortion—central to his argument in *Areopagitica*—appears illogical in the face of medical, literary, legal, and religious precedent. One must therefore question Milton's motive to employ such a tactic. Circumstantial evidence indicates that one possible motivation for Milton to compare licensing to abortion likely stemmed from a desire to exert control over women's bodies when he was estranged from his wife and could not control hers.

In support of this thesis, I will begin by demonstrating historically widespread tolerance of abortion, analyzing works such as John Gerard's *The Herball or Generall Historie of Plantes* (1636), Sir Edward Coke's *Institutes of the Laws of England* (1644), and the King James Bible. I will then outline the circumstances leading to Milton's estrangement from his wife, Mary, two years prior to his publication of the *Areopagitica* and seven months prior to his publication of the first of four divorce tracts, plainly indicating Milton's frustration with the arrangement. Finally, I will tie all these elements together to argue that Milton's comparison of licensing to abortion likely stemmed from a desire to exert greater control over women.

PRIMARY PRESENTER

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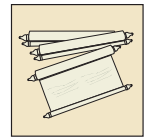
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HUMANITIES



ELLIOTT SCHOOL OF INTERNATIONAL AFFAIRS

Rice Wars: The 1943 Bengal Famine and its Impact on the U.S.-UK Wartime Alliance

Sandwiched between the sweeping tides of the Second World War and the tragedy of Partition, the Bengal Famine of 1943 has been largely neglected by scholarship. Much of the existing literature on the famine focuses on its local character: the culpability of landowners, the ineffective provincial response, and the endemic history of famine in Bengal stretching back to 1770. In fact, the event was not a simple market failure or even a product of regional policy, but a pivotal moment in international history. The famine was the first relatively large-scale, government-backed humanitarian intervention by the United States. The intervention is even more anomalous because it took place in territory under the hegemony of the United Kingdom, and directly challenged British authority in the region. Using both British and American primary-source archival material, I chart the course of the American intervention, and the subsequent British response. The United States was able to use its intricate intelligence networks in India, and its ties to the diaspora community to assert itself as a strong contender for regional influence, and in turn, as an ally to the Indian Nationalist Movement. As the United Kingdom felt its global hegemony under threat, this development became a critical point of friction in the "Special Relationship," and partially sabotaged the early stages of the reconquest of Burma. Ultimately, the famine and its aftermath had a lasting impact on the way in which these two great powers perceived one another, and how they imagined themselves in the post-war world.

PRIMARY PRESENTER

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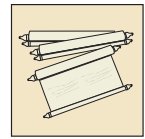
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HUMANITIES



COLUMBIAN COLLEGE OF ARTS AND SCIENCES

“Trauma y Recuerdo en Chile: Testimonio y Resistencia femenina” (Trauma and Remembrance in Chile: Testimony and Feminine Resistance)

Since studying in Santiago, Chile, during the spring of 2018, I have been interested in learning more about Chile’s transition from a 17-year dictatorship to the democracy that it is today. More specifically, I want to study the human rights abuses committed during Augusto Pinochet’s regime, and how sexual violence against women was employed as a tool of torture. Following this extreme trauma, The National Commission for Truth and Reconciliation Report, also known as the Rettig Report, was commissioned by President Patricio Aylwin in 1991. While this was an important step in assessing the crimes against humanity that occurred, this report focused on deceased victims, rather than on what survivors suffered. For this reason, I find it particularly compelling to read testimonies of what women endured as well as how they have remained resilient and chosen to confront their personal and collective trauma.

This thesis will be composed of three sections: during Pinochet’s dictatorship (1973-1990), immediately following the return to democracy, and today. Through primary source material recording abuses Chilean women suffered, as well as through an analysis of cultural production in the 1990s and between 2015 and now, I aim to demonstrate how memory and the personal and collective act of remembrance has been used to empower survivors of this violent dictatorship. Ariel Dorfman’s play, *La muerte y la doncella* and Diamela Eltit’s novel, *Lumpérica*, will provide the foundation for the discussion on cultural production during Pinochet’s rule, while the performance work of Colectivo Acciones de Arte (CADA) as well as the establishment of public spaces of memory such as Villa Grimaldi, will allow for a better understanding of how individuals and Chile as a whole sought to move forward after returning to democracy. Finally, I will explore the Ni Una Menos movement that focuses on the killings of women and girls in Latin America, which began in Argentina in 2015. The organizing and resistance currently occurring in Chile against machista violence in its ultimate and fatal manifestation—femicide—is directly related to and can only be understood in its historical context. Chilean women have suffered and continue to confront gender-based violence, and the ways they have written, spoken about, and embodied this trauma have taken many forms since Pinochet assumed control of Chile in 1973 and should be viewed as interconnected strategies of not only survival, but of resistance.

PRIMARY PRESENTER

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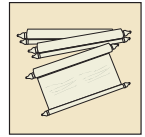
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HUMANITIES



COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Depicting Drama: An Analysis of Greek Tragic Vase Painting

Mythology played a fundamental role in the lives of ancient Greeks. Myth was spread and altered to match varying societal and regional factors, resulting in different artistic depictions. Widespread exposure to myths became possible with the introduction of theatrical performance in the fifth century BC, and the versions of myths resulting from tragic plays have been preserved both in texts and material culture. In particular, the abundance of black and red figure painted pottery preserved from the Greek world provides insights into how depictions of myth as portrayed in tragic plays changed with respect to both time and region. The epic myth or tragic performance that an artist references for depicting these scenes, as well as stylistic differences, result in varying iconography. Artistic liberties taken by the painter can also produce additional versions of the myth, known regionally through the hand of an artist as opposed to from the stories of a bard or a theatrical performance. Still, the source of the myth, either epic or tragic, can often be recognized based on this iconography regardless of the creative choices made by the artist. To explore these changes, this project analyzes Greek pottery depicting one myth that was retold from the Greek Bronze Age through the classical period: the death of Sarpedon during the Trojan War. This episode is clearly depicted on two vases, one dating to the sixth century BC which recalls the Homeric telling of the myth, and the other dating to the fifth century BC which references Aeschylus' fragmentary play *Europa*. As with many of the vases depicting scenes from Greek tragedy, these two pots were found in Southern Italy and Apulia, regions which were large consumers of Attic red-figure pottery. The spread of pottery from Greece, where tragedy originated, into Italy shows there was great interest in tragic performance throughout the Greek world. Theatrical performance, in addition to vessels depicting it, was also exported into Italy and adapted there from the Greek original works. The resulting pottery features elements unique to South Italian and Apulian vases, displaying the widespread impact tragic performances had on myth and its representation in the ancient world.

PRIMARY PRESENTER

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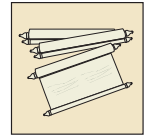
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HUMANITIES



COLUMBIAN COLLEGE OF ARTS AND SCIENCES

If You Want Peace You Got to Fight for It: How Multiracial Organizing Shaped Chicago in the 1960s

The 1960s tore through Chicago like a hurricane. Thousands of people marched up and down its broad boulevards demanding justice year after year. A movement that began small and with local ambitions soon became a city-wide groundswell, a virtually unified call for action and revolution that echoed similar calls across the nation. This movement, known commonly as the original Rainbow Coalition, consisted of young people from Chicago's working-class white, Latinx, and black communities as well as students, teachers, revolutionaries and politicians.

My paper focuses on the origins of this Rainbow Coalition in the social organizing life of Chicago in the 1960s. Starting in 1963, I trace the development of community organizing through the 1960s when both students and neighborhood institutions began radicalizing and taking on racist power structures. I discuss how the Black Panther Party flourished in Chicago thanks to a robust network of youth gangs and community institutions centered around Black Power and self-defense ideology. I also discuss how a similar form of radicalization was taking place in white and Latinx communities at the time. The Young Patriots Organization and the Young Lords Organization, representing white and Latinx youths respectively, joined with the Panthers to form a militant anti-racist and anti-capitalist network of organizing dubbed the Rainbow Coalition. I detail their battles against urban developers, police, and targeted harassment. These groups, and many others, sought to provide for their communities where the government did not. They set up health centers, schools, food pantries, and kitchens.

I rely heavily on primary sources in this paper. Using personal notes and correspondences as well as nationally-syndicated and community-based newspapers, I build a narrative tying early radical efforts of the Civil Rights Era to the Black Power movement of the late 1960s and early 1970s in Chicago. I also consult previously classified records from the so-called "Red Squad," the Chicago police unit that focused solely on investigating left-wing political and social organizations.

This was a critical time in American history. Participants of the movement saw their success as something predicated on solidarity with people from different races and backgrounds. "All power to all the people," they demanded. It was a working-class movement. The Rainbow Coalition was an incredible example of multiracial solidarity-building and social activism. Their work shaped Chicago and the United States for decades.

PRIMARY PRESENTER

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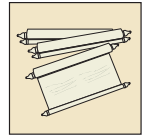
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HUMANITIES



COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Allegory of Weather: Theophanic Visions in Medieval Prognostication

The medieval period is often overlooked as a time defined as the dark ages. This connotes an idea that those who lived within this timeframe and all artistic and literary creations are retrograde. This association with pre-Enlightenment artistic and literary productions being lesser or more naïve than anything created post-Renaissance hinders full understanding of the period. The object of this research is to look at and analyze medieval manuscripts in order to better understand pre-Enlightenment concepts of science, by focusing on representations of weather in the Middle Ages. It can be seen throughout many artistic works and manuscripts that in the medieval era, there was a desire to understand the world beyond the physical on earth. It became very popular at the time, particularly in England, to create meteorological prognostications and almanacs that would predict weather patterns for the year. Often, these almanacs combined both Christianity and the zodiac to study and predict the weather. This shows the human desire to explain and study the world outside their own control, and to do so by using previously-established and known laws that rule the universe, an early approach to the scientific method. The Almanac and calendar (MS M. 941) created in England, 1433 exemplifies the combination of Christianity and astrology to predict weather patterns. Studying this work helps explain the creation and dissemination of knowledge during the medieval period. By exposing the critical thinking found within the medieval period, it reduces bias when discussing the Middle Ages and brings a more reasonable and holistic view.

PRIMARY PRESENTER

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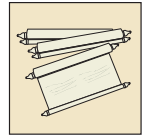
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Elizabeth Dospel Williams

HUMANITIES



COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Disregarding Disregard? The Representation of Passive Complicity among European Civilian Populations in Holocaust Museums

In large part due to the clouded and inarticulate nature of moral ambiguity, many questions surrounding inaction during the Holocaust remain unanswered. Yet it is possible that more still remain unasked. Since the 1990s, several academics have noted that the passive complicity of European civilian populations during the genocide is far less examined than other areas of Holocaust scholarship. Though in some cases quick to warn against passivity through a quote in their final installation or slogans printed on pencils in their gift shop, many Holocaust museums similarly devote limited attention to non-structural “bystanders” within their exhibitions. This supposed underrepresentation of passivity is curious not only due to the fantastic breadth of Holocaust scholarship, but also because of the prominent didactic position the inaction of individuals occupies in popular discourses surrounding the genocide. If action is to be projected as a salient moral lesson from the Holocaust, it seems justified that a thorough and nuanced understanding of inaction as it existed from 1933 to 1945 should be further developed in Holocaust historiography and presented in museums.

My project seeks to a) assess the capacity in which the relative paucity of academic literature surrounding Holocaust “bystanders” has been manifested in public history and b) analyze museum representations of passive complicity among European civilians in a comparative framework. Through archival research, interviewing curators and scholars, and conducting fieldwork throughout Europe, I explored if and how a selection of Shoah exhibitions presented passive complicity at the level of the individual. My analysis of four case studies in Germany, Italy, Poland, and the United States suggested three main findings. First, the reasons predicating the relative absence of “bystanders” in Holocaust scholarship and commemoration run parallel in a variety of capacities. Second, while the majority of Holocaust museums limit their discussion of passivity among European civilians, institutions inside or on the periphery of concentration camps are more likely to examine the inaction of local individuals. Third, the exhibitions that do historicize the “bystander” narrative often utilize oral histories of “bystanders” to mitigate curatorial concerns surrounding the sensitivity of the subject.

PRIMARY PRESENTER

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Youth and Women Inclusion in Decision-Making in Jordan

Representation is key for democracy, and it is more so when it incorporates true plurality. This entails that all groups of society get equal representation in decision making, particularly women and youth. According to IPU, of the 45,000 parliamentarians around the world, only 1.9% is under the age of 30 and only 4 countries have 10% youth representation. More than 40 countries have none. This is of particular concern given that people of the age group 18-30 vote more than any other group around the world.

Looking at the Jordanian context, none of the MPs are under the age of 30. This is the direct result of stipulations in the constitution that members of parliament must be at least 30 years old. A large proportion of young voters are therefore prevented from being able to run for political office. UN Security Council Resolution 2250, which was sponsored by Jordan shows that Jordan has been a strong advocate for the Sustainable Development Goals (SDGs)". Yet, this support of these statements must be accompanied with action. Currently, young women in Jordan are even less engaged in the political process than their peers. In the 2017 elections, women aged 18-24 voted at a rate 5% less than men the same age. Women face many additional obstacles to political participation.

Why is youth and women inclusion important? The largest voting age group is that of the young people. The average turnout of voters aged under 25 was 38%, higher than the national average of 36%. In the 2017 local elections, 5.4% of all candidates were aged under 30 years. Based on the global NotTooYoungToRun model, it is proposed to establish a national campaign in Jordan to lower the age of candidacy for elected offices, culminating into policy amendments taking in consideration means to mitigate challenges.

In order to explore support for lowering candidacy age in Jordan, I ran an online survey in both English and Arabic and found a higher support rate for lowering age of candidacy for elected offices to 25 than to 23, coupled with a high support rate for further inclusion for women. The research also studied the challenges and found that campaign financing, social stereotypes, and electoral laws were amongst the most prevalent challenges. This entails that there is an interest and need for advancing such a campaign in Jordan and to tackle these challenges.

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Southern Laggards or Misfits? A Comparative Assessment of Energy Policy Europeanization

The concept of “Southern lag” describes the lack of compliance of Southern European countries with EU law which has had increased salience after the 2008 eurozone crisis. This article identifies the most binding constraints on energy policy, a previously overlooked area in the Southern lag debate. Two factors make the evaluation of the Europeanization of energy policy critical: first, the energy union is a key objective of the EU and understanding the constraints to compliance is essential for its success. Second, EU energy policy objectives provide concrete goals that make measuring Europeanization in terms of actual policy outcomes easier. This article first identifies the key explanations of this Southern lag that scholars have proposed. Then, it evaluates and compares the levels of compliance of Greece and Austria with EU energy policy objectives. By contrasting the empirical policy outcomes with the predictions of the various theories of Europeanization, this article establishes that the level of compliance is mostly determined by the level of misfit. A policy has a high misfit when it has high political and economic costs associated with its implementation. Furthermore, this comparative analysis introduces the importance of geography in affecting the level of misfit in energy policy. This result implies that the most successful strategies for Europeanization will be focused on bringing down the level of misfit by tailoring goals and policies to each country’s starting point.

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A Tale of Gender in Two Bilateral Aid Agencies

Significant gaps persist in the literature surrounding what works in gender and development. As countless aid agencies recognize and craft robust approaches to gender equality and women’s empowerment within their work, policymakers struggle to keep up with the ever changing priorities of feminist movements all over the world. This project comparatively analyzes the gender equality and women’s empowerment policies of two bilateral aid agencies: the United States Agency for International Development and the UK Department for International Development. My research currently explores the question of “How have USAID and DFID responded to and kept up with the conceptual shifts in the gender and development discourse?” In recent years, both of these agencies have led the charge on gender and development by introducing updated policies and commitments to their work in gender equality. This project offers a look at these changes in their policies, identifying key similarities and differences to showcase their merits and identify trends in the gender and development discourse. It also showcases the strengths and weaknesses of such policies by analyzing the effectiveness of these agencies’ work on various gender-related projects in Nepal. This project has been designed to offer a look into the ways in which the conceptual approach to gender and development have changed over time, specifically focusing on two of the most prominent contributors of foreign aid in the world.

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Sustainable Tourism Practices in Vietnam: The Influence of Institutions and Case Study of Sapa’s Growing Tourism Industry

Renowned for being rich in culture and home to diverse natural landscapes, Vietnam is quickly growing into a highly attractive tourist destination. While the government has made efforts to take advantage of this exceedingly profitable economic sector as a means of development, Vietnam is struggling to ensure that tourism remains both economically viable and sustainable (both environmentally and culturally). The purpose of this research is to continue the analysis of Vietnam’s evolving tourism industry and examine how influential institutions create and maintain sustainable practices.

As tourism becomes increasingly important to Vietnam’s economy, so too does the country’s ability to safeguard the aspects of the culture and environment that appeal to tourists. Over the course of four months, this research was conducted in several regions via semi-structured interviews with locals, government officials, and education officers, participant research, and observation. The principal actors in setting tourism policy and priorities emphasized in this research are the state and educational institutions. Both actors have been progressively shifting towards a new perspective on tourism which favors sustainability instead of the previous numbers-only approach. New regulations, strategic marketing, higher visibility of sustainability, and improved resources for academic study are several of the ways in which these institutions have adopted and promoted more sustainable practices.

Nevertheless, this research also reveals that there are critical issues which continue to stunt sustainability in Vietnam’s tourism sector. For many, especially in rural regions where poverty and inequality are prevalent, the economic gains from tourism outstrip the desire to implement sustainable habits which may restrict the number or access of tourists. Furthermore, large corporations have capitalized on Vietnam’s growing popularity by constructing mega “tourist traps” that encroach on locals and cause destruction to the environment.

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The Intersection of Affect and Employment: A Gender and Migration Perspective on the Complexities of the Labor Relationships of Paraguayan Domestic Workers in Argentina

This study analyzes the intricacies and nuances of the relationship between female Paraguayan domestic workers and their female Argentine employers, with a specific focus on the emotional and financial consequences that this relationship can have on both women. This labor relationship is unique and complex because it tends to be more affective and familial than a typical employer-employee relationship, given that the employee's workplace is the home of her employer. While the closeness of their relationship has clear benefits, this intimacy can also create major ambiguities regarding the limits of the work partnership they share. These ambiguities often lead to different emotional and financial consequences for both the employer and employee. This paper takes a special look at how this unique employer-employee relationship is impacted by the migration experiences of Paraguayan domestic workers in Argentina. It concludes by analyzing ways in which the Argentine laws and society can better serve both female migrant domestic workers and their female employers, and address workforce gender inequality in general.

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Russia's Frozen Conflicts and the Donbas

This paper describes the evolution of Russia's use of unconventional warfare within regions that have large populations of ethnic Russians and explores the social, legal, political, and military considerations of frozen conflicts. The purpose of Russian unconventional warfare is usually to counter the growth of Western alliances in the region within the boundaries of international law. Russia's use of frozen conflicts has developed into a coherent strategy by the Kremlin to assert and expand dominance over post-Soviet states including Moldova, Georgia, and, most recently, in the Donbas region of Ukraine.

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The Paradox of Women’s Rights Campaign: An Investigation into the Chinese #MeToo Movement

The US-born anti-sexual harassment campaign, the #MeToo movement, has received attention around the globe, and has made its way from West to East. However, in China, #MeToo faces unique social-political challenges, and has turned into a different animal compare to its counterparts elsewhere. This research investigates the three major features of #MeToo in China, and attempts to offer explanations of the unique #MeToo phenomena, which are contextualized in the Chinese authoritarian environment. The movement in China is a (1) social media initiative, (2) an activist-led effort, and (3) a women’s movement. Although Chinese activists aim to improve women’s rights through anti-sexual harassment campaign, #MeToo authors often consciously disassociate themselves from other feminist and activist groups, and some #MeToo women even issued open letter to denounce feminism. This presents a paradox, which has been largely neglected by mainstream Western media and scholars, such as the Washington Post. Through conducting over 30 interviews with some of the most prominent exposé authors, I found that the lack of cultural contextualization led to report bias and created undue burden to the victims.

In addition, #MeToo in China rejects the approach of intersectionality. The government divides and isolates these marginalized groups from one another, in the same way the paradox has been created that advocating for sexual harassment prevention is no longer even considered a feminist issue. Chinese #MeToo activists have to employ various tactics to overcome state oppositions to reconcile with the authoritarian government, such as claiming-patriotism, self-censoring, and using creative hashtags. The movement has been facing the “triple pressure” for being a feminist, activist, and online movement all-in-one. The action of the #MeToo activists, therefore, is a process of empowerment but also of making concession. As a result, Chinese #MeToo deploys a different type of rhetoric outside the traditional feminist narrative, and resonates with a niche audience. #MeToo in China provides a case study for examining the contemporary form of civic engagement. It shows evidence of women’s active participation in the online protest, as well as the process in which grassroots campaigns find its narrow surviving space in the negotiation with the state.

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A Retrospective Analysis of Theories of Alliances on a Comparative Case Study of New Zealand and Australian Foreign Policy towards the U.S. during the ANZUS Crisis of 1985

In 1951, Australia, New Zealand, and the United States forged the ANZUS Treaty, a tripartite security treaty meant to provide mutual defense between the three parties. By 1985, New Zealand had overhauled its foreign policy and subsequently left the mutual security agreement, thereby downgrading its relationship with the US from an ally to a friend. Meanwhile, Australia stayed party to the agreement, despite the countries sharing similar levels of threat perception, participation in international institutions and economic linkages, and cultural traditions and historical legacies from British colonial rule. Due to the unique similarities between the two countries, this comparative case study utilizes domestic political actor theory to analyze each government's management of their respective intrastate anti-nuclear movements and their success/failure's impact on shaping one of the most radical departures from a country's status quo foreign policy in the Asia-Pacific region.

Through a retrospective analysis of historical data gathered through British Foreign and Commonwealth archival documents on both Australia and New Zealand, this research compiles a history of anti-nuclear movements in both countries and applies relevant IR theoretical constructs to identify an applicable theoretical causal mechanism. This work highlights the incoherence between neorealism, economic and institutional neoliberalism, and constructivism in providing a causal mechanism for New Zealand's departure in light of Australia's continued persistent relationship. Consequently, this inquiry assists in validating the application of domestic political actor theory, and its corresponding sub-state level of analysis, in contributing to the formation and decomposition of security alliances.

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Rising of the Far Right – On Success of AfD and PVV

This paper focuses on far-right parties in Europe. The two parties that will be discussed in this paper are Alternative for Germany (AfD) and the Dutch Party for Freedom (PVV). The paper will compare and contrast the two parties and discuss their similarities and differences. Also, the author will discuss the successes and failures of both parties at both the domestic and European Union levels, with a focus on the regional races. 2014 is an important year for these two parties. Even though the PVV and AfD have a history that extended before 2014, AfD won European Parliament seats for the first time. 2014 was also the key time for the European refugee crisis. This paper will test two hypotheses that seek to explain the relative success of these two far-right parties in Europe. The two hypotheses will focus on the domestic level and the European Union level. The first hypothesis will focus on the domestic sector in the Netherlands and Germany. Both the Netherlands and Germany are facing various challenges, from the economy to culture. One cannot ignore the existence of the domestic reasons for the rise of these far-right parties. The second hypothesis is related to AfD and the PVV's performances in the European Union. Both parties are deeply related to European politics as a whole. AfD and the PVV have achieved relative success and currently hold seats in the European Parliament. This relative success is an extension of their popularity at home. The second hypothesis will focus on AfD and the PVV's performances in the European Parliament.

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Documenting the Oral History of Palestinian Refugees

Western historical documentation tends to, whether consciously or not, lend legitimacy solely to the historical narratives that have been recorded on paper. This manages to erase the voices of communities from a “non-western” perspective and methodology throughout history, particularly among those groups with large rates of illiteracy. This essay seeks to document a number of the many oral histories of the Nakba, otherwise known as the historical event that led to the expulsion of Palestinians in 1948 and their subsequent, ongoing plight as refugees for the decades since. Time has passed, but the urgency is still present to record these stories in the only way that western historical documentation will permit in order to heed reliability. Oral testimonies serve as a source of criticism for their credibility as it is widely held that they contain confusion, misinformation, and lapses in connection by the witness, especially as time passes. However, in order to analyze the Nakba, one must analyze the oral histories of those who experienced it, as the majority of villagers, or fellahin, lacked the literacy and means to record their story on paper in the same manner as their wealthier, city-dwelling counterparts. Seventy-one years after the Nakba, this work aims to document the expulsion of Saffuriya, a village six kilometers northwest of Nazareth, and to put the words of its inhabitants into the historical record. On the night of July 15, 1948 the citizens of Saffuriya were expelled under air and tank attack, and fled in multiple directions among the chaos and fright. Many fled to the city of Nazareth, where they permanently settled, while others ended up being continuously pushed further north until they were condemned to life as refugees in neighboring countries. This is a multigenerational testament to the reality of Palestinian refugees. Following the testimony of one family from Saffuriya, this essay details some of the ways in which Palestinians in the diaspora have coped with their circumstances as refugees since 1948. This work finds that the response to these circumstances has taken various forms, through expressions of nationalism and resistance, particularly among those in refugee camps beyond the borders of where they once called home. These expressions have persisted throughout generations, irrespective of location and age. Against all odds, Palestinian refugees have survived the loss of land, home, and dignity by maintaining an identity that is intimately connected to land and return.

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Role of Religious Identity in Violent Conflict

The role that religious identity plays in the perpetuation and continuation of violent events is one that has been debated intensely by scholars. Two areas that have a legacy of religious identity violence are Northern Ireland and Bosnia, during the "Terrors" and the in the aftermath of the Yugoslavian breakup, respectively. In the case of Northern Ireland, violence was carried out between Protestants and Catholics, and in Bosnia between Catholics, Orthodox, and Muslims. A detailed analysis of scholarly and qualitative research on the subject shows that religious identity plays a vital role in the continuation of violent conflict, specifically in Northern Ireland where religious identities are a factor in combination with nationalistic politics, and in Bosnia where the combination of ethnic-religious nationalism and elite-driven quests for power led to the fighting. In both cases, the violent conflict was carried out because each religious group felt threatened by the "other" and would use violent means to achieve "peace" in order to keep their religious communities safe. Religious symbols, myths, iconography, and higher degrees of religiosity were used as a motivating call to the fighting. In addition to this, both post-conflict societies have seen a retreat into their own separate living space, separated by physical "peace walls" in Northern Ireland and federally in Bosnia-Herzegovina.

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Legal Discrimination: The Case of Jordanian-Palestinians in Amman

From Black September in the 1970s to present day, Jordanians have witnessed their national identity become continuously more homogeneous at the expense of marginalized political communities who do not fit within the government-promoted ideas of who and what Jordanians should be. The post-1970s Jordanian national identity transformation shaped the current social dynamics in Jordan and redefined what being Jordanian means today. This homogenous Jordanian identity created divisions between those who were seen as true Jordanians and those who were the “others.” These led to two different understandings of national identity, the Jordanian identity promoted by the government and the Jordanian identity created by the Jordanian-Palestinian communities. Therefore, it is worth exploring how political communities, specifically Jordanian-Palestinians, have been affected by the government’s efforts to promote a specific Jordanian national identity.

In January 2019, I traveled to Amman, Jordan to conduct face-to-face semi-structured interviews and observational study. During that trip, I interviewed 16 participants, 10 women and six men. Using theme analysis, I found that the Jordanian government has a clear agenda regarding who serves in the government and has access to more sensitive positions. Furthermore, I found that the lack of connections Jordanian-Palestinians have has directly impacted their employment opportunities, and possibly stagnated their social mobility within Jordanian society. The Jordanian government’s elevation of a specific Jordanian national identity is reflective of its motive to control who has access to positions of power.

Moreover, I also found that the younger generation is more inclusive of various ethnic groups and national identities, while the older generation is more protective of their national identity due to the unique historical circumstances. Jordanian national identity is fluid amongst the younger generation. There are less barriers to identify as Jordanian amongst the younger generation, since the idea of who a Jordanian is within society is unclear.

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Terrorism Versus Legitimate Resistance: A Comparative Study of Jordanian Attitudes Towards Hamas and Hizbullah

In the wake of President Trump’s decision to move the U.S. Embassy in Israel from Tel Aviv to Jerusalem, it is more important than ever to study both anti-occupation Palestinian resistance organizations and how they are perceived by the citizens of neighboring Arab states. Jordan hosting the largest number of Palestinians refugees in the world, is especially vulnerable to this shift and the accompanying potential for radicalization (UNRWA, 2017).

Due to the topic’s timely and relevant nature, this research will examine the difference in Jordanian perceptions of Hamas and Hizbullah, specifically as either a legitimate resistance or terrorist organization. Acting under the hypothesis that this difference is the result of dissimilar political strategies and armed uses of force, not sectarian divisions, the researcher will strive to answer the following questions: (a) Although both Hamas and Hizbullah are anti-occupation Palestinian organizations, do Jordanians view these two groups differently? (b) If so, why is one of groups viewed comparatively more or less favorable? (c) Are these groups viewed as legitimate resistance movements or terrorist organizations?

This research was conducted through formal interviews with Jordanian experts, surveying the opinions of Jordanian youths, and reviewing existing quantitative and qualitative reports. By addressing growing concerns in Jordan and the entire region, about the recent rise in non-state armed groups and the “Jerusalem Decision”, this research aims to fill a substantial gap in existing literature regarding the potential for region-wide, pro-Palestinian mobilization.

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Schooling Silence: Sexual Harassment and its Presence and Perception at Uganda’s Universities and Secondary Schools

Although reports indicate that a majority of students in Uganda are sexually abused while in school, sexual harassment and its impact on educational attainment is a rampant yet understudied problem (The Uganda National Strategic Plan on Violence Against Children in Schools, 2015). While harassment in schools by teachers and students is not the only factor leading to high dropout rates among students, the behavior of teachers and students in school, and the lack of discipline towards their actions is an internal contribution to this effect. This study aims to better understand the perceptions on what constitutes “sexual harassment” in Uganda (specifically sexual harassment in schools), if this conversational definition matches up with what the legal definition currently is, and to also assess the effectiveness of reporting systems on sexual harassment and what can be done to improve what is currently inefficient. Through focus groups with secondary school students and university students (n=13), as well as key informant interviews (n=10), participants were asked how they defined sexual harassment, how they came to know about it, and the barriers they saw to speaking up about it. Findings indicate that though the perceptions and definitions of sexual harassment are varied, young people perceive this to be a problem of great concern in schools. Despite this perception, schools themselves effectively foster a culture of silence around the topic of sexual harassment, ultimately resulting in ineffective reporting procedures and an environment that shames and mentally disturbs survivors. Recommendations include comprehensive anti-sexual harassment education mechanisms and the creation of distinct anti-sexual harassment policies that separate this action from other forms of “bad behavior” that violate schools’ codes of conduct.

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A Comparative Analysis of the Development Impacts and Financial Strategies of Chinese and U.S. Energy Investments in Ghana

The US and China are competing in Africa for investment opportunities, particularly in the energy sector, as African countries seek investment from both countries to drive infrastructure development. This can be seen in projects such as the Chinese-backed Bui Dam hydroelectric project and the US-backed Power Africa Amandi Power Plant in Ghana. Chinese financial strategy in the region is significantly different from US financial strategy: while the US tends to create energy investment partnerships through private sector initiatives and grant funding, China tends to leave energy investments in the hands of its state and semi-state enterprises and channel funding to them through the Belt and Road Initiative. Although both countries create partnerships with Ghana on the premise of promoting economic development through energy access and subsequently economic growth, the outcomes for both countries' projects are ambiguous.

Using a mixed-methods approach, I utilized data from AidData to analyze the impact of China and US energy investments on energy access and job creation in Ghana. Time series quantitative data on energy investment projects sourced from AidData and Power Africa was used to determine whether US and Chinese energy investments improved energy access and distribution. Then, I travelled to Accra to conduct semi-structured interviews with project officials from the Bui Dam project and the Amandi Power project as well as government officials and environmental NGO officials. In this research, I discovered that Chinese energy investments are often better or equal to US energy investments in terms of improving energy access in Ghana and reducing energy costs, but do not surpass US energy investment in terms of creating employment opportunities, encouraging technology transfers, or mitigating environmental damages. Additionally, the negotiation process for Chinese energy investments is much quicker than US energy investments, but compliance with environmental and labor regulations is much lower. The Chinese energy investment model is loan based, while the US energy investment model is donor based.

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The Obesity Epidemic: A Comparative Study of China and India

Although the obesity phenomenon first appeared in high-income nations, recent trends suggest that obesity rates are rapidly rising worldwide, creating a paradox of under- and overnutrition in countries struggling with food security. While an abundance of research has been conducted on obesity, existing scholarship tends to categorize countries as “developed” or “developing,” thereby ignoring trends in the mid-range of economic development. A polarity thus exists in the scholarship, as most studies have been confined to high- and low-income nations. In order to fill this gap, this research seeks to answer the following: What accounts for the rising rates of obesity in middle-income countries as undernourishment lingers?

In examining existing literature, scholars claim that urbanization is the primary cause of the obesity epidemic. According to this urbanization theory, urban environments encourage sedentary lifestyles and increased consumption of sugar- and fat-laden foods. As such, this research aims to test the urbanization theory within the context of middle-income countries by employing a comparative study of China and India. These countries were selected as cases because of similar patterns in demographics, economic growth, and prevalence of urban environments. Population-specific data (i.e. urban and rural) on body mass index (BMI) from national health surveys are utilized to determine levels of obesity. The rate of change of obesity is examined in order to discover if a correlation between urban settings and BMI exists. Additional rates of television ownership are assessed in order to examine the health and lifestyle habits of rural and urban populations.

This research finds that the urbanization theory does not hold true within the context of middle-income countries. In fact, this research suggests that obesity is actually rising at a higher rate in rural environments. Although nationwide examinations of obesity rates display a correlation between obesity and urbanization, population-specific data indicates that nationwide data over-generalize nutritional status. As such, this study concludes that “urbanization” is an inappropriate research term, as it draws a false dichotomy between urban-living and modernity, thereby mischaracterizing rural lifestyles in terms of physical activity and dietary patterns.

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Tribal Favoritism or Class-Based Wasta? Class, Tribal Affiliation, and Interpretations of State-Led Tourism Development in Petra

Petra is the focal point of Jordan's national tourism economy. Tourism also represents the lifeblood of the tribal communities that surround Jordan's archaeological jewel. The chaotic jumble of commercial activity around Petra bustles with souvenir tents, food stalls, and assertive locals offering their horses, donkeys and camels to shuttle visitors around the park. Indeed, these interactions with representatives of Petra's Bedouin economy make clear even to casual visitors the degree to which the livelihoods of Petra's *Bdoul and Layathna* tribespeople depend on revenues derived from tourism. Although Petra's transformation into a tourism hub has dramatically increased the city's revenues, these financial flows have failed to translate into wealth and development for many of the region's indigenous tribespeople.

To explore this contradiction, I travelled to Jordan to interview 39 members of Petra's *Bdoul and Layathna* tribes to determine how tribal- and class-based factors influence indigenous interpretations of state-led tourism development efforts in the Petra region. Using theme analysis, I discovered that most *Bdoul and Layathna* tribespeople agree that uneven opportunities for development exist between communities across the Petra region, particularly with respect to village infrastructure and access to formal work in the tourism sector. However, competing narratives propagated by the members of each tribe to rationalize their group's privilege or marginalization reveal the fissures that exist between *Bdoul and Layathna* interpretations of the distribution of developmental resources in Petra, and whether they perceive this allocation to be fair. For policy-makers interested in ensuring indigenous participation in Petra's growth, these findings reveal that paying lip service to inclusive development is not enough. Instead, state actors must actively reconcile differences between planned policy impacts, their actual effects, and how they are perceived by local actors on the ground, whose subjective interpretations are informed by class- and tribe-based frames of analysis.

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When Sexuality is Politics: The Struggle for LGBT+ Rights in Egypt

As countries throughout the world struggle to legalize same-sex marriage, in Egypt, suspected homosexuals are regularly arrested, tortured, and disenfranchised for their sexuality. However, existing research on Egypt and homosexuality has shown that the violently anti-LGBT+ Egyptian narrative is relatively recent. Evidence of homo-romantic relationships appear throughout Egyptian history, and at times they have acted as a pillar of social stability. In the modern era, the lack of clear international consensus on what sexual minority rights should look like has created a very dangerous atmosphere for the LGBT+ community throughout the world. Unfortunately, the United Nations and the international community are essentially toothless in their efforts to protect sexual minorities in domestic situations. This is because “sexual orientation” and “gender identity” are not listed as protected categories under the UN Declaration of Human Rights, so the international community is legally bound to respect the sovereignty of the Egyptian government and not intervene in their domestic affairs. The lack of UN influence and the erasure of regional LGBT+ history, especially in regard to the history of homosexual and bisexual women, leaves a gap in the historical narrative. To further strengthen LGBT+ identity politics in the Middle East, the norm of LGBT+ rights within international politics must be institutionalized. I have conducted interviews and surveyed Egyptian activists in order to understand the current oppressive narratives promoted by the Egyptian government regarding sexual minorities, while additionally gathering observational data in two separate trips to Egypt in 2015 and 2019. My goal was to explore what role outside influences, such as colonialism, military conquests, and modern media, have had on the perception of sexual minorities in Egypt, to better understand how contemporary LGBT+ activists can use the historical process of identity politics to counteract modern day systematic and social prejudice.

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“While the World Waited”: U.S. Security Policy Towards Iraq, 1987–1991

With the beginning of the Iran-Iraq War, the United States saw Iraq as its key ally in the Gulf Region. From the tilt towards Iraq under Reagan to the full embrace under George H.W. Bush, the United States had an increasing relationship with Saddam Hussein leading up to August 2, 1990, when Iraq invaded Kuwait. This paper seeks to answer the question, “Why did the US change its policy towards Iraq from January 1, 1987-December 31, 1991?” It presents a detailed chronology of domestic politics and security policy towards Iraq, highlighting a key policy turn during this time: the decision to move from a policy of appeasement for the sake of economic and political interests to an offensive policy of intervening militarily into Iraq.

Alongside the chronology, the paper examines and applies Kimball’s theory of factionalism and McDermott’s prospect theory to effectively explain the motives behind the United States’ security policy objectives. These theories both help explain the change in US security policy towards Iraq during this time period as they examine the consequences of emerging factions after the election of Ronald Reagan and the resurgence of the Republican Party and the ways various factions and policymakers associated with them attempted to use their influence.

While common thought usually points to US foreign and security policy as being reactionary to the actions of other states, this paper looks at evidence from the system, state, and individual levels to analyze the security policy of the Reagan and Bush administrations towards Iraq. This paper argues that the factions inside these administrations primarily influenced security policy and highlight the role domestic politics can have on security policy.

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The Influence of ILO Convention No. 189, The Domestic Workers Convention: A Comparative Case Study of Legal Changes in Argentina and the United Arab Emirates

On June 16, 2011, the International Labour Organization (ILO) adopted Convention No. 189, the Domestic Workers Convention, at the 100th session of the International Labour Conference in Geneva (C189 or “the Convention”). The passage of this historic convention marked a major milestone in terms of legal recognition for domestic workers. With the use of two country case studies, this paper seeks to answer the crucial question: How has ILO Convention No. 189, the Domestic Workers Convention, impacted changes to laws governing domestic workers worldwide and what challenges still remain? The history-making convention led to a much-needed shift in laws protecting the rights of domestic workers in ratifying and many non-ratifying countries, alike. Argentina, a state that has ratified C189, and the United Arab Emirates, which has not ratified C189, have both made major changes to their laws protecting domestic workers in the years since passage of the Convention; consequently, they serve as instructive case studies to examine the impacts and oversights of this landmark Convention.

Through examination of these case studies, this paper concludes that the Domestic Workers Convention (C189), passed by the ILO in 2011 and entered into force in 2013, represents a major step forward in domestic workers’ rights. Its applications in Argentina and the United Arab Emirates represent two different responses to the Convention and exemplify some of the Convention’s weaknesses. Laws implemented across the world in response to the Convention largely lack effective mechanisms for workplace inspections and protections for migrant workers are largely inadequate. These uneven protections place certain domestic workers in legal limbo and create a situation in which many others are still highly vulnerable to exploitation.

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Women's Access to Transitional Justice: The Case of the Acholi Sub-Region of Uganda

The Lord's Resistance Army (LRA), a rebel group led by Ugandan national Joseph Kony, led an insurgency in northern Uganda between 1987 and 2006, causing widespread violence and social upheaval. While the LRA has been inactive in Uganda for nearly 13 years, the effects of the conflict can still be felt in everyday life. Local and international actors, including NGOs and the International Criminal Court (ICC), have attempted to address the ills of war in the region by implementing varying transitional justice mechanisms, including both prosecutorial and restorative methods. These transitional justice efforts have been under criticism from scholars and activists who claim a lack of attention paid to gendered justice issues and common values of the Acholi ethnic group, the predominant ethnic group in much of northern Uganda, weakens the justice processes.

I conducted in-person interviews and observational analyses in the Acholi sub-region of Uganda to identify some of the major conflict-related issues still facing Acholi women, the wide variety of conflicting transitional justice processes present in the Acholi region, and the multiple factors that prevent women from achieving transitional justice. Noting the unique and disproportionate impacts of conflict on women, I analyzed the effectiveness of both legal and traditional processes at addressing women's issues and achieving justice.

I found that women typically avoid transitional justice processes that are not locally-sourced and rooted in Acholi conceptions of justice, including the values of reconciliation and forgiveness. Familial connections, village leaders and trusted indigenous NGOs play a larger role than governmental and international systems in achieving transitional justice for women and assisting women with the social, psychological and economic impacts of conflict in the region. However, the distinctions between legal and traditional justice systems that existing literature focuses on are fading, as some prosecutorial systems are beginning to incorporate local values and traditions into their processes. I conclude with a series of recommendations for local, national and international purveyors of transitional justice.

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Homegrown Safety: A Comparison of the International Treaties Preventing Gender-Based Violence vs. Localized Prevention Programs

Recent political discourse argues that the International Community needs to take a firmer stand on ending gender-based violence (GBV) as a consequence of war. However, an analysis of International policy prescriptions compared to grassroots programs and local policy initiatives indicates that localized efforts have a greater impact. The Preventing sexual violence initiative of 2012 (PSVI) attempts to curb GBV in conflict through identifying variables of causation and with several solutions, such as better education, increased access to healthcare, and more comprehensive training for those involved in peacekeeping missions. However, the initiative fails to include actionable steps towards prevention because its generalizations about the sources of the problem are too broad. Causes and implications of GBV in conflict are unique and depend on conflict specificities. Examining and preventing GBV during conflict is most effective when viewing the situation through an Advocacy Coalition Framework in order for practitioners along with policymakers and academics to provide training, technical assistance and policy suggestions to prevent future violence. The paper offers a comparative analysis of the PSVI and a community-based GBV prevention program during the post-conflict era in the Ivory Coast. Both short-term and long-term outcomes of the prevention program suggest that it is important to look at the cultural and relational contexts in the region. The paper will also examine the cultural norms of Congolese genocide survivors and Sudanese and South Sudanese survivors of their country's genocide. Based on this analysis, future policy research and proposals should follow an Advocacy Coalition Framework to create initiatives that are successful on the localized level.

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China's Pivot to the Middle East: An Evaluation of China's Role in the Israeli-Palestinian Conflict

Since the early 2010s, China has taken an increasingly active and engaged role in the Middle East, a region crucial in China's ambitious Belt and Road Initiative (BRI) and a critical energy supplier. With development aid and investment in infrastructure projects already underway, China will be unable to circumvent the hot-button political issues plaguing the region and will, in particular, need to address the Israeli-Palestinian conflict.

What role has China played in the Israeli-Palestinian conflict so far? How will the BRI shape China's role in the future? To answer the former, the first portion of the study presents China's interests in and policy discourse on the region; next, it evaluates the evolution of China's position and assesses initiatives taken towards a peace process. The study finds that although China has adopted a more balanced approach and made several unprecedented attempts to facilitate peace in recent years, Beijing has ultimately failed to demonstrate a sincere commitment to resolving the conflict. Rather, the Chinese government has been more concerned with stabilizing the conflict to protect its regional interests. Addressing the latter, the second portion of the study examines the BRI's plans in Israel/Palestine, focusing on how it will shift China's historically anti-interventionist stance in Middle Eastern conflicts. A successfully implemented BRI will propel China to have a more vested interest in the conflict in order to protect its long-term power projection in the region and globally.

This study is supported by primary sources including news articles, official Chinese government statements and reports, and public opinion data; secondary sources such as think tank publications and scholarly journal articles were also utilized.

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Epigenetic Inheritance of Alcohol Sensitivity in *Drosophila Melanogaster*

In natural populations, *Drosophila melanogaster* oviposit in fermenting fruit and encounter alcohol at concentrations up to 14%. My research investigates whether alcohol consumption in *D. melanogaster* affected their offspring's ability to resist intoxication. We used Capillary Feeder Assays (CAFEs), where adult males and females were fed liquid media containing sugar, water, and alcohol (A treatment) or sugar and water (N treatment). After six days of CAFE feeding, we set up breeding vials with five males and five females in all possible combinations (FxM): AxA, AxN, NxA, NxN. Progeny were collected as virgins into single-sex vials and assayed two days later for alcohol resistance. For this assay, we recorded the time required for half the flies to become sedated on their backs after exposure to alcohol vapor (time to 50% sedation or ST50). We found that progeny with two alcohol-fed parents had an increase in resistance over the NxN control that was approximately twice that of progeny of one alcohol-fed parent. We found little difference in maternal and paternal effects, and sons and daughters were both affected. This acquired alcohol resistance (AAR) effect was detectable for at least five generations after the initial parental alcohol feeding. Moreover, as little as a single day of alcohol feeding was sufficient to produce AAR in AxA progeny, and as few as three days of alcohol feeding elicited AAR in AxN and NxA progeny as well. AAR continued to be detectable in progeny for the entire reproductive life of the parents, suggesting that epigenetic changes generating this effect are stable over time. Ongoing experiments are equalizing caloric value of the A and N CAFE treatments to eliminate any potential confounding factors due to caloric restriction, and we are evaluating the alcohol metabolism of progeny using an alcohol absorbance assay.

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Synthesis of FR900098 Analogs as Inhibitors of the Methylerythritol 4-Phosphate (MEP) Pathway in *Plasmodium falciparum* and *Mycobacterium tuberculosis*

Every year, millions of lives are lost due to infectious diseases worldwide. Tuberculosis and malaria are among the top causes of death in low-income countries. While current drug therapies for malaria and tuberculosis exist, drug resistance among microorganisms, including *Plasmodium falciparum* (Pf) and *Mycobacterium tuberculosis* (Mtb), the causative agents of malaria and tuberculosis, respectively, has grown significantly. Thus, the need for further development to discover more effective treatments persists. The methylerythritol 4-phosphate (MEP) pathway of isoprenoid biosynthesis is a validated set of novel drug targets. Inhibition of the second enzyme in this pathway, 1-deoxy-D-xylulose-5-phosphate reductoisomerase (Dxr), can be used to target and control the spread of these infectious microorganisms. FR900098 is a natural product inhibitor of Dxr. However, the low lipophilicity of FR900098 limits its activity against bacterial cells and presents room for improvement in drug design. Previously, an FR900098 analog discovered in our lab, SRW-61, which includes a 3,4-dichlorophenyl and N-acyl ether substituents, was found to have improved Dxr activity and whole cell permeability. We present new efforts to design, synthesize, and test analogs of SRW-61 to further optimize efficacy.

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Investigate The Role of O-GlcNAcylation in Medulloblastoma Tumorigenesis

The Hedgehog (HH) pathway plays a pivotal role in brain development. Perturbation of the HH pathway and activation of a glioma-associated oncogene (GLI), a dedicated transcription factor in the HH pathway, is responsible for approximately 30% of medulloblastomas, a common and aggressive type of pediatric brain tumor. However, the mechanism of abnormal activation of HH pathway in MB is still not fully understood. We identified a previously unknown mechanism by which the HH pathway is regulated by glucose-sensing O-GlcNAcylation. O-GlcNAcylation is a post-translational modification in which a sugar molecule covalently attached a Serine or/and Threonine residues of a protein. O-GlcNAcylation is significantly involved in a variety of cellular processes. OGT catalyzes the modification by adding the sugar molecule, whereas OGA removes the molecule. Recently, the studies have introduced O-GlcNAcylation as a new hallmark of cancer, and the aberrant activity of OGT enzyme actively involved in oncogenic events. Thus, investigating and targeting O-GlcNAcylation abnormality is significant for cancer therapy. This project will investigate the roles of O-GlcNAcylation in HH pathway activation and MB radiochemotherapy. We found that GLI1 is O-Glycosylated at specific 4 sites by OGT. GLI1 O-GlcNAcylation blocks its interaction with SUFU, promoting its nuclear localization and target gene transcription. We will further investigate the function and the mechanism of OGT-mediated GLI O-GlcNAcylation in Hedgehog pathway activation, and study the relationship between GLI O-GlcNAcylation and MB development. Additionally, we will use patient-derived xenograft models to examine the effects of O-GlcNAcylation-targeted inhibition in medulloblastoma treatments. This project will provide new clues for the regulation of Hedgehog pathway and provide new theoretical bases for the diagnosis and treatment of SHH subtype medulloblastoma.

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Optical Superkick for Cold Trapped Ions

Cold trapped ions have been used for decades in spectroscopy and tests of quantum systems. More recently, experiments involving quantum state engineering have studied the interaction of light with trapped ions for quantum computing applications. Light beams with singularities can pass mechanical angular momentum to matter, including to individual atoms. An atom's absorption of optical angular momentum in the form of linear momentum of recoil is the focus of this study. Calculations are based on a trapped Calcium-40 ion interacting with light at a wavelength of 397 nm. The ion is cooled to its motional ground state, and the lowest few energy levels are calculated. By varying the impact parameter between the center of the light beam and the atom, a strong longitudinal recoil of the ion, or a *superkick*, is obtained for certain values of the impact parameter.

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Sexually Dimorphic Facial Patterns in Wild Red Bellied Lemurs (*Eulemur Rubriventer*): Quantifying Patterns and Assessing Function

Sexual dichromatism refers to a difference in coloration or pattern between sexes within a species, and studying its evolution can aid our understanding of mate choice and mating competition based on sexually selected traits. While sexual dichromatism is common among birds, and to a lesser extent among lizards and fish, it is fairly rare among mammals, with the exception of primates. Traditionally, its evolutionary function has been attributed to intersexual selection, or female choice. However, most of this research has been done on birds, and its role in primates remains unclear, particularly concerning its relationship to mating systems. Part of the difficulty in addressing this issue is related to the ability to quantitatively measure and compare differences in particular traits. One such trait, is the distinct white eye patches observed in male, but not female, red-bellied lemurs (*Eulemur rubriventer*). In collaboration with colleagues studying this species in the wild, I developed a method to characterize and quantify variation in these patch patterns via digital photography and imaging analyses (Image J). I quantified size and shape variation of white eye patches for 26 males in a wild population of *E. rubriventer* across four sites in Ranomafana National Park. These males reside in different social groups, and offspring parentage has been genetically identified via microsatellite genotyping (N = 1-3 offspring per group). I used microsatellite- marker based paternity analysis to expand the sample size and determine which male is the father of each offspring. This involves extracting DNA from fecal samples already present in the GW Primate Genomics Lab. The extracted DNA is amplified by Polymerase Chain Reaction (PCR) to target and genotype 7 segments of DNA (microsatellite markers) that are used for paternity analyses in this species. Although *E. rubriventer* is often characterized as monogamous, reproductive success among males appears to be variable in this population, allowing me to examine whether eye patch patterns are associated with aspects of reproductive success. Preliminary analyses indicate that the males with the highest reproductive success have the smallest eye patches (eye patch area standardized by eye size). Results from this study provide new opportunities for testing how female choice might shape this sexually dimorphic trait.

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Characterizing MID1-mRNA Binding in Huntington's Disease

Huntington's disease is an inherited neurological disorder that causes widespread cell death in brain cells. Patients with Huntington's Disease (HD) suffer from increasingly severe motor and neurological impairments, eventually leading to death within a decade of first symptoms. There is currently no cure for HD. HD is caused by the production of a mutant huntingtin protein (HTT), characterized by poly-glutamine (polyQ) stretches typically longer than 35 amino acids in patients with HD. In healthy individuals these polyglutamine stretches do not exceed 20 glutamine residues. It was recently shown that the MID1 protein binds to the mRNA of the huntingtin protein. This mRNA contains the CAG trinucleotide repeats that, when translated, correspond to the polyQ stretches in the protein. MID1 binding by CAG repeats stabilizes the repeats and allows for their translation, promoting production of the mutant HTT. This study presents data that characterize the binding of the B30 domain of MID1 and CAG trinucleotide expansion mRNA relevant in HD. Disruption of MID1 and mutant HTT mRNA binding has potential to be an effective strategy to combat HD. If we can better understand the mechanism behind MID1 and RNA binding in HD, then we can begin to rationalize avenues for a cure.

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Optical Biosensor Development for the Characterization of Ubiquitin Enzyme Interactions

Ubiquitin is a prominent regulatory protein that interacts with and subsequently modifies a range of target proteins responsible for activating a variety of biological processes. Before it can bind to a target protein, ubiquitin must interact with three substrate enzymes: ubiquitin-activating enzyme, ubiquitin-conjugating enzyme, and ubiquitin ligase. The ubiquitin enzyme binding kinetics are not well understood and to this end, an optical-fiber-based in vitro biosensor using a histidine-tagged ubiquitin is being developed to collect data on these interactions in real time. Biosensor development involves synthesis of a molecular complex to connect the gold-nanoparticle-coated optical fiber to the histidine-tagged ubiquitin. Upon successful ubiquitin addition to the molecular complex, the enzyme substrates are added and the ubiquitin substrate-enzyme interactions are monitored. Monitoring entails the passing of a laser light through the optical fiber. Light shines through the fiber and the fraction that is reflected back has imprinted on its spectrum the signatures of the substrate binding. Additionally, this technique is also used to monitor the synthesis of the molecular complex, addition of histidine-tagged ubiquitin, and binding of ubiquitin antibodies to determine whether successful binding has occurred at each juncture. Ultimately, the results of the enzyme binding will provide insight into the specific binding mechanisms between ubiquitin and its substrate enzymes, insight which is of central importance in order to further understand how this interaction catalyzes many life-sustaining cellular processes. We acknowledge helpful assistance from Kate Strachan, Morgan Joyce, and Loren Marino.

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The Immune Response in Sea Urchin *Strongylocentrotus Purpuratus* has Dynamic Changes in Immune Cell Populations

The ability to analyze individual cell types within a population and to quantify changes over time is a powerful tool in understanding how immune cells respond to pathogens. The sea urchin, *Strongylocentrotus purpuratus*, has four, morphologically different coelomocyte types; phagocytes that have key activities in phagocytosis, red spherule cells that secrete echinochrome A with antimicrobial activity, colorless spherule cells that have cytotoxic capabilities, and vibratile cells with unknown function. Although changes in coelomocyte numbers increase in response to pathogen challenge, the details of how each cell type responds are not known. Here we developed distinct gates for flow cytometry based on cells separated by density centrifugation into different types that were capable of distinguishing different sub-populations of unseparated coelomocytes including large phagocytes, small phagocytes, red spherule cells, and a mixture of vibratile cells and colorless spherule cells. Immunoquiescent sea urchins ($n = 3$) were injected twice on days 2 and 5 with heat killed *Vibrio diazotrophicus*, a marine bacterium known to activate an immune response, or with artificial coelomic fluid (aCF) as a negative control ($n = 4$). Coelomocytes were collected on day 0 to characterize the pre-challenge cell populations, day 1 to observe response to needle puncture and withdrawal of CF, day 3 to test the response 24 hours after the first injection of *Vibrio* or aCF, and day 6 to test the response 24 hours after the second injection of *Vibrio* or aCF. Coelomocyte populations were evaluated with an Accuri C6 Cytometer and analyzed using FlowJo V10. Total coelomocyte populations for immunoquiescent sea urchins did not show significant variation among the animals on day 0 prior to injections. However, after injection with *Vibrio* there was an increase in total coelomocyte concentration. The immunoquiescent control animals that received aCF showed a decrease in coelomocyte concentration. *Vibrio* challenge decreased significantly the number of large phagocytes and significantly increased the number of red spherule cells compared to day 0 and to aCF injected controls. Changes in these cell populations may be due to their unique functions in the sea urchin immune response. We speculate that the decrease in the phagocyte population may be related to the process of phagocytosis and clearing the *Vibrio*, whereas the increase in the red spherule cell population may be based on an increased usage of echinochrome A to combat the *Vibrio*.

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Novel Small Molecule Design and Synthesis to Selectively Inhibit Dxr and Combat Malaria and Tuberculosis

Tuberculosis and malaria are caused by the pathogens *Mycobacterium tuberculosis* (*Mtb*) and *Plasmodium falciparum* (*Pf*), respectively, and are two of the world's deadliest infectious diseases. As such, their complicated life cycles and the emergence of resistant strains highlight the necessity of novel treatments. Many modern antibiotic small molecules primarily target metabolic enzymes. As with most microbes, *Mtb* and *Pf* rely heavily on these proteins to synthesize important biological molecules. Current inhibitors affect only certain stages of the *Mtb* and *Pf* life cycles; 1-Deoxy-D-xylulose-5-phosphate reductoisomerase (*Dxr*), however, has been identified as an essential enzyme because of its role in isoprenoid biosynthesis. Its role in the Methyl Erythritol Phosphate (MEP) pathway, present in *Mtb* and *Pf* but not in humans, highlights *Dxr* as a key target for inhibition. Natural products fosmidomycin and FR900098 are retrohydroxamic acids that are *Dxr* inhibitors. Based on these structures and prior inhibitors from our lab, we have designed and synthesized a novel series of small molecules with a variety of *N*-acyl substituents. We present the synthesis and early biological evaluation of these compounds as inhibitors of *Mtb* and *Pf*.

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Schur Multipliers and Second Quandle Homology

Quandles are self-distributive algebraic structures with axioms motivated by the three Reidemeister moves in knot theory. They were discovered independently by Joyce and Matveev in 1979. Since there are adjoint functors between the category of quandles and the category of groups, it is natural to expect relations between the homology theories of quandles and groups. We demonstrate a new relation between the second quandle homology and the group homology by defining a map from second quandle homology to the Schur multiplier. Furthermore, we express the second homology of Alexander quandles in terms of exterior algebras.

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Design and Synthesis of Novel MEPicides to Inhibit Malaria and Tuberculosis

Tuberculosis (TB) and malaria are very prevalent today, due to resistance to current anti-infective drugs coupled with a discovery drought of new classes of drugs. As resistance spreads across the globe, the urgent need for an innovative approach to treat *Mycobacterium tuberculosis* (Mtb, causing TB) and *Plasmodium falciparum* (Pf, causing malaria) becomes evident. Certain metabolic pathways in these pathogens are different than those of humans. We can take advantage of those differences in order to develop a pathogen-specific agent. The Methyl Erythritol Phosphate (MEP) pathway is used by Mtb and Pf to synthesize isoprenoid precursors. Isoprenoids are used by these cells for many things including aerobic respiration and membrane support. Natural product inhibitors fosmidomycin and FR900098 target a specific enzyme in the MEP pathway, 1-deoxy-D-xylulose-5-phosphate reductoisomerase (*Dxr*). Inhibition of this enzyme halts the production of these precursors, thus killing the pathogen. Utilizing the structure of fosmidomycin and FR900098 as well as the knowledge of the MEP pathway, we design and synthesize molecules that bind to and inhibit *Dxr*. Based on our prior work and discovery of *N*-acyl substituted inhibitors of *Dxr*, we present a set of new compounds designed to determine the structure-activity relationship around this moiety and improve the efficacy of this structure class.

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The Effect of the Lab Environment on Sperm and SR Length in *Drosophila Melanogaster*

Drosophila melanogaster is a useful model organism for studying environmental influences on genetic variation. Observing variation in sperm length over generational time in a constant lab environment allows for the potential effects of environmental alterations to be observed simultaneously. While *Drosophila melanogaster* has been domesticated for study in standard lab environments, the species usually exists in wild populations. In the Manier Lab, researchers observed a decrease in sperm tail and head length after six generations of a wild-type *Drosophila melanogaster*. Research suggests that due to the high heritability of sperm, their condition should be independent of environmental influences. However, due to the costly nature of sperm, in a lab environment with high quality, unlimited resources, sperm should be longer. In repeating this formerly conducted procedure, we expect to incorporate a controlled lab population while also observing wild type *Drosophila melanogaster* over 6 generations. The goal of this study was to compare the effects of generational time and environmental change on sperm length in a short sperm *Drosophila* species. In addition, we examined the influence of a lab environment on the length of seminal receptacles, the sperm storage organ in female flies.

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Global Well-Posedness of the mZK Equation in 2 Dimensions for Rough Data

We consider the modified Zakharov-Kuznetsov (mZK) equation in two space dimensions. Using the I -method, we prove the global well-posedness of the solution in H^s space for $s > 3/4$, under the assumption that the mass of the initial data is less than the mass of the ground state solution of the elliptic equation $\Delta \ell - \ell + \ell^3 = 0$. We obtain the same result for the defocusing mZK equation without any smallness assumption.

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The Effects of Atrazine Runoff on the Microbiome of the Eastern Oyster: *Crassostrea virginica*

The Chesapeake Bay has suffered a dramatic loss of its native mollusk species, the eastern oyster, *Crassostrea virginica*. It is believed that this loss is caused in part by herbicidal agricultural runoff discharging into the surrounding surface and groundwaters of the Chesapeake Bay following heavy periods of rain in spring and summer months. The most widely used herbicide in the region is atrazine. Although the manner in which atrazine hinders the survival of juvenile oysters remains unknown, the present study investigates how exposure to atrazine affects the core microbiome of *C. virginica* juveniles. Here, 16S rRNA gene amplicons were used to evaluate how microbial compositions shift in response to exposure of environmentally relevant concentrations of atrazine found within the Chesapeake Bay (30 µg/L, 20µg/L, 10µg/L and 3 µg/L respectively). The dominant bacterial groups found within all groups included those belonging to the order *Rickettsiales*, *Vibrionales*, and *Alteromonadales*, family *Pseudoalteromonadaceae*, *Vibrionaceae*, and *Planctomycetaceae*, and genera *Pseudoalteromonas*, *Vibrio* and *Nocardia*. Our results indicate atrazine exposure changes the relative abundance of native microbial inhabitants in a dose-dependent manner. Additionally, it was found that both *Catabacter* and *Nocardia spp.*, known oyster pathogens, were detected in all atrazine treated oysters but not found at detectable levels in the controls. Our research clearly illustrates adverse outcomes of atrazine exposure on a keystone species of the Chesapeake Bay and may indicate why native populations have had a difficult time being reintroduced to the Bay.

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Investigation of Structure-Property Relationships in a Family of Uranyl Tetrahalides Paired with Substituted Methyl-Pyridinium Cations

There remains a continued interest in understanding the fundamental behavior of uranium-containing hybrid materials owing to their relevance to nuclear waste stewardship and non-proliferation efforts. When compared to the more common d-block elements, the chemistry of those situated in the f-block (like uranium and the actinides), is much less developed with respect to behavior and properties. As such, there is a critical need to fully understand their chemistry, and specifically, the role of f-electrons in the chemical bonding of these materials (i.e. covalency). Our approach is to systematically study families of these materials to establish modes of assembly, explore their properties, and highlight trends throughout. As such, a series of uranyl tetrahalides ($[\text{UO}_2\text{X}_4]^{2-}$ where X= Cl or Br), paired with substituted methyl-pyridinium cations, has been prepared with aims to correlate trends in assembly to observed shifts in the Raman and luminescence spectra. The compounds were prepared via slow-evaporation at room-temperature from acidic, high halide media, to prevent hydrolysis of the uranyl species in solution and promote formation of discrete uranyl tetrahalide tectons. Organic ligands were chosen for their ability to provide non-covalent interactions, which can be promoted in the second coordination sphere. In particular, the substituted methyl-pyridinium cations are able to donate charge-assisted hydrogen bonds to the equatorial halide ligands of the uranyl. Both Raman and luminescence spectra have been shown to be affected by both the types and strengths of hydrogen bonding motifs. As such, an overview of the influence of hydrogen bonding on both the structure and spectra will be presented.

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Phytolith Analysis as a Proxy for Vegetation Reconstruction: A Study from Omo National Park, Ethiopia

Phytoliths are microscopic silica particles that precipitate in living plant cells. Different plants produce distinct phytolith morphotypes that can be indicative of their living environment. When the plants die, phytoliths are then deposited in the soil and can be preserved. Because of their inorganic composition, phytoliths have a high preservation potential and are abundant in the fossil record. By analyzing the phytolith assemblages from human fossil bearing sites, we can reconstruct vegetation cover in the past and how it changed through time. This can add to our current knowledge and understanding on the influence of environment on the course of human evolution. Although phytoliths have been known since the 19th century, their use in vegetation reconstruction is relatively recent and has been evolving since its discovery. Using the proportions of environmentally indicative morphotypes in phytolith assemblages, various indices have been developed to provide information on the environment. Despite all the research effort, the effectiveness of these indices as a proxy is still debated to be biased towards grasses. Hence, this study focuses on employing the D/P ratio, which looks at the proportion of woody dicotyledons to grasses in phytolith assemblages, as an index of tree cover density. A higher D/P ratio indicates a higher woody cover. In this study, we are interested in testing the hypothesis that the D/P ratio will accurately reflect the observed tree cover density.

To test our hypothesis, we analyzed 8 soil samples from the Omo National Park. These modern soil samples represent distinct vegetation settings, ranging from riparian forest to grassland. After a series of chemical extraction processes, phytoliths were successfully extracted from 7 of the samples and were studied under the microscope. We also compiled a dataset from the literature, which consisted of 93 samples with known vegetation and environmental data for comparison. In contrast to our hypothesis, the 7 samples failed to distinguish between the different vegetation types, which could be attributed to our limited sample size. However, when taken together with the compiled dataset, the result indicates that D/P ratio can be a useful proxy for reconstructing vegetation cover. More modern soil samples are needed to build a reference database and to calibrate the D/p ratio. This can help to more accurately reconstruct vegetation and infer the environmental settings in which our ancestors lived, when studying fossil soils.

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The Curious Case of the Termites: How Rainfall Affects Diversity in the Australian Tropics

Termites are critical components of tropical systems where they are thought to decompose up to 50% of plant organic material in litter, wood and soil. Termites have adaptations (e.g., the ability to scavenge and store water in their mounds) allowing them to thrive in habitats with variable rainfall and remain active during droughts. One frequently drought-affected area, the Australian tropics, is thought to show a unique pattern of termite distribution, with termite diversity and abundance lower in rainforests, peaking in drier savannah ecosystems. This pattern, if true, is opposite to what is found in tropical regions around the globe where termite diversity and abundance is highest in rainforests. Our study aims to survey termite turnover across a precipitation gradient and examine the causes and consequences of this anomaly. In five sites in Northern Queensland ranging from 600–5000 mm annual rainfall, we collected samples from 50 m transects and 50 m x 50 m plots and measured termite abundance and diversity, deadwood occupancy, and termite mound abundance. We analyzed turnover of feeding types and landscape types among sites with differing rainfall. We observed dramatic decreases in termite abundance in both mounds and deadwood corresponding to an increase in rainfall (107 mounds per 1/4 hectare plot in the driest site, compared to 1 mound per plot in the wettest). Of the 18 termite species encountered in this study, none were soil feeders; litter and grass feeding termites were found only in the savannah sites, while wood feeders were found in both rainforest and savannah sites. These results support the termite diversity anomaly and point to turnover in feeding guild with greater diversity in savannah, suggesting that part of the anomaly lies in the adaptations to food resources across habitats. We found that presence of several common species of termites including *Amitermes laurensis*, *Nasutitermes magnus*, and *Microcerotermes cerratus*, corresponded more closely with habitat type than with distance from other sites. These results suggest that termite communities assemble in large part based on habitat type. Rainfall is an important factor in termite community assembly shaping the termite diversity distribution although why so few termites are found in the rainforest remains elusive.

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Figuring Out What Wnt Wrong – Genotyping of Wnt Pathway Perturbations Using CRISPR-STAT

The Wnt signal transduction pathway is a complex signaling pathway that is essential for proper development. In humans, dysfunction of this pathway may lead to breast, colon, intestinal, and skin cancers as well as skeletal defects and human birth defects such as spina bifida. A robust understanding of how the pathway functions is required for the understanding of organismal development and related human pathologies. Since the Wnt family is essential in nearly all metazoans and is largely conserved, study of the Wnt pathway in insects can guide applications in human medicine. Lepidopteran wings provide an interesting method to monitor the Wnt pathway. Since Lepidopteran wing patterns are determined by scales that are each produced by a single cell located on a single epithelial layer, it effectively transforms a complex 3-dimensional problem into a 2-dimensional one. This now 2-dimensional problem is further simplified since wing growth is relatively proportionate, keeping much of the wing's final shape throughout development and sculpting the final details through cell death. Recently, we have been able to get preliminary knockout results in a 2D system for the highly pleiotropic Wnt pathway gene *Wls*, which encodes for a membrane protein essential for the secretion of all Wnt ligands used in the Wnt pathway. This was achieved through CRISPR-Cas9 induced mosaic knockouts in *Vanessa cardui*. The CRISPR-Cas system creates double strand breaks early in the first exon of *Wls* to create indels and a 2/3 chance of a frameshift mutation that prevents the coding of functional protein. These results will be confirmed by the use of mosaic mutants, providing comparison between mutant and wild type phenotype within the same individual since *Wls* is only knocked out in portions of the wings, and CRISPR-STAT. CRISPR-STAT allows for analysis of the effectiveness of the CRISPR-Cas cutting and the level of mosaicism by genotyping and quantifying indel variation in *Wls* throughout the body of the whole organism. The ability to distinguish between wild type, heavily mosaic mutants, and especially homozygous mutants can guide time series injections to increase mosaicism if the knockout is too lethal, indicate if a sudden die-off in injected specimens is from rearing errors or the lethality of the mutation, and delineate between unusual wild type phenotypes and *Wls* mutant phenotypes.

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The Effects of Atrazine on the Transcriptome of the Eastern Oyster: *Crassostrea Virginica*

From the time humans first began settling in the Chesapeake Bay area to now the population of the Eastern Oyster, *Crassostrea virginica* has diminished to 98% of its original size. This current population's small size is concerning since oysters play a vital role in marine communities by filtering water and stabilizing sediments for plants to latch onto and other species to live around. While this change has been precipitated by a variety of physical and chemical changes within the bay, the increased amount of the triazine herbicide Atrazine is especially concerning given how little is known about its effect on the growth and development of Eastern Oyster populations. This study provides insight into this topic by sequencing and identifying changes in the *C. virginica* transcriptome in response to ecologically relevant doses of Atrazine. A retinal dehydrogenase 1-like gene that plays a role in melanin deposition in the adductor muscle scar and free radical management was downregulated across low treatment groups. Genes related to biomineralization processes and shell formation such as carbonic anhydrase 1-like were also impacted by low levels of atrazine. This differentially expressed gene and others also play a role the regulation of reactive oxygen species, as well as the process of apoptosis. These findings are important as they represent the first investigation into how this herbicide specifically affects the functioning of the Eastern Oyster. Additionally, they add to the growing body of work regarding the harmful and unintended effects Atrazine can have when organisms come into contact with it in their environment.

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Hepatitis C Viral Infection Promotes Tumorigenesis by Altering Expression of Proteins Responsible for Chromatin Remodeling, Proliferation, and Cell Motility

Hepatocellular carcinoma (HCC) is the most common primary malignancy of the liver and the 2nd leading cause of cancer-related deaths worldwide. Approximately 80% of HCC cases develop from cirrhosis brought on by chronic liver disease and thus remains one of the major risk factors for HCC incidence. Further, HCC is often associated with other factors such as hepatitis virus infection (HCV) that can lead to chronic inflammation and cirrhosis of the liver. Though chronic HCV infection is well documented to promote hepatocarcinogenesis, the mechanisms are still unclear.

Here, we use differentiated hepatocytes to assess changes in biological functions - namely proliferation, migration, invasion and anchorage independent growth. Our experiments show change in these biological functions upon transfection by HCV 1a RNA (H77) and synthetic non-coding viral RNA (vmr11-mimic), suggesting induction of oncogenic phenotypes. Furthermore, these phenotypes could be restored by co-transfection with antisense oligonucleotide Anti-vmr11, suggesting specificity of the phenotypes. Results of Transwell migration and invasion assays indicate increase in migration and invasion capability of hepatocytes transfected with H77 or vmr11-mimic. We also observed increased proliferation as seen by Ki67 (a proliferation marker) staining and induction of anchorage independent growth in soft agar.

The complex oncogenic phenotypes (such as enhanced cell invasion, migration or cell proliferation), usually result from deregulation of multiple genes. To gain better understanding of specific downstream targets that are dysregulated as a consequence of up or down regulation of various genes (especially the tumor suppressor genes), we planned to determine quantitative changes in the intracellular proteome by SILAC analysis. SILAC analyses were performed at two different time points, 12 and 24 hours. The results show a marked increase in chromatin remodeling proteins (in response to oncogenic RNAs, and its recovery towards normal levels by co-transfection of Anti-vmr11 oligonucleotides) and proteins related to lipid metabolism. We selected and immunoprecipitated a chromatin remodeling protein, ARID 1A/B and observed distinct enrichment of WT vmr11-mimic in addition to the enrichment of histones (H3 and H4) that is associated with WT vmr11-mimic in the nuclear fraction.

Our future plan includes exploration and identification of other such proteins with similar address sequences that may be simultaneously targeted for treatment of hepatocellular carcinomas.

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An Exploration of Dice Landing Probabilities

The study of how cuboidal dice land dates back to Issac Newton, who tackled the problem in 1664 in his mathematical papers. Predicting the final state probabilities of dice has evolved from a mathematics problem in Newton's paper to a physics one where researchers have used classical mechanics and thermal and statistical mechanics in an attempt to describe such probabilities. Useful applications could be in predicting landings of robotic spacecrafts such as the Mars Pathfinder rover which resembles a tetrahedron, calculation of casino game odds and perhaps the science of granular flow. There are also pedagogical applications in describing concepts such as the Boltzmann factor, Markov chains, and basic mechanics because of the visual and conceptual simplicity of such a problem. In a 2014 paper, Pender and Uhrin were able to predict probabilities of rectangular dice landing in two dimensions with great precision using a combination of geometric properties of rectangles and a Markov chain model. My research has been mainly comprised of extending the Pender and Uhrin theory to other shapes such as cylinders and cuboids and investigating theoretical and experimentally where the theory fails and why. In addition, I have been developing a theory that makes use of a Boltzmann factor that has some promising advantages over the Markov chain model.

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Implications of Agricultural Runoff on the Chesapeake Bay Ecosystem

Agricultural pollution in the form of sediment, fertilizer, herbicide, and pesticide runoff have impacts on the ecological viability of the Chesapeake Bay. Excess sediment deposition leads to increased turbidity that can prevent sunlight from reaching underwater grasses which in turn has harmful effects on the fish and shellfish. On average five million tons of sediment enter the Chesapeake each year. Agricultural production accounts for 42 percent of the nitrogen and 55 percent of the phosphorus entering the ecosystem, with 17 percent of the nitrogen and 19 percent of the phosphorous from just fertilizer runoff alone. The increase of nitrogen leads to algal bloom which result in low oxygen environments creating a dead zone in the water. Such high pesticide concentrations can impact aquatic life by increasing intersex conditions and suppressing immune and behavioral systems in fish populations. Impaired reproduction has also been noted in predator bird populations. Crops relevant to the Chesapeake such as wheat, soybean, corn, canola, and sorghum are also impacted by the runoff of these chemicals into the bay and surrounding streams. The impact on the aquatic system is noted by the dramatic loss of keystone species such as the Eastern Oyster, *Crassostrea virginica* whose population has diminished to 98% of its original size in large part due to increased use of the herbicide Atrazine. Filtration of water and stabilizing sediments are vital roles filled by oysters in a marine system. The overall impact on an aquatic system when faced with such immense quantities of agricultural runoff is profound.

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A New Many-Body Physics Theory of Online Social Media Aggregation

Understanding how people aggregate online in support of controversial topics such as anti-vaccination movements, hate speech, extremism, and financial scams, is a crucial challenge. This affects policy makers, public health officials, and federal and state agencies charged with ensuring societal security and safety. The topic of aggregation is of great interest to scientists, in the separate context of populations of molecules, cells, and organisms. These studies are made very complex due to strong spatial dependencies: specifically, the physical location of the molecules, for example, can hinder aggregation. The online social media world breaks this limitation completely, with near instantaneous interactions occurring between users who may be on opposite sides of the planet.

The intriguing question then arises: can a new theory of aggregation be developed for the online human social media world. One that would not only provide new research in the area of physics, chemistry and biology, but would also provide much-needed insight into societal challenges concerning public health, safety and security?

This study provides a first step in this important direction. By looking at populations comprising individuals with distance-independent interactions, it is seen that they give rise to the formation of large 'gels' of individuals that may then present a threat to the system. As part of the work, an in-depth mathematical analysis is performed on the formation of these gels, in particular when they form and how quickly. By looking at how different types of user-user interactions will slow down or speed up the gel formation, insight is gained into the system dynamics and potential mitigation schemes.

This research is performed by (1) investigating changes to the aggregation mechanism that might be introduced from the outside, e.g. by a social media platform controller such as Facebook; and (2) investigating what happens if a second population is introduced to interact with the first one. The output is compared to available social media data of social clusters.

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A Novel Massively Parallel Sequencing Panel of Microhaplotypes for Mixture Deconvolution

Microhaplotypes (MHs) are markers defined by multi-allelic SNPs within < 300 bp displaying multiple allelic combinations. These are promising loci for improving human identification and mixture deconvolution while enabling ancestry inference. The main advantages of MHs over short tandem repeats (STRs) are the absence of stutter peak, same-size alleles within each marker, lower mutation rate, and ancestry informative alleles. MHs can yield a power of discrimination similar to conventional STRs while potentially providing greater information on the source of a DNA sample. Sanger sequencing does not enable determining the *cis/trans* relationship among SNPs while massively parallel sequencing (MPS) allows the determination of the parental haplotypes at each locus as each DNA molecule is being clonally sequenced. This study describes the performance of a new 74 MH loci panel on the Ion S5™ (Thermo Fisher Scientific) MPS platform. The project evaluated the assay's efficiency for mixture detection and deconvolution.

The limit of detection of the panel was tested between 2 ng and 25 pg of DNA input. The performance of the assay on mixtures was evaluated in parallel with capillary electrophoresis (CE) (GlobalFiler™ Kit) and MPS-based STR analysis (Precision ID GlobalFiler™ NGS STR Panel v2). Two to five person mixtures at 1-10 ng DNA input were simulated, with each donor with a distinct ancestry and contribution ratio to mimic casework-like mixed samples. Representative examples of tested ratios included 10:1 to 40:1 for two-person mixtures, 5:1:1 10:5:1 for three-person, 5:5:1:1 and 10:5:1:1 for four-person mixtures, and 5:5:1:1:1 and 10:5:1:1:1 for five-person mixtures.

The assay was found sensitive down to approximately 50 pg of input DNA and minimal allele/locus dropout was reported at lower input DNA. As expected the deconvolution of STR mixtures by CE was challenging, but it could be enhanced by sequenced-based STR analysis, which allowed reporting additional alleles of the minor contributor detected whenever the corresponding sequence of minor alleles was different from the stutter sequence. For two-person mixtures, full MH profile of the minor donor was reported at a 1:10 ratio while allele/locus dropouts were observed at more extreme ratios. For three, four and five-person mixtures a full MH profile was reported for all minor contributors at the mixture ratios tested.

These results suggest that the new MPS panel of 74 MHs enhances the deconvolution of two to five person mixtures genotyped using the Microhaplotyper Plugin v8.1 (Thermo Fisher Scientific), especially for mixtures with incomplete STR profile.

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Investigating UV Iridescence Patterns in Pierid Butterflies

UV iridescence in pierid butterflies is species specific and often highly sexually dimorphic. *Delias* is the genus within the family Pieridae of which there are approximately 250 described species. *Delias* color patterns include white, yellow, orange and red generated by leucopterin xanthopterins and erythropterin pigments. In previous literature this UV reflection was seen to be a product of a combination of pterin pigments and structural features. The purpose of this research was to expand on and quantify these findings. This was done through analyzing how pterin pigments act in tandem with nanostructural features on the butterflies' integuments to produce the observed iridescence. This was accomplished through recording reflectance spectra of the original wings. The pterin pigments were extracted from the wings with solutions of isopropyl alcohol and ammonium hydroxide, and the reflectance spectra of the treated wings was recorded. Additionally, the extracted pterin pigments were analyzed for their spectrophotometric transmittance values to determine which pigments were present and in what proportion. This research is currently ongoing and conclusions have not yet been reached.

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The Best Genes for the Job: Evaluating Phylogenetic Informativeness

Phylogenetics is the field of biology devoted to untangling the tree of life. It attempts to understand the processes which shape the incredible diversity of organisms that exist today. In the past, phylogeneticists were limited to using morphological characteristics to hypothesize relationships among organisms, presented in the form of trees or ‘phylogenies’. The use of genetic information has revolutionized our understanding of evolution and provides exponentially more data for examining these relationships. However, vast quantities of data (based on hundreds or thousands of genes) have precipitated new conflicts over the best methods of analysis. Measures of “phylogenetic informativeness” (PI) for different genes have been proposed to determine which data may provide the best signal for resolving phylogenies. Genes that change too rapidly are likely to lose their phylogenetic signal over time, while those that change too slowly do not provide enough information to distinguish between closely-related taxa. I explore the utility of this approach to filter out less informative genes (and hence “noise”) from a large dataset with more than 1000 genes to resolve relationships among a diverse group of freshwater fish families. I compare results after excluding genes based on their PI with other standard approaches that use all the available evidence. The long-term goal of this project is to contribute towards establishing the best approach for the analysis of huge “genome-wide” datasets for phylogenetic analysis.

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A 28-Year History of HIV-1 Drug Resistance and Transmission in Washington, DC

Washington, DC consistently has one of the highest annual rates of new HIV-1 diagnosis in the United States over the last ten years. To guide intervention and prevention strategies to combat DC HIV infection, it is helpful to understand HIV transmission dynamics in a historical context. Towards this aim, we conducted a retrospective study (years 1987 to 2015) of 3,349 HIV pol sequences (1,026 bp) from 1,996 individuals living in the DC area belonging to three different cohorts. We coupled HIV sequence data with clinical information (sex, risk factor, race/ethnicity, viral load, subtype, anti-retroviral regimen) to identify circulating drug resistant mutations (DRM) and transmission clusters and assess their persistence over time. Of the transmission clusters identified in the DC area, 78.0% and 31.7% involved MSM and heterosexuals, respectively. The longest spread of time for a single cluster was 5 years (2007–2012) a distance-based network inference approach and 27 years (1987–2014) using a maximum likelihood phylogenetic approach. We found eight subtypes and nine recombinants. Genetic diversity increased steadily over time with a slight peak in 2009 and remained constant thereafter until 2015. Nucleotide diversity also increased over time while relative genetic diversity (BEAST) remained relatively steady over the last 28 years with slight increases since 2000 in subtypes B and C. Sequences from individuals on drug therapy contained the highest total number of DRMs (1,104 - 1,600) and unique DRMs (63–97) and the highest proportion (>20%) of resistant individuals. Heterosexuals (43.94%), MSM (40.13%), and unknown (44.26%) risk factors showed similar prevalence of DRMs, while injection drug users had a lower prevalence (33.33%). Finally, there was a 60% spike in the number of codons with DRMs between 2007 and 2010. Past patterns of HIV transmission and DRM accumulation over time described here will help to predict future efficacy of ART drugs based on DRMs persisting over time and identify risk groups of interest for prevention and intervention efforts within the DC population. Our results show how longitudinal data can help to understand the temporal dynamics of HIV-1 at the local level.

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The Landing of Fallen Objects

Being able to predict how an object will land after falling has been left mostly untouched in the scientific community, despite the benefits this information would have such as the ability to, when dropping objects from space onto a planet, predict the possible landing orientations of the payload. This drastically reduces the amount of weight the payload must carry. The extra tools needed to reorient itself once on the ground could be lowered to almost none.

This research tests how cylinders land, specifically the probabilities that they will land on either a face side or its rolling side. Furthermore, this research tests a set of mathematical theorems on the subject of falling cylinders by Hermann Bondi. He predicts a cylinder's chance of landing on its rolling side after a perfectly inelastic collision with a "rough" surface heavily reliant on a value k , the rotation of gyration, a , the radius of the cylinder's faces, and $2h$, the height of the cylinder. Since this research uses short, sorbothane cylinders, if h squared is less than or greater than k and a squared, the value of $\tan(\sigma)$ is greater than $4/3$. Essentially this σ then, with our $h = .25$ in. and $a = .75$ in. $\text{Arctan}(.75/.25) = 71.565$ degrees. $\text{Cos}(71.565)$ gives us the probability of it landing on its rolling side, 31.6%.

For this research I drop cylinders from a meter off of the ground at a high angular velocity or low. This gives me values to compare seeing if random rotating speed effects how often the cylinder lands on its rolling side. The data will lend insight into whether or not Bondi's theories fit with how cylinders actually land when falling.

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Designing Safer Insecticides: An In Silico Study of Coumaphos and Chlorpyrifos

Over 85% of the 700+ commercial chemicals introduced to the domestic market each year have no health and safety data. Animal-based testing of chemicals has proven key in developing effective methods for diagnosing and treating diseases that result from chemical exposure. However, animal studies are prohibitively expensive in both economic and ethical terms to conduct toxicity testing on every new chemical in the market. Alternatively *in silico* tools can be used to screen existing chemicals and predict their adverse effects on living systems. Such tools offer greater speed at much lower costs however, their accuracy is mostly unsatisfactory. To address this challenge, a novel *in silico* framework that allows molecular redesign of existing xenobiotics that pose hazard to human and/or environmental health had to be developed. This was accomplished by applying proven methodology from computational drug discovery to suit the purposes of safer chemical design. Specifically, statistical free energy perturbation calculations of solvated host-guest systems were employed to develop this approach for organophosphate pesticides, a prominent class of chemicals that replaced the very toxic polybrominated diphenyl ethers (PBDEs). Chronic exposure to organophosphates is associated with a host of adverse effects, including neurotoxicity, genotoxicity and disruption of the endocrine system. This study examines two high-volume pesticides, coumaphos and chlorpyrifos, which are modified so as to minimize undesirable biological activity against multiple human targets while retaining acceptable functional efficacy against target insects. This innovative approach will advance our fundamental, molecular-level understanding of organophosphates' structural role in human disease onset and in causing acute neurotoxic effects in insects. Furthermore, this study can help establish a foundation for computational redesign of existing chemicals in commerce that is both fast and cost-effective and can be readily extended to other chemical classes and toxic endpoints.

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Massively Parallel Sequencing of Microhaplotypes for Biogeographic Ancestry Inference

With the advent of massively parallel sequencing (MPS) technology new genetic markers called microhaplotypes (MHs) have become available to the forensic community. MHs are loci characterized by the presence of two or more single nucleotide polymorphisms (SNPs) within a short distance from each other (<300 nucleotides) with three or more allelic combinations. Conventional Sanger sequencing method is unable to determine the *cis/trans* relationship between SNP alleles within the same amplicon while MPS technology allows distinguishing the parental haplotypes at any locus within the same amplicon. This is achieved by specific clonal sequencing of each individual DNA strand, which allows determining the phase of SNP-alleles. Key characteristics of MHs include multi-allelic nature, absence of stutter peaks, small amplicon size and lower mutation rates than conventional short tandem repeats (STRs). These features make MHs candidate markers for different human identification applications including mixture deconvolution and ancestry inference. In this study we evaluated the performance of a newly developed MPS based MH assay for the prediction of biogeographic ancestry of individuals using PHASE-inferred allele frequencies from ALFRED database.

A set of 20 African-Americans (AAs), 20 European-Americans (EAs), 20 East Asians (EASs) and 20 South West Hispanics (SWHISs) was initially selected and typed on the Ion Chef™ and Ion S5™ MPS (Thermo Fisher Scientific) platform using a novel forensic assay of 74 MH loci⁵. All 80-unknown test-samples representative of each population group was chosen and tested for biogeographic ancestry prediction. Allele frequencies of the 74 loci were extracted from the extensively used ALFRED repository and further utilized to calculate the random match probability (RMP) of the unknown samples in each population. In particular, the Log₁₀RMP of the test-samples was calculated using the previously PHASE-inferred allele frequencies from the 74 MH loci across 62 selected populations representative of the four global population clusters. Overall the biogeographic ancestry of the 80-unknown test-samples was correctly predicated using the ALFRED MH allele frequencies. Among the populations studied, the Log₁₀RMP calculated for each test-sample averaged significantly higher in the corresponding population of origin.

These initial findings indicate that the 74MHplex MPS panel is an effective DNA tool, which provides useful information on the biogeographic ancestry of individuals and complements the accuracy of current binary and non-binary forensic-based ancestry prediction assays. Continuing work includes expansion of types of population and increase of the sample size in all populations tested.

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Bloody Surfaces: The Effects of Fabrics on the Surface of Wounds and Their Bloodstain Patterns

A 30-year-old woman was found stabbed in her home. She was found lying face down and the stab entrance wounds were found in the back of her denim jacket. There were slight bloodstain patterns on the wall next to her but due to the placement of the stab wound in the jacket, the bloodstain pattern analysis did not correlate. Bloodstain pattern analysis (BPA) is the interpretation of bloodstains at a crime scene to piece together the events following up to the blood being shed. There are many factors that go into distinguishing a certain bloodstain, such as size, shape, and location of the stain. Bloodstains are classified into three basic types: passive stains, transfer stains, and impact stains. The type of pattern that this study focuses on is the impact stain, which is distinctive of blood projecting through the air and landing as a "spatter" on a surface. As for the surfaces, the texture on which blood lands matters significantly, however, for the 30-year-old woman, it was not what the blood landed on that mattered but where the blood could not go through. More so, this experiment focuses on the cast-off bloodstain that comes from the weapon and the person pulling away from the object. This project analyzes the different textures that may be found on a person, specifically when they are stabbed. These different textures such as cloth, denim, leather, etc. were placed on a blood-soaked sponge with a perimeter surrounding it, and immediately differences in the bloodstains were visible. The aspects explored were the type of impact spatter that is acquired from various textures on a bloody sponge, the velocity of the force impacting a bloody surface and the effect of the number of blows, and finally the effect of the size of the weapon.

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Synthesis and Characterization of Non-Magnetic Analogs of Spin Crossover Molecular Quantum Bit Candidates

With new advances being made everyday, the theory of quantum computing is slowly but surely becoming a reality. In our day to day work in the Besson lab, we work to synthesize and characterize magnetic complexes that display specific magnetic properties that could be useful in the field of molecular spintronics and quantum computing. Up until now, the bulk of our work has focused on iron complexes of trispyrazolylborate ligands which display spin crossover properties. Spin crossover is a process by which a molecular complex can switch between two different states with different spins, bond lengths, colors, and more. The spins of these complexes can be used as bit components to store and manipulate data. The goal of the research conducted in our lab is to attach these complexes to carbon nanotubes which will be used as readout channels for this data. The main thrust of this project is to synthesize and characterize zinc analogs to the iron complexes we have prepared so far. Our interest in these complexes stems from our desire to gain a better understanding of the properties of magnetic complexes by comparing and contrasting the differences between iron derivatives and non-magnetic zinc species. Our route of synthesis begins with making 1-nitropyrazole from nitric acid and pyrazole, then converting it to 3-nitropyrazole. In parallel, we react pyrazole with borohydride to prepare the non-functionalized trispyrazolylborate ligand. Its reaction with the 3-nitropyrazole yields the functionalized ligand. We then insert the desired metal (in this case zinc) to complete the target complex, which is then characterized by X-ray diffraction, NMR, IR, and UV-visible spectroscopies.

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DAQ Hardware & Debugging for MUSE

Until recently, it was thought that the proton radius was known with an uncertainty of 1%. However, in 2010, a measurement of the proton radius using muonic hydrogen yielded a radius value an order of magnitude more precise but 4% smaller than and completely inconsistent with the previous results. Resolving this discrepancy, known as the Proton Radius Puzzle, requires new and different measurements. The MUon proton Scattering Experiment (MUSE), carried-out at the Paul Scherrer Institute (PSI), Switzerland, will thus be the first to utilize elastic muon proton scattering with sufficient precision to address the Proton Radius Puzzle.

The current project covers the design and development of an ECL-to-LVDS logic level converter. The converter is currently used as a part of the MUSE Trigger and Data Acquisition (TDAQ) system, interfacing between hardware with different logic standards. In addition, in order to test the performance of the Time-to-Digital Converters (TDC), a hardware test stand and supporting software were developed. This software was used during the assembly of the MUSE TDAQ in order to test the performance of new TDC modules. Moreover, to improve the timing resolution and efficiency of MUSE beamline detectors, high voltage (HV) calibration software based on Charge-to-Digital Converter (QDC) spectra was developed.

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Analysis of the Role of HDAC6 on MITF Pathway, in the Pathogenesis of Melanoma

Various studies have shown that aberrant activity of HDACs plays a significant role in critical oncogenic events. Pan-HDAC inhibitors act broadly on all isoforms of the zinc-dependent classes of HDACs, but, they have adverse effects. Thus, targeting individual isoforms of HDACs becomes important. HDAC6 which belongs to class IIb of the zinc-dependent family of HDACs is found to play a significant role in different cellular processes, most of which are involved in immune regulation. Thus, to further investigate these unexplored regulatory mechanisms, we performed a time-course transcriptome analysis after cytokine stimulation on the WM164 non-target (control) and HDAC6 knock-down human melanoma cell lines. From the gene ontology analysis of pathways using MetaCore, a significant number of genes were found to be involved in the upregulation of the Microphthalmia-Associated Transcription Factor (MITF) pathway in Melanoma. MITF is a lineage-specific transcription factor, necessary for the normal melanocytic development and pigmentation process and plays a critical role in malignant melanoma, leading to BRAF-inhibitor resistance. The expression of MITF and other components of this cellular pathways was validated by qRT-PCR using matching initial samples from the RNA-Seq analysis. qRT-PCR and Western Blot analysis showed the MITF mRNA and protein expression to be decreased on the genetic knock-down of HDAC6 and the treatment with the HDAC6 inhibitor Nexturastat-A. Although the HDAC6 KD showed no impact on the nuclear localization of MITF, the amount of MITF protein expression was decreased. We are currently characterizing this mechanism and the potential participation of HDAC6 in the post-translational functional activity of MITF, including post-translational modifications and interaction with other transcriptional regulators involved in the pathogenesis of melanoma, including STAT3, which is another HDAC6 target. Thus, targeting HDAC6 with selective HDAC6 inhibitor will have a critical implication in the treatment of BRAF-resistant melanoma patients.

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A Putative UDP-Glycosyltransferase from the Entomopathogenic Nematode *Heterorhabditis Bacteriophora* Suppresses *Drosophila* Immunity and Pupation

As a general practice, the entomopathogen *Heterorhabditis bacteriophora* has been incorporated into integrated pest management programs as a viable biocontrol agent of insect pests due to its efficacy, specificity, and negligible effect on the environment, which exempts it from EPA regulation as a pesticide. Because naturally occurring *H. bacteriophora* are likely not operating at the theoretical maximum degree of their virulence, the specific virulence factors employed by *H. bacteriophora* have become a topic of interest meant to inform the eventual development of more efficient strains of entomopathogenic nematodes. The additional incentive is that the shared evolutionary history between *H. bacteriophora* and related vertebrate-infective nematodes including *Ancylostoma ceylanicum* may be exploited to describe in parallel infective mechanisms of nematode parasites in human hosts. To this end, an RNA-seq assay was performed to identify the genes of *H. bacteriophora* that are upregulated in response to host hemolymph, carry secretory signal peptides, and bear sequence similarity to proteins of *A. ceylanicum*. The pool of genes resulting from this query was then narrowed manually, yielding among its members a putative UDP-glycosyltransferase, Hba_07292, which was produced in recombinant form via an Sf9 expression system. Adult *Drosophila* flies were injected with the purified recombinant protein and then monitored for immune and physiological responses. Hba_07292 was found to be mildly lethal to *relish* mutant flies that are diminished in their capacity for Immune deficiency (Imd) pathway activation, but the protein had no effect on wild type controls. Concordantly, quantitative PCR showed that though not lethal in wild type flies, Hba_07292 does significantly reduce Imd pathway activation. Because the Imd pathway has been previously associated with the molting hormone ecdysone, and in another system a UGT-glycosyltransferase has been shown to deactivate ecdysone, Hba_07292 was monitored for effects on the pupation rate of third instar *Drosophila* larvae, a process initiated by high titers of active ecdysone. The putative UGT significantly reduced pupation rate, indicating that the altered immune activity may be due to interactions between Hba_07292 and ecdysone. Generally then, Hba_07292 has been demonstrated to be a potentially effective candidate for genetic manipulation towards developing entomopathogens with enhanced virulence.

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Statistical Analysis of GLCM Texture Features and Microstructures in SEM Images of *Crassostrea virginica* Exposed to Atrazine

The Eastern oyster, *Crassostrea virginica*, influences a range of economic and ecological systems. The effects of agricultural runoffs, such as the herbicide atrazine, on marine species, has not been well documented. To analyze the effect of atrazine, the oyster shell surface was analyzed. The shell protects the internal organs from predators. The shells of adult oysters are also required in the spawning of new oysters. This study analyzed the effects of atrazine on oyster shells using Scanning Electron Microscopy (SEM). SEM images were taken of juvenile oysters exposed to three different concentrations of atrazine (30, 10, 3 $\mu\text{g/L}$) to determine if there is a statistical significance in microstructure frequencies and GLCM texture features of three regions of the shell. Using a multivariate t-test, a significant difference was found in the texture features of the edge regions of the shells treated with 30 $\mu\text{g/L}$ and 0 $\mu\text{g/L}$ of atrazine. The same t-test found a significant difference in microstructures near the edge regions for shells treated with 10 $\mu\text{g/L}$ and 0 $\mu\text{g/L}$ of atrazine. These results provide computational strategies to distinguish shells treated with high concentrations of atrazine. Future work will tie evidence collected from imaging analysis into transcriptome data to illustrate the genetic impacts of atrazine exposure.

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The Immune and Physiological Roles of Amphibian (*Xenopus laevis*) CXCL8 Isoforms

Soluble mediators of immunity known as chemo-attractive cytokines, or chemokines, recruit distinct immune cell lineages to specific locations within organisms. A notable chemokine, CXCL8 belonging to the CXC chemokine family, induces chemotaxis of innate immune cells known as granulocytes. In turn, the CXC chemokine family may be further divided into chemokines bearing, or lacking an ELR motif, a short amino acid sequence that is typically associated with recruitment of cells during inflammatory responses. Intriguingly, whereas higher vertebrates possess a single CXCL8, the African Clawed frog (*Xenopus laevis*) encodes two CXCL8 isoforms, one of which (CXCL8a) contains an ELR motif, while the other (CXCL8b) does not. Our combined *in vivo* and *in vitro* studies in both tadpoles and adult frogs revealed that both frog CXCL8 isoforms chemo-attract frog granulocytes, although the frog CXCL8a and CXCL8b differ in their gene expression during inflammatory and wound repair responses, suggesting that these chemokines may be recruiting functionally distinct populations of granulocytes. Supporting this notion, our studies indicated that CXCL8b recruit granulocytes with increased expression of genes associated with tissue repair and angiogenesis. Moreover, our findings suggested that the frog CXCL8a and CXCL8b may be involved in the metamorphosis of tadpoles into adult frogs; a process that involves major restructuring of organs and tissues in the tadpole. Notably, the onset of metamorphosis is controlled by increased tadpole production of thyroid hormone and when we artificially induced tadpole metamorphosis with thyroid hormone T3, we observed an increase in CXCL8b gene expression in tadpole skin and tails, followed by a corresponding increase in expression of genes regulating inflammation and the development of blood vessels. Together, our findings suggest that the frog CXCL8 isoforms are involved in not only immunity, but also other aspect of this organism's physiology.

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Gram Determinant of the Klein Bottle

We investigate the Gram determinant of the Klein bottle by defining a bilinear form based on curves in a Mobius strip with $2n$ boundary points. We calculate several examples of the Gram determinant of the Klein bottle. This is an active project with prospects to proving Qi Chen conjecture.

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Analysis of Genetic Diversity Across a Wild Population of *Propithecus verreauxi* Using Microsatellite Genotyping

The use of microsatellites to characterize genetic variation within and between wild animal populations has become increasingly common in the last few decades. Microsatellites, also known as short tandem repeats (STRs), are a category of genetic elements identifiable by their repeating motifs of two-four nucleotides. These segments of DNA can vary in length because of variation in the number of repeats. Their repeating nature and high mutation rates allow for greater polymorphism, or variation, and a large number of alleles. Thus, microsatellite genotyping can be used to infer genetic relatedness, and is often used in the study of population genetics to interpret genetic diversity. Using fecal samples from a wild population of Verreaux's sifaka lemurs (*Propithecus verreauxi*) from the Beza Mahafaly Special Reserve (BMSR) in Madagascar, I am working with collaborators to assess the genetic variation and possible barriers to gene flow across specific sections of the protected reserve. Samples were collected from a variety of areas within and around the reserve, including the northernmost area of the reserve (Parcel 1), the southernmost area (Parcel 2), the area between Parcels 1 and 2 (New Core), and, most recently, the unprotected, less researched areas outside the reserve. We genotyped 7 microsatellite loci for samples (N = 45) collected during the 2017 field season to identify variation within and between the Parcels, the New Core, and the unprotected areas. Preliminary results suggest variable diversity between and within various regions of the reserve. This research will expand upon the long-term field studies conducted at BMSR. With this research, we hope to better characterize the population genetics of this population of sifaka lemurs in order to aid in the conservation of this unique species.

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Design and Synthesis of CoaBC Inhibitors

The overuse of traditional antimicrobial therapeutics has resulted in an increasing number of drug-resistant bacteria. As a result, there is a demanding need for the development and discovery of novel antibiotics that are able to circumvent traditional pathogen resistance mechanisms. Coenzyme A (CoA) is required for energy production and regulation of metabolic pathways in both prokaryotes and eukaryotes; however, there are significant differences between CoA production in these organisms, making its biosynthesis a potential drug target. The initial stages of the CoA pathway result in generation of CoA precursor pantothenate (Pan) through the PanB, PanC, PanD, and PanE enzymes. Later stages convert Pan to CoA in a series of steps through the PanK, CoaBC, CoaD and CoaE enzymes. Knocking out CoaBC results in bactericidal activity, while knockouts of the other enzymes are only bacteriostatic. The vital role CoaBC plays in the survival of prokaryotic pathogens makes inhibition of CoaBC attractive as a drug target. CoaBC inhibitors will likely disrupt key metabolic and regulatory pathways required for survival. The reactive intermediate in conversion of Pan to CoA is 4'-phospho-pantothenoyl-CMP (Pan-CMP). We report on the design and synthesis of Pan-CMP mimics. Such compounds that mimic Pan-CMP have the potential to be less reactive towards acyl-transfer and be bactericidal.

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The Effect of Hand Grip on the Cutting Efficiency and Edge Dulling of Basalt Flakes

Factors affecting the efficiency of a task can be useful ways to investigate behavioral choices, particularly when considering the evolution of the hand in relation to tool use. The two-jaw chuck pad-to-side, three-jaw pad-to-pad, and four-jaw pad-to-pad hand grips were tested in terms of the effects on cutting efficiency (time taken and number of strokes needed to cut through a standardized length of meat) and edge angle change. Significant differences in cutting efficiency were found between the three-jaw pad-to-pad and the four-jaw pad-to-pad hand grips, with the four-jaw pad-to-pad grip having the greatest cutting efficiency. Due to sample size it was not possible to statistically analyze edge angle change in relation to hand grip type, but in general a minimal effect was observed. This suggests that the number of digits solely in direct contact with the flake has an effect on the cutting efficiency.

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Whole-Collection COI Barcoding and Species Delimitation of Neopilionidae (Opiliones) Reveal Need for Family-Wide Taxonomic Revision

The harvestmen of the family Neopilionidae are represented by 64 described species in 20 genera and are distributed across temperate Gondwana in Chile, Argentina, southern Brazil, South Africa, Australia, and New Zealand. The family has the potential to be a valuable biogeographic model for New Zealand, but until recently neopilionid harvestmen have been taxonomically neglected, with recent work largely limited to revisions of New Zealand members of the family. We aim to supplement these revisions with molecular phylogenetic evidence in order to delimit existing species, lay the groundwork for subsequent collecting efforts, and prepare the family for use as a robust biogeographic model. We sequenced approximately 400 New Zealand neopilionid specimens from the Museum of Comparative Zoology at Harvard University, including the first neopilionid specimens found on New Caledonia, and 200 specimens from the University of Auckland for cytochrome c oxidase subunit I (COI). These data were combined with previously unpublished data from almost 100 South American specimens to create the most broadly-sampled phylogeny of Neopilionidae to date. In addition to the phylogeny, we used the multi-rate Poisson tree process to delimit species in order to test current taxonomic hypotheses about the amount of species within neopilionid genera. A number of genera and species were recovered as monophyletic with high bootstrap support values, but many were also disrupted by our analyses. In particular, *Forsteropsalis* and *Pantopsalis* taxa were dispersed in well-supported clades throughout the tree, as were *Megalopsalis* taxa; however, the backbone showed weak support values and had poorly resolved relationships between genera. Species delimitation analyses showed the existence of many more species than previously thought in *Mangatangi*, *Thrasychirus*, and *Forsteropsalis*. The majority of extant species were supported by the analyses, but we found evidence for the synonymization of *P. listeri* and *P. cheliferooides*. These results point to the need for more in depth analysis of Neopilionidae, as they contest a large amount of our current taxonomic understanding of the family. If Neopilionidae is to become a biogeographic model for New Zealand, we must continue to add morphological and molecular evidence to future analyses in order to identify new species and resolve paraphyletic genera.

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I Can See Clearly Now the Scales Have Gone: Aberrant Vein Morphologies in Mutant Butterfly Wings

The wings of butterflies are a canvas for intricate patterns, which are used by butterflies for a variety of purposes. In order for the wing to function and the pattern to be displayed, the wing must be held open by veins, which are hardened, tubular structures. The Wnt signalling pathway is important for building the wings of insects. Previous research has highlighted the important role of the *WntA* gene in patterning the wings of butterflies, where it can mark edges and boundaries in pattern elements. Previous research in the Martin Lab has shown that the frizzled-2 (*fz2*) receptor is the main *WntA* receptor involved in wing-patterning in *Vanessa cardui*. But there are several other Wnt pathway receptors in the Frizzled family. One of these, frizzled-3 (*fz3*), also produces phenotypic changes when knocked out using CRISPR/Cas-9. Some of these phenotypic changes appear to be in the vein structures of the wings. By clearing wild-type and mutant wings by alternating between placing them in ethanol and 10% bleach, the veins on the wings will become visible and can be characterized using microscopy and computational analysis. Differences between the wild-type and mutant characterized wing veins will subsequently be analyzed. We have been able to visualize and characterize the presence of extra veins in *fz3* mutants.

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Investigation of Cortical Bone Permeability to Microbes and Implications for Marrow Consumption in the Scavenger Hypothesis

The goal of archaeologists is to construct an accurate and comprehensive image of behavior in human evolution with only the artifacts left behind by hominins. One of the major components of this image is the description of food items hominins consumed and how these were obtained. Among the hypotheses set forth to characterize the feeding behavior of hominins is the scavenger hypothesis, which proposes that early humans accessed carcasses post-carnivore processing to extract the remaining flesh, and calorie-rich, fatty, long bone marrow. Bone marrow is believed to be an especially unique resource to hominin scavengers not only because of its exceptional energetic value but because it may be resistant to contamination of pathogen microbes. This is thought to be the case because marrow is encased in cortical bone tissue and not directly exposed to the environment where microbes can infect and quickly putrefy the flesh. We set out to determine the validity of this argument by performing an actualistic experiment in which we simulated carcass decomposition. At three time points (t=0 days, t=3 days, t=9 days) we measured the microbial density in the marrow of butchered and defleshed bovine long bones to verify if cortical bone acts as a barrier to microbial contamination. From this study, we aim to shed light on the scavenger hypothesis and gain a better understanding of the rate of marrow putrefaction.

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Supervolcano: Analysis of Distal Lava Creek Tuff at Yellowstone

Over 630,000 years ago, the Yellowstone Supervolcano in Wyoming erupted 1,000 cubic kilometers of molten ash and pumice that covered about two-thirds of the United States. The resulting volcanic formation is called the Lava Creek Tuff and is considered one of the most voluminous rhyolitic ash deposits in the world. Such ash flows, and particularly those which have originated from the Yellowstone volcanic system, pose a significant threat to life and to the maintenance of ecological and climatological processes. As the energy source that supplied heat for the Lava Creek Tuff eruption is still active today, detailed analysis of such volcanic products remains an important aspect of modern volcanological hazard mitigation.

In general, microscopic textures in the glass and minerals of a volcanogenic rock provide clues about the heat content and eruptive mechanisms of the eruption that produced it. Prior to this study, an initial petrographic study of Lava Creek Tuff revealed textural and chemical complexities that did not necessarily fit the previously accepted idea that Lava Creek Tuff member B is a single ash sheet resulting from a single pulse of volcanic activity.

The observed complexities from the initial analysis presented the research questions for this study: does evidence exist to support a more dynamic (and potentially more energetic and therefore dangerous) model for eruption at Yellowstone? If so, what is the nature of this evidence and what theoretical model for eruption does it indicate?

A distal section of the Lava Creek Tuff member B ash flow was sampled at Glassy Lake Reservoir in Wyoming, about 40 kilometers from the volcanogenic source vent. These samples were studied using petrographic techniques, and the results of textural analysis has helped to reconstruct the magmatic and volcanic processes undergone by the ash during various phases of its eruption. The findings of this study are illustrative of high thermal pre- and syn-eruptive processes, which show a temperature gradient within the ignimbrite sheet made visible by post-eruptive processes. Ultimately, the petrographic work done here provides new evidence for a dynamic, multiple-pulse theory of eruption for Lava Creek Tuff member B.

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Complementary Approaches to Dissect Regulatory Mechanisms Behind the Expression of a Sodium Calcium Potassium Exchanger in *Caenorhabditis elegans*

Neurons utilize Na^+ and Ca^{2+} ions to regulate excitability. Defects in exchange can lead to a variety of health problems, such as epilepsy, which is characterized by an onset of spontaneous, recurrent seizures, arising from a loss in the balance of excitatory and inhibitory nerve impulses. One of the primary mechanisms by which cells maintain balanced levels of these Na^+ and Ca^{2+} ions is by utilizing Sodium Calcium Exchangers (NCX).

Very little is known about the regulation of *ncx* genes, of which the *ncx* sub-family remains particularly under-studied. To learn more about the transcriptional regulation of this gene family, I am studying an *ncx* expressed in *C. elegans* named NCX-5. *ncx-5* expression is limited to six sensory neurons.

The goal of my research is to build a gene regulatory network for *ncx-5* and understand why its expression is limited to a specific sensory circuit. I have performed a forward genetic screen to uncover determinants of *ncx-5* transcriptional regulation. The screen yielded a mutant containing very faint expression. I will attempt to identify the underlying lesion within this mutant by using whole-genome sequencing.

In order to study the cis-regulatory elements of *ncx-5*, I dissected the *ncx-5* promoter sequence into two portions of approximately 700bp in size. I fused each half of the promoter to the coding sequence for Green Fluorescent Protein (GFP) and generated transgenic animals expressing these truncated promoter::GFP fusions. One of the constructs yielded a transgenic animal with GFP expression in all six sensory neurons, suggesting that this region of the promoter contains the minimal regulatory motif required to activate the wildtype *ncx-5* expression. In order to find this motif I have further dissected this 700bp region and have identified a ~300bp region of the promoter, which is sufficient to turn on *ncx-5* expression exclusively in the six sensory neurons. Further refinement of this 300bp region is now required to identify the minimal cis-regulatory element necessary for *ncx-5* expression.

Together, both approaches should allow us to develop a better understanding of how this family of proteins are regulated.

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Closed Braids and Torsion in Khovanov Homology

In 1984, knot theory was revolutionized with the discovery of the Jones polynomial. Fifteen years later, with several questions about it still unanswered, the polynomial was categorized into what is presently known as Khovanov homology. Parts of the Przytycki-Sazdanovic braid conjecture state that the order of the torsion subgroups in the Khovanov homology of a closed braid is less or equal to its braid index. With the discovery of links with large torsion subgroups of even order in their Khovanov homology, this statement has been partially resolved. In this talk, I will resolve the aforementioned statement completely. Finally, I will introduce the first known examples of knots and links containing large odd torsion in their Khovanov homology.

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A Microscopic View into Amylin Aggregation

People diagnosed with Type II Diabetes exhibit abnormal protein structures linked to the aggregation of amylin, a small peptide co-secreted with insulin by pancreatic β -cells. Amylin aggregation contributes to induced β -cell inflammation, stress, and apoptosis resulting in a wide variety of symptoms, including cardiovascular complications and limb loss. While the toxicity of amyloid fibrils (fibers) resulting from amylin aggregation is known, the exact mechanism behind the aggregation process itself is still largely unknown. A better understanding of amylin aggregation kinetics is needed to develop potential therapies for patients with Type II Diabetes. *In vitro* analysis of amylin aggregation shows that the process is characterized by formation of monomers followed by an increased formation of oligomers, resulting in mature insoluble fibrils. Current research has shown that the intermediate conformations of amylin oligomers are the most toxic, not the mature fibrils. Analysis by TEM (Transmission Electron Microscopy) gives an image of intermediate amylin oligomers at nanometer resolution, allowing for detailed comparisons of morphology between different states of aggregated amylin over a large time scale. The data analysed from TEM will be beneficial in the development of an amylin biosensor to detect early warning signs of Type II Diabetes, by recognizing the presence of different amylin conformations through antigen-antibody binding. An accurate understanding of the different morphologies of amylin aggregation is essential.

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Energetic Proton Hazard Modeling on a High Performance Computing Platform

During severe geomagnetic storms some parts of the magnetosphere can be suppressed. These events are caused by coronal mass ejections (CME), which structurally distort the Earth's magnetic field. solar energetic particles (SEP) can areas of low Earth orbit. The community coordinated modeling center (CCMC) at NASA was used to run the LFM magnetospheric model, reproducing the magnetohydrodynamics (MHD) of such an event. Then, SEP trajectories were traced using code acquired from the Cooperative Institute for Research in Environmental Sciences (CIRES). This allowed for the observation of SEP cutoffs with and without electric fields present by directly turning them on and off. My individual work consisted of two main tasks. First, I executed our model to collect and process the data. Second, developed Python libraries for post processing analysis of the data collected. The results indicated that the presence of electric fields do have a significant effect on SEP penetration cutoffs. SEPs penetrated further and were more evenly distributed when electric fields were present.

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Are Coral Reefs Really the Most Diverse Tropical Shallow-Water Habitats?

Coral reefs are commonly thought to be the most diverse of all marine habitats and existing surveys support that assumption. However, these surveys are based almost exclusively on a few groups of large, conspicuous species such as corals and fish, whereas the majority of marine species are extremely small, difficult to identify, and/or undescribed. We therefore sought to take advantage of recent advances in DNA sequencing to test if the pattern of exceptional diversity on coral reefs held when considering the potentially highly diverse suite of small organisms that have been largely ignored in surveys to date. We used high-throughput DNA sequencing of taxonomically informative gene regions (metabarcoding) in a spatially-structured study design to describe patterns of biodiversity of organisms < 2mm from four tropical marine ecosystems (seagrass beds, coral reefs, mangroves, and sediments) in the tropical lagoon of Bocas del Toro on the Caribbean coast of Panama. To our surprise, sediments—rather than coral reefs—contained both the greatest number of operational taxonomic units (OTUs; computationally produced approximations of biological species) and the highest proportion of OTUs not identifiable with public databases. Additionally, the regional OTU pool of mangrove root epibionts was comparable to that of coral reefs, suggesting mangrove roots may also host more biodiversity than previously thought. These results suggest generalizations from studies of large organisms may not apply to small organisms and our understanding of the processes that maintain diversity for these understudied groups is incomplete.

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TGF- β Signaling Interferes with the *Drosophila* Innate Immune and Metabolic Response to Parasitic Nematode Infection

Drosophila melanogaster is an excellent model to dissect the molecular basis of the anti-pathogen defense. The nematode parasite, *Heterorhabditis gerrardi*, and its mutualistic bacteria, *Photorhabdus asymbiotica*, form a complex that invades multiple species of insects. Our recent work has shown that Transforming Growth Factor- β (TGF- β) signaling pathway participates in anti-nematode immunity in *D. melanogaster*. The TGF- β pathway in flies is composed of two signaling branches: the activin and the bone morphogenic protein (BMP). Here, we investigated the contribution of activin and BMP signaling to *D. melanogaster* immune response against infection with *H. gerrardi* nematodes. We have used *D. melanogaster* larvae carrying loss-of-function mutations in the genes encoding extracellular ligands *Daw* or *Dpp* and estimated immune activity during nematode infection. We found that the number of circulating hemocytes in uninfected *daw* and *dpp* mutants decreased 2-fold compared to background controls, yet we did not observe any significant changes upon nematode infection. However, we found that nematode-infected *daw* mutants expressed *Duox* at higher levels and they contained lower levels of phenoloxidase activity compared to their background controls. To elucidate whether TGF- β signaling is involved in the metabolic response of *D. melanogaster* to parasitic nematodes, we measured lipid and carbohydrate levels in *daw* and *dpp* mutant larvae infected with *H. gerrardi*. We found an increase in the size of lipid droplets in nematode-infected *daw* and *dpp* mutants, with the latter also containing elevated glycogen levels. Elucidating the complex interplay between *Drosophila*-*Heterorhabditis*-*Photorhabdus* tripartite system facilitates our understanding of the immune and metabolic regulatory mechanisms that insect hosts activate to fight nematode-bacterial complexes.

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Characterizing Phase Singularities in Light Interference Patterns

The project investigates interference between light waves that carry additional orbital angular momentum along the direction of propagation, also known as optical vortices. Specifically, studying optical vortices, it is advantageous to analyze the singularities of optical fields because the singularities are relatively stable with respect to propagation in media. This project aims to characterize light beams carrying OAM in regions of singularities by studying the topological charge of phase singularities and by parameterizing the polarization states from the electric field. Circularly polarized light expands the dimensionality of light momentum by introducing angular components. Polarization of light has potential for quantum and classical applications, especially those pertaining to communication where additional modes allow more information to be processed expanding bandwidth.

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Endoplasmic Reticulum Stress Responsiveness of the 5' and 3' UTR in Islet Amyloid Polypeptide mRNA

Type 2 diabetes mellitus (T2DM) manifests as chronically elevated blood glucose levels which are a result of decreased insulin production and amylin-induced pancreatic β -cell death. Previous research has shown that the aggregation of human amylin, a 37 amino acid pancreatic peptide hormone, is toxic to β -cells. This study examines the previously unexplored roles of the human amylin promoter and its 5' and 3' untranslated regions (UTR) in post-transcriptional control of the human amylin gene in response to stress conditions. The first set of studies aimed at modulating the detrimental impact of the ER-stress inducers, thapsigargin, tunicamycin, and brefeldin-A, on cultured rat insulinoma β -cell line (RIN-m5F). Cells were treated with 0.5 μ M or 1.0 μ M of thapsigargin, tunicamycin, or brefeldin-A for increasing period of time (4, 8, and 24 hours). These cells were then collected and changes in expression of ER stress markers, BIP and TXNIP, analyzed by western blot and quantitative real-time RT-PCR. Western blot and qPCR revealed that the 1.0 μ M treatments upregulated the protein and mRNA levels of both ER stress markers after 8 hours. The second set of studies aimed to establish the specific roles of amylin's promoter, 5' UTR, and 3' UTR in gene translation in beta-cells undergoing ER stress. In order to achieve this goal, plasmid constructs encoding luciferase gene under the control of amylin promoter, its 5'/3' UTRs, or their combinations, were generated by cloning strategy. These plasmids were transfected into RIN-m5F β -cells for 18h and then treated with 1 μ M thapsigargin, tunicamycin, or brefeldin-A for 8h in order to induce ER stress in the cells. The relative translation efficacy of the luciferase protein in cells transfected with amylin constructs or empty vector (control) cells, reflecting the activity of amylin's promoter and UTR control elements, were then determined using the luciferase luminescence assay. The luciferase assay revealed that the 5' and 3' UTRs of human amylin restricted expression of luciferase in both normal and stressed β -cells and only in constructs driven by the human amylin promoter. These findings suggest that the amylin promoter may act in concert with its 5' and 3'UTR to restrict expression of human amylin gene under normal and stressful conditions as seen in T2DM. In summary, the current study points to the novel and permissive role of human amylin promoter and its UTRs in transcriptional and post-transcriptional regulation of human amylin gene in pancreatic β -cells.

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High Capacity Selenium/Carbonaceous Composites for Li-Ion Cathodes

Lithium ion batteries (LIB) have proved to be reliable energy storage devices, however, more research is needed for them to continually match the ever rising energy demands of portable electronics, electric vehicles (EV's), and for large scale grid storage. Current LIB's are limited by low-performance cathode materials such as Nickel-Cobalt-Aluminum compounds (~195 mAh/g), or Nickel-Manganese-Cobalt compounds (~153 mAh/g) which provide low energy densities and small capacities. Ideally, improvements in cathode materials should increase energy density, capacity, decrease manufacturing costs, and maintain safe reliable function. Selenium shows promise as an alternative cathode material due to its high volumetric capacity (675 mAh/cm³ theoretical) and good electrical conductivity (1x10⁻³ S/m). However, bulk selenium cathodes are plagued by rapid expansion upon lithiation and considerable levels of polyselenide dissolution in electrolytes. As a result, pure selenium is not suitable for Li-ion batteries.

We are exploring the synthesis of selenium@carbon-nano-chain composites as an alternative cathode material to alleviate detrimental mechanical expansion and to inhibit polyselenide dissolution while still providing increased capacity and cyclability. By infusing selenium onto a porous host material, selenium particles may expand upon lithiation without disrupting essential electrochemical performance. In addition, the carbonaceous host material deters polyselenide dissolution by providing electrostatic interactions as well as a physical barrier inhibition. Here we report a carbonaceous-Se composite characterized by scanning electron microscopy (SEM) and surface area analysis (BET) as well as their electrochemical performances.

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George Washington Ecology and Pollinator Biodiversity Study

This study explores the effect of ecological factors such as plant density, shade, location, and vulnerability to foot traffic on the health of plant-pollinator relationship. By monitoring numerous pollinator populations during Summer of 2018, we gained an understanding of GW's current biodiversity. Targeting specific plots on campus, researchers tracked the appearance of flowers and recorded what insects each plant attracted. Pollinators belonging to six different insect orders were recorded. A total of 53 different pollinator species were identified: 1 dermaptera, 1 orthoptera, 4 hemiptera, 10 coleoptera, 18 diptera, and 19 hymenoptera. The results revealed some plants attracted a greater variety of pollinators, while others attracted many of only one family. For example, Echinacea was located in two different locations. One location labeled "Tonic" was larger in area and had a denser, diverse population of available flowers in comparison to the "Bell Hall Plot" where Echinacea was the only resource, and planted equidistant. The Echinacea in "Tonic" attracted over six times the amount of pollinators (Tonic 59: Bell Hall 9 from the Apidae, Megachilidae, and Halictidae). We observed 25 different plant species, each for about a month, tracking the appearance and disappearance of pollinators with flowers, throughout the summer. For example, plants such as the purple sage, which originally received roughly 10-13 honeybees per survey at the beginning of June, only received an average of 4 per survey by the end of June. Overall, the Tonic Plot attracted the largest number of species. It was in direct sunlight, isolated from foot traffic, and had diverse floral resources available the entire summer. This study will continue on into the Summer of 2019. Currently, the survey has provided a basic preview of factors creating a healthy ecosystem on campus, as well as the pollinators living here.

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Designing Safe and Efficient Ionic Liquids to Hydrolyze Cellulose

Developing an efficient process for the production of fuel from biomass has been a critical challenge in sustainable development. Cost, biodegradability, and toxicity prove to be an issue with current biomass conversion methods, emphasizing a need for a functional and environmentally benign process for the deconstruction of cellulose. Ionic liquids, salts that are liquid at or near room temperature, have unique properties that enhance their ability to solvate the complex structure of cellulose by disrupting the vast network of hydrogen bonding. Imidazolium-based ionic liquids, specifically, have the ability to hydrolyze the cellulose into glucose monomers. In this process, the imidazolium cation must form a carbene, which is proposed to attack the axial hydroxyl of reducing sugars. In this study, we investigated the mechanism of covalent disruption of cellulose by imidazolium salts using computational modeling. Specifically, we computed the relative thermodynamic and kinetic stabilities of carbenes and carbon dioxide molecules resulting from heterolysis of several imidazolium cations at the M062X/6-31++G(d,p) level of theory. Calculations were carried out in the gas phase and in an implicit solvent medium that used a dielectric constant of the ionic liquid bulk from a group-contribution model. By assessing a series of imidazolium compounds, we were able to evaluate the effects of different substituents on the decarboxylation thermodynamics and kinetics, and propose an *in-silico* model that would guide development of novel ionic liquids with high efficacy of cellulose hydrolysis.

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Diffusive and Deterministic Transport in Gels

We present a novel lab for teaching diffusion and electrostatics in ionic solutions. Two challenging topics in our introductory university physics course with a bio focus are diffusion and electrostatics in salty solutions. In the diffusion unit, the students work through a laboratory in which they observe two dyes diffuse in agarose gels. In the second semester course, electrostatics is introduced and the students investigate and model interactions between charges in conducting solutions. We developed a new laboratory in which the students investigate the movement of dye molecules with different charges and sizes under electric field in agarose gels. In this lab, the students observe the gels made with pure water, as well as in media prepared with salt and buffered solution. The lab also allows students to use image analysis to determine pH change, how far the dyes have traveled, the effect of additional ions in the solution on the dyes and their interactions in different media, the change in current over time, and to estimate the unknown molar mass of one of the dyes.

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The Roles of Chemokines During Hematopoiesis of the Amphibian *Xenopus laevis*

Across all vertebrates, hematopoiesis (blood cell development) occurs in designated sites. In the *Xenopus laevis* frog, the main site for hematopoiesis is thought to be the liver periphery (LP). However, macrophage precursors are not found in the LP and instead they reside in the bone marrow. Because of this unique strategy of dividing hematopoiesis across multiple tissues, *X. laevis* is a useful model to study blood cell development, enabling us to better understand the evolution of hematopoiesis across vertebrates. We hypothesized that macrophage precursor cells are produced in the LP and migrate to the bone marrow in response to chemokines produced by the bone marrow stroma (BMS). To test this hypothesis, adult *X. laevis* frogs were injected with erythropoietin (EPO), a growth factor for red blood cells, or colony stimulating factor-1 (CSF-1), a growth factor for macrophages. Following these stimulations, frog LP and BMS cells were isolated and processed for gene expression analyses. Transcript levels of a select panel of chemokines (*cxcl12*, *ccl19*, *cxcl10*, *ccl3*, *cxcl16*) were assessed in BMS and LP. We observed that in control animals *cxcl12* exhibited significantly greater gene expression in BMS compared to LP. Interestingly, animals injected with CSF-1 displayed significantly greater transcript levels of *ccl19* and *cxcl10* in both BMS and the LP compared to control animals. In contrast, these animals displayed significantly lower mRNA levels of *ccl3* in BMS, relative to controls animals. Furthermore, the gene expression of *cxcl16* was significantly upregulated in BMS after injection of animals with EPO. Together, LP and BMS showcase differential chemokine expression, suggesting that these distinct chemokines facilitate homing of different cell lineages to these respective frog tissues. Research to determine the specific cellular targets of these disparate chemokines will offer new insights into the mechanisms by which blood cell precursors are trafficked during distinct stages of hematopoiesis.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Morphological Characterization and Development of Lepidopteran Structural Color

Perhaps the most fascinating colors in nature—the iridescent blues and greens of a peacock feather, and the metallic gleam of jewel scarabs—are produced not by pigments, but by intricate photonic structures. Many of these stunning displays of structural color are in butterflies, most famously in the blue of the *Morpho* family, but also in colors and pattern elements ranging from silver spots to ultraviolet iridescence spanning nearly the entire wing.

In butterflies the fundamental unit of color is the scale, with each acting as a ‘pixel’ in the 2D patterned array of the wing. Structural color likewise has its roots in single scales; morphology varies from reflective mirrors to elaborate photonic crystals, which likely must adhere to a narrow range of nanomorphometric parameters for successful production of color. Furthermore, each scale develops from a single cell, which is able to faithfully reproduce these structures via cytoskeletal scaffolds to guide the deposition of chitin.

A variety of structural colors exist; here we examine the blue of a *Vanessa cardui* eyespot, silver in *Agraulis vanillae*, and UV iridescence in *Colias eurytheme*. Cryofracture of single scales, scanning electron microscopy, and semi-automated nanomorphometric measurements reveal unique mechanisms of generating structural color, and pupal wing stains for actin, chitin, and fascin demonstrate corresponding differences in development that are translated into the mature scale.

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Transgenerational Effects of Parental Ethanol Consumption on Offspring Anxiety Behavior in Response to Stress

In the wild, *Drosophila melanogaster* is exposed to ethanol as a result of yeast fermentation of the sugar that is found in its natural food source, fruit. Previous work in our lab found that diet-induced ethanol exposure created heritable epigenetic changes in subsequent generations. Here, I investigated whether this epigenetic change was correlated with anxiety. To test this I fed a parental generation of *Drosophila melanogaster* alcohol using Capillary Feeders (CAFES) of liquid media containing sugar, water, and ethanol (A treatment). A control group was also fed using CAFES, with liquid media that did not contain alcohol (N treatment). After three days of this treatment, I bred the alcohol-fed males and females (AxA) and the control males and females (NxN) to produce the F1 generation. I exposed the F1 generation to variable chronic stressors over six days, consisting of alternating heat shock at 34 degrees for 3 hours, cold shock at 4 degrees for 3 hours, and starvation (48 hours without food). I then measured the anxiety levels of these offspring using two different assays: a light-dark box (LDB) and a forced swim test (FST). These results were compared to the positive control, represented by a strain of *Drosophila melanogaster* that was given food (consisting of water, sugar, agar, and yeast) without the use of CAFES. All behavioral trials were run with care given to isolating the stress response (indicative of anxiety behavior) from any other behavioral interactions. This included running male and female trials separately, aging flies for the same number of days before the trial runs, running trials at the same time of day, and taking precautions to minimize disruptions so to maintain a controlled testing environment throughout all assays.

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Simulating the Effectiveness of Proton Radiation Therapy for the Treatment of Cancer

Proton radiation therapy is a type of external beam radiotherapy that uses a beam of protons to irradiate diseased tissue, most commonly used in the treatment of cancer. Proton radiation therapy is a rapidly growing modality, and the number of new facilities and clinical evaluations worldwide is increasing. The primary advantage and motivation behind proton radiation therapy are based on the physical characteristics of energy loss by protons in matter. The proton beam dose is deposited over a narrow, specific range of depth and there is minimal scattered radiation in the body. This results in more accurate targeting of tumors and lower radiation exposure to normal tissue, reducing the short- and long-term side effects of radiation. This energy deposition of protons in matter is characterized by the plot of energy loss of radiation as a proton travels through matter. From the electromagnetic and nuclear interactions of charged ions in matter, we can predict and simulate the penetration depth and peak energy deposition of the proton beam in matter. The software program, Stopping and Range of Ions in Matter (SRIM), calculates many features of the transport of ions in matter, and is used to describe and simulate proton energy deposition in tissue and different types of tumors. To simulate, optimize, and analyze the effectiveness of proton radiation therapy, we investigate the effects of nuclear reactions on tumor material as the incident proton approaches its end of penetration depth and peak energy deposition.

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Neonicotinoid Pesticides and the *Varroa* Mite Synergistically Contribute to *Apis Mellifera* Death and Colony Collapse Disorder

Honeybee populations have experienced a dramatic decline due to the increasing incidence of Colony Collapse Disorder. Colony Collapse Disorder (CCD) refers to the sudden and catastrophic loss of adult bees from their hives, resulting in colony failure and swift hive death (vanEngelsdorp et al., 2009). Although *Varroa* mites, pesticides, disease, and climate change are all possible contributors to CCD, studies fail to concede that CCD may result from multiple, synergistic factors (Abbo et al., 2017; Blanken et al., 2015; Ellis et al., 2010; Farooqui, 2013; Martin, 2001; Nazzi, 2012; Sanchez-Bayo et al., 2016; Simon-Delso et al., 2014; Smith et al., 2013; vanEngelsdorp et al., 2009). From investigating both individual and colony wide behavior patterns upon exposure to neonicotinoids pesticides (Imidacloprid) and the *Varroa* mite, data suggest that CCD may result from synergy between multiple factors. Specifically, neonicotinoid pesticides appear to affect individual and colony behavior more negatively than the *Varroa* mite itself.

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Using Machine Learning to Tackle Online Hate and ‘Anti-X’ Sentiment

Understanding the extent to which machine learning can be used to classify images is a hot topic in artificial intelligence. Applications range from human medicine, to the automatic identification of items in an online marketplace, through to national security issues related to risk assessment. The goal of any image recognition task is to create a machine learning classifier that can correctly identify as many objects pictured in an image as possible. Much of the fundamental research focuses on one particular type of classifier: a Convolutional Neural Network (CNN). A particularly topical area of such image analysis concerns the analysis of human faces. In particular, there is a growing body of work using a CNN to try to identify a person’s emotion or gender based on an image of his/her face.

This paper examines a novel application of such machine learning in the field of human facial recognition, concerning people’s likely membership of online groups that promote hate speech. Specifically, our research uses a CNN to try to determine whether the facial profile picture that individuals choose to represent themselves online, provides an indication of their membership of online social media groups associated with hate speech.

Our social media data from online hate groups contains 5,331 profile images containing faces from the VKontakte social media platform (www.vk.com) and comprises entirely publicly available information. We have no need of, nor do we collect, any private information about individuals. An additional 4,555 faces came from the AffectNet dataset and were used as training data for faces not in an online hate group. We trained a multilayer classifier using the Microsoft Cognitive Toolkit module for Python. Of the total 9,886 images, 6,920 were used as training data, 1,482 were used as test data, and 1,483 were used to evaluate the accuracy of the trained model.

Our results show a surprisingly high success rate for the CNN (approximately 70%), in terms of predicting whether a given facial profile belongs to a member of an online hate group. We discuss the likely reasons for this success, as well as providing some initial observations concerning broader ‘anti-X’ hate aimed at historically marginalized populations, religion, race, women and genders.

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Spatial Coincidence and Clustering Between High-Energy Neutrinos and Gamma-Ray Sources

The IceCube Neutrino Observatory has detected a number of very high-energy muon neutrino events, of several hundred TeV to a few PeV. These events are unlikely to have originated in the atmosphere and are believed to be of astrophysical origin. Potential sources of these high-energy neutrinos may be observed with the Fermi Gamma-Ray Space Telescope. Identifying sources of high-energy neutrinos can also identify potential sources for high-energy cosmic rays, an unsolved problem in astrophysics.

The aim of this study is to determine the likelihood of spatial coincidence between IceCube neutrinos and active galaxies. We have explored the gamma-ray sky around 35 IceCube neutrino positions, in search for point sources within one degree of the neutrino.

By scrambling the neutrino positions many times and sampling from the scrambled sets, we determine the probability of random spatial coincidence. We use a clustering method to determine if the sources coincident with neutrino events tend to be clustered near each other. We use the results determined from these methods to indicate the likelihood of random spatial coincidence between IceCube neutrinos and gamma-ray sources. It is important that this is established, because the IceCube data does not contain the distance traveled by the neutrino, only the vector position, so it is not possible to say that a candidate source produced a neutrino by spatial coincidence alone.

Our methodology can be utilized for other problems in data science that are concerned with the co-location of points from two distinct sets within a three-dimensional space.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Live Imaging of Subcellular and Molecular Processes Involved in Repairing Cell Injury

The first cell on Earth originated from the spontaneous formation of a primordial lipid membrane, called the plasma membrane, which has since then evolved into one of the most complex and significant components of prokaryotic and eukaryotic cells alike. The plasma membrane provides the overall structural support of a given cell and is responsible for the protection of genetic material and other subcellular components. It is also involved in selective transport of molecules and substances that are essential for cell survival and for its response to the surrounding environment. Therefore, repair of plasma membrane after physical trauma or injury is critical for the survival of the cell as well as the tissue.

The process of plasma membrane repair after injury requires formation of a highly-organized, time-sensitive network of cellular signaling machinery initiated by calcium entry. This machinery involves fusion of vesicles to the membrane, shedding of the damaged portion of the membrane, and polymerization of cortical F-actin to remodel and structurally sustain the repaired plasma membrane. Defects in these processes result in diseases associated with tissue degeneration including muscular dystrophy, cardiomyopathy, and neurodegeneration.

As the repair process occurs within minutes of injury, there is insufficient understanding of the components and the kinetics of their interactions that enable plasma membrane repair. The repair process employs proteins and lipids present in the membrane, while also relying on signaling from organelles, such as mitochondria. This study investigates the involvement of organelles and molecules in plasma membrane repair by (1) live confocal imaging of cells expressing fluorescent biosensors to track the movement of mitochondria and selected lipids and analyze their kinetics during repair after a focal laser injury; and (2) quantifying the plasma membrane repair ability of a population of cells following mechanical wounding. These techniques were also utilized to study cells whose membrane repair is modified by genetic knockout or targeted drug treatment. This study presents a valuable approach for studying plasma membrane repair and enhances our understanding of how deficiencies in these mechanisms may contribute to the development of degenerative diseases.

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Investigating the Ecological Niche of the Invasive Marsh Grass *Phragmites australis*

Invasive species pose an increasingly relevant threat to coastal ecosystems that already face mounting pressure from sea level rise and climate change impacts. *Phragmites australis* is a perennial species of marsh grass that is responsible for widespread and aggressive invasions of wetland habitats, which often lead to habitat degradation and native species exclusion. The east coast, specifically the Chesapeake Bay region, has been pinpointed as a region experiencing critical conditions of proliferative *P. australis* spread. Further research is required to provide comprehensive understanding of the ecological niche of *P. australis* so as to properly inform effective management decisions. *P. australis* has previously been characterized as a high light species; however, we have observed mature stands invading the understory of forested areas with high shade cover. Our research analyzes the relationship between *P. australis* density and varying light environments, as well as other environmental variables including redox potential, soil moisture, canopy cover and salinity. A strong positive correlation was found between *P. australis* density and low canopy cover/high light environments, and *P. australis* was observed at the highest density index value at sites with as high as >80% canopy cover (low light environments). Further, field site maps utilizing satellite imagery display high density *P. australis* growing in closed canopy areas that would typically be ruled out as forested area rather than wetland vulnerable to potential invasion. Redox potential was found to be only slightly negatively correlated with *P. australis* density, while soil moisture and salinity were found to have positive correlations with density. Findings from this study point to the need for more comprehensive research to inform the parameters of *P. australis* mitigation strategies.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Examining Methods for Quantifying Lateral Iliac Flare in Hominoids

A key anatomical feature used to define transitions in the human lineage is the bony structure of the pelvis, which is comprised of the iliac blades superiorly. Lateral flaring of the iliac blades has changed significantly through time, causing the shape of the human pelvis to look much different from our closest living relatives, the lesser and great apes. Measuring lateral iliac flare has been exploited as a useful tool to infer locomotor capabilities among hominoid species. However, inconsistencies and subjectivity remain in multiple methods to measure lateral iliac flare. Lateral iliac flare was initially defined by Lovejoy et al. (1973) as the angle between the iliac blade and the sagittal plane, but in subsequent publications, researchers have used flare to refer to the lateral projection of the ilium in the coronal plane. VanSickle (2017) describes the inconsistency in four measurements used to quantify flare, as it is originally defined. It remains to be seen if linear measurements that explicitly measure lateral projection of the ilium suffer from the same consistency issues. I used three ratios based on linear measurements to quantify lateral projection of the ilium in hominoids (N = 154). Iliac flare was quantified as: the ratio between bi-iliac breadth and bi-acetabular breadth (BIB:BAB); the ratio between the length of the false pelvis and iliac fossa width (FPL: IFL, from Hammond et al., 2013); and the ratio between iliac blade width and lower ilium width (IB:LIW). ANOVA with Tukey's post-hoc correction was then used to identify significant group differences in flare. Results suggest that FPL:IFL was the best ratio at distinguishing among species, but each yields different result for which ape is the most flared. There is also substantial overlap between the great apes for each measurement, as well as between Hylobates and Homo. Sex drives variation in flare within Pongo and Gorilla. These measurements produce conflicting results regarding which species is the most flared, and I agree with VanSickle (2017) that geometric morphometrics is potentially a better way to quantify differences in iliac flare.

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Climate Change According to Twitter, A Network Analysis

Understanding Climate Change is important from a practical perspective, because it is related to the environment we live in and the health of the planet. Understanding Climate Change is also important from an academic perspective because it is related to public opinion on politics and economics. There is an extensive literature on Climate Change which ranges from entirely theoretical through to more recent empirical studies. One notable example is publication International Public Opinion, Perception, and Understanding of Global Climate Change which shows that over the past few years there has been a rise in public knowledge on the subject of climate change (Leiserowitz, 2007). However, given the recent increase in interest in big data and the use of novel analysis techniques from data science, new opportunities have arisen to examine empirical data about Climate Change in a broader way—for example, accounting for distributions that lie beyond the typical normal distribution (Gaussian) assumption, and also using visual and analytical representations in terms of complex networks.

In this paper, we analyze Climate Change using a dataset that looks at tweets from mid February 2019. Specifically, this dataset includes data at the individual user level whose tweets were directed to #climatechange or #globalwarming and any links, favorites and retweets that resulted. This allows a complex networks analysis to represent the implicit correlations in a visual way, as well as shedding light on heterogeneous classes of behavior. It also enables exploration of the possible self-similar power-law form of the various distributions, which in turn would suggest that the system's behavior is dominated by large fluctuations. Such self-similar distributions are in stark contrast to conventional assumptions of a near-Normal distribution and embrace extreme points instead of presuming they are outliers.

Results are presented of this dataset using these new complex-systems tools of networks. The implication of such findings of non-trivial network structure, non-normal distributions and non-Poisson timing of events, is that there may be a generative mechanism present that is common to a broader class of systems, and hence which offers broader insight into the role of feedback processes in the public discussion and opinion of Climate Change.

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Predicting HIV Drug Resistance with Neural Networks

Human immunodeficiency virus (HIV), which causes acquired immunodeficiency syndrome (AIDS), affects over 1.1 million people in the U.S. today. While it cannot be cured, HIV can be treated with antiretroviral therapy, extending the life expectancies of HIV-positive individuals to nearly the same as people without HIV. However, HIV exhibits high rates of mutation leading to antiretroviral drug resistance. As a result, the analysis of drug resistance is critical to treating HIV, and thus is an important focus of HIV research. Currently, drug resistance is evaluated using a laborious and expensive phenotypic test. Virtual phenotypic tests are an alternative which predict the outcome of a phenotypic test based on results of genotypic tests. This project proposes to develop two neural network models, a Deep Neural Network and a Bidirectional Recurrent Neural Network, to analyze genotypic-phenotypic data relating to seventeen antiretroviral drugs. The performance of these models in identifying HIV drug resistance will be compared to that of existing methods involving linear regression and Bayesian statistics. It is anticipated that the neural network methods will outperform existing statistical methods in predicting HIV drug resistance, demonstrating their viability for industry use. An accurate, efficient neural network model for drug resistance prediction will allow clinicians to bypass expensive phenotypic tests currently in use to better formulate ART regimens for HIV-positive patients.

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The Role of *Center Divider* on Sperm Length in Males and Seminal Receptacle Length in Females of *Drosophila melanogaster*

Drosophila produce extremely long sperm, measuring up to 5.8 cm in *D. bifurca*. Sperm are stored within the female seminal receptacle (SR), where they compete for fertilization with sperm from other males under a form of postcopulatory sexual selection known as sperm competition. Sperm length and SR length are genetically correlated and coevolve across the *Drosophila* lineage, perhaps via Fisherian runaway selection. The gene *center divider* (*cdi*) encodes a serine/threonine protein kinase that is homologous to the human *testis associated actin remodeling kinase 1* (*TESK1*), which shows testis-specific expression within round spermatids. *cdi* is involved in cytoskeleton control through phosphorylation of *Cofilin*. Because cytoskeletal dynamics are likely important for spermatid elongation, we sought to examine the role of *cdi* on sperm length using knockdown. We also examined SR length in *cdi* knockdowns, localized *cdi* within both testis and the female reproductive tract, and characterized allelic variation in *cdi* in isolines producing long or short sperm. Within the testis, *cdi* is expressed at the apical end, where germline hub cells actively divide, and in the seminal vesicle, where the final stages of sperm differentiation occur and mature sperm are stored. *cdi* knockdowns produced longer SRs, but knockdown had inconsistent effects on sperm length, perhaps because it is expressed very late in spermatogenesis, and our knockdown targeted expression earlier in spermatogenesis. We found strong allelic differences associated with sperm length, but RNAseq data found no significant differences in gene expression, suggesting that *cdi*'s effect on sperm length variation may be explained entirely by sequence level variation. *cdi* represents a potential molecular mechanism for Fisherian runaway selection between sperm and SR length in *Drosophila*.

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Biogeographic Ancestry Prediction using a Forensic Assay of 74 Microhaplotypes by Performing Massively Parallel Sequencing (MPS)

Microhaplotypes (MHs) are new forensic DNA markers based on two or more SNPs within less than 300 bp from each other and can be genotyped using MPS platforms. MPS enables distinguishing the parental haplotypes by clonal sequencing of each individual strand of DNA, thus providing unambiguous information of the phase of SNPs within a given locus. The features that make MHs a promising marker for addressing relevant forensic challenges including human identification, ancestry prediction and mixture deconvolution are the small amplicon size, absence of stutter peaks along with lower mutation rates than conventional short tandem repeat polymorphism (STRP) loci. In this study we generated allele frequency databases for the four American population groups and explored the potential for MPS-based MH analysis to provide biogeographic ancestry information.

A novel forensic panel of 74 MH loci was developed and implemented on the Ion Chef™ and Ion S5™ MPS (Thermo Fisher Scientific) platform. A total of 100 European American (EA), 100 African American (AA), 100 South West Hispanic (SWHIS) and 39 East Asian American (EAA) samples were selected and genotyped using the 74-plex forensic assay. Allele frequencies were further generated to create the in-house database specific for each population group tested. In addition, a set of unknown testing-samples representative of each population group was genotyped and related biogeographic ancestry inferred by calculating the Random Match Probability (RMP) in the four corresponding American populations. The RMP calculated for the full set of population samples was found remarkably higher for all those populations where individuals self-identified as such. The level of heterozygosity of each MH locus was also calculated along with the power of exclusion (PE) to determine how good the multi-SNP markers are at discriminating individuals and excluding a random person as a possible contributor of an allele at a given MH locus, respectively. It was found that the overall heterozygosity of the markers ranged from 0.4 to 0.85 and the overall PE of the markers ranged from 0.1 to 0.5. The biogeographic ancestry of the full set of testing-samples was correctly predicted using the in-house database. In addition, STRUCTURE-based iterative Bayesian clustering software was used for the analysis of population structure and to further confirm the origin of unknown test-population samples.

These preliminary results suggest that the MPS 74-plex MH assay is an effective forensic DNA analysis tool, which provides enhanced biogeographic ancestry inference capabilities while supplementing the accuracy of existing ancestry prediction tools.

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Assessing Sperm Motility and Directionality Under Differing Calcium Concentrations

In many insects, females store sperm within specialized sperm storage organs that maintain sperm viability and motility for days to months or even years. Insects represent a major component of diverse ecosystems globally, are economically important as pests or pollinators, and impact human health by spreading diseases such as malaria. However, we know very little about many aspects of insect reproduction, including how females are able to store sperm for extended periods, continuing to produce fertile eggs long after mating. In *Drosophila melanogaster*, the primary sperm storage organ is the seminal receptacle (SR), a long, coiled tube up approximately 2.5 mm long that can hold up to 250 sperm (each 1.8 mm long). Sperm are known to be able to swim in a tail-leading direction in the SR, and calcium is believed to play a role in swimming direction. To explore this idea further, we assessed motility and directionality of sperm in the SR across four media with differing calcium concentrations: Grace's Insect Medium (1.0 g/L CaCl₂), Grace's with additional calcium (1.5 g/L CaCl₂), Schneider's Insect Medium without calcium (0 g/L CaCl₂), and Schneider's with calcium (0.6 g/L CaCl₂). To observe sperm motility, we generated males that express both a GFP-labeled *don juan* protein in sperm tails and an RFP-labeled protamine (DNA-packaging protein) in sperm heads, allowing us to distinguish sperm heads from tails and thus directionality of swimming. We dissected the SRs from 40 females (n=40) into 50 µL of each medium and observed sperm motility under the red fluorescent protein (RFP) filter at times 0, 5, 10, 15, 30, 45, and 60 minutes after dissection. At each time point, the percentages of nonmotile (0), slowly motile (1), and highly motile (2) sperm were recorded. Finally, directionality was observed using a dual fluorescence filter at 10 minutes after the dissection. No significant variation in motility or directionality was observed across the four media, however, the difference in concentration of highly motile sperm at 30 minutes in Schneider's without calcium from the other three media suggests the presence of calcium may be necessary for sperm motility. In addition, there appeared to be variation in nonmotile sperm between media type after 15 minutes and after 45 minutes for slowly motile sperm, suggesting differences in media composition may affect sperm motility. Further testing is needed to support these results.

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Employing the Sortase A Enzyme to Link Different Combinations of Protein for Structural and Functional Studies

Linking two different proteins is important for bioengineering proteins with different functions to work synergistically to target specific processes in the cell that could be linked to diseases such as cancers. Current approaches require chemical reactions that can be harsh on proteins and where the yields of linked proteins are very low. We are using an innovative approach in which an enzyme, Sortase A, will link two different proteins with yields that are much higher than most other chemical approaches. Sortase A is a peptidase enzyme that will link any two proteins with specific sequence signatures at the C- and N-termini. For my project, I will use the Sortase A enzyme to link the C and N termini of alpha4, a substrate that binds to MID1 and assists with the E3 protease ligase. Mutations in MID1 cause X-linked Opitz BBB/G syndrome (XLOS), characterized by mental retardation, cleft lip and/or palate, and organ complications. We would like to understand how alpha4 interacts with MID1 via structural and biochemical studies. Sortase A will link the two termini of alpha4 for NMR structural studies where one terminal will be isotopically labeled, allowing us to investigate the structure of one terminal at a time within a much larger protein, for which solving the structure is not feasible. This will allow us to understand how XLOS-observed mutations affect MID1 and its substrate binding that otherwise cannot be accomplished with other techniques.

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Trade-Offs in Locomotion Performance Across Ecological Contexts: Turtle Ant Running Speed in the Canopy

Evolutionary trade-offs in trait function constrain how organisms interact with their environment. The canopy environment is structurally complex, with foraging surfaces of a range of sizes and orientations, and often dominated by ants. Nevertheless, little is known about how ants use canopy structures as they forage, and what trade-offs they might experience. Turtle ants (*Cephalotes*) are a species-rich genus of canopy ants that have undergone exceptional morphological diversification. In particular, there is a five-fold difference in body length across species, which is likely to have important consequences for locomotion performance. This project examines performance trade-offs in turtle ants across a variety of ecological contexts that occur in the canopy. The focal species for this study were *Cephalotes varians*, in the laboratory, and *Cephalotes pusillus*, *Cephalotes clypeatus* and *Cephalotes borgmeiri* in the field. Field experiments were conducted in the cerrado region of Brazil. Performance ability was measured by recording peak running speeds across a variety of surface widths and orientations in all experiments. Running performance was only minimally reduced by path width in most species, allowing peak speeds on many structures in the canopy. On larger paths, vertical orientation reduced speeds in most species, possibly impacting the use of vertical paths when maximizing foraging efficiency. Slower species maintained similar running speeds on smaller paths, suggesting they may use smaller paths more frequently. Body size was not a reliable predictor of running speed in *Cephalotes*, suggesting other morphological and behavioral traits may influence speed. Ongoing laboratory studies are examining leg shape and length in absolute terms and relative to body size, to assess how these morphological features may influence running performance across species. Moreover, newly collected field data will be analyzed to provide contrasts with additional species that have different body sizes and morphology. Broadly, this research contributes to understanding functional trade-offs between organismal structure and environment.

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How do Institution Types and Cost-Related Variables Correlate with Enrollment and Graduation?

According to the Bureau of Labor Statistics, 69.7% of U.S. high school graduates enrolled in college in 2016. College attendance has become increasingly common among American students; however, many students are not fully informed when making decisions on where to apply to college and this is worth further study. Characteristics of colleges and universities have implications for students' college decisions. For example, some students may choose to study in a public institution in order to avoid high tuition costs. Tuition and fees vary considerably between public and private institutions and increase over time, which may alter the distribution of students across all types of institutions (College Board, 2018).

American Talent Initiative is a public effort that aims to expand access for talented, low-and moderate-income students at the nation's top universities (most of them are private). Due to this effort, universities such as Yale and Princeton have increased enrollment of low-income students (Korn 2018). However, studies show that even at elite colleges students from low-income families and underrepresented backgrounds tend to face more challenges when graduating (Korn, 2019). Using visual and analytical representations in terms of complex networks, we examine empirical data related to higher education institutions (public, private not-for-profit, and private for-profit).

In this paper, we utilize a dataset from National Center for Education Statistics' Integrated Postsecondary Education Data System. The dataset includes all U.S., title IV participating, degree-granting, 4-year colleges or universities. and variables related to tuition costs, enrollment, graduation, financial-aid status, and race/ethnicity in school years 2016-2017 and 2015-2016. This allows a complex networks analysis to represent implicit correlations (between tuition costs and institution type; and financial aid and enrollment or graduation) in a visual way, as well as shed light on heterogeneous classes of institutions. It also enables exploration of variations across these two school years.

Results are presented using these new complex-systems tools of networks. The implication of potential findings of non-trivial network structure and analysis could identify the various benefits that certain institutions can provide to low-and moderate-income students and provide a clearer understanding of return on investment for students that can help them make more informed college decisions.

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A Single-Cell Look at Biological Nitrogen Fixation: Direct Determination of Metabolite Formulas from Isotopic Fine Structures in Heterogeneous Cell Populations

Many legumes, such as soybean (*Glycine max*), do not depend on synthetic fertilizers for nitrogen uptake. Instead, they create mutualistic relationships with diazotrophic bacteria, called rhizobia. Root nodules, the organs associated with biological nitrogen fixation, exhibit high level of cellular heterogeneity. Plant cells hosting the symbionts exist at different infection stages, and are interspersed with uninfected cells. This manifests in varying spatial and abundance distributions of endogenous compounds. Exploring the metabolic profiles for these heterogeneous systems requires methods designed for the analysis of single cells. We have combined an ambient ionization source, fiber-based laser ablation electrospray ionization (f-LAESI), with 21T Fourier transform ion cyclotron resonance mass spectrometry (21T FT-ICR-MS) for the direct metabolic analysis of single cells in soybean root nodules infected by *Bradyrhizobium japonicum*, and small clusters of uninfected cells, and for the direct determination of metabolite formulas from isotopic fine structures (IFS). The sample was positioned between an electrospray emitter and the orifice of a 21T FT-ICR-MS. A mid-IR laser beam was coupled to an optical fiber with a finely etched tip for optically-guided ablation of individual cells. The ultra-high mass resolution of the 21T FT-ICR-MS resolved close-to-isobaric species separated by less than 1 mDa. Up to 200 spectral features were observed per cell. Using the Formularity software, over 100 compounds were directly assigned based on ultra-high mass accuracy, and 47 of these were further verified by IFS. Comparing the calculated IFS patterns for several possible ions and their M+1 and M+2 peaks with the experimental data enabled the identification of close-to-isobaric compounds with different elemental compositions. Single-cell analysis revealed a difference in the abundances of certain chemical species between infected and uninfected cells. Nitrogen-containing compounds, such as heme *b* and daidzein, a key compound in establishing symbiosis, were significantly more abundant in infected cells. Heterogeneity among infected cells was observed by determining the metabolic noise (η^2). Within a population of 20 infected cells, several primary metabolites, such as saccharides and nicotinamide diphosphate, exhibited relatively low metabolic noise ($\eta^2 \leq 0.50$). This could be explained by the involvement of primary metabolites in a vast network of metabolic pathways that are essential for cellular growth and maintenance. Lipids, on the other hand, mainly phosphatidylcholines and phosphatidylglycerols, showed greater noise levels ($\eta^2 \geq 0.50$) indicating a larger variance in cell membranes.

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Diving into Salt Tolerance of Germinating Crop Seeds

As sea level continues to rise, salt intrusion into coastal lands becomes an increasing problem. Salt intrusion poses a threat to coastal agricultural fields as crops are not equipped to tolerate extreme levels of Sodium Chloride (NaCl). This study aims to better understand crop response to increased levels of NaCl and which crops are better equipped to tolerate NaCl. Salt intrusion is dangerous to crops in two ways: it increases the osmotic potential around germinating seeds, and dissociated Na⁺ and Cl⁻ ions can be toxic to plants. In this study, these two negative effects were examined separately. We have mixed Polyethylene glycol (PEG) with water to create solutions of ten different osmotic potentials. Solutions of PEG do not contain the toxicity of NaCl solutions. NaCl was also mixed into solutions at concentrations that created corresponding osmotic potentials to the PEG solutions. Nine crop species were germinated in petri dishes on filter paper saturated in the different PEG and NaCl concentrations and incubated under a diurnal pattern. Germination was monitored and larger seeds (corn, soy, and salt-tolerant soy) were weighed through-out germination. Findings were analyzed using stress tolerance curves and it was found that quinoa was the most tolerant to both the PEG and NaCl solutions. Patterns across species also emerged. Seeds in lower (more negative) osmotic potentials saw a significant delay in germination, and those in the highest potentials saw no germination. Larger seeds in higher potentials increased in weight by about 100% before germination. Seeds in lower potentials reached 100% a few days later, and after reaching this point, began to germinate. Seeds that were more successful in germinating were able to uptake water (increase in weight) faster.

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Supramolecular Assembly of Molecular Rare-Earth–3,5-Dibromobenzoic Acid–2,2':6'2"-Terpyridine Materials Across the Rare Earth Series

Supramolecular chemistry is the study of how molecules arrange themselves in three dimensions on the molecular level. Knowledge of assembly mechanisms informs everything from drug discovery to environmental remediation to molecular sensing. Our efforts focus on the latter by forming supramolecular assemblies of lanthanide (aka 'Rare Earth') ions in order to harness their inherent luminescent properties. These elements are found at the bottom of the periodic table and have applications in optical materials. A pre-requisite for the preparation of materials in this arena is the formation of discrete molecular building units of a uniform size and geometry. To achieve this with the rare earth elements in particular, we have developed a "cap" and "link" synthesis approach. This involves controlling the immediate coordination environment of the metal center with an N-donor "cap," coupled with benzoic acid molecules acting as "links" between metal centers. This strategy has been employed herein to yield uniform molecular units of RE³⁺ ions assembled into extended architectures via non-covalent interactions. We have prepared sixteen new rare earth [(RE = Y³⁺–Lu³⁺) - 3,5-dibromobenzoic acid - terpyridine] molecular materials synthesized using a hydrothermal method. Halogenated ligands were included in order to probe the role of non-covalent interactions (specifically halogen bonding) in the supramolecular assembly of these species. Characterization of these compounds was carried out via single crystal and powder X-ray diffraction. Two main structure types consisting of either dimers (La³⁺ - Gd³⁺) or tetrameric building (Tb³⁺ - Lu³⁺) units were identified. These compounds add to our group's broader portfolio of now 80+ crystal structures employing the N-donor "cap" and halogenated benzoic acid "link" strategy. As a whole, these compounds provide a platform for probing the role of coordination environment control and non-covalent interactions in supramolecular assembly.

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Applying Machine Learning On Radio Transient Searches

The goal of this research project is to enhance the search for new transient and variable sources in data from the VLA Low Band Ionospheric and Transient Experiment (VLITE) instrument on the Very Large Array (VLA) telescope. This will be done by applying machine learning techniques on output from the Transients Pipeline software. A transient source is one that has a change in its brightness in a short amount of time. These flux changes are shown in light curves. From these light curves, we are able to obtain statistical values of η , the probability that the data is drawn from the fitted model of constant flux, and V , which compares the observed scatter in flux densities to the average flux density of the source, that represent the variability of the sources with multiple data points. An η versus V graph is generated to find which sources have large value of both parameters, and these are the most likely points to be transient sources. Up until now, this process was done by hand. We will be using machine learning techniques to process which combinations of η and V would lead to the most likely transient candidates. This will offer a fast and more statistically robust search for transient candidates.

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Musculoskeletal Stress Markers of the Terry Collection and Possible Implications of Early Hominid Tool Making

Despite more recent discovery of the Lomekwi 3 stone tools that were dated to 3.3 million years ago, it is largely recognized that the intentionally modified stone tools emerged at approximately 2.6 million years ago. Scholars argued that early hominids had used possibly modified tools before that time and that those tools were not preserved for various reasons. Past researches suggested the correlation between the continued heavy use of muscles and the possible presence of musculoskeletal stress markers on bones. The objective of this study is to identify the MSM related to excessive uses of forearms and hands among the Terry individuals with the references to the previous study of the arm and hand muscle recruitment during the manufacture of the Oldowan tools. By using the visual scoring system, the MSM were observed on individuals' radii, ulnae, pollices, and fifth fingers in relate to habitual gripping. Assumed markers or fractures related to occupational stress were not observed on the second and third fingers, carpal bones or distal end of the radii among the sampled individuals. This research contributes to what is known about MSM induced by heavy labors and future studies regarding to the tool-making capabilities among early hominids predating the Oldowan technology.

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Disparate Pathogen Recognition Capacities of Amphibian (*Xenopus laevis*) Macrophage Subsets

Infectious agents such as the Frog Virus 3 (FV3) rana virus are contributing to the worldwide amphibian declines. While amphibian macrophages (MΦs) are central to the immune defenses against these viruses as well as to many of this pathogen's infection strategies, the pathogen recognition capacities of disparate amphibian MΦ subsets remain unexplored. Concurrently, *Mycobacteria marinum*, a close genetic relative to the causative agent of human tuberculosis (*M. tuberculosis*) is also known to thrive within MΦs. In turn, MΦ differentiation and functionality are interdependent on the colony-stimulating factor-1 receptor (CSF-1R), which is ligated by colony-stimulating factor-1 (CSF-1) and the unrelated interleukin-34 (IL-34) cytokines. Notably, the *Xenopus laevis* frog CSF-1- and IL-34-derived MΦs are functionally distinct, and while the CSF-1-MΦs are more susceptible to FV3, the IL-34-MΦs are highly resistant to this pathogen. Intriguingly, CSF-1-MΦs are also more permissive to *M. marinum* than IL-34-MΦs. Here, we elucidate the pathogen recognition capacities of the *X. laevis* frog CSF-1- and IL-34-MΦs by evaluating their transcript levels of key pathogen pattern recognition receptors (PRRs). Compared to the frog CSF-1-MΦs, their IL-34-MΦs exhibited greater expression of PRR genes associated with viral and bacterial recognition, which may be contributing to their greater anti-viral and anti-mycobacterial nature. By contrast, the CSF-1-MΦs displayed greater expression of toll-like receptors (TLRs) that are absent in humans. Moreover, the two MΦ types possessed similar expression of most downstream PRR signaling components, while the two MΦ subsets undergo very disparate responses following recognition of distinct pathogen components.

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Decoupled Trait-Evolution among Worker and Soldier Castes in the Turtle Ants (*Cephalotes*)

The evolution of functional traits within an organism determines the ecological niches and roles it can occupy. Within an organism, the development of different traits is intimately linked by a variety of genetic, developmental, and functional constraints. Yet it is possible for trait evolution to be decoupled to some degree, such that different traits can respond more independently to certain selection pressures in the environment. The concept of “decoupling” within trait evolution is therefore an important evolutionary principle for explaining morphological diversification in biological forms. However, this process has mostly been studied in solitary vertebrate systems, in which the adaptive evolution of traits is constrained by all of the traits being bound together in a single organism. For complex social insects, the whole colony is the adaptive organismal unit, and traits can therefore be partitioned among different individuals that perform distinct functional roles within the colony. How the evolution of traits may be decoupled within complex social organisms is largely unknown. In the turtle ants (genus *Cephalotes*), there is distinct polymorphism between worker and soldier “castes”: workers have thickened body armor extensions to protect against enemy attacks while foraging, while soldiers have armored heads that they use to defend the colony’s nest entrances. The extent to which the evolution of body armor and head armor is decoupled among castes within the turtle ants, potentially allowing greater morphological diversity within the group, is not known. Here, we test the hypothesis that more specialized head armor in the soldier caste is associated with greater decoupling of traits between the worker and soldier castes. Results from geometric morphometric analyses of body armor and head armor show considerable variation in the degree of trait decoupling among castes. In particular, the degree of decoupling among castes shows distinct clustering and increases relative to discrete transitions in soldier specialization, consistent with our predictions. These results offer novel insights into the dynamics of adaptive trait evolution within social insect lineages and better position us to address questions about how ecology drives adaptive evolution in such taxa.

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Confirmation of Phased-Inferred SNP Haplotype Data of 74 Microhaplotype Loci Across a Global Set of Populations by Massively Parallel Sequencing

Microhaplotypes are loci with two or more closely linked single nucleotide polymorphisms (SNPs) within 300 bp associated in multiple allelic combinations. These have small amplicon size, no stutter and lower mutation rate than short tandem repeats (STRs), which make them promising loci for human identification, ancestry prediction and mixture deconvolution.

Albeit Sanger sequencing and TaqMan® assay can be used for SNP typing, these methodologies do not enable the determination of the *cis/trans* relationship among individual SNPs at a locus (i.e., phase). PHASE is a statistical Bayesian-based software used to reconstruct haplotype patterns from genotype data and although it is accurate on a population level it can make mistakes on an individual level and also for rare alleles. On the contrary, massively parallel sequencing (MPS) allows distinguishing the parental haplotypes at a given locus by cloning and sequencing of each individual DNA strand. This project is about confirming phased-inferred SNP haplotypes of 74 microhaplotypes from a large set of populations by MPS.

For this study, we used a global set of > 500 samples representative of populations from Africa (Sandawe, Hausa), Europe (Danes, Khanty), South Central Asia (Laotians, Keralites), East Asia (Koreans, Atayal), Native America (Mexican Pimas) and Oceania (Papua New Guineans). All samples were genotyped by TaqMan® assay and haplotypes of 74 MH loci inferred using PHASE software. To confirm the phase of parental haplotypes at each locus, all samples were genotyped using a novel MPS assay of 74 MHs totalling 230 SNPs on the Ion S5™ (Thermo Fisher Scientific) platform that was developed to enhance mixture deconvolution and ancestry inference capabilities.

Overall, over 94% of concordance was observed between statistically phased-inferred haplotypes and MPS determined haplotypes. This suggests that PHASE is accurate at the individual level when SNPs are homozygous within a MH allele and when no more than one site is heterozygous. However, < 5% differences were identified in haplotypes with multiple heterozygous SNPs within a locus and these were due to missing or mistyped SNPs using TaqMan® or incorrect phase estimation by PHASE.

These results showed that computational/statistical phasing is a valuable and inexpensive approach for searching for MH loci, which uses already available databases (e.g., ALFRED). PHASE provides accurate reconstruction of haplotype for prediction of population allele frequency, and in particular for common alleles. Nonetheless, MPS is a cost-effective confirmatory technology, which also enables the detection of rare SNP haplotypes.

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Medical Marijuana Legalization on the Crime Clearance Rate in Washington

The purpose of the legalization of medical marijuana in Washington (I-692) was to help patients with terminally ill or debilitating conditions. Medical marijuana's introduction to state policy and economy created a natural experiment that I use to look at its impacts beyond the medical community. One potential impact is police effectiveness for other crimes due to reallocation of police resources. This study utilizes UCR data from 1994 to 2004 to determine if such an impact exists. I test whether the null hypothesis, which suggests no correlation of the legalization of marijuana on the crime clearance rate, can be rejected. My results show no means of rejecting this hypothesis, implying that the legalization may not have had any influence on the police allocation of resources to violent or property crime.

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'What Was the Video For?' Reality Monitoring Errors and Hindsight Bias in a Social Learning Task

Human memory is notoriously fallible. We not only forget what *others* have said and done, we also incorrectly remember what we have said and done. Given this, perhaps it's not surprising that people also misremember whether they themselves or another person were the source of what was said and done. These different lapses in memory are referred to as internal, external and reality monitoring errors, respectively. Such memory errors often produce powerful metacognitive biases. Hindsight bias is one such bias where individuals incorrectly estimate their knowledge of events for which they had no prior knowledge. Here, we summarize preliminary results from pilot data showing a significant hindsight bias in a social learning task. In the study, participants were presented with a video showing one model building the base of a tower (stacking 2 hollow cubes) followed by another building the apex of a tower (combining 2 flat squares). Participants were then handed 4 hollow cubes and 4 flat squares and told to "build the tallest possible tower." 75% of participants stacked 3 or more cubes using the method demonstrated in the video (compared to just 15% in Baseline, without a video demonstration). However, when asked about the usefulness of the video on a scale of 1 (not useful) to 5 (indispensable), the mean score was 1.86 (Range 1-3; SD = .69). Moreover, when asked to justify how they stacked the cubes, participants confabulated, providing egocentric explanations for their responses without reference to the most likely source, the video. Source monitoring errors and hindsight biases are understudied in the social learning literature. Yet, these results, while preliminary, suggest that such errors are widespread. On-going studies are exploring various hypotheses concerning the source of these errors when learning from others. One hypothesis is that such errors aren't errors at all, but adaptive cognitive features. If correct, one might predict that individuals prone to making such errors are better social learners than those who do not.

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How Effective has Development Aid Been Over the Years: A Panel Data Analysis of Sub-Saharan Africa

Post-War Africa has experienced different forms of aid. Every year, millions of dollars in the form of aid flow to Africa purposefully to make Africa a better world, but the continents remain poor. Poverty keeps growing in the region with development moving at a slow pace. The effectiveness of aid in any form has been researched over the past years with different economic models and analyses. While some researchers believe that aid has a positive impact on economic growth, others find a negative impact on growth.

This paper examines the effectiveness of different types of foreign aid in Sub-Saharan Africa using an unbalanced panel of all Sub-Saharan countries from 2000 to 2017. A regression analysis of entity fixed effect is used to control for omitted variable bias. Various regressions and tests of the most significant and robust individual interactions are simultaneously modeled, thereby deriving multiple conditions of aid effectiveness. Six different regression models is used in other to find how effective foreign aid is to economic growth.

It was found out that, Other development aid (aid to support the economic, social, and political development of developing countries) has a negative effect on economic growth in countries with higher inflation compared to Private aid (Direct investment, portfolio investment, and net exports credit) which has no significant effect on economic growth. Again, in countries with higher inflation; food aid (hunger alleviation and food security) has a positive impact on economic growth while grant has a negative impact. In Francophone countries; other development aid and grants have a negative impact on economic growth.

This means donors need can be more specific with the kind of aid sent to sub-Saharan Africa (developing countries) example is food aid which has a positive impact. Aid effectiveness depends on the policies of the country thus, more of what Sub-Saharan counties (developing countries) can do for themselves than what they receive from foreign organizations and countries. African countries need to get good economic policies for foreign aid to be effective. Also, donors can consider the specific needs of countries and give a specific kind of aid.

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Postcolonial Approaches to Democracy and Gender in Jordan

My research seeks to explore the way non-Western forms of democracy function in non-Western societies and how women specifically experience these forms of democracy. The Middle East has suffered for years under Western imposition of “democracy,” which has almost always led to brutal dictatorships or civil wars. This has led to academic discourse that operates under the assumption that there is just “something about the Middle East” that makes it immune to democracy—the people just aren’t ready, the religion and the culture are incompatible. In my research, I seek to expose this take as not only reductionist but inaccurate. I do this by establishing a theoretical framework which dissects the very concept of and even the word “democracy”—situating it as separate from liberalism, as the problematic, and as a colonial force.

The research I conducted using this theoretical framework was mainly through interviews and surveys. I interviewed various women, ranging from experts to teenagers. I surveyed one general education biology class of 55 students at the University of Jordan that ended up only having three men in it. I received a variety of responses, but the overwhelming theme was “we want more democracy, but Western democracy won’t work here.” In the interviews, I dove a bit deeper to further analyze what that statement really means. My study contributes to the field by enhancing the already present wealth of knowledge surrounding postcolonial democracy, specifically with respect to gender. Not much literature explores specifically how women in the Middle East experience “alternate” democracies, so I hope that my findings can contribute positively to this research area.

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Implications of Art-Making During Pregnancy and for Perinatal Care

Pregnancy is a major transition in a woman's life, and yet standard practices in the United States do not often include mental health preventative care support for expectant mothers. The link between expectant mothers' mental health during pregnancy, infant neurodevelopment, and mother-child attachment is increasingly supported by a growing body of research based in neuroscience, attachment theory, and mindfulness. Art therapy can provide an expressive and therapeutic opportunity to deepen the experience of pregnancy through exploration of personal emotions, mind/body awareness, and maternal identity.

A heuristic arts-based research study explored the experience of pregnancy for a first-time mother. The researcher was concurrently an art therapist in-training who engaged in self-inquiry by exploring personal meaning in her art. Qualitative data consisted of artwork and written journal responses created bi-weekly for the duration of the pregnancy using preferred art mediums, watercolor and ink.

Thematic analysis of artwork and written journal responses revealed three major themes which emerged during researcher's pregnancy: 1) somatic and kinesthetic sense, 2) spirituality, and 3) support-enhancing resources.

This heuristic study demonstrated the applicability of art therapy and personal art making for expectant mothers. The bi-weekly art making sessions became an anticipated time of reflection which appeared to decrease anxiety, strengthen new maternal identity, and increase attunement to the developing child. Art making during pregnancy facilitated exploration of mindfulness and emotions in a supportive and therapeutic manner. These findings can serve as a foundation for developing art therapy for standard preventative care models regarding support for perinatal care and postpartum depression.

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Now You Know: The Use of Sensitization in Sexual Assault Bystander Prevention

Sexual assault bystander prevention programs use several components, e.g., bringing awareness of a continuum of sexual violence behaviors, and teaching intervention skills designed to prevent sexual violence. (Burn, 2017). Appealing to participants' emotions, primarily empathy, is another strategy used in sexual violence prevention programs. Such interventions have participants read testimonies written by sexual assault survivors or watch videos of a sexual assault survivor discussing the impact of his or her assault (Lee, 1987; O'Donohue, Yeater, & Fanetti, 2003). However, these presentations are sometimes performed by actors, which may place an emotional and authentic constraint on the delivery of the presentation (O'Donohue, Yeater, & Fanetti, 2003). Piccigallo, Lilley, and Miller (2012) found that men who knew women that were assaulted were more likely to participate in antiviolence and anti-rape organizations, suggesting the importance of live disclosure about sexual violence. Prior literature, to our knowledge, has not compared live disclosure to taped disclosure with an experimental design. This study addressed that gap.

Participants were randomly assigned to one of three conditions: a live presentation by a sexual assault survivor, a video presentation previously recorded by the same sexual assault survivor, or a control condition (participants watched a video of a cancer survivor). All conditions occurred at the same date and time, and participants completed surveys before and after the talk or video. Surveys included an adjective checklist that measures emotions (Marks & Miller, 1988) and a bystander attitude scale assessing willingness to intervene during a potential case of sexual assault (Banyard, Moynihan, & Plante, 2007). Analysis of covariance (controlling for pre bystander attitudes in order to show change) revealed that the condition had a significant effect on the participants' bystander attitudes following the disclosure ($F = 4.61, p = 0.0112$). Further analysis (pair-wise comparisons) showed that bystander intentions were significantly higher in the live condition and the video condition than the control group. This suggests that individuals in those two groups have a greater likelihood of intervening during a potential sexual violence incident. Future analyses will examine how changes in emotion (particularly empathy) related to changes in bystander intentions.

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Associations between Ostracism and the Need to Belong on Maladaptive Eating and Marijuana Use and Cognitions

Ostracism—being ignored and excluded—is a situation that occurs across many contexts, specifically among college students (Wesselmann & Williams, 2013). Laboratory studies have shown that ostracism is associated with depleted self-control and self-destructive tendencies, including dysfunctional and maladaptive eating behaviors (Baumeister et al., 2005; Beekman et al., 2017). Ostracized individuals have shown to respond with psychologically aversive reactions such as engaging in marijuana use and emotional eating (Prinstein & La Greca, 2004; Bandewalle et al., 2014). Although previous literature has focused on maladaptive eating in response to ostracism, the current study addresses the impact of ostracism on restrictive eating in particular and marijuana use among a college student cohort.

The current study assessed correlations among college students' ($n=346$) eating behavior and marijuana use at baseline. College students who reported a greater need to belong also reported greater restrictive eating ($p=.001$) and emotional eating ($p=.003$). More frequent reports of ostracism experiences were also associated with more restrictive and emotional eating ($ps<.001$). Ostracism experiences ($p=.824$) and need to belong ($p=.612$) were not correlated with frequency of marijuana use. However, college students who reported greater marijuana use reported less emotional eating ($p=.026$) and less restricted eating ($p=.01$).

At time 2, participants were randomly assigned to be included or excluded in a game of Cyberball, an online ball tossing game. Regressions controlling for gender and past eating behavior examined the effect of Cyberball exclusion, ostracism, and their interaction on willingness to eat unhealthily. Participants who reported greater ostracism experiences had greater willingness to eat unhealthily ($p=.016$), and this was qualified by a significant interaction between ostracism experiences and Cyberball exclusion ($p=.036$). Those who reported lower ostracism experiences and were included had the lowest willingness, whereas those who were excluded and reported higher ostracism experiences had the highest willingness. Participants' willingness to use marijuana was also assessed after Cyberball. However, exclusion through Cyberball, ostracism experiences, and their interaction were not significant predictors of marijuana willingness.

These findings demonstrate that college students reporting the greatest ostracism experiences and higher levels of need to belong are the most willing to engage in unhealthy eating behaviors. The present findings may have implications pertaining to on-campus interventions in ensuring the enhancement of student social life among other social peers.

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The Influence of Japanese Colonialism on South Korea's Development

This paper explores the ongoing scholarly argument concerning Japanese Colonialism's role in South Korea's development in the 20th century. Kohli (1994) suggests that the Japanese occupation of South Korea laid the ground work for rapid development to occur. In a response to Kohli's scholarship, Haggard, Kang and Moon (1997) suggested that the Japanese occupation of South Korea was less relevant to South Korea's rapid development as Kohli had thought. They identify the cause of South Korea's development to be the political, policy, and institutional changes which occurred following the military coup in 1961. This paper analyzes per capita GDP changes in South Korea in relation to Japan's per capita GDP changes alongside historical eras to suggest that Japanese colonialism only modestly influenced South Korea's rapid development in the latter half of the 20th century.

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Proximity Moderators on the Effects of the Fight Flight Freeze System on Adolescents Aggressive Behavior

Past research suggests that aggression outcomes differ depending on the interaction between adolescents' community violence exposure (Gudino et al., 2012; Tache et al., 2018) and their temperament (e.g., Reinforcement Sensitivity Theory [RST]; Gray & Naughton, 2002). Other evidence suggests that for youth who witness violence, their proximity to the victim (family member, close friend, acquaintance, stranger) affects aggression outcomes (Lambert et al., 2012). However, no prior research examined whether how close adolescents are to the victim of the community violence that they witness interacts with temperament to predict aggression. Thus, the current study examined whether the association between witnessed community violence varies according to adolescents' proximity to the victim and their temperament. Two RST (i.e., a temperament theory defining neurobiological systems that govern approach and avoidance behaviors; Gray, 1987) systems, the fight-flight-freeze system (FFFS) and the behavioral inhibition system (BIS), were examined. The FFFS helps explain whether adolescents respond to imminent danger proactively or passively (Gray, 1987). The BIS reflects whether adolescents respond to aversive stimuli with fear and avoidance or approach behaviors (Gray, 1987).

Participants were 263 African American adolescents, who reported about their behavioral inhibition and fight-flight-freeze systems (FFFS) in grade 9 and their proximity to the victim of community violence experienced through witnessing in grade 10. Teachers' reported on aggressive behaviors for these adolescents in grade 10. Regression analysis results revealed that witnessing violence against a family member, close friend, or acquaintance and the fight-flight-freeze system did not interact to predict aggression. However, witnessing violence against a stranger and the fight-flight-freeze system interacted significantly to predict aggression ($p = .02$). Simple slopes analyses also indicated that more exposure to stranger violence was associated with less aggression for adolescents who reported low fight-flight-freeze system sensitivity ($B = -.16$; $p = .02$), but that exposure to stranger violence was not related to aggression for adolescents who reported high fight-flight-freeze system sensitivity ($p = .19$). Proximity to the victim of community violence experienced through witnessing did not interact with the behavioral inhibition system to predict aggression.

Results suggest that interactions between adolescents' temperament and witnessing community violence against a stranger may affect aggression outcomes. Understanding why some adolescents exposed to community violence develop negative outcomes is imperative for programs that intend to advance the emotional and psychological well-being of these youths. To provide adolescents with the necessary tools, consideration for how their proximity to the victim affects outcomes is important.

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Examination of Medicare Part D and the HIV Drug Market

Medicare Part D is an optional prescription drug coverage plan offered through private insurers to Medicare beneficiaries in two forms: 1.) A stand-alone prescription drug plan, and 2.) A set of benefits included in a Medicare Advantage plan. Every Part D plan covers a different list of drugs (formularies), of which must include a list of six protected drug categories. HIV/AIDS medications are one of the protected classes (KFF, 2018). But, with the existence of drug tiers (lower tiers/ generic brands being least expensive), the out-of-pocket expenses for different medications vary. Presently, the two largest market suppliers of antiretroviral drugs are Gilead Science Inc. and Viiv Healthcare, who have drastically increased prices from 2012-2016 (Stein, 2018). As the first generation of AIDS survivors from the epidemic in the 1980s turns 65 in the coming years, we will see a large increase of demand for coverage. With regard to Part D, Medicare beneficiaries receiving HIV medication often exceed the coinsurance level of \$3700 coverage early on and fall into the “donut hole” due the nature of treatment (drug combinations), the lack of generic brands, and drug tiers (KFF, 2018). From a policy perspective, we will conduct an economic analysis on the potential effects of this new wave of Medicare beneficiaries against the continuous rising costs of HIV medication given the presence of patents and federal regulations.

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Linear Enamel Hypoplasia as a Systemic Stress Indicator in Chalcolithic & Late Bronze Age Megiddo

The goal of this project was to use linear enamel hypoplasia (LEH) as a systemic stress indicator to assess differences in the prevalence of stress within and between the Chalcolithic and Late Bronze Age (LBA) samples from the Smithsonian's Megiddo collection. This was done through macroscopic observation, with chi-square tests and supplemental Fisher Exact Tests used to assess statistical significance. There were no significant differences when comparing: Chalcolithic/LBA Teeth overall, Chalcolithic/LBA anterior teeth, Chalcolithic/LBA individuals, males/females overall, Late Bronze Age males/females, Chalcolithic males/females, Chalcolithic/LBA males, Chalcolithic/LBA females, child/adult permanent teeth, child/adult permanent and deciduous teeth, and tombs T-1103/T-903 Upper. Statistically significant differences did exist in comparisons between tombs T-910/T-1103 and T-910/T-903 Upper due to the high prevalence of LEH in the theoretically richer T-910. This is hypothesized to be due to either the osteological paradox or a nutritional deficit in high status individuals as a result of conspicuous consumption of low-nutrition, high-prestige food.

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Perpetration to Reconciliation: On the Experience of Female Génocidaires in Rwandan Conflict and Resolution

Conflict resolution is an interdisciplinary field of study with far-reaching implications, the discourse for which tends to be dominated by male voices deliberating over equally male narratives of conflict. This paper defies this norm by focusing on the unique role of women in conflict to unpack one of the most infamous crimes against humanity in modern history: the 1994 Rwandan Genocide Against the Tutsi. The purposes of this paper are twofold. First, the study analyzes the roles of Rwandan women as perpetrators of the genocide, contextualizing their participation in the violence through traditional gender roles, ethno-politics, and socio-economic theory. The paper proceeds by integrating a micro-level sociological field study comprising of interviews with twelve convicted female perpetrators of genocide to address the more nuanced question of how their individual experiences in the justice system after the conflict impacted their sociological development and identities. The study breaks down the post-conflict Rwandan justice system into three distinct institutions: the traditional court system known as *Gacaca* court, prison, and community service camps referred to as *Travaux d'Interêt Général (TIG)*. Analysis of the qualitative data from the interviews is probative into which justice institution had the greatest impact on female perpetrators' identities and sense-of-self, whether that impact was positive or negative, and what sociological forces within the justice system contributed most to this development. Results showed that the Rwandan justice system uniformly eschews labeling genocide perpetrators as criminals and acknowledges their potential to internalize values of justice and reconciliation, emphasizing the positive impact of their empowerment on Rwandan society. Positive socialization of female genocide convicts by the justice system led them to perceive themselves as having contributed to Rwandan justice and reconciliation instead of having violated it, and that this pro-social approach to restorative justice and sentencing lead to successful and sustainable conflict resolution in the Rwandan case.

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The Role of Working Memory in the Theory of Mind (ToM)

Theory of Mind (ToM) is an ability to allow people to understand that others have beliefs and perspectives that are different from their own. A typical test to study ToM is the false belief (FB) task, in which participants are asked to hold someone else's belief that is either the same as their own which is called true belief (TB), or different from their own which is called false belief (FB). Although there is robust evidence showing that cognitive control, such as inhibitory control, plays an important role in the FB task, the role of working memory (WM) in ToM remains unclear. The cognitive control may contribute to ToM through working memory and inhibitory control. The present study aims to examine if working memory (WM) load and individual's WM capacity will modulate the behavioral performance in the FB task. We had college students complete a dual task that included a working memory load task and a false belief task. The working memory load task included high and low WM load conditions, which tested the impact of working memory load on participants' performance in false belief task. In addition to the dual task, participants' working memory capacity was measured by utilizing a visual working memory task that involves change detections. The researcher predicted that the reaction time in the false belief task will be longer in the high WM load condition compared with the low WM load condition. Another prediction is that individuals with high WM capacity perform well in both high and low WM load conditions; however, individuals with low WM capacity only perform well in the low WM load condition. Together, the results can improve understanding of relations between cognitive control and ToM, especially the role of working memory. The results will also have implications for interventions related to individuals with ToM impairment such as autistic individual.

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Support of Art Therapy on Trauma Focused-Cognitive Behavioral Therapy: Case Study

Trauma Focused- Cognitive Behavioral Therapy (TF-CBT) is an evidence-based treatment that reduces posttraumatic symptomology caused by childhood sexual abuse and its aftermath. Research has shown that the brain goes through significant changes after a traumatic experience. When the survivor is “triggered” the part of the brain used for verbal communication becomes impaired, which can be an obstacle for trauma treatment. Art therapy, which integrates verbal communication with intentional art making, offers as a useful tool in processing trauma and decreasing the severity of posttraumatic symptomology. As such, integrating art therapy with the TF-CBT framework may prove beneficial. A qualitative case study demonstrated how art therapy supported TF-CBT for a survivor of sexual abuse who sought out therapy at a Child Advocacy Center. The therapist followed the TF-CBT treatment model and implemented art therapy. The University of California at Los Angeles Post-traumatic Stress Disorder- Reaction Index (PTSD-RI) was used to measure trauma symptomology at the beginning, middle and end of treatment.

Art therapy provided metaphoric communication for the client to discuss her trauma, enhanced communication between client and therapist and the creation of the trauma narrative, and also aided in parent-child communication. In some directives however, the art was created in a more decorative way versus therapeutic. UCLA PTSD-RI scores indicated that the client’s trauma symptoms doubled from the beginning to end of treatment.

The increased trauma symptoms at the end of therapy may indicate enhanced self-awareness of how trauma affected her. This assertion stems from the qualitative results, which found that art therapy promoted self-expression, provided relaxation, and assisted the client to tell her trauma narrative. These findings offer promise for integrating art therapy into existing standard trauma protocols.

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The Effect of Physical Activity on Vitality

According to Self-Determination Theory (SDT) individuals have three psychological needs, competence, autonomy, and relatedness. Competence describes the need to feel good and effective in one's environment. Autonomy refers to the need to perceive oneself to be the agent of his or her own actions. Relatedness reflects the need to experience a connection to others or to feel like one belongs. According to the SDT framework subjective vitality is affected either directly or indirectly through competence, autonomy, and relatedness. Subjective vitality is described in the SDT framework as the energy available to the self. It is described as energy that excites and empowers one to engage in action that reflects one's personal values or interests. Due to the positive affect that physical activity (PA) has on mood, it is reasonable to expect that PA can affect vitality (Kinnaefick, Thogersen, Duda, & Taylor, 2014).

The objective of the present study was to test whether PA can lead to higher levels of subjective vitality.

The study included a three-group design (pre-exercise, post-exercise, no exercise). Participants for the pre- and post- exercise conditions ($Ns = 75$ and 75 , respectively) were recruited at a university exercise center either just before they exercised or just after they exercised. Participants in the no exercise condition ($N = 92$) were recruited from the psychology department subject pool. Participants completed a short questionnaire that assessed, vitality, positive affect, negative affect, and demographic information. Subjective vitality was assessed with the subjective vitality scale (Ryan & Frederick, 1997). Responses ranged from 1 to 5 where higher numbers reflected more vitality. Analysis of Covariance (ANCOVA) was used to test the study objective. Age and general levels of PA were entered as a covariate in all analyses.

The ANCOVA showed statistically significant differences in vitality between conditions ($F_{2,233} = 13.88, p < .01$) whereby participants in the post-exercise condition reported the highest levels of vitality ($M = 23.14, SE = 0.57$), followed by those in the pre-exercise condition ($M = 20.62, SE = 0.60$), followed by those in the no exercise condition ($M = 18.31, SE = 0.53$). All pairwise comparisons were statistically significant.

Results of the study suggest that PA may lead to increases in subjective vitality. That the pattern of results for positive and negative affect differed from those for subjective vitality implies that these are different constructs, a view that is consistent with SDT.

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Rivers as Systems: Evaluating the Degradation and Restoration of the Anacostia River through a Social-Ecological Framework

“Urban River Syndrome” describes the poor water quality and degraded ecosystems common to urban rivers and streams. Poor river health is typically the result of historic land-use conversion and infrastructure design which have altered ecosystem function and introduced excess amounts of organic and inorganic pollutants to waterbodies. Recently, increasing political pressure has catalyzed the restoration of urban river ecosystems, with new emphasis on social, political, and economic outcomes. The degradation and restoration of urban rivers is a linked social and ecological challenge in need of interdisciplinary analysis for effective planning. Rarely applied to restoration, the “Social-Ecological Systems” (SES) framework provides a means for understanding the complex and dynamic social and ecological factors leading unhealthy urban rivers. This research focuses specifically on the Anacostia River in Washington, D.C., a well-known example of “urban river syndrome” resulting from centuries of resource exploitation and institutional neglect. Specifically this paper analyzes four subsystems: biophysical, governance, social, and economic; that influence river health. In addition, the SES framework is used to analyze the “Anacostia River Watershed Restoration Plan and Report,” a document published in 2010 to guide overall watershed restoration. The framework is used to assess whether the “holistic” plan truly addresses river restoration through both social and ecological means. This analysis found that the Anacostia Restoration Plan directly addresses government’s role in retrofitting infrastructure and protecting green spaces, but does little to address social and economic pressures which may undermine ecologically-sound restoration efforts.

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How Much Do Unions Effect Low Income Workers?

In this paper, I will investigate the relationship between unions and wages of low-income workers within the state of Massachusetts. The main objectives were to: 1) Discover the effects, if any, of unions on low-income worker wages within Massachusetts, and 2) investigate whether the effects of unions are greater for low-income workers than workers of other income groups. The first objective is achieved by using a log-linear OLS regression model with the natural log of income as the dependent variable. I will attempt to isolate percent increases in wages directly related to the presence of unions via this method. For objective two, each worker was grouped into their respective income decile (i.e. 0th-10th percentile, ..., 90th-100th percentile). From there, a multiple means comparison test in tandem with the Bonferroni method to decrease Type I error was theorized to be needed to see whether the changes for low-income workers is greater than, less than, or equal to other income group wage changes. This concept was then removed due the lack of significant findings within different income groups.

The OLS regression showed us that the presence of unions increased wages for all workers within Massachusetts by 11.96%; however, when looking at the effects unions have on wages for each income decile, the regression model found unions did not impact wages for low-income workers within Massachusetts as largely. Oddly enough, only income earners within the 10th and 20th percentile saw a significant increase in wages due to being within a union, which was merely 1.95%, while the other income deciles had insignificant changes. This led to the conclusion that the presence of unions had an unclear effect on low-income worker wages.

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Approaches to Addressing Food Insecurity Across Arctic Cities

Arctic cities typically rely on long supply chains for their food consumption. In addition to concerns about accessibility, affordability, and nutritious quality, researchers warn that certain groups of people in the Arctic are “highly exposed to environmental contaminants”, partially due to their local dietary habits. Trends in climate change can exacerbate this and other environmental stressors, impacting the prospects of agriculture and confidence in local food production.

Each region of the Arctic faces its own host of challenges and opportunities, but all share fundamental ecological vulnerabilities which stress the capacity of local and global food supply chains. As the cryospheric landscape at the northern pole changes, state and non-state actors across the world are paying more attention to opportunities to advance their respective commercial and geopolitical interests, opening a range of opportunities as the countries lining the Arctic Ocean invest in the construction and/or modernization of northern coastline ports to attract international freights. While this attention and investment has potential to advance sustainability goals, the increase in traffic will have implications for fishing and herding communities, which have historically sustained and supported components of community food supply in the Far North.

I will identify the current state of adaptability from literature, available data, and on-the-ground research. This snapshot represents where we stand in 2019 with consideration of 50 cities across the eight Arctic countries. The data will follow the International Organization for Standardization’s Sustainability Index Urban Agriculture and Food Security indicators (ISO 37120).

These figures supplement fieldwork in March in Alaska, which currently imports at least 95% of its food supply. To gain a comparative perspective, in the early summer I will visit a cluster of cities in Russia’s Murmansk Oblast. Though they are all within a few hours’ train ride of each other, they are still remote enough for critical vulnerabilities of Arctic challenges to manifest.

Another component of the project is predictive, analyzing which of the indicators are likely to change, elaborating with a breakdown of what is more immediately actionable, what a medium-term forecast might look like, and where the longer-term importance lies. I expect that some indicators adjust faster than others, especially if there is historical precedence of certain initiatives, either top-down, grassroots, civil society, or a collaborative effort.

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It's a Dog-Eat-Dog World: Navigating Stigma in a Zoophile Cyber-Community

Sexual deviants often experience intense social isolation due to the stigmatization their behaviors elicit in the public sphere. Online environments may have a liberating effect on these historically marginalized sexual communities by allowing members to negotiate their deviant identities, validate their sexual practices, and manage issues of stigma. Using a sample of 1,381 posts collected from 32 discussion threads, preliminary findings suggest that members in a zoophile cyber-community confront multiple dimensions of stigma. Within the cyber-community, posters risk being shunned for violating communal rules and norms, not displaying sufficient respect for authority, and disregarding the ethical principles of zoophilia. In real world environments, members must also navigate the persistent risk of being exposed as a sexual deviant. We conclude by discussing how the ability to negotiate issues of stigma in supportive online settings provides zoosexuals with an important support structure mechanism to develop and manage their sex-based identities, confront and resolve ethical dilemmas, and reassert shared norms and values.

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Assessing Supervisors' Fidelity Ratings of a Preventive Intervention for Perinatal Depression in Kenya

Intervention Fidelity (IF) is often used in treatment trials to examine the extent to which an intervention is delivered in the way it was intended to be, in order to assess the effectiveness of treatment outcomes. The current study examined IF in the context of evaluating an intervention to prevent perinatal depression among pregnant and postpartum women in rural villages in Kenya. The intervention was delivered by community health workers/CHWs who were supervised by two groups of raters: (1) case managers (CMs) who had experience with this intervention in a previous intervention trial; and (2) sisters from a Catholic organization who in turn were trained by the CMs ("sisters"). The goal of this study was to examine if intervention fidelity differed between CMs and sisters: that is, if the two groups provided different and/or similar ratings on how CHWs delivered the intervention. The study sample included CHWs who were the facilitators of a 13-session group intervention ($n = 7$), and supervisors (2 CMs and 2 sisters). In preparation for the intervention trial, the supervisors observed seven practice groups and completed fidelity rating forms for these 7 groups. In each session, supervisors (CMs or sisters) observed the session and provided ratings on seven-session topics across three factors: content (extent to which the CHW covered all topics in the session), comprehension (how well the participants understood content), and participation (group engagement level) from 1-10 (1 = least observed; 10 = most observed). The total rating for each of the three factors used in the analyses was calculated by adding the ratings from each of the 7 topics. The analytical sample included 29 CM ratings and 9 sister ratings over 6 sessions in which both groups provided ratings. Independent samples t-tests were conducted to compare the two supervisor groups on three factors. Results indicate no significant differences in ratings between CMs and sisters on content (CM: $M=49.76$, $SD=7.06$; Sisters: $M=53.56$, $SD=6.09$); $t(36) = -1.45$; comprehension (CM: $M=49.90$, $SD=6.98$; Sisters: $M=53.56$, $SD=4.16$); $t(37) = -1.49$; and participation (CM: $M=53.41$, $SD=7.55$; Sisters: $M=56$, $SD=4.53$); $t(36) = -.97$, all $p_s = ns$. Overall, CMs and sisters rated the facilitators as equally effective in delivering the intervention in the way that it was intended. These findings suggest that sisters, with less mental health experience, can be trained to learn the intervention and supervise CHWs with fidelity. Implications for effective disseminations will be discussed.

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Influence of National Culture on Corporate Social Responsibility

Corporate social responsibility, or CSR, has become a buzzword both within business settings and business management literature. While CSR has become widely adopted, the origins of the practice, as well as its implications are still being researched. CSR has been observed in several different forms. One proposed explanation for differing practices has been a variation in environmental factors. Organizations exist within a number of environments, including national culture. This research aims to determine if variations in national culture influence the types of CSR practiced by companies within a specific country.

National culture has been defined by Geert Hofstede, who proposes six cultural dimensions which vary among countries: long-term orientation, masculinity, uncertainty avoidance, power distance, individualism, and indulgence. This study will collect national culture data on ten countries varying in both geographical location and national culture to capture variance. Hofstede measures and assigns a score between 0 and 100 for each of the six dimensions. These values will be recorded and will serve as predictor variables against the outcome of CSR.

Three companies from each country will be analyzed to represent how companies within that country perform CSR. The quality of CSR initiatives within companies in these countries will be evaluated by CSRHub which aggregates data from 584+ sources such as research firms, indexes, publications, rankings lists, NGOs, and government agencies. CSRHub's overall performance rating for each company will be recorded. Data will also be collected from more granular CSRHub categories including community, employees, environment, and governance.

In total, there will be 30 connections drawn (10 countries X 3 companies in each country) yielding enough data to be normalized in the analysis phase. An index score of each of the 10 countries' three respective companies' overall CSR rating scores will be computed by SPSS. This will create one measure upon which one country's national culture can be related to one country's CSR practices. This study aims to add to existing literature which has found inconsistent correlations between national culture and corporate social responsibility. Further, it will take a global perspective by analyzing countries from all over the world. Finally, the data will capture not only the quality of overall CSR practices, but the potential variation of specific CSR areas as well.

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“So What Are You?:” Nepali Third Gender Women’s Identities and Experiences Through the Lens of Human Rights Development Discourse

Nepal is the site of many national and international human rights development measures focused on the country’s gender and sexual minorities (SGM). Given the significant impact those development efforts have on SGM and Nepali society, national and international development actors need to understand the identities and experiences of the populations they attempt to help. Performed in Kathmandu and Bharatpur, this study attempts to understand the identities used by third gender women and if those identities are reflected in development discourse. Furthermore, this research seeks to understand the life experiences of these women and the discriminations they face, a reflection on national measures to eliminate discrimination against sexual and gender minorities. Over the course of this research, self-identified third gender women and members of organizations that work with SGM were interviewed. Observations were also conducted in a Bharatpur SGM-advocacy organization.

This research questions the homogeneity of SGM described by some development organizations and their critics. Identity should be understood as context-specific, and SGM identities as intertwined and mutually-informing. Understanding the framework for gender and sexuality that underlies Nepali sexual and gender identity terms is important in order to supplement and contextualize the identities that, otherwise, may be misrepresented and misunderstood. Furthermore, development organizations should be cognizant of the impacts donor sources may have on development projects and on sexual and gender minorities. The national government should focus on successful implementation of measures already executed, and interested parties should hold the government accountable for following through with these SGM-focused human rights measures.

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The Role of Different Forms of Racism on Risky Health Behaviors among African American Young Adults

Though research has shown that racism predicts risky health behaviors (Gerrard et al., 2012), current literature has failed to investigate whether specific forms of racism are more predictive of certain health behaviors. Additionally, gender differences in amount of experienced racism have been examined (Chavous et al., 2008) but not in types of racism experienced. We performed a secondary data analysis on a community sample of 249 Black adults (Age $M = 24.04$; 142 Female) to examine gender differences in types of racism on alcohol and marijuana use. Partial correlations and regressions controlled for education level, student status, income, and age.

Greer (2010) found that the Schedule of Racist Events (SRE; Landrine & Klonoff, 1996) was composed of different types of racism. Our exploratory factor analysis of the SRE partitioned into four subscales: Racism Reactions (e.g., telling someone off for being racist), Intense Racism (e.g., being called a racist name), Institutionalized Racism (e.g., being treated unfairly by a teacher), and Every Day Racism (e.g., being treated unfairly by people in helping jobs). Independent sample t-tests revealed that females reported higher levels of Racism Reactions ($p = .007$) and males reported marginally higher levels of Intense Racism ($p = .056$), but we found no gender differences for the other scales. A partial correlation revealed that alcohol use was significantly correlated with Racism Reactions ($r = .137, p = .042$). Separating by gender, alcohol use and Racism Reactions were significantly correlated among males ($r = .213, p = .046$), but not females ($r = .135, p = .129$). Intense Racism significantly correlated with marijuana use ($r = .166, p = .013$), a relation that remained significant for males ($r = .219, p = .037$), but not for females ($p = 0.28$).

We assessed the relation between subtypes of racism and substance use and whether gender differences exist in these relations. Results indicated that the type of racism African Americans encountered predicted substance use differentially, and that males and females have different racism experiences. Altogether, our findings demonstrate the necessity of exploring how different types of racism influence health outcomes, and indicate that gender should be considered when studying the negative effects of racism.

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Pursuing Tzedek: Building Movements for Jewish Social Justice by DC Synagogues

Many Jews view the pursuit of social and economic justice as an ethical and historical mandate. Throughout American history, Jews individually participated in various social movements. However, starting in the 1990's, a new form of Jewish social justice emerged: synagogue community organizing. Although congregation-based community organizing appears to amplify church communities' influence in public changemaking, the specific ways in which synagogues organize for social change remains unclear. This research addresses how Jewish institutions in D.C. are building movements for inclusive, equitable, and impactful social justice work.

Three synagogues in Washington, D.C. comprise case studies that offer insight into how synagogues of various sizes and sects relate to and act upon the value of social justice, reflecting ideological and strategic differences. Data include interviews with clergy or professional staff as well as three focus groups with lay leaders, exploring the following topics: personal definitions of social justice, motivations for organizing within the congregation, intentionality around including diverse participants, conflict resolution tactics, and views on how the synagogue's work achieves systemic change.

Thus far, the data, though preliminary, has revealed that while participants agreed that Jewish texts and shared history as a minority group motivate their social justice work, they disagreed about the importance of mobilizing for systemic change versus volunteering for incremental service. In addition, while nearly all participants emphasized egalitarian relationships in this work, only a minority of participants highlighted candid discussion about race and other social identities as a necessary and challenging aspect of synagogue organizing. Consequently, this research provides a sample of how Jewish establishments deploy the resources and interests of their congregants toward the long-standing priority of social justice. The discussion of results identifies several assets and recommendations for future development of the work done within these synagogues as well as provides context for future studies of similar institutions in other communities.

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Impact of Sanctuary Policies on Victimization and Discrimination among Latino Immigrants

Contributing to the growing body of research on the impact of sanctuary policies on crime, this paper examines the relationship between enacted policies and reported experiences of victimization and discrimination among Latino immigrants using the Educational Longitudinal Study of 2002 (ELS:2002). Situated within the immigration-crime nexus, individual-level analyses have consistently demonstrated that immigrants are less crime-prone than their native counterparts, and at the aggregate-level, studies demonstrate either no empirical relationship or that immigrants are associated with statistically significant lower overall crime rates. In response to the highly-publicized concerns regarding ‘law and order’ in sanctuary cities, the immigration-crime literature has expanded to examine linkages between sanctuary policies and crime, focusing on changes in overall violent crime and/or property crime. However, individual-level impacts have yet to be examined. Following the findings of past work, the hypothesis for this study is that discrimination and victimization incidences are lower for immigrants in localities with enacted sanctuary policies. Several theoretical frameworks and sociological concepts also inform this hypothesis, including theories of social disorganization, immigrant revitalization, and politicized places in conjunction with Emile Durkheim’s concept of collective consciousness, Erving Goffman’s work on stigma, and Jane Addams’ concept of ethics.

Using confidential data from the ELS:2002, American Community Survey data, and FBI Uniform Crime Report data, logistic regression models are employed to examine the relationships between sanctuary status and victimization and discrimination. Preliminary findings indicate a statistically significant negative relationship between both the existence of sanctuary policies and victimization of Latino immigrants, as well as discrimination of Latino immigrants, compared to their counterparts not residing in sanctuary locales. The final model will include other independent variables, largely informed by previous studies, including generational status, parent’s country of origin, educational attainment, parent’s educational attainment, employment status, socioeconomic status, immigrant concentration, aggregate crime levels, and median household income. This study will offer a discussion of explanations for these correlations, identifying implications for sanctuary policies. Better understanding the role of sanctuary policies on the lived experiences of Latino immigrants through their comparative victimization and discrimination experiences can provide important insights both to the growing body of literature on sanctuary policies and crime as well as the victimization literature, and address public fears over the growing number of sanctuary policies. Additionally, we can begin to understand the extent to which sanctuary policies offer protections beyond limiting the role of local law enforcement on apprehending and deporting immigrants.

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What is the Structure of Poverty? Using Networks Analysis to Re-Evaluate the Weights in the Multidimensional Poverty Index

The Global Multidimensional Poverty Index (MPI) implemented by the Oxford Poverty & Human Development Initiative and the United Nations Development Programme, serves as a more holistic and comprehensive approximation to poverty that goes beyond a unidimensional monetary approach. More than 100 countries have implemented some structure of the MPI. The MPI includes ten different indicators in three poverty dimensions: education, health, and living standards. However, a key shortcoming of the MPI measure is that it assigns equal weights to each of the three dimensions, implying that there are no correlations or interactions between them. We propose a framework to understand poverty as a complex system rather than as a linear approximation of multidimensional poverty.

We use data from Colombia's 2017 Quality of Life Survey, which the government officially uses to calculate their MPI. We perform a network analysis to understand the structure of poverty, and suggest a newly weighted MPI measure, using the follow four analytical steps: (1) test the normality of the indicators' distributions; (2) assess the correlation strength between different indicators based on the normality of the parameters; (3) develop a new MPI measure that uses the correlation data to construct new weights for the indicators; (4) examine whether there is heterogeneity in the network based on demographic and geographic characteristics.

Based on initial analyses, we find that key indicator variables used to measure multidimensional poverty in Colombia, such as labor income, are not normally distributed. Additionally, we find a high degree of multicollinearity between key indicator variables such as educational attainment, labor income, and the possession of assets. Furthermore, considering that the market infrastructure is more developed in urban areas, we expect income to have a bigger role in explaining poverty in urban than in rural areas.

Our findings provide evidence for policymakers and researchers to question the validity and reliability of the MPI as a means to measure poverty in low- and middle-income countries due to critical problems with the indicators, including multicollinearity, non-normal distributions, and geographic variations of the different parameters. From our findings, we suggest that policymakers and researchers consider an alternative approach to measuring multidimensional poverty that considers within-country geographic variations and utilizes variable weights for the indicators to illustrate more contextually relevant MPI measures.

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Dodd-Frank and the Closure of Virginia Community Banks: How Regulatory Burden and “One Size Fits All” Policy Unintentionally Expanded Large Financial Institutions at the Expense of Community Banks

The differences between American community banks and more well-known large financial institutions have long been overlooked in the financial and regulatory environment. Despite the importance community banks provide to small-businesses, agricultural industry and in increasing financial literacy in America, regulatory legislation fails to assure that their business will be protected. In doing so, regulatory institutions are often unable to predict and assist financial institutions from failing and leading to larger scale financial downfall. Such an example comes with Dodd-Frank, established to stop “Too Big to Fail” institutions from taking advantage of the system and protect American consumers at large. Examining the existence of community banks in Virginia specifically, reveals that after Dodd-Frank passed community banks uncoincidentally closed or merged. This paper argues that the Dodd-Frank Act imposes a “one-size fits all” approach to the banking industry of Virginia, and as a result negatively impacts Virginia community banks who cannot afford to enact strict regulation with their already conservative lending model, one that uses customer relationships to ensure safe and sound services.

Using publicly available FDIC data, this paper builds on existing literature pertaining to the downsides of Dodd-Frank and regresses the “Outcome” of Virginia bank closure or merging against the “Treatment Effect” of the passage of Dodd-Frank, also accounting for the financial institutions’ ROA, a measure of stability, and “Asset Size” to allow for the influence of asset size on bank stature. Data was compared from the period between 2009 and 2010, as the control group, as well as 2010 to 2013, the “Treatment Effect” group. One can note that the purposeful unevenness and limitation to account for the preceding Great Recession, as well as to account for the time needed following Dodd-Frank for banks to be inspected and closed or merged. This regression provides important assumptions about the ever-present responses of large financial institutions in response to community bank closures and can be further used to track the health of small-businesses, financial literacy, and trends in banked populations of America.

In sum, the “Treatment Effect” appeared to be a statistically significant against the “Outcome” in every regression while the bank’s ROA and asset size were not statistically significant in any included combination. After proving a statistical causation of Dodd-Frank against the downfall of community banks in Virginia, this paper includes several potential solutions for future regulations, to ensure the health of community banks, and thus small businesses and agricultural lending in America, and to push the economy towards recognition and fairness.

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Resilience Resources are Associated with Fewer Symptoms of Postpartum Depression

Women of childbearing years are at high risk for depression, with an estimated 11 to 21% of women meeting diagnostic criteria for major depression (Fairbrother et al., 2015). Most research in this area has focused on risk factors for the development of depression, with much less focus on protective factors. Resilience resources are associated with better mental health outcomes in healthy adult populations, and some studies indicate they may be important to study in perinatal populations as well (Cheadle et al., 2018; Dunkel Schetter & Dolbier, 2011; Rini et al., 1999). We tested associations of optimism, mastery, and positive affect (conceptualized as resilience resources) with symptoms of postpartum depression from 6 weeks through one-year postpartum. The sample consisted of 234 women from Los Angeles, CA ($n=116$) and Denver, CO ($n=118$) who participated in the Healthy Babies Before Birth (HB3) Study, a longitudinal study examining antenatal mood disorders, pregnancy-specific stress, and poor pregnancy outcomes. Interviews were conducted during pregnancy at 8-16 weeks (T1), 20-26 weeks (T2), and 30-36 weeks gestation (T3), and postpartum at 4-8 weeks (T4), 5-7 months (T5), and 11-13 months (T6). The sample was 45% White ($n=105$), 37% Latina ($n=86$) and 18% Other ($n=44$), and was relatively young ($M=30.31$ years, $SD=5.98$), with the majority married or cohabitating (87%). A resilience resources index (RRI) reflecting relatively stable traits was formed by standardizing and summing scores of three measures: Mastery at T1 (Pearlin Mastery Scale; Pearlin et al., 1981); Dispositional optimism at T2 (Life Orientation Test-Revised; Scheier et al., 1994); and Positive affect at T2 (positive affect items from the Positive and Negative Affect Schedule/PANAS; Watson et al., 1988). Postpartum depressive symptoms were measured by the Edinburgh Postnatal Depression Scale (EPDS; Cox et al., 1987) at each of the three postpartum time points. Pearson's correlation coefficients were used to examine bivariate associations between the RRI and the EPDS at all three postpartum timepoints. Results indicate that greater RRI scores were significantly associated with lower EPDS scores at each time point: T4 ($r=-.45$), T5 ($r=-.38$), and T6 ($r=-.36$), all $p<.001$. Overall, results indicated that greater resilience resources were significantly associated with fewer symptoms of postpartum depression over the period of one year after giving birth. These findings highlight the importance of studying the factors that promote resilience in the face of risk for perinatal mood disorders and inform future intervention development.

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The Future of Youth Voter Turnout: Why Young Voters Fail To Show Up at the Ballot Box

Young people today are part of the largest, most diverse generation in history. Historically, young people have had disproportionately low voter turnout. In the last midterm election, young people had the highest voter turnout in the last 25 years at 31% (CIRCLE). However, this still means that 69% of young people failed to complete their civic duty at the ballot box.

This research will assess youth voting trends by looking at the following factors: modes of youth voter outreach such as social media, online marketing, and in person and on-campus registration efforts, civic education and how rates of civic literacy across the country impact youth voter attitudes and outcomes, and the mediums in which voting and voter registration occurs and if and how voting reforms could increase youth voter turnout. Finally, my research will conclude on recommendations for increasing youth voter turnout and predictions of whether or not young people will ever be a reliable voter bloc and how they may or may not influence future elections.

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Therapeutic and Patient Attachment, Therapy Alliance, and Progress in Psychotherapy

Researchers have found that both therapists and patient attachment influence the alliance, process, and outcome of psychotherapy. We also know that the therapy alliance is a strong predictor of change in psychotherapy. Although there has been a link between attachment and alliance to outcome, there has been less attention to how the attachment between the therapist and patient relate to the development of the alliance over the early phases of treatment, and how that leads to immediate symptom change. The current study will explore how therapist and patient attachment influence perceptions of the alliance, perceptions of ruptures in the alliance, and changes in symptoms and interpersonal functioning. Forty psychotherapy dyads participated at the start of the psychotherapy treatment, and completed self report measures of attachment, alliance, ruptures, and symptoms. The main effects of therapist and patient attachment, and the moderating effects of perceived ruptures and alliance change will be examined in light of changes in symptoms and interpersonal functioning. Implications and future research directions will be discussed.

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Effects of Delayed Gratification on Finances

As technology becomes a more intricate part of our lives, this study will highlight the consequences of technological convenience and the impact it has on delayed gratification. Delayed gratification is the ability to wait for any kind of pleasure, in which has become difficult for the millennial generation as well as Generation X. The millennial generation has grown up with cellular devices and online enabled applications. Technology gives people the opportunity to purchase almost anything they want in an instant, and has further worsened the issue of people requiring instant gratification. Online applications such as social media spreads the ideology of consumerism, which combined with the inability to wait can result in steeper debt totals. This will not only affect one's personal finances, but it can also affect the greater U.S. economy as a whole. This study will measure individuals' ability to delay gratification, and will be compared with their views on debt and personal finances.

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Effectiveness of Short-Term Mindfulness-Based Group Therapy in Improving Executive Function Skills

Executive dysfunction is not just linked to ADHD, but is also linked to depression, and drug/alcohol dependency, meaning a wide range of people experience executive function (EF) inhibitions. While most literature on interventions for executive dysfunction has mainly focused on children and adolescents, researchers know very little about interventions for executive dysfunction with young adult and adult populations. Limited research examining EF interventions with this population has utilized problem-solving therapy and support therapy, but to our knowledge, no research has examined the effects of short term group therapy on EF among young adult and adult populations. The current study strives to investigate the impact of group therapy on EF skills by running a 4 week intervention at a community clinic. This study aims to examine 1) whether short-term group therapy intervention improves EF skills 2) whether short-term group therapy intervention improves general functioning 3) whether clients felt their understanding of EF improved. It was hypothesized that there will be a change in EF and general functioning from T1 to T2, and participants' sense of understanding the content will be significantly greater.

Participants were young adults and adults waiting for assessment or psychotherapy services at The Meltzer Center, a community-based training clinic. Only those, above the age of 18, who were interested and available for the specific dates enrolled in the group.

Based on paired t-tests, there were no significant changes in EF skills or general functioning in participants from T1 to T2, thus rejecting both hypotheses 1 and 2. However, the means decreased at T2, suggesting improved EF and general functioning, even though not statistically different. Additionally, results indicated that on a 10-point scale [(0) *not helpful*, (10) *most helpful*], participants rated their understanding of how EF affects their lives significantly high ($M=9.167$, $SD=1.330$), supporting hypothesis 3.

Since there have been no previous studies analyzing the effectiveness of short-term interventions on improving the EF of young adults and adults, it is hard to say whether these results are consistent with previous studies. This study may have broader clinical implications by helping low-fee training clinics develop programs that manage client flow while keeping client needs a priority. Future studies could implement a longer intervention with more group sessions to see if that impacts the results as well as implementing a pre and post knowledge test to better assess content gained with the intervention and to see if knowledge works to help decrease executive dysfunction over time.

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What Communication amongst College-Aged Students on Initiating Sexual Experiences Implies about Women’s Agency

In light of the me too movement, increasing fights for gender equality and the increasing communication about sex in daily life, how has the power dynamics amongst intimate partners shifted? My research intends to uncover how sexual communication frames women’s agency particularly during sexual initiation. An increased culture of casual sex, and the prevalence of technology in communication allows for accessible and immediate sexual interactions in the United States . From the framework of societal scripts, I relate the use of language and gendered perspectives to the narratives of college-aged students about their sexual experiences. Collecting data from students at the George Washington University, and other schools on the east coast, my study used an anonymous qualitative survey to gain insight on their sexual experiences. Thanks to the responses of 6 male and 7 female participants, I analyzed the rhetoric and generalized opinions on sexual initiation in reference to their partner(s). Not only did the data indicate that both genders have significant power, but females and males went as far as recount sexual encounters in which females initiated sex. Perceptions of societal gender norms guided sexual behavior more than interpersonal experiences. In addition, language surrounding sexual experiences was closed-off and stereotypical, suggesting that in order to shift the power dynamic in heterosexual relationships, open dialogue needs to be increased. Participants have positive perceptions of the opposite sex, but still perpetuated societal scripts whether in their own actions or expectations of behavior. This further informs the importance for sexual communication to dissolve traditional societal scripts and of research based on females’ agency.

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Reasons for Not Intervening as a Bystander to Prevent Sexual Assault

College students have been encouraged to engage in bystander interventions in order to prevent sexual assault. A “bystander” is defined as a person who is present at an event or incident but does not take part. In contrast, bystander intervention programs train students to actually engage when they observe situations of sexual assault, when they become aware that a sexual assault has taken place, or when they encounter cultural norms that support sexual assault (Banyard, Plante, & Moynihan, 2005). Bystander intervention can take on several forms, such as directly stepping in when witnessing a rape, discouraging a friend from making unwanted sexual advances towards someone at a party, or calling campus security when concerned that there might be sexual violence taking place in the dorm building. While bystander intervention programs might educate students in general about ways to intervene, it is also important that such programs investigate and address the nuances of individuals’ reluctance to intervene, as this could better equip bystanders to feel capable of intervening in a variety of complex circumstances. An individual’s identity (i.e., gender, race, age, culture) might influence perceived ability to intervene as a bystander, in addition to personal beliefs about intervening. Prior research has found evidence that some assumptions, such as the notion that men would directly intervene more often than women, are not supported (Palmer, Nicksa, McMahon, 2016). Therefore, this study examines not only an individual’s reluctance to intervene but also the specific reasons behind an individual’s reluctance to intervene.

This study is using data from a survey of undergraduates at the George Washington University (N=160). Participants will be asked about their top reason for being reluctant to intervene as a bystander, in addition to noting other reasons that might impact their decision to intervene. We hypothesized that individuals may be reluctant to intervene for varying reasons based on their identity and on how they relate to the identity of the perpetrator. In particular, we are examining differences in response based on the gender of the participant (the potential bystander) and how that relates to the gender of the perpetrator. This research will inform future intervention programs aimed at reducing sexual assault on college campuses. By understanding what reasons impact undergraduates’ intentions to act, researchers can help tailor intervention programs to better empower students who may not otherwise intervene.

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Perception, Education, and Practice of Acupuncture in Singapore

Holistic medicine has gained popularity in recent years by providers and patients; this has generated interest in complementary and alternative medical practices including Traditional Chinese Medicine (TCM) which may provide insight into how people can lead healthier lives. In this study, survey data was collected on the perceptions of TCM by Singaporeans and compared to the perceptions of TCM by Americans. Moreover, interviews were conducted with practitioners at TCM clinics and schools in Singapore to learn more TCM practice and outreach to the local community. Survey data revealed more Singaporeans knew what TCM was (96.88%) when compared to Americans (58%). When asked if they believe that TCM can complement traditional western medicine, the percentages of Singaporeans and Americans were similar at 77.42% and 63.04%, respectively. Around the same percentage of Americans and Singaporeans noted that they are interested in learning more about TCM practices and acupuncture (71.88% Singaporean, 75% American). Interviews with TCM practitioners cleared misconceptions about TCM and explained the cultural significance of TCM to Singaporeans. The data suggests that while Americans are not as cognizant of TCM practices as Singaporeans are, they are just as likely to believe TCM practices can be used to complement western medicine. With this knowledge, the Confucius Institute at GWU can consider integration of TCM into the curriculum at George Washington School of Medicine and Health Sciences and University as a whole so that more students, undergraduate and medical, are aware of and consider practicing TCM in the future.

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Revealing Trending YouTube Videos and their Relation to Power Laws

Social networks are a relatively new, and rapidly evolving method of human interaction. In particular, the video-sharing website, YouTube is one of the most popular social media platforms, and involves a set of interactions that is relatively unique among such platforms. YouTube trending videos are of particular interest as they have captured a large audience attention over a short period of time.

In this work we analyze data on trending YouTube videos and determine the functional forms of the distributions for the number of views, likes, dislikes, and comments. As many of these variables have long tails, corresponding to videos with a disproportionately large amount of activity, it is suspected that the functional form of these distributions are power laws or log-normal distributions. Additionally, the strength and direction of correlations between these variables are calculated. Examination of this data allows inferences to be drawn regarding user behavior corresponding to trending YouTube videos, and comparisons to be made between the behavior of users in different countries over the span of a decade.

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The Socio-Economic Impacts of Higher Education on DREAMERS/DACA Recipients in Virginia

The study relies upon over 225 surveys collected from 2014-2018 among students who participated in The Dream Project Scholarship program. The Dream Project, a not-for-profit foundation dedicated to mentoring and financially supporting undocumented youth in Virginia. The Dream Project empowers students—ninety percent of whom are from Latin America—whose immigration status creates barriers to education by working with them to access and succeed in college through renewable scholarships, mentoring, family engagement, and advocacy. This study aims to address the dearth of knowledge about Dreamers during their college years and afterwards, especially from new destination states such as Virginia. Using survey data and focus groups we examine the factors that contributed to graduation and their post college employment and activities. While these students face serious obstacles, collectively their socio-economic outcomes are more positive than those in other studies (Gonzales, 2016). Eighty-five percent of the students stayed in college or graduated, eighty percent of college graduates reported working in a job related to their careers, and fifty-eight percent of graduates earn more than \$40,000 per year. Theoretically, we are interested in understanding how this population responds to oscillating precarity, as their legal status faces on-going challenges. The data show that having DACA--or something like it--is fundamental to the their achieved socio-economic attainment, hence the urgency of resolving the DACA question is highlighted by these results.

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Food Addictive and Selective Eating Traits in Autism and their Health and Behavioral Consequences

Obesity is prevalent in those with Autism Spectrum Disorder([ASD]; Curtin et al., 2014), yet the underlying mechanisms remain unclear. There is some evidence for increased overeating in ASD (Hess et al., 2010). Food addiction[FA] is a set of traits used to explain the drive to eat due to the rewarding nature of food, despite potential accompanying negative health consequences. To date, neither FA traits, nor their health-related correlates have been examined in individuals with ASD. Furthermore, the overlap between FA traits and food selectivity has yet to be examined. Participants consisted of parents of children with ASD($n=153$;M age=8.9,109 males) and of typically developing[TD] children($n=78$;M age=8.3,36 males). FA was assessed using The Yale Food Addiction Scale for Children(Gearhardt et al., 2013). Food selectivity was assessed using the Eating Habits Survey(Wilde et al., 2012). Lastly, Body Mass Index[BMI] was calculated using Center for Disease Control norms. Children with ASD were more likely to be rated as picky eaters than TD children(ASD:55.6%,TD:29.5%; $X^2=14.1, p<.001$). Additionally, parents rated children with ASD as having more FA traits than TD children($t=4.15, p<.001$), and significantly more children with ASD than TD children surpassed the threshold for elevated FA traits(ASD: 23.8%,TD: 8.5%; $X^2 =7.40, p<.01$). Of the children with ASD surpassing the threshold for elevated FA traits, 68.6% were also rated as being picky in their eating, which was significantly higher than among the non-picky eaters(50.9%, $p<.05$). Finally, among the children with ASD, BMI was found to be lower for picky eaters compared to non-picky eaters($t=3.84, p<.001$), but positively correlated with FA traits($r=.20, p<.05$). Furthermore, those who have elevated FA traits alone and those who exhibit both elevated FA traits and picky eating have higher BMI than those who are picky eaters only($F=18.05, p<.001$). This study indicates that food avoidant and FA traits are overrepresented in children with ASD. Moreover, there appears to be an overlap between selective eating and FA traits in ASD, suggestive of a 'selective overeating' phenotype. Finally, picky eating(lower) and FA(higher) exert opposing influences on BMI in the context of ASD. This study informs our understanding of eating behaviors in ASD that could serve as behavioral risk factors for obesity.

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Interrupting Lady Lawyer: An Analysis of the Mere Exposure Effect and Implicit Gender Bias During Supreme Court Oral Arguments

The purpose of this study is to examine the impact of the mere exposure effect on the manifestations of implicit gender bias towards female lawyers during Supreme Court oral arguments. Implicit gender biases are unconscious and automatic associations of gender with a role, assumption, or evaluation. The mere exposure effect is a psychological tendency where people are inclined to develop a preference for things simply because they are familiar with them. To answer this question, this study measured the treatment of female attorneys based on frequency and length of interruptions and types of questions from justices throughout female attorneys' careers arguing before the Supreme Court. A match sample was conducted in order to track changes in treatment towards male attorneys during oral arguments, allowing for a comparison of the manifestations of the mere exposure effect and the identification of differences in the rate of change potentially due to attorney gender. From these data, turning points in the rate of change were identified and corresponding cases were content coded to measure the information-seeking level of justices' questions. This research adds to the understanding of the treatment and social phenomenon that female attorneys experience because of their gender before the highest court in the land. The results have significant implications for any organization where women are in the minority and are in leadership positions—whether it is the glass “bar” or the glass ceiling, women face real challenges in advancing in their profession.

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Depressive Symptoms, Child Adjustment, and Father Involvement in African American Families

The association between maternal depressive symptoms and adverse child outcomes (Goodman et al., 2001) may be moderated by father involvement (Mezulis et al., 2004). These associations are understudied among low-income, unmarried or non-cohabiting African American families.

We hypothesized that: (1) father involvement would be negatively associated with (a) maternal depressive symptoms and (b) child externalizing and internalizing behaviors, (2a) maternal depressive symptoms would be positively associated with child internalizing and externalizing behaviors, and (2b) father involvement would moderate these associations such that the positive associations between maternal depressive symptoms and child internalizing and externalizing behaviors would be weaker with higher levels of father involvement.

Participants were 79 low-income, African American mothers ($M = 31.96$, $SD = 7.85$, range 22-59 years), with a child between ages 2-12 years ($M = 6.25$, $SD = 2.76$; 52% boys). The majority were unmarried (78%) and non-cohabiting with the child's biological father (62%).

Depressive symptoms were measured using the Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977; 20 items).

Child behavior problems were measured using the internalizing and externalizing subscales from the Strength and Difficulties Questionnaire (SDQ; Goodman, 1999; 25 items).

Father involvement was measured using the Multidimensional Father Involvement Scale (MFIS), adapted from existing scales (e.g., Hawkins et al., 2002; 43 items).

In contrast to hypothesis 1a, Pearson correlations indicated that father involvement and maternal depressive symptoms were not significantly correlated ($r = .02$, $p = .43$). Partially supporting hypothesis 1b, father involvement was inversely associated with child internalizing behaviors ($r = -.22$, $p = .03$), but not externalizing behaviors ($r = -.11$, $p = .17$).

Hierarchical regression analyses supported hypothesis 2a that maternal depressive symptoms were positively associated with both child externalizing ($\beta = .32$, $p = .005$) and internalizing behaviors ($\beta = .37$, $p = .001$). However, the interaction of maternal depressive symptoms and father involvement was not significant (internalizing $\beta = .13$, $p = .232$; externalizing behaviors $\beta = .04$, $p = .706$).

Findings indicate that maternal depressive symptoms may be a risk factor for child behavior problems and that interventions promoting increased father involvement may be helpful in reducing these problems. In contrast to previous research (Mezulis et al., 2004), we did not find support for moderation, possibly due to the use of cross-sectional, maternal reports of father involvement. Future research could examine father reports of the quality of their involvement (Coley & Morris, 2002).

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Neuro-Cognitive Models to Predict Differences in Social and Non-Social Learning Among Typically Developing Adolescents and Adolescents with Autism Spectrum Disorder

Learning is critical for acquiring skills in both social and non-social contexts. Learning in a social context is a prerequisite to foster positive peer relationships, whereas learning in a non-social context is imperative to promote positive academic outcomes. Formally, learning can be defined as the ability to update predictions through prediction errors (PEs—the difference between expected outcomes and actual feedback from the environment). Despite observed differences in social and academic outcomes of adolescents with autism spectrum disorder (ASD), a mechanistic understanding of how adolescents with ASD integrate feedback to learn is lacking.

In a preliminary study, Dr. Rosenblau and colleagues found that adolescents with ASD integrate feedback to a lesser extent than typically developing (TD) adolescents when learning about their peers (i.e., social learning). To assess whether adolescents with ASD show specific differences in social learning, or whether they generalize across social and non-social domains, we have recently devised a non social learning task. In this task, participants are introduced to robots who invented a new language. These robots introduce a pseudo-adjective, or “nonsense” word (e.g., soaf) to the participant. These “nonsense” words have an English translation, for example colorful. The participants do not know the English translation. During the task, participants are asked to rate items on how ‘soaf (i.e., colorful)’ they are. Following each rating, the participant will receive the robot’s judgement on how ‘soaf (i.e., colorful)’ the item is. Upon completion of the task, participants are asked to infer the translation of the “nonsense” word.

We hypothesize that adolescents with ASD will use a more similar strategy to TD adolescents when learning in the non-social condition compared to the social condition (e.g., they will integrate feedback more in the non-social compared to the social condition). In order to answer this research question, we are currently collecting pilot data on both non-social and social tasks in TD adolescents and adolescents with ASD. We will compare PEs in the social and non-social conditions and whether they decrease over time across TD and ASD groups, and whether the difference in learning between social and non-social conditions are more pronounced in ASD compared to TD adolescents.

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The Real Housewives of Cultivated Aggression: How Docusoap Viewing Correlates with Negative Behavior

Through the use of surveys, this study aimed to examine the correlation between The Real Housewives reality television show (TRH) viewing and the approval of verbal and physical aggression, with the hypotheses that viewing will positively correlate with the approval of verbal and physical aggression for women. The issue is not how much television we are consuming, but what the consequences of this are. Participants in the survey were asked to rate their approval of verbal and physical aggression in response to prompts taken from TRH. After the prompts, participants were asked to respond to general belief questions relating to verbal and physical aggression. The findings suggested there to be weak to no correlations between the variables. This paper concludes with a discussion of the implications and suggestions for future research.

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Leadership and LGBT Workplace Equality

Existing research has demonstrated the positive effect transformational leadership has on diversity management in organizations; however, limited research has been conducted that explores this relationship with regard to sexual orientation and gender identity diversity specifically. This study seeks to examine the relationship between leadership style and LGBT equality in organizations. The data utilized in the study focuses on Fortune 500 companies that were included in the Human Rights Campaign's 2015 Corporate Equality Index (CEI). Data about the leadership styles of Fortune 500 executives was drawn from a content analysis of 2014 CEO shareholder letters conducted by Legutko (2016). Preliminary findings show little relationship between a company's CEI rating and the CEO's leadership style, but a strong relationship between CEI rating and the regulatory framework of the state where the companies' headquarters resides. The study concludes with a discussion of findings and implications for organizations and future research.

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What is the Impact of Marijuana Legalization? Testing for Differences in Marijuana Cognitions as a Function of Marijuana Policies

Over the past decade the US has seen significant shifts in marijuana policy with some states having no marijuana legalization (NML), some passing medical marijuana laws (MML) and others passing recreational marijuana laws (RML). Previous literature, which has focused almost exclusively on adolescents or young adults, suggests that legislation impacts marijuana cognitions. One gap in the literature is an absence of research testing whether there are differences in perceived norms and attitudes associated with marijuana among adults as a function of legislation. The Prototype Willingness Model (PWM) and Theory of Planned Behavior (TPB) are two dominant models that explain decisions to use substances. These models posit that attitudes and perceived social norms have an indirect impact on behavior, marking these as important cognitions to study in the context of marijuana.

The present study tested whether (1) injunctive norms, (2) descriptive norms and (3) attitudes, differ as a function of the legal status of marijuana.

Sample matching was used to recruit a nationally representative sample of US adults (N=3150; 41.1% female; 57.5% White). Participants' state of residence was classified as NML, MML, or RML. Analysis of Covariance (ANCOVA) tested whether attitudes and norms (i.e., injunctive and descriptive) differed as a function of state after controlling for age, gender, and ideology.

Objective 1. Those in RML states reported higher injunctive norms ($M = 3.78$; $SE = .06$) than those in MML states ($M = 3.25$; $SE = .04$) and NML states ($M = 2.91$; $SE = .05$; $F = 71.33$, $p < .01$). The difference between MML and NML states was also statistically significant. *Objective 2.* Those RML states reported higher descriptive norms ($M = 47.92$; $SE = 1.03$) than those in MML states ($M = 45.07$; $SE = .66$) and NML ($M = 44.18$; $SE = .82$); $F = 4.22$, $p < .05$). The difference between MML and NML states was not statistically significant. *Objective 3.* There were no significant differences in attitudes in RML states ($M = 3.21$; $SE = .06$) compared to MML ($M = 3.07$, $SE = .04$) and NML ($M = 3.03$; $SE = .05$; $F = 2.66$, $p > .05$).

Results suggest that among US adults, legislation has the potential to influence norms, but may not have an impact on attitudes.

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The Role of Norms and Best Practices in Commercial Rendezvous and Proximity Operations (RPO) and On-Orbit Satellite Servicing (OOS)

The modern space economy is regulated by a complex array of international treaties and principles, domestic legislation, governmental and corporate policies and traditions, and the particulars of party-to-party contracts. Despite the diversification of commercial actors in space activities since 2000, space law has been characterized by an insufficiency of legally binding treaties; none have been negotiated in the Legal Subcommittee (LSC) of the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS), let alone adopted, for more than three decades.

Part of the reason for the relatively small amount of legislation governing space activities is that UNCOPUOS operates on a basis of full consensus. As a result, the treaties and principles of space governance agreed upon in the LSC contain legally vague language, so as to make unilateral consensus more plausible for all members. In the case of commercial space activities, the OST empowers member States to pursue individual legal implementations of their obligations to suit their domestic market, and often falls short of explicitly defining key terms. Consequently, potential commercial providers of OOS enter into an operational domain in which their activities are dominated by a combination of domestic regulatory oversight and the “norms” and “best practices” that constitute nonlegal industry standards.

The 1972 Convention on International Liability for Damage Caused by Space Objects provides that a launching State shall be liable to pay compensation for damage caused by its space objects (including those from commercial actors) on the surface of the Earth or to aircraft and due to its faults in space. This convention provides both barriers and opportunities for commercial actors looking to develop RPO and OOS services. As OOS remains an emergent technology heavily dependent on accurate Space Situational Awareness (SSA) data, commercial providers of RPO-enabled OOS stand poised to act as major players contributing to and directly influencing these “best practice” standards of operation. Forums such as CONFERS (Consortium for Execution of Rendezvous and Servicing Operations) provide a venue for developers, operators, investors, customers, policymakers, and insurers to engage in a norm-building process, fostering Transparency and Confidence-Building Measures (TCBMs) and working towards a collective set of industry standards that jointly protect commercial participants’ financial and strategic interests. This paper will elaborate on the importance of such norm-building institutions to developing regulatory guidelines in space law, as well as implications of commercial OOS for active debris removal (ADR) activities and other space sustainability efforts.

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The Silenced Women: An Investigation on Reporting of Violence Against Women

How does public mobilization affect reporting of violence against women (VAW)? I investigate this question in light of a brutal gang rape incident that took place in Delhi in December 2012 and catapulted all of India into a public outcry. Protests and demonstrations of an unprecedented magnitude broke out across the country, marking a social shock. I document evidence on the impact of this social shock on reporting of VAW. In doing so, I utilize a set of difference-in-difference models, exploiting regional variation in exposure to the shock, which is measured by proximity to the focal district (i.e. district where the incident took place). Treatment is assigned based on 2 types of proximities, physical proximity (measured by road networks) and social proximity (a multi-dimensional measure that compares locations on an array of baseline socio-economic indicators). Estimates from both models yield a counter-intuitive result; districts that were closer to the focal-district witnessed a higher rate of VAW post-incident. The increase in VAW is finding is surprising, especially in light of various legislative and policing measures that were undertaken to mitigate it and may be reconciled by a mechanism where the increase is stemming from rise in reporting rather than surge in incidence. To substantiate this thesis, I furnish evidence on retrospective reporting of VAW, using a unique repository of complaints I compiled, which records daily crime data at incident-level. This evidence suggests a 12 p.p. increase in retrospective reporting of rape, post-incident. These findings inform us on the role of public mobilization in encouraging reporting of VAW—a grave global issue subject to considerable pervasive under-reporting.

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Policy and Practice of Disability in Rural Zones of Southern Peru and Coastal Ecuador

This project investigates the sociopolitical realities for individuals with physical disabilities in rural zones of Ecuador and Peru.

Ecuador is an exemplary country for the inclusion of disabled individuals in public and private spaces. In 2012, former President, Rafael Correa, signed La Ley Orgánica de Discapacidad, a law that protects the rights of individuals with disability and calls for the inclusion of these individuals in public spaces. Current President, Lenin Moreno, understands the importance of the inclusion of disabled individuals as he himself has been in a wheelchair since 1998. Peru is attempting to follow Ecuador in terms of disability policy. Law No. 29973 of Peru grants individuals with disabilities the same rights and protections as the rest of the population. Individuals can also receive benefits from the Ministry of Health which seeks to guarantee the entry of the disabled person into a system of universal insurance.

While at the global and country level, policy makers and institutions such as the World Health Organization, seek to define physical disability, at the local level, care providers have to consider policy guidelines handed down to them from above and manage scarce resources to address needs. This project intends to understand the policy and practice of disability at the most local level. 22 case studies were taken between 2017-2018 within two communities in Ecuador and Peru, whose names are protected based on the recommendations of the George Washington University Institutional Review Board. Ethnographic research was primarily collected through one, 1-2 hour interviews with individuals with disabilities, their family members, medical professionals, and community leaders.

This study found there is a shortage of medical professional to diagnose disability in rural zones of Ecuador and Peru. Individuals can travel to urban centers to receive a diagnosis from a registered medical professional, but many physically disabled individuals must, nonetheless, rely on familial support and must have the financial ability. Support and financial ability were not the case for many research participants. Without proper diagnoses from registered medical professionals, individuals with disabilities are not qualified to receive economic aid and political support. This research seeks to contribute to a greater understanding of the extent to which individuals with disabilities do not have access to needed support services.

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Coparenting, Parenting Style, and Child Behavior Problems in a Diverse, Low-Income, Community Sample

Coparenting quality describes the collaboration between two parental figures who share child-raising responsibilities (Feinberg, 2002). Lower coparenting quality is associated with more child behavior problems (Teubert & Piquart, 2010). Research suggests that some parenting behaviors mediate the relationship between coparenting and child behavior problems (Jones et al., 2003; Krishnakumar, Buehler, & Barber, 2003; Sturge-Apple, Davies & Cummings, 2006). However, these studies lacked representative samples and solely focused on coparenting conflict, while neglecting other aspects of coparenting. The current study examines the associations between coparenting, parenting style, and children's behavior problems with a self-report measure of coparenting quality in a sample of ethnically diverse, low-income mothers. We hypothesized that higher levels of coparenting quality would be associated with lower levels of child behavior problems and that parenting style would mediate this association.

63 low-income mothers (73% African American, 14% Latina, and 13% Other) with young children were recruited as part of a larger parenting study. 42% were in romantic relationship with their child's father and 36% were living with their child's father. Participants completed three self-report measures: Coparenting Relationship Scale (CRS; Feinberg, Brown, & Kan, 2012), Parenting Styles and Dimensions Questionnaire (PSDQ; Robinson et al., 2001), Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997).

Pearson correlations indicated that coparenting quality was negatively correlated with children's externalizing ($r(63) = -.48, p < .00$) and internalizing ($r(63) = -.30, p < .05$) behaviors. Authoritarian parenting was positively correlated with children's internalizing behaviors ($r(63) = .38, p < .01$). We analyzed the hypothesized mediating effect of authoritarian parenting on the relationship between coparenting and internalizing behavior. The indirect effect was $-0.17, 95\% \text{ CI} [-0.54, 0.14]$; so, we cannot conclude that authoritarian parenting mediated the effects of coparenting quality on children's internalizing behavior.

Our findings are consistent with previous research in indicating that positive coparenting quality is associated with lower levels of externalizing and internalizing child behavior problems. These results suggest that coparenting quality may be a protective factor for child adjustment. We also found evidence for the association between authoritarian parenting and higher levels of internalizing behaviors. Our results did not support the notion that parenting style was a mediating effect on the association between coparenting and internalizing behavior problems. Limitations to the current study include its limited and exclusively female sample size and its cross-sectional design. These results expand the current coparenting literature by including a sample of low-income, racially diverse mothers who are not romantically involved and/or living with their child's other parent. Future studies should continue to examine the relationship between coparenting quality, parenting style, and child behavior problems in diverse samples.

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SCHOOL OF MEDIA & PUBLIC AFFAIRS

The Untold Stories of Migrant Individuals

The subject of my creative research project is the stories of some of the most marginalized individuals in the current political climate: Latinx migrants who travel to the United States who are fleeing systemic poverty and gang violence in their native country. I will contextualize and analyze their stories under the impression that their stories often go unheard—creating a disconnect between what U.S. citizens believe to be true of these migrants and what the reality of their stories tell us.

What inspired me to start this project is the dozens of stories that I heard directly from the hundreds of travelers that I came across while I volunteered as a research and administrative assistant at Casanicolás, a migrant hostel in Monterrey, Mexico for 7 weeks in the summer of 2018. These people were traveling with the final goal of Monterrey or to cross the Mexican-U.S. border for various reasons, but most commonly in order to flee poverty and gang violence in Honduras. My work there included conducting interviews with them, record-keeping and serving meals. I also took on a research project aimed at compiling resources for the travelers to use in order to find work visas for jobs in the United States.

I plan on focusing on one central character throughout a short documentary—a migrant who has stopped to rest at Casanicolás before continuing onto the final leg of their journey to the border. This story will be interspersed with video interviews of other people who can further contextualize the challenges that these people face, such as other travelers or legal personnel in Monterrey. Specifically, I would like to ask the Honduran satellite ambassador for a video interview, as I had already spoken to her on my last trip to Monterrey.

Since the travelers are about to cross the US-Mexican border within about 3 days of arriving at Casanicolás, I would like to ask them: 1) What circumstances made you feel like this dangerous journey was necessary? 2) What are you seeking in the United States? and 3) What you have observed in the U.S. immigration system, if you have been deported before? (as many of the people who attempt to cross the border have been detained and deported from the United States before).

In terms of research and data that I will present to my audience (outside of the individuals' stories), I will introduce them to the realities of the US's modern immigration process—specifically with the more than 10-year-long wait times for citizenship applications to be processed and the risky and nearly impossible process of obtaining work visas in the United States.

I will also use four video interviews that I have already conducted with a co-worker of mine—Luis Abdiel, a Puerto Rican student at the University of the Sacred Heart in San Juan—with the interviewee's permission for it to be used for social media and education in the United States.

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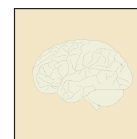
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Measuring the Evolution of Innovation in Patent Citation Networks

Economists, historians and business leaders generally agree that innovation is inextricably linked to continued prosperity and national competitiveness. Accordingly, nations sponsor research and craft legislation, such as intellectual property protection, to stimulate innovation. Yet, to persuade a public skeptical of government expenditures, leaders and policymakers often seek ways to assess this investment and quantify its benefits. This study aims to address the broad practical question: is there a rigorous way to quantifiably assess innovation and its spread with currently available data?

This investigation measures the propagation of innovation and the evolution of knowledge by examining the changing structures of patent citation networks. Patents comprise the best source of public intellectual property information and are commonly used to construct a large network of patent nodes linked by their citations, which generally represent flows of knowledge.

Within this analytical framework, an index of total knowledge contribution (TKC) is developed to measure the impact of the intellectual property in individual patents on subsequent inventions. The index is applied to citation networks constructed from patents granted between 1976 and 2018 in a variety of USPC technology sectors. Comparing the distribution and rates of TKC for networks from different fields of research, this study interprets statistically significant differences between sectors and identifies quickly evolving areas of development. Subsampling by policy regime determines the impact of “first-to-file” patent legislation on innovation rates (ongoing). Finally, an ARIMA model is applied to forecast TKC for each test sector, demonstrating the use of the index to identify emerging areas of appropriate research (ongoing).

This research constitutes a novel method for assessing the contribution of individual patents to public knowledge and predicting the effect of observable patent features, technology sectors, and policy programs on the evolution of innovation in patent citation networks.

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U.S. Bank Clearinghouses Before the Fed

Merchants and banks routinely accumulate claims against other merchants or other banks. To pursue such claims one by one would be onerous. Multilateral clearing arose to address these kinds of problems, culminating in organized clearinghouses. Clearinghouses were a surprisingly effective way to reduce the costs of trade processing, and economize on scarce hard currency reserves.

Clearinghouses have arisen several times in financial history. An early appearance was in the Medieval era, as an outgrowth of a series of international trade fairs. Bank clearinghouses also arose with early modern era banks, such as in England in the 18th century. More recently, and in the United States, the first US bank clearinghouses began to appear in the mid 19th century, the first in New York in 1853, but eventually spreading to other cities. Later in the 19th century, and also in the early 20th century, some stock and commodity exchanges developed their own clearinghouses. As a consequence of clearing claims among banks, bank clearinghouses also acquired a regulatory role, even in some cases acting as a kind of 'lender of last resort' for member banks. Then, in the early 20th century, with the Panic of 1907 and then the founding of the Federal Reserve System in 1914, which cleared bank claims on a national level, city-based US bank clearinghouses lost their main function and seem to have nearly withered away.

On the other hand, since the financial crisis of 2007-2009, some financial reformers are increasingly arguing for renewed reliance on clearinghouses to better control over the counter derivatives such as the notorious credit default swaps. It would be useful to have a broader understanding of the strengths and weaknesses of the clearinghouse structure.

What factors led to the rise and fall of so many bank clearinghouses? What lessons can be learned from the history of older clearinghouses for the operation of modern clearinghouses?

This research will proceed in stages. From our reading, we have already learned that there were many more clearinghouses that are discussed in the academic literature. We have begun to gather data on these early clearinghouses and their members. Then, as adequate data becomes available, we will explore what kinds of roles clearinghouses played, what factors clearinghouse cities shared, and which were extraneous, which promoted clearinghouses, and which discouraged them.

With these findings, we expect to be able to make a compelling argument for or against the revival of clearinghouse structures to assist in the regulation of new financial products and other potential roles.

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Let's Talk About Food: The Social and Economic Implications of Living with Celiac Disease

Our ethnographic research addresses the effects of an invisible food disability and the role of food in social settings of first-year college students. As freshmen ourselves, we acknowledge the role food plays in structuring our social lives and recognize the need for equitable access to nutritious and balanced meals. We studied the effects of celiac disease disability on two white heterosexual males from a strong socio-economic background, while also considering the support and roles of the participants' family, friends, and academic settings. By doing so, we wish to increase awareness about celiac disease, address the social significance of food in society, and explain the role of others in supporting individuals with the condition. We hope that family and friends of those with celiac disease make a greater effort to include them in their settings and we urge food organizations and academic institutions realize to understand the importance of providing easily accessible, appetizing and affordable gluten-free products.

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The Power of Collective Song in a Gender-Diverse Singing Group

Recommended techniques for gender-related voice modification services include resonant voice (Kapsner-Smith, 2015, Carew, Dacakis, & Oates, 2007) and semi-occluded vocal tract exercises (Titze, 2002b, 2006); these are also used in singing pedagogy in the form of Chiaroscuro (Kirkpatrick, 2009). Psychosocial benefits of choral singing (Von Lob, Camic, & Clift, 2010) could be valuable to the marginalized gender-diverse populations. This research study explores auditory-perceptual, acoustic, and psychosocial effects of a gender-diverse singing group experience for transgender and gender diverse participants.

Four 90-minute sessions each included self-reflection of voice use over the week, guided relaxation and postural alignment, a series of vocal warm-ups, and learning of two songs. Home practice guides and digital recordings were provided. Five participants identifying as trans or gender-queer took part in the program, but only two (one trans man assigned female at birth and one gender-queer, masculine of center person assigned female at birth) completed pre- and post- evaluations of average speaking and singing fundamental frequency (pitch) and range, and auditory-perceptual ratings of vocal qualities, and guided interviews about their gender positioning and experiences. Follow-up phone calls two weeks following the program collected more impressions.

Both participants were interested in exploring their vocal abilities in a group singing setting, and specifically desired to improve their vocal control and quality. Auditory-perceptual ratings confirmed that both participants improved their overall voice quality, roughness, breathiness, strain, pitch, and loudness. Fundamental frequency (pitch) during speech and singing samples were stable within 1 ST over the program; total pitch range ability was stable for 1 participant and increased by 30% (from 7 to 21 ST) for the other. Participants felt that the program positively affected their vocal tension, vocal health, self-image, sense of community, understanding of voice, control over volume, and oral resonance. However, they wished the program was longer and included more participants. Participants noted that the program allowed them to experiment with their voice in a comfortable and safe environment, and that there was a pressing need for voice and communication services to the transgender community.

Participant feedback and subjective data indicate the program positively affected participants' vocal experience and sense of community although little voice change occurred. The experience of group singing provided many positive psychosocial aspects, warranting further studies of how singing can support populations working towards their desired vocal presentation. Future studies should include participants seeking change in the speaking voice.

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The Effect of Physical Activity on Motivation

Self-Determination Theory (SDT) explains that individuals have three psychological needs: competence, autonomy, and relatedness. If one has high levels of these needs, they will engage in more physical activity (PA). Existing research has also shown that PA can increase levels of psychological needs (Gunnell, Belanger, & Brunet, 2016). A person's competence would increase after going to the gym to exercise, if they exerted effort and succeeded. Similar logic applies to autonomy and relatedness as well. The objective of the current study was to examine the immediate effect of PA on competence, autonomy, and relatedness.

The study involved a three-group between subjects design. All participants were undergraduate or graduate students at the university ($M_{age} = 20.35$, $SD = 3.31$; male=117; 50.6% White). Participants in the pre- ($N = 75$) and post-exercise ($N = 75$) groups were recruited from the university exercise facility. Participants in the control group ($N = 92$) were recruited from an undergraduate student subject pool. Participants in the pre-exercise condition completed the questionnaire immediately before exercise, those in the post-exercise condition completed the questionnaire immediately after exercise, and those in the control condition completed the questionnaire in lab. Participants completed the Basic Psychological Needs in Exercise Scale (BPNES; Vlachopoulos, Ntoumanis, & Smith, 2010). They were asked to respond to 11 statements about competence, autonomy, and relatedness. The response options included 1 (*I don't agree at all*), 2 (*I agree a little bit*), 3 (*I somewhat agree*), 4 (*I agree a lot*), and 5 (*I completely agree*). Levels of competence, autonomy, and relatedness were compared between conditions using a multivariate analysis of covariance (MANCOVA).

Competence ($M_{pre} = 4.06$, $M_{post} = 4.02$, $p = 0.70$), autonomy ($M_{pre} = 4.22$, $M_{post} = 4.25$, $p = 0.50$), and relatedness scores ($M_{pre} = 3.82$, $M_{post} = 3.60$, $p = 0.42$) were not significantly higher in participants in the post-exercise condition, compared to participants in the pre-exercise conditions.

This data does not support the study hypothesis that PA has an immediate effect on competence, autonomy, and relatedness levels. Need levels were significantly higher in participants who were in the pre- and post-exercise condition compared to participants in the control group. The results do not indicate an immediate effect on competence, autonomy, and relatedness from PA. Future research should test the effect of physically going to a fitness center on psychological need levels.

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Culture and Student Engagement: Making Success in Your Own Way

Higher education has been considered a mainstay for economic self-sufficiency and responsible citizenship. A considerable amount of Western research has identified student engagement as a key element for understanding and predicting students' learning outcomes. However, due to cultural differences in educational philosophies, it remains questionable whether this model receives universal support from different cultures. As more Asian students are coming to the U.S. for higher education, it becomes imperative for American educators to understand how Asian students may differ from domestic American students in their motives to engage in various in-class and outside-of-class activities, as well as how these motives predict their learning behaviors and outcomes so as to better integrate Asian students to the American educational system.

Building upon existing studies, this research examines cultural variations in the effect of students' interaction goals for engagement (instrumental, identity, and relational goals) on various types of engagement behaviors (behavioral vs. cognitive engagement) and learning outcomes (educational vs. social learning outcomes).

Data were collected from students at the George Washington University. Participants were 461 American students and 55 sojourning students from Asia. Participants were asked to fill out an online survey questionnaire that measures various types of interaction goals for student engagement, various types of engagement behaviors, as well as various types of learning outcomes. Statistical analysis techniques, such as t-tests and multiple regression, are being used to analyze data.

The research tests the following hypotheses:

H1: Asian students will place more importance on instrumental and self-effacement goals and less importance on social and self-enhancement goals for engagement than American students;

H2: Asian students will report higher cognitive engagement and lower behavioral engagement than American students.

H3: Asian students will rate higher in educational outcomes and lower in social outcomes than American students.

H4: The effect of engagement on learning outcomes is moderated by culture, such as (a) the effect of cognitive engagement on educational learning outcomes is more pronounced for Asian students, whereas (b) the effect of behavioral engagement on personal/social learning outcomes is more pronounced for American students.

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Predictors of Willingness and Intentions to Binge Drink among College Students

In order to design effective interventions to combat binge drinking, it is important to understand how college students' beliefs about alcohol predict their willingness to engage in such behavior. Several studies demonstrate that injunctive and descriptive norms about drinking predict alcohol use (Bosari & Carey, 2003). The college life alcohol salience scale, which measures students' perceptions of how central drinking is to the college experience, is also positively correlated with alcohol use (Osberg et al., 2012). Personality variables, such as a tendency to use substances to cope with negative emotions and a greater need for inclusion (i.e., need to belong) have also been linked to greater alcohol use (Gerrard et al., 2012; Litt et al., 2012). Using a cross-sectional survey of 349 college students (61.3% female), we examined which of these variables are the strongest predictors of men versus women's willingness and intentions to binge drink.

Simple linear regressions revealed that, for both males and females, descriptive norms, injunctive norms, college life alcohol salience, and substance use-as-coping, were associated with willingness to continue drinking after already feeling drunk (all p s < .01). Greater endorsement of the need to belong was significantly associated with willingness to continue drinking among men (p = .015) but not women (p = .09). Multiple linear regressions revealed further differences for men and women. For women, when all variables were included in the model, alcohol salience (p < .001), substance use-as-coping (p < .001), and injunctive norms (p = .002) predicted willingness to continue drinking. For men, only alcohol salience (p < .001) and substance use-as-coping (p = .048) emerged as significant predictors.

For participants' willingness to get drunk/wasted, for both men and women, all variables were significant predictors (p s < .01) other than need to belong. When all variables were included in a single model, women's willingness to get drunk/wasted was predicted by injunctive norms (p = 0.015), college life salience (p < .001), and substance use-as-coping (p < .001). For men, only college life salience (p < .001) and descriptive norms (p = .009) were significant predictors. The pattern of results was identical for students' intentions to binge drink.

Results suggest that college life alcohol salience is a key predictor of both men and women's drinking behaviors. Women may be more influenced by injunctive norms, whereas men are more influenced by descriptive norms. Further, women's drinking cognitions may be more motivated by a need to cope with negative emotions. Results can inform alcohol use interventions, and support the idea that gender is important to consider in these interventions.

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SCHOOL OF BUSINESS

Waste, Space, and Place: The Study of the Circular Economy Applied to DC's Economic Development Progress

Within the DC Metropolitan Area, growth in urban development projects has drastically increased over the past 20 years. Though the DC Government strives to generate sustainable economic development, the paper hypothesizes that these approaches are not fully taking into consideration circular economy theories. The Ellen MacArthur Foundation defines the circular economy on three pillars: to design out waste and pollution, to keep products and materials in use, and to regenerate natural systems. Utilizing this lens of the circular economy, this research study applies these concepts to development in DC.

This paper follows the pillars outlined above, and reviews each of the components to highlight a holistic approach to urban development. Specifically, the paper will further dive into the design aspects of creating metropolitan environments suitable for sustainable growth, applying current literature on retail placemaking and innovation districts. Furthering this process, the study will shift to current practices of construction and demolition, as well as the waste that comes from this process. The paper will then briefly touch on how communities as a whole are impacted by this type of development. As case studies this research will specifically focus on two communities with differing challenges and assets: DC's 1st and 8th Wards. From this analysis, we will build a set of principles and policy recommendations based on the case studies previously discussed.

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The Market Relationship between Ride-Hailing and Urban Transit: Evidence from a Natural Experiment in Portland, Oregon

The service of ride-hailing, most famously provided by transportation network corporations (TNCs) Uber and Lyft, presents a new mode of transportation in American urban areas. This paper explores the microeconomic relationship between ride-hailing and public transit in Portland, Oregon. Exploiting the legalization of ride-hailing as a discontinuity in treatment, this paper identifies the effects of ride-hailing on the ridership of Portland's transit agency TriMet. The results of a basic regression discontinuity in time (RDIT) model and a nonlinear piecewise regression model suggest that the legalization of ride-hailing caused a consistent decrease in monthly ridership rates over time rather than an immediate level decrease. Assuming the presence of a trend change in the data, a final trend change-based RDIT model controls for other determinants of ridership and identifies more stark effects occurring for TriMet's city buses and commuter rail services. Ultimately, the paper concludes that ride-hailing generally substitutes for public transit in urbanized areas, but that this effect varies across public transit modes. For TriMet's total ridership, the legalization of ride-hailing changed the trend of ridership over time from a relatively constant trend to a decrease of about 0.4% each month on average.

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The Relationship Between Callous-Unemotional Behaviors and Social Fear: A Cross-Lagged Analysis

Callous-unemotional behaviors (CU) (e.g., low empathy and callous treatment of others) are an early risk factor for severe conduct problems. The temperament characteristic “social fear” may protect children from developing CU behaviors by rendering children more aware of social cues and inhibiting behavior during unfamiliar social situations. To date, few studies have examined the associations between CU and social fear (SF) in toddlerhood. The current study examined their association by using a cross-lagged twin design to examine the stability, change, and reciprocal influences of these constructs from ages 2 to 3 years, and the extent to which genetic and environmental factors contribute to observed associations.

Participants included 314 same-sex twin pairs from the Boston University Twin Project ($N_{MZ}=144$, $N_{DZ}=168$) assessed at ages 2 and 3. CU was assessed via an empirically validated five-item subset of the Child Behavior Checklist Ages 1½-5 (parent report). SF was assessed via the Social Fear subscale of the Toddler Behavior Assessment Questionnaire (parent report), a measure of child temperament.

CU showed moderate genetic influences at ages 2 ($A^2=.54$) and 3 ($A^2=.31$). Shared and nonshared environmental influences were observed at ages 2 ($C^2=.17$; $E^2=.29$) and nonshared at age 3 ($C^2=.09$; $E^2=.41$). SF showed shared and nonshared environmental influences at ages 2 ($C^2=.24$; $E^2=.24$) and 3 ($C^2=.07$; $E^2=.31$). Genetic influences on SF were significant at age 2 ($A^2=.52$) and at 3 ($A^2=.35$).

The phenotypic associations between CU and SF at ages 2 and 3 were respectively $r=.47$ and $r=.22$. This relationship was explained by genetic and environmental factors.

SF and CU were correlated across age (SF $r=.55$, CU $r=.49$). Both SF and CU were moderately stable over time ($\beta_{CU}=.43$, $\beta_{SF}=.52$). SF at age 2 significantly predicted CU at age 3 ($\beta_{21}=-.13$), and this association was primarily driven by genetic factors. CU did not predict SF over time.

These findings suggest higher social fear predicts less callous-unemotional behaviors over time, and that a common set of genes explain this relationship. It is possible that higher social fear makes some toddlers more aware of social cues and, perhaps, more sensitive to social consequences of CU behaviors. Genetic influences may be driving this relationship. This finding shows promise for early intervention in CU.

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Workplace Tracking: Impact of Job Title on Experience

Since the release of the American Management Association's (AMA) "2007 Electronic Monitoring & Surveillance Survey", no updated list of workplace tracking types has been published (2008). The survey does not include tracking types that are nearly ubiquitous in the present day, including audio and video surveillance. It is essential that a current list of items be established considering the advancements in workplace tracking systems and their use, like for the promotion of sustainable behaviors. Researchers found that feedback and goal setting, which can both be achieved through the use of workplace tracking systems, provided the most positive changes concerning waste reduction, a sustainable behavior (Young et al., 2015). The present study supplied an updated inventory of workplace monitoring, which includes monitoring types such as waste disposal and energy use.

The foundation of the updated inventory was developed using the results of the AMA's survey. Other forms of workplace tracking were found through additional research in addition to personal observations from I-O psychology doctoral students. To condense the list of items for use in a Qualtrics survey, some subcomponents were created. For example, the tracking of cell phone, computer and internet use were broken down into content (ex. websites visited) and activity (ex. track time spent online). The inventory and Qualtrics survey were reviewed again, in conjunction with further research to form the finalized list of 42 workplace tracking items. Using a pool of MTurk workers, the survey established how individuals are monitored, the categories that the monitoring falls into and how job title (using O*NET occupation codes) might be correlated with acceptance of and experience with workplace tracking. These correlations have important implications for how employees view and accept workplace tracking within their workplace and how monitoring can be used to implement positive changes. The development of this inventory may alert employers to more recent forms of tracking, which can be implemented in their organization. Furthermore, this inventory can be used by employers and future researchers to better understand how employees perceive monitoring technology within their organization, their 'acceptance' of it.

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