



University of South Alabama

**Journal of Undergraduate
Research and Creative
Activities**

JOURACA, Volume 1, Issue 2, 2018

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| Table of Contents | ii |
| Welcome | iii |
| A Message from the Editors | iv |
| Aims and Scope | v |
| Greetings Curious Readers | v |
| RESEARCH ABSTRACTS | 1 |
| Volunteer Research Internship (VIP) Program Participants | 56 |
| Louis Stokes Alliances for Minority Participation (LSAMP) Program..... | 63 |
| (LSAMP) Program Participants | 64 |
| Original Undergraduate Research Articles | 66 |
| Communicating with Contemporaries: A Chapbook By: Micaela Walley | 67 |
| Defining a Monument: Claude Monet's Grande Décorations and Their Failure to Post-War France Tiffany Hester | 92 |
| A q -Analog of Legendre's Theorem Sam Formichella..... | 106 |
| 1 Introduction..... | 106 |
| 2 q -Analog..... | 107 |
| 3 Cyclotomic Polynomials..... | 109 |
| 4 A q -Analog of Legendre's and Kummer's Theorems | 111 |
| 5 Acknowledgements..... | 112 |
| Synthesis of Pt/Ceria Catalysts for the Water-Gas Shift Reaction Using Supercritical Deposition Mikayla Walters..... | 138 |
| REFERENCES..... | 153 |
| A Message from Alan F. Chow | 155 |

WELCOME

Undergraduate research (UR) is a high impact practice! What does that mean? It means that it positively effects GPA, retention, graduation rates, and acceptance into graduate programs. How does it do this? Is it magic?

Well yes, sort of, it is! UR requires students to learn new knowledge and techniques and to apply them rapidly while they are being acquired. This intense and goal-directed learning changes students perception of College, of their relationship with faculty, of their field of study, and of their place in the world. This magical type of learning is called transformational learning, and really changes students lives.

When I first started the Student Organization for Undergraduate Research, and hired the first Undergraduate Research Ambassadors, I had no idea how wonderful they would be. Now I can plainly see that being student leaders for the SOAR has also been transformative, and that the student leaders for this journal have pushed the boundaries of the journal in terms of scope and quality.



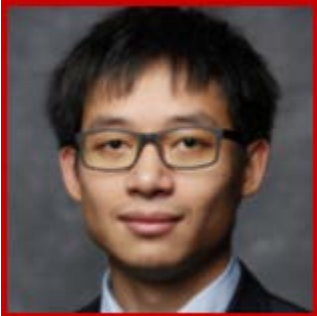

I want to give a special thank you to Dr. Al Chow, who has sought out and taken charge of the Journal. He has been a great sponsor, mentor, and friend to me and the students this year, and his leadership is greatly appreciated! I want to encourage all faculty and students to read and submit to JOURACA, South Alabama's first and only truly interdisciplinary, undergraduate journal.

Sincerely!

Jack Shelley-Tremblay, Ph.D.
Director of Undergraduate Research
Advisor of the Student Organization
of Academic Research
Professor of Psychology
Department of Psychology



A MESSAGE FROM THE EDITORS

| | |
|---|---|
|  | <p>I am excited to join the JOURACA Team as a new JOURACA editor. My name is Monica Sai Pasala, and I am currently a junior pursuing a major in biomedical science and a minor in computer science. I was born in India and moved to America when I was 10 years old. Recently I have realized that my aspirations to become a physician come with a passion for research. I thoroughly enjoy researching on the molecular level and see myself working as a clinician and a researcher. Along with serving the people, I hope to make contributions to scientific and technological advances through research.</p> <p style="text-align: right;">-Monica Sai Pasala, SOAR Secretary</p> |
|  | <p>As Managing Editor for the Journal of Undergraduate Research and Creative Activities (JOURACA) and as President for the Student Organization of Academic Research (SOAR), I see that JOURACA and SOAR are organizations founded by students for students. Our biggest goal is to provide students with more opportunities to publish their work and develop themselves professionally to promote their future careers and enable opportunities. We hope that our readers will take advantage of this opportunities and gives us editors plenty of late nights working getting the next edition out.</p> <p style="text-align: right;">- Kevin Ingles, President, SOAR</p> |
|  | <p>As the SOAR Vice-president, I have been helping out with the other officers to plan out different SOAR events and put together this journal. Thank you for reading the first issue of JOURACA. Our goal is to showcase the variety of research and other creative activities in which undergraduate students from various academic disciplines at the University of South Alabama have been involved. We are excited to jumpstart this preliminary edition containing the abstracts from students who participated in SURF and VIP programs in summer 2016. After going through this first issue, please let us know if you have any comments, suggestions, or questions.</p> <p style="text-align: right;">Phiwat Klomkaew, Vice President SOAR</p> |
|  | <p>I will graduate in December 2017, after which I will begin Graduate School at the University of South Alabama to obtain an Alternative Master of Secondary Education as a Noyce Pathway to Mathematics Scholar, a part of the NSF Robert Noyce Teaching Scholarship Program. I have greatly enjoyed editing this volume of JOURACA.</p> <p style="text-align: right;">Dru McCleave, SOAR Treasurer</p> |

AIMS AND SCOPE

The Journal of Undergraduate Research and Creative Activities is a platform of undergraduate researchers to present their works in all fields of study. The goal of this journal is to provide students of South Alabama with an opportunity to promote their work and receive real feedback from professionals in their respective fields of study, as well as, promote professional development. We aim to publish original and high quality work from all fields of study.

All submission should be in English and can be formatted in the convention typical for your discipline. All submission are subject to a peer-review process. Preference is given to novel work the contributes to the knowledge of the respective field.

Submission deadlines for the spring issue in March 1st and October 1st in the fall. Publication can be expected to be completed by the following month and will be made available online.

GREETINGS CURIOUS READERS

This is our first official publication of the Journal of Undergraduate Research and Creative Activities! We started this journal with the intention of providing a platform for aspiring researches and enthusiasts to put forth their ideas and receive real-time feedback from experts in their field. We also know that having a publication one's CV can leave quite the impression, both for private jobs and graduate school applications, and so wanted to provide a local opportunity to develop themselves professionally.

But aside from enabling current researchers, we also hope to encourage more student to engage in undergraduate research. There are simply skills that cannot be learned in the classroom, but obtaining hands-on experience in a laboratory can. This is what makes students that have completed undergraduate research so attractive to future employers.

We hope you enjoy our first edition, and look forward to many more in the future. Stay on the lookout for our Spring call for papers!

-JOURACA Team

RESEARCH ABSTRACTS

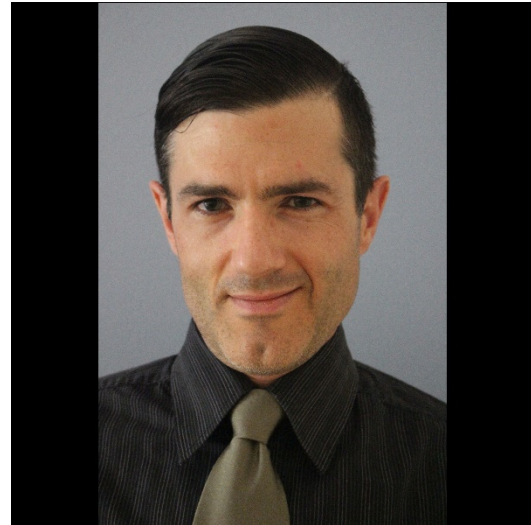
Chad Austin

Department of Electrical Engineering

Mentor: Dr. David Nelson

Department of Mechanical Engineering,
College of Engineering

*Integration and Optimization of an Antenna-Sensor
System for Biomedical Applications*



It is well established that hemodynamics can provide information regarding patient health. Particularly, the velocity of blood flow can indicate the existence of vascular disease, such as peripheral artery disease. Moreover, a survey of current vascular diagnostic methods provided on the websites of the National Heart, Lung and Blood Institute of the NIH and Harvard Medical School presently indicates a significant need for simple and efficient blood flowmetry device. One proposed method of measuring blood flow involves heating the skin and observing the temperature response. More specifically, the core idea in this approach is that the rate of skin heating is a function of blood flow, where different rates of heating are associated with different blood flow rates. The key components of such flowmetry methods are the thermal applicator and sensors to measure the change in temperature, and various techniques have been proposed. Webb et al. have proposed the use of actuator-sensor system embedded in a thin, skin-conforming material. However, Nelson et al. have proposed using electromagnetic radiation in the millimeter wave spectrum for the mechanism of heating. This project concerns the design optimization and system integration for a blood flowmetry device that relies upon millimeter wave heating and infrared sensor technology. This patented Millimeter Wave Flow (MMWF) technology has great potential for use in clinical applications, and previous design challenges have been ameliorated by use of new microstrip antenna design. Thus, a major aspect of the optimization process is focused on determining which operating parameters, keeping the device design in mind, obtain the best and most efficient heating from the antenna. The vector network analyzer was used to calculate the reflection coefficient for the fabricated single patch antenna when used in close proximity to a dielectric polyethylene gel. This data is useful for determining the resonance behavior of the antenna in close proximity to the gel. Several antennas were tested at distances of 2mm, 3mm, 4mm and 5mm from the gel. The data from the VA indicated the reflection loss is well below the desired -10 dB threshold, and resonance is between 32.5 and 34 GHz at distances from 2 – 3mm. This indicated possible improved surface heating in the near field. This data was used for optimizing and matching of the oscillator. It indicated that the 35 GHz oscillator needed to be tuned-down for better matching with the antenna.

Shahrzad Badri

Department of Chemistry

Mentor: Dr. Alexandra Stenson

**Department of Chemistry,
College of Arts and Sciences**

*Method Development for Nondestructively Quantifying
Concentrations of Carbon in Fractions of Humics*



Natural organic matter (NOM) is ubiquitous in ground and surface water and has been shown to possess biological activity, such as cancer cell suppression, at low concentrations. The most accurate method for obtaining concentration involves sample combustion through a total organic carbon (TOC) analysis system. Although TOC analysis allows for quick and direct carbon quantification, its primary weakness is its destruction of samples. Concentration calculation based on sample weight per amount of solvent is a nondestructive method, but often unreliable for trace analysis. Here, carbon concentration for samples of NOM were quantified nondestructively following Tipping et al.'s method of relating absorbance at two wavelengths to NOM total organic carbon content. Several fractionated and whole samples of NOM were weighed, dissolved, and serially diluted in preparation for UV testing. Samples were measured at 254, 280, and 340 nm (wavelengths pertinent to the study of NOM). As expected, concentrations from weighing produced the least accurate results for samples below ~0.5 mg. Relative errors were 0.25%, 1%, and 5% for the combustion-TOC method, Tipping-UV method, and weighing method, respectively. The data showed a strong correlation ($R^2 = 0.9968$) between the Tipping-UV method concentrations and combustion-TOC concentrations, particularly for the 254/340 wavelength pair. Statistical analysis with Excel's ANOVA function further corroborated the agreement between Tipping-UV and combustion-TOC results. The data suggests that Tipping-UV can nondestructively quantify carbon content, indicating that it is a viable alternative to TOC analysis for our samples.

Samuel Barber

Department of Geology

Mentor: Dr. Alex Beebe

**Department of Earth Sciences,
College of Arts and Sciences**

*Zonation of Coastal Dune Lakes in the Northwest
Florida Panhandle*



Coastal dune lakes (CDLs) are recognized as inland bodies of water that share an intermittent connection with sea and are typically found within dune ecosystems. These lakes are unique in that they are only found in a few locations worldwide including (e.g. Madagascar, Australia, Florida, etc.). Therefore, the purpose of this study was to investigate the formation and geo-evolution of a Florida CDL (i.e. Eastern Lake) through a detailed sedimentary analysis. Ten Ekman grab surface sediment samples were collected along a canoe transect spanning the length of Eastern Lake. The samples were dried, split, and processed to determine grain size distributions, fractions of organic carbon, grain angularity, and mineral composition. Results from sedimentological analyses reveal at least three unique depositional environments including: (1) a coarse-grained, moderately well-sorted, organic-poor, sandy beach 2) a fine-grained, very poorly-sorted, organic-rich central mud basin 3) a coarse-grained, poorly-sorted, organic-rich sandy marsh delta. These three environments are found in much larger nearby estuaries including Choctawhatchee Bay, Pensacola Bay, and Mobile Bay. Our results therefore suggest that coastal dune lakes may serve as down-scaled “micro-estuaries” and are functionally related to larger estuaries of the gulf coast and throughout the world.

Caroline Barnes

Department of Biology

Mentor: Dr. Kelly Major

**Department of Biology,
College of Arts and Sciences**

*The Role of Proteins and Oxidative Stress Tolerance in
Halotolerant Algae*



Studies that target extreme environments, and the microbes that inhabit them, offer invaluable insight into the mechanisms of stress tolerance and are likely to contribute to our understanding of the synergistic effects of multiple stressors in heavily-impacted or highly variable ecosystems. Moreover, microbial communities represent a largely untapped resource for potentially unique and economically or medicinally useful organisms. Isolates of *Dunaliella* (*Dunaliella* sp., a new species from the Salt Plains National Wildlife Refuge, OK; Henley et al. 2002) and *D. salina*, a well-characterized laboratory strain) are green algae that can survive and grow in salinities ranging from zero to > 150 ppt, withstand prolonged exposure to high temperatures of 38-45°C, and light intensities up to that of full sun (Henley et al. 2002). Our preliminary data show no evidence of any long-term culturing effect; both strains of *Dunaliella* grow equally well in salinities of 25 and 100 ppt (ca. 0.2 μ d⁻¹). Additionally, we have pigment and photosynthetic physiological data that also confirm this result. The next step of this project is to run single-factor salinity and temperature trials that will allow us to generate protein profiles for each species and condition. Ultimately, we plan to use proteomic approaches to identify proteins that change in abundance in response to environmental condition. We anticipate candidates responsible for conferrence of stress tolerance will likely include those involved with oxidative stress response, and photosynthetic pigment synthesis and binding, among others.

Cosette Baumgarten

Department of Speech and Hearing Sciences

Mentor: Dr. Kimberly Smith

**Department of Speech Pathology and Audiology,
College of Allied Health**

*Effects of Stimulus Presentation Timing and Response
Timing on Multimodality Sentence Recognition in
Older, Normal Hearing Individuals*



Individuals are faced with degraded listening and reading conditions in everyday environments; thus, having to understand both speech and text signals in conditions that may not allow for either signal to be fully obtainable. Understanding in these environments is particularly difficult for older listeners, even those that have age-normal hearing. By supplementing degraded speech information with visual cues (or supplementing text information with speech cues), sentences can be better comprehended. A previous study found that older adults perform poorer on both speech only and text only degraded conditions compared to younger, college aged adults. However, older listeners' performance improved in multimodality conditions compared to unimodal conditions. Many factors, including age, contribute to the success of processing multimodality information, such as stimulus presentation timing and response timing. Presenting text after speech can be less beneficial compared to a simultaneous presentation. Furthermore, having a delayed response to multimodality stimuli was found to be more beneficial than a simultaneous response. Despite these findings, questions remain regarding how these factors relate to processing of multimodality information in older, normal hearing adults. This study included four participants all native speakers of English between the ages 60-70. Testing was completed monaurally over headphones at a comfortable presentation level. All listeners completed testing for degraded speech and text stimuli in unimodal and multimodal conditions. Participants were instructed to repeat the sentence aloud or read the sentence as accurately as possible depending on the experimental condition. Only key words repeated exactly correct were scored as correct. So far, the unimodal delayed response appears to yield better accuracy than simultaneous, and the speech modality better than text in both the 8Hz and 16Hz data. Surprisingly, the presentation and response timing appeared to have no effect in the multimodal data meaning these factors may not matter for older listeners. However, more data is needed and more participants could affect the results or lead to a stronger pattern.

Kavlyn Bellais

Department of Geology

Mentor: Dr. Murlene Clark

**Department of Earth Sciences,
College of Arts and Sciences**

*Benthic Foraminiferal Assemblages of Eastern Lake,
Walton County, Florida*



The coastal dune lakes of Walton County, Florida represent a rare environment only found in a few other areas of the world, such as New Zealand and Madagascar. The lakes originally formed as estuaries in the geologic past, when sea level was much lower than today. At the end of the last ice age, these estuaries became drowned and separated from the Gulf of Mexico by migrating sand, as rising waters moved into the area. Today, the coastal dune lakes are largely controlled by streams that drain into them, although they are periodically invaded by salt water from the Gulf during storm surges. The ecology and overall health of these lakes has become an important environmental concern as the area has developed into a tourist center. An investigation of benthic foraminiferal populations in Eastern Lake has revealed information about the salinity, pH and bottom substrate of this understudied environment. Ten samples were collected from a north-south transect of Eastern Lake using a box core sampler. Samples were washed through a 63 micron sieve, and air dried. Benthic foraminifera were then picked, mounted on a slide and identified using a binocular microscope. The population in the lake is a zoned microcosm of foraminiferal populations described elsewhere along the Gulf Coast. Agglutinated forms are predominant in the less saline areas of the lake, while carbonate forms dominate areas under the influence of invading saltwater.

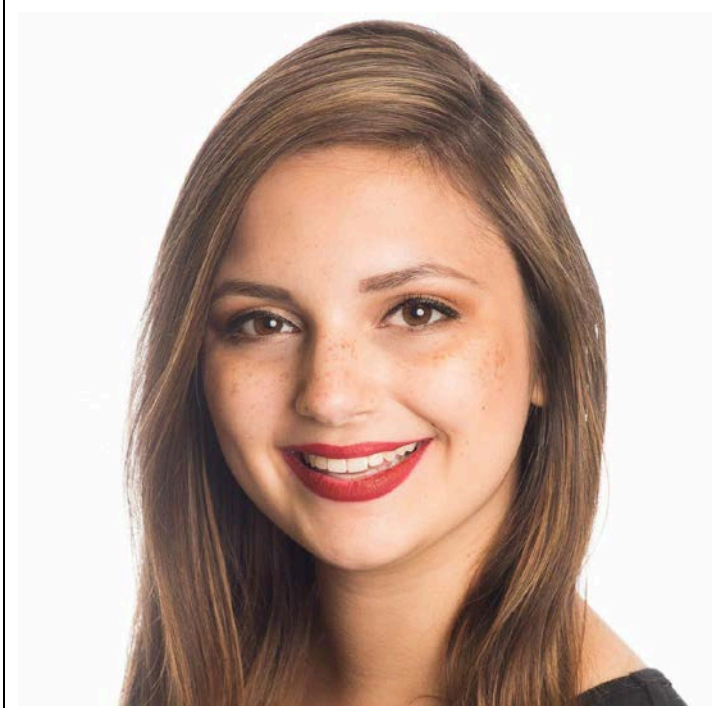
Elizabeth Bemis

Department of Music

Mentor: Dr. Dahye Choi

**Department of Speech Pathology &
Audiology, College of Allied Health**

*Autonomic Nervous Response During Fast
Speech in Children Who Do and Do Not
Stutter*



There has been a considerable number of studies that investigated the relation between linguistic stress and stuttering in adults and children who stutter. In order to rate the relative stress of each spoken syllable, most researchers used a subjective and perception-based scale (Cheung, Holden & Minifie, 1975); Prins, Hubbard & Krause, 1991) and based their stress analysis on a model of a nonstuttering adults' prosody. However, to date, no study has verified those studies' assumption that a nonstuttering adult's reading of the transcript of the stuttering child's speech represents or is comparable to the actual child's speech in terms of prosody or linguistic stress at the perceptual as well as physical/acoustic levels. Therefore the purpose of the study is to determine 1) whether there is a difference in stress patterns between an adult's and a child's speech based on perceptual judgment, and 2) whether there is a difference in acoustic features of linguistic stress between an adult's and a child's speech based on acoustic analyses. Eight children were prompted by photos to tell their own original narrative. From this narrative, six total utterances were selected - the three longest and three shortest utterances. Using Praat, the utterances were rated by the author in terms of stress perception and then annotated. The author then recorded herself saying these narratives and rated the perceived stress of the identical utterances as an example of adult speech. Both the children's and adult's examples were annotated on Praat with two levels. Then vowel duration, pitch, and intensity were measured and compared to identify correlates between stress perception and acoustic properties. These findings confirm much of the literature on acoustic correlates, indicating that duration and intensity are the most accurate correlates of stress. Fundamental frequency was not found to be of significant in terms of acoustic correlates of stress. The results also establish that adult and child speech patterns are significantly associated.

Dillon Blount

Department of Meteorology

Mentor: Dr. Sytske Kimball

**Department of Earth Sciences,
College of Arts and Sciences**

*Sea Breeze and Bay Breeze Interaction and Its Impact
on Thunderstorm Formation in Mobile County*



Sea and bay breezes are primary weather makers in the warm season along the southwest Alabama coast. In some cases, severe thunderstorms with dangerous lightning and flash flooding can occur. Such storms cause significant damage to life and property each year in our area. Predicting the exact location and timing of thunderstorms remain a challenge and analyzing a large number of past events will provide forecasters will helpful information. One way, sea and bay breezes can cause thunderstorm to form is when the two features collide. The sea (or Gulf) breeze moves northward from the Gulf coast, while the bay breeze moves westward from the western shore of Mobile bay. The two breeze then collide in the southeast corner of the county and frequently, but not always, a thunderstorm will form in that area. Environmental conditions such as wind speed and direction determine whether a sea and/or bay breeze will occur. Atmospheric sounding data from the National Weather Service in Slidell, Louisiana and WSR-88D radar data from the National Weather Service in Mobile, Alabama will be used in the analysis. During the warm season, sea and/or bay breezes are a factor in our weather in Mobile County quite often. On days when there is a Mobile County sea and bay breeze, convection occurs a little over half the time. The intersection of the breezes seems to be a key development area for this convection. The results are preliminary and future work will need to be done including a larger data set of years.

Tyler Brandon

Department of Music

Mentor: Dr. Rebecca Mindock

**Department of Music,
College of Arts and Sciences**

*Analyzing the Grail Motif in Richard Wagner's
"Parsifal"*



Richard Wagner's final stage work, *Parsifal*, represents the composer's most mature writing. It is in this work that Wagner perfected his compositional style, including his treatment of leitmotifs, or leading themes associated with specific characters or ideas. The story of *Parsifal* takes place in the Grail kingdom, a domain whose power lies within the Holy Grail. It describes the redemption of sin through the struggles of three characters: Amfortas, Kundry, and Parsifal; redemption is achieved for these characters through the power of the Grail. The music of the Grail plays an important role in the work because of the religious aspects that it conveys. These are furthered by its basis on the Dresden Amen, a popular church melody during Wagner's time. Through a methodical analysis with specific criteria, the Grail motif may be classified into three categories that describe its function – direct mention of the grail, slight reference to the motif, and interaction with another motif – each with a unique importance to the establishment and the reworking of the motif. The organization of the motifs asserts the Grail's importance in the work. Act I and Act III contain many references to the Grail, while Act II contains very few; this creates an arch structure that centralizes the role of the Grail

Rowland Burrell

Department of Psychology

Mentor: Dr. Benjamin Hill

Department of Psychology,
College of Arts and Sciences

*Improving Psychological Pre-Surgical Evaluations: A
Follow Up Study of Surgical Outcomes in Chronic Pain
Patients*



Chronic postsurgical pain has been implicated in a significant number of patients and can impact cognitive abilities and psychosocial functioning. Pain is a complex multidimensional construct that involves various psychological and physiological dimensions associated with the subjective experience of pain. Certain components can either influence the severity or capacity to regulate pain, such as, “pain catastrophizing” and “self-regulation.” Thus, it is important to consider appropriate evaluation methods that provide an accurate assessment of the domains pertaining to the pain experience (Epker, 2013). Improvements in pre-surgical psychological evaluations in chronic pain patients may facilitate enhancements in treatment outcomes resulting in a reduction of post-surgery recovery time, overall improvement in post-surgical psychological reports and enrichment of patient quality of life. The study focused on chronic pain patients with a surgical intervention to assuage the experience of pain and underwent previous evaluations several years after their surgery. Charts were reviewed for patients who met certain inclusion criteria including both cognitive screening evaluations and psychological variables related to pain and completed the Minnesota Multiphasic Personality Inventory (MMPI-2). Patients who met inclusion criteria were contacted by telephone and asked to complete a brief measure of pain symptoms and physical functioning. They were also asked to rate their level of satisfaction with the surgical procedure. This information was used to categorize patients into 3 group types, satisfactory, unsatisfactory and ambiguous. The information obtained at the pre-surgical evaluation was then used to predict membership in one of these outcome groups.

Benjamin Burton

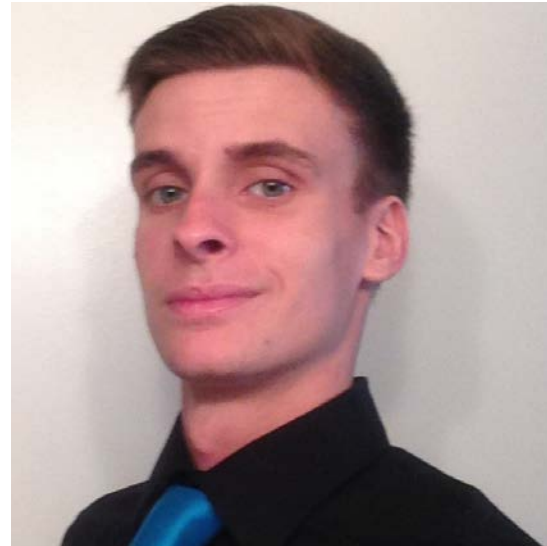
Department of Civil Engineering

Mentor: Dr. Samantha Islam

Department of Civil, Coastal, and Environmental Engineering,

College of Engineering

The Evaluation of Traffic Control Devices Used to Combat Rural Unsignalized Intersection Crashes and Their Effectiveness in Alabama



The research described in this paper analyzed historical crash data obtained from the Alabama Department of Transportation (ALDOT) to identify contributing factors in the crash severities of rural stop-controlled intersection accidents. Data analysis was performed for rural intersection accidents in Alabama by using the Critical Analysis Reporting Environment (CARE) system. All stop-controlled intersections in Alabama that received 20 or more than crashes during the time period between January 1st, 2010 and December 31st, 2014 were selected for this study and were identified using ArcMap 10.5 (GIS tool) along with CARE data. Eight problematic stop-controlled intersections were selected. Fourteen intersections received 20 or more crashes between January 1, 2010 and December 31, 2014. However, six intersections have since been signalized, leaving a remaining sample size of eight stop-controlled intersections. Eight problematic stop-controlled intersections were analyzed and are presented with recommended safety devices to reduce accident frequency. This paper focuses on cost-effective safety measures that are expected to reduce accident frequency at the selected intersections. The total estimated material and labor cost for the implementation of the recommended safety devices is also provided

Collin Carithers

Department of Mechanical Engineering, Music

Mentor: Dr. Carlos Montalvo

**Department of Mechanical Engineering,
College of Engineering**

Mobile Atmospheric Sensing System



The Facility for Aerial Systems and Technology (FAST) Lab currently has designed two custom made atmospheric sensors for autonomous quadcopters. They are codenamed FASTPitot4 (FP4) with the name given due to the use of 4 orthogonal pitot static probes on board the sensor. The FP4 sensor also contains a GPS sensor to measure Latitude, Longitude and Elevation as well as a BME280 sensor which measures pressure, temperature and humidity. All of this data is logged internally on a microsd card. The initial design of said sensor involved placing all pitot static tubes on long carbon fiber rods to remove the effects of propeller wash from the large 4 rotors on a quadcopter. During testing it was found that vibration noise from aerodynamics and spinning rotors causes a lot of signal noise; thus a new sensor codenamed FASTPitot4-V (FP4-V) where the V stands for vertical. In this design the four pitot probes are elevated above the rotor plane to try and mitigate vibration noise and propeller wash unfortunately thus far, all problems have not been eliminated. Future work must be done to isolate the inherent problems of measuring atmospheric winds onboard a moving platform. Thus, the goal of this SURF proposal is to improve the accuracy of these sensors by isolating the vibration patterns and determining the optimal way to reduce this vibration. In order to improve the accuracy of the FP4 sensors the number one concern is eliminating the vibration noise from the transducers. There are two ways to reduce the vibration. One, redesign the sensors and relocate the transducers to an area with lower vibration Two, apply for funding specifically for improved pitot probe technology and improved transducers (preferably Aeroprobe). In order for this project to be at its best both of these accomplishments need to be completed

Rebekah Cheatham

Department of Meteorology

Mentor: Dr. Sytske Kimball

**Department of Earth Sciences,
College of Arts and Sciences**

*Assessing the Relationship Between Land-Sea
Temperature Gradient and Sea Breezes on the Gulf
Coast*



Sea and bay breezes are primary weather makers in the warm season along the north-central Gulf Coast, including Mobile and Baldwin counties. In some cases, severe thunderstorms with dangerous lightning and flash flooding can occur. Such storms cause significant damage to life and property each year in our area. Therefore, being able to predict when sea breezes occur would be very helpful to local forecasters and the general public. Sea and bay breezes form in response to a difference in land and sea temperature during the warmest part of the day; this is known as a land-sea temperature gradient. The stronger the land-sea temperature gradient, the more likely the formation of a sea breeze. The (land-based) South Alabama Mesonet station for Loxley, AL is used for land temperature data. National Data Buoy Center (NDBC) buoy 42012 in the Gulf of Mexico 23 km south of Baldwin County is used for sea surface temperature data. This buoy can be used to calculate land-sea temperature gradients for Gulf breezes. Python code was written to calculate the land-sea temperature gradients. The results verify that stronger land-sea temperature gradients are associated with the occurrence of sea breezes in Southwest Alabama. Also, the number of sea breeze days per month generally increases as the sea breeze season progresses

William Chen

Department of Biomedical Sciences, Philosophy

Mentor: Dr. Kevin Meeker

**Department of Philosophy,
College Of Arts and Sciences**

*A Defense of Skeptical Theism: How Our Physical and
Cognitive Faculties Can Be Unreliable*



The probabilistic argument from evil claims that some features of evil provide strong evidence for atheism. Many philosophers have developed “skeptical theism” as a way to undermine this inference. According to this view, humans have a limited ability to perceive the complex relationship between good and evil. As a result, we cannot say that evils of this world are sufficient to count against the existence of God. In “Skeptical Theism and Skeptical Atheism”, J.L. Schellenberg criticizes skeptical theism by creating a parody argument called “skeptical atheism”, which is an argument that aims to undermine essential ways of justifying theistic belief. In this paper, I will be defending skeptical theism and demonstrating how Schellenberg’s argument fails to defeat skeptical theism.

Alexander Coley

Department of Biomedical Sciences

Mentor: Dr. Glen Borchert

**Department of Biology,
College of Arts and Sciences**

*SnoRNAs Have Gene-Regulatory Function in
Pancreatic Cancer Metastases*



Pancreatic ductal adenocarcinoma (PDAC) is an extremely lethal pancreatic cancer that is difficult to detect in its early stages and resistant to treatment once identified in a patient. PDAC growth is a stepwise process by which a primary tumor develops in the pancreas and differentiates itself into subclonal populations which metastasize to other organs, ending the life of the patient. In a recent study investigating the metabolic pathways of PDAC, we found that divergent metabolic pathways exist in metastases to the liver and the lungs (distant metastases) as compared to those that migrate to the peritoneal region (local metastases). Aware of the emerging role of noncoding RNAs (ncRNAs) as regulators of cancer growth, in our current study we have elected to examine the RNA landscape of PDAC tumors to determine what role specific RNAs play in the divergence of metabolism in PDAC metastases. ncRNAs are a broad group of RNAs that are not translated to protein. They exhibit gene regulatory function, and in recent studies have been linked to cancer growth, proliferation, metastasis, and invasion. In order to test whether ncRNAs fulfill this role in PDAC metastases, we sequenced the noncoding RNAs from multiple tumors. Several candidate noncoding RNAs were identified as misexpressed in the tumors, and thus represent possible drivers of PDAC metastasis. These ncRNAs will be targeted in knockout studies to further determine their role in PDAC progression. The identification of ncRNAs driving tumor differentiation in this study provides valuable insights into both the pathological impact of ncRNAs in pancreatic cancer as well as the overall importance of ncRNAs in gene expression and regulation.

Michael Cox

Department of Mechanical Engineering

Mentor: Dr. Gregory Poole

**Department of Mechanical Engineering,
College of Engineering**

*Modeling and Verification of Flow Patterns in
Inductively-Heated Risers for Metalcasting*



Electromagnetic induction heating of open risers presents an energy efficient means to maintain the alloy in its molten state for mass feeding whilst allowing riser size reduction and substantial material savings. This paper presents preliminary simulation results of solidification phenomena in an inductively heated top riser. The electromagnetic field was calculated using a hybrid control volume/integral method to solve the magnetic diffusion equation with accompanying boundary conditions, and used temperature dependent electrical conductivity. The heat transfer equation was solved using the control volume method. Computed results show that it is possible to prevent premature solidification of the riser even though Chvorinov's design criteria are violated. The significance of these findings pertaining to sand and ingot casting systems will be discussed.

Joshua Crownover

Department of Economics and Finance

Mentor: Dr. Alan Chow

**Department of Marketing and Quantitative Methods,
Mitchell College of Business**

*Connecting Student Activity Fee Allocation Systems with
Retention & Graduation Rates*



This study is part of a University Honors Thesis and assesses the various structures of higher education student fee allocations with particular interest in relation to Student Government, and attributes them to student success and retention. Institutions from several categories are reviewed including geographic location (Northeast, Southeast, Southwest, and Northwest), size of institution, research activity of institution (Carnegie Classification), and public vs. private institutions. Focus groups and surveys are used to collect relevant data.

Donavon Dahmer

Department of Biomedical Sciences

Mentor: Dr. Glen Borchert

**Department of Biology,
College of Arts and Sciences**

Novel Small RNA (sRNA) Landscape of the Starvation-Stress Response Transcriptome of Salmonella Enterica Serovar Typhimurium



According to the CDC, *Salmonella enterica* is responsible for millions of food-related illnesses each year resulting in approximately 19,000 hospitalizations and 400 mortalities annually. Treatments for *Salmonella* are becoming increasingly limited as individual *Salmonella* strains continue to develop novel antibiotic resistances. That said, within just the last few years, several small RNAs (sRNAs) have been identified as key, previously uncharacterized drivers of microbial defenses against stressors (e.g. sterilization techniques and antibiotics). In short, sRNAs are now known to be bacterial regulators that specialize in altering the levels of protein coding genes in correspondence to their external surroundings to ensure a high survival rate. Of note, less than 10 *Salmonella* sRNAs had been identified just five years ago. That said, the Borchert lab published work just last year identifying 58 entirely novel sRNAs involved in regulating the *Salmonella* carbon starvation response. Excitingly, through coupling the methodologies presented in that original study with several novel strategies, we have now successfully identified and validated 756 entirely new *Salmonella* sRNAs as presented here. Strikingly, in addition to their practical implications, our results suggest sRNA genes actually outnumber protein coding genes in *Salmonella* as well as in many other bacterial species. Perhaps most importantly, however, we find evidence suggesting several of the sRNAs identified in this work will likely prove functionally relevant to *Salmonella* stress adaptation and the acquisition of antibiotic resistances and therefore represent novel therapeutic targets.

Makavla Davis

Department of Biomedical Sciences

Mentor: Dr. Silas Leavesley

**Department of Mechanical Engineering,
College of Engineering**

Development of a Hyperspectral Imaging for Endoscopy



The use of different illumination conditions alters the way the human eye perceives objects. This perception is crucial in surgery, because it is how we determine if the tissue of a particular area appears abnormal and needs removal. The necessity of removal depends on if the tissue is cancerous or could potentially become cancerous. If it is determined that the tissue needs removal, margins of the tumor must be estimated to ensure no further growth of the abnormal tissue. The focus of this summer research was to develop an endoscope system that uses a mixture of endoscopic light source techniques to detect colorectal cancers in ex vivo tissues. Over the course of the summer we developed and tested a prototype spectral endoscope that was designed to image excised colorectal tissues. Spectral imaging detects the light-tissue responses at different wavelengths. This allows the operator to view the lesion in question with enhanced accuracy by generating different types of wavelength-dependent contrast within tissues. Tissues were procured through ongoing collaboration with the University of South Alabama College of Medicine, Departments of Surgery and Pathology. Preliminary data indicate that the spectral endoscope can be used for enhanced visualization of colorectal tissues when compared to others on the market.

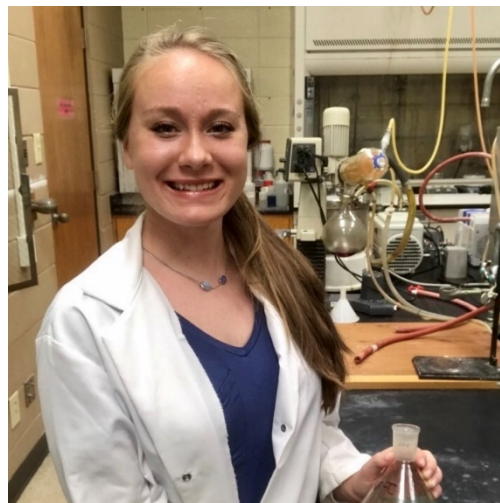
Emily Denison

Department of Music

Mentor: Dr. Larry Yet

**Department of Chemistry,
College of Arts and Sciences**

Imidazopyridine Ligands for Cross-Coupling Reactions



Cross-coupling reactions create a new carbon-carbon bond which cannot be achieved by other means. Our research project is based upon efficiently synthesizing numerous imidazo[1,2-a]pyridine ligands. When combined with a transition metal such as palladium, these ligands serve as a catalyst within cross-coupling reactions, allowing target molecules to be synthesized with greater ease than if no catalyst were present. Analogs of imidazo[1,2-a]pyridine ligands are made by reacting various aryl acetylenes with differing functionality with 2-aminopyridine and iodine. A diphenyl, dicyclohexyl, or di-tert-butyl phosphine group is then substituted in place of the iodine. Further reactions such as the Suzuki or Buchwald-Hartwig with the multiple imidazo[1,2-a]pyridine ligands will be done to understand how the structure and electronic environment of the ligand affects its ability as a catalyst.

Tyler Ellett

Department of Biomedical Sciences

Mentor: Dr. William Reichert

Department of Chemistry,
College of Arts and Sciences

Novel 3-D Printing Technology Utilizing Ionic Liquids



Additive manufacturing (AM), most commonly known as 3-D printing, has become the preferred method for many industries to make prototype objects because of its precise, rapid, and cost-efficient production of sophisticated geometric shapes. Currently, many techniques of AM use petroleum-based polymers, which are hazardous and non-degradable. Biopolymers, such as cellulose, have considerable properties of biodegradability and sustainability making it a main prospect for replacing petroleum-based polymers. The obstacle of incorporating cellulose is the difficulty of producing a consistent printable medium. Ionic liquids have provided solutions while simultaneously impacting various areas of research in the AM field. For example, ionic liquids can dissolve various biopolymers such as cellulose and chitin. The ionic liquid's ability to dissolve these biopolymers gives researchers a practical approach to produce mediums of biorenewable, biocompatible, and recyclable polymers. Additionally, as plasticizers, an ionic liquid incorporated within plastic improves both its durability and flexibility. Thus, the incorporation of ionic liquids as additives to stereolithography (SLA) and digital light processing (DLP) also provides another advantageous application. Ionic liquids can contribute to these current models of AM by furnishing the final 3-D printed product with a variety of properties, from increase durability over a longer time range to increased thermal stability. The final product will not only be a high-detailed object, but it will also possess the chemical functionality of the embedded ionic liquid. By incorporating ionic liquids into current additive manufacturing, technologies can have a considerable environmental and geopolitical benefits as well as increases in consumer safety and product lifetime.

Molly Espenan

Department of Psychology

Mentor: Dr. Benjamin Hill

Department of Psychology,
College of Arts and Sciences

*Effects of Chronic Pain on Personality, Pain Perception,
and Cognitive Functioning*



Objective: The purpose of the current study was to examine the relationship between emotional/internalizing dysfunction, neurocognitive status, and pain catastrophizing. **Participants and Methods:** Two hundred sixty-three participants (M age=52.3, SD=12.9; M education=13.5, SD=2.5; 60.5% Female, 89.9% White, 10.1% African American) presented to a Southeastern pain clinic for pre-surgical evaluation. All participants completed the Emotional/Internalizing Dysfunction (EID) scale as part of the Minnesota Multiphasic Personality Inventory-2-Restructured Form (MMPI-2- RF). Additionally, participants completed the Repeatable Battery for Assessment of Neuropsychological Status (RBANS), and the Pain Catastrophizing Scale (PCS) as part of a larger battery of tests. **Results:** Pearson's product-moment correlations revealed that both the EID scores $r(261) = .361, p < .001$ and RBANS total scores $r(261) = -.233, p < .001$ were significantly correlated with PCS ratings. Additionally, a multiple linear regression using backwards elimination was calculated to predict scores on the PCS based on both the EID scale and the RBANS total score. A significant regression equation was found ($F(2,260)=24.80, p < .001$), with an R^2 of .160. **Conclusions:** The experience of pain is multidimensional and may depend on many intrapersonal factors including mood, affect, and cognitive status. Higher scores on the Emotional/Internalizing (EID) scale as well lower scores on the RBANS significantly predicted the catastrophizing of pain. Further research should investigate the relationship between cognitive status, pain, and restructured clinical (RC) subscales of the MMPI-2-RF.

Sam Formichella

Department of Mathematics and Statistics

Mentor: Dr. Armin Straub

**Department of Math and Statistics,
College of Arts and Sciences**

q-Analogs of Factorials and Binomial Coefficients



From a classical combinatorial perspective, the binomial coefficient $\binom{n}{k}$ is defined only for non-negative integers n and k . Using complex analysis and the gamma function, one can extend the binomial coefficient to arbitrary complex entries. In the case when n and k are integers, a uniform combinatorial interpretation of the resulting binomial coefficient has been provided by Loeb (1992), based on the concept of sets with a negative number of elements. We extend this combinatorial interpretation to the case of q -binomial coefficients, which are the natural polynomial generalization of binomial coefficients. Moreover, we demonstrate that several of the well-known arithmetic properties of binomial coefficients also hold in the case of negative entries. In addition, we prove a q -version of Lucas' Theorem.

Gabrielle Gill

Department of Chemistry

Mentor: Dr. Jaclyn Bunch

**Department of Political Science and Criminal Justice,
College of Arts and Sciences**

A Comprehensive Study of the Affordable Care Act



Values are what shape multiple facets of any one individual's thoughts, opinions, and decisions. Health care values are similar in that they affect how a patient perceives their care. Health care professionals should, therefore, be conscious of how members of their community identify with common values in order to improve patient satisfaction and overall healthcare outcomes. This study utilizes survey research data and statistical software in order to analyze the opinion of high-frequency patient types on two key health care values: protecting a patient's right to privacy and health practices being guided by principles of fidelity and respect. The groups of interest in this study are categorized based on age and gender; in addition, these groups are chosen in such a way to complement those populations that are common patients in the community pharmacy setting as well as those most frequent users of healthcare services in general.

Lauren Hand

Department of Psychology

Mentor: Dr. Kim Zlomke

**Department of Psychology,
College of Arts and Sciences**

*The Effects of Childbirth Education on Mothers' Health
and Preparedness*



Background: Often, new mothers experience feelings of uncertainty, lack of preparation for parenthood, and postpartum depression during and after giving birth. Childbirth education may be able to compensate for these feelings by preparing and educating expectant mothers about the options they have and to give them the strength to labor and birth with confidence. **Research Question:** We explored the question: In what way does childbirth education prior to labor and motherhood influence mothers' health, confidence, and overall preparedness? We also studied the way that childbirth education impacts low income mothers, especially in circumstances where there is an absence of any other birth support for the expecting mother. **Further,** we examined the relationship first-time mothers' participation in childbirth education classes has with factors such as labor confidence and preparedness, parenting confidence and preparedness, and finally postpartum maternal health and well-being. **Methods:** Participants were screened to fit specific criteria such as female, aged 18-45, gave birth to their first child in the last 2 years, English as first language and a citizen of the United States. These participants completed a 30- minute online survey conducted through the online survey machine Amazon Mechanical Turk. This series of survey questions asks questions on several topics including demographics, participation in childbirth education class during pregnancy, self-report of birthing confidence, birth anxiety, coping during childbirth, satisfaction with birth experience, parenting confidence, support system, presence of postpartum depressive symptoms or clinical diagnosis of postpartum depression. **Results:** As we are still in the process of implementation and data collection, we hope to obtain a small sample of participants' responses. We will use this data to look for a correlation between participation in childbirth education courses during pregnancy and preparedness for birthing and parenting. **Conclusions:** We hope to see a positive correlation between participation in childbirth education and good maternal health, birthing confidence and preparedness as well as parenting confidence and preparedness. This study is anticipated to have an effect on first time expectant mothers' decisions to participate in educational programs during pregnancy and hopefully encourage childbirth education before birth to increase the overall health and knowledge of new mothers.

Elizabeth Hernandez

Department of Biomedical Sciences, Foreign Language

Mentor: Dr. Diego Alvarez

**Department of Physiology and Cell Biology, College of
Medicine**

*Identification of Health Literacy in the Immigrant
Latino Population in Mobile County, Alabama*



The degree to which individuals obtain, process and understand health information needed to make health decisions (health literacy) positively correlates with life quality and health care cost burden. It is projected that the Latino population, who historically has resided in marginalized areas and has little education, will become the largest minority group by 2020 in the United States. Considering that Latinos represent a group with little access to education and health care due to their immigrant status, it is likely that they have poor life quality and represent a burden for our health care system. However, the health literacy possessed by the immigrant Latino population is unknown, specifically in relation to diseases that they are commonly diagnosed with in the United States. Thus, we sought to determine the degree of health literacy of the immigrant Latino population in Mobile County particularly pertaining to diabetes. To achieve our goal, we are in the process of carrying out a community-based participatory study that has been approved by the University of South Alabama Institutional Review Board. The community to be studied will be centered around the advocacy group “Belong” located on Old Shell Road Mobile, AL 36608. Data will be acquired via a modified FINDRISK (FINnish Diabetes RIskSCore) diabetes survey. The survey will be administered at the headquarters of the advocacy group “Belong”. Questions in the survey will be asking about the participant’s knowledge of diabetes. It will also ask about regular physician visits and clinical conditions that run in their family. Data will be analyzed using Minitab software and categorical data (yes or no questions/answers) will be transformed into numerical (1 and 0) for quantitative purposes. Graphical display of the data will be performed using a Graphpad software. We anticipate that at the conclusion of our study, we will identify the basic knowledge (health literacy) of the Latino population in relation to diabetes.

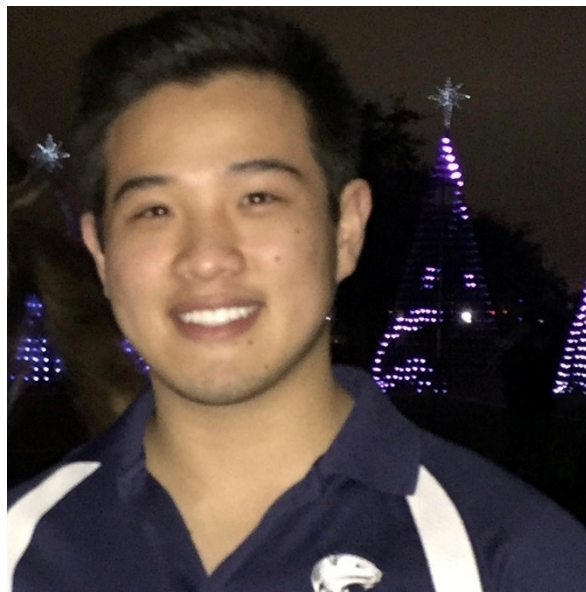
Meng Hu

Department of Biomedical Sciences

Mentor: Dr. Jianing Han

Department of Physics,
College of Arts and Sciences

Laser Amplification



What distance should atoms be pushed apart in order to maximize Van der Waals' repulsive forces? Building a laser amplification system can answer this question. Specifically, a low power laser beam will be sent to a high power laser diode. In other words, the low power laser will be used as a seed, which will be amplified through a high power laser diode. The beam comes out of the high power laser is similar to the incoming beam in polarization and frequency. There are many potential applications for this laser amplification system. For example, this can be used in laser trapping, based on the Stark effect, to trap both ground state atoms and excited state atoms. In addition, this can be also used for non-linear optics to generate other frequencies, such as frequency doubling, which can be used to excite ground state atoms to excited states. Atoms have to be in the excited states in order to exhibit the repulsive forces that will be studied. The high power laser will be the tool used to change the distance between the atoms through the Stark effect, which then changes the repulsive Van der Waals interaction strength. Ultimately, the repulsive forces will be utilized to push out an unneeded atom from a molecule. For example, this can be applied to cancer research, using visible laser light can push out certain atoms of cancer cells instead of ionizing the cells with high power rays. Currently, each component of the Laser Amplification system is working efficiently. The next step of this project is to actually seed the tapered amplifier properly in order for it to perform at maximum efficiency. Trials of seeding the tapered amplifier is currently unsuccessful, this may be explained by the fact the the tapered amplifier is multimode and all of the ones used in the references that we used were single mode. Efforts are currently made to try to change the multimode tapered amplifier to single mode through the use of partial reflective mirrors, in order for it to be seeded by a single mode seed laser. Once the proper seeding of the tapered amplifier is achieved, it will be used to run experiments on different atoms. The infrared ray produced by the seeded tapered amplifier will be focused on a single atom in hopes of exciting the electrons from the 1s orbital to the 2s orbital. Ultimately, this will be used to change the repulsive Van der Waals interaction strength in hopes of pushing out unwanted atoms from a cluster.

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|--|----------------------|
| <p><u>Jared Johnson</u></p> <p><i>Department of Biomedical Sciences, Philosophy</i></p> <p>Mentor: Dr. David Weber</p> <p>Department of Physiology and Cell Biology, College of Medicine</p> <p><i>TRPV4</i></p> | <p>Not pictured.</p> |
| <p>The progression of vascular stenosis in coronary and peripheral artery disease, atherosclerosis, and following stent placement are exacerbated by disturbances in blood flow and changes in shear stress to the vascular wall. Such flow changes signal via a variety of receptors on the endothelial cell (EC), many that respond via Ca²⁺ signaling. These Ca²⁺-mediated pathways in turn regulate vascular smooth muscle cell function and/or VSMC-mediated wall remodeling. It is surprising that the underlying EC Ca²⁺ signaling remains poorly understood. Accordingly, we investigated the TRPV4 channel, a potentially important contributor to EC Ca²⁺ regulation. Because the TRPV4 channel potentially mediates flow induced relaxation, we hypothesized that endothelial-specific TRPV4 ^{-/-} mice would therefore have hypercontractile activity and altered Ca²⁺ signaling patterns. Employing myography techniques to assess artery constrictor and dilator responses, we observed that the carotid arteries of these TRPV4^{-/-} mice have enhanced capacity for contraction and enhanced endothelium-dependent vasodilation. We also observed basal and agonist-induced changes in Ca²⁺ signaling via confocal microscopy. Basally we measured fewer signaling events but increased magnitude and duration, while Ach-induced Ca²⁺ responses showed an increased magnitude of dynamics. Initial observations suggest under chronic low flow conditions, induced via a carotid partial ligation model, EC TRPV4^{-/-} mice have exacerbated contractility and attenuated Ach-induced relaxation. Endothelial TRPV4 channels appear to be playing an underlying role in modulating vascular tone via their influence on calcium events and suggest TRPV4 plays an important role in endothelium regulation. EC TRPV4 channels might also play a role in helping to maintain vascular function in chronic low flow. Future studies will utilize pharmacological activators and inhibitors of TRPV4 channels to further clarify its overall contribution to vascular function during both normal and low flow conditions.</p> | |

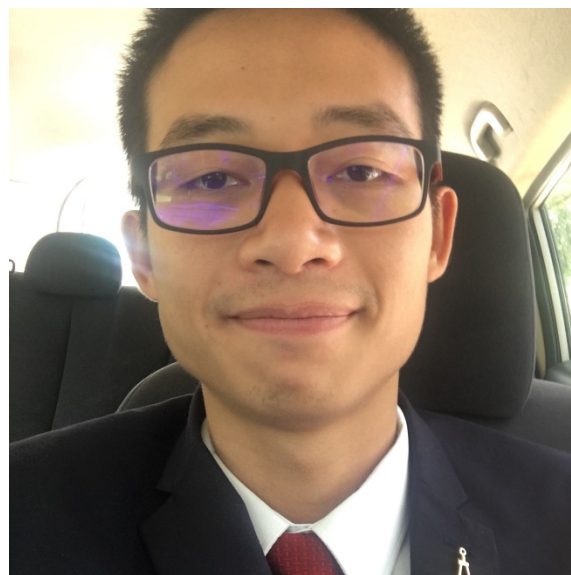
Phiwat Klomkaew

Department of Chemical Engineering

Mentor: Dr. Sean Walker

**Department of Chemical and Biomolecular
Engineering, College of Engineering**

*Optimization of Renewable Hydrogen Production for
Energy Storage*



Renewable energy sources like wind, solar, wave, and hydroelectric powers are environmentally friendly and sustainable ways to produce energy. During peak hours, the energy generated by a renewable energy source may exceed the general demand of the population, thereby causing excess energy being wasted. One way to make use of this excess energy is power-to-gas (P2G), the conversion of electrical energy to another stable, energy-efficient, and storable form as hydrogen gas. One interesting case study is the use of hydrogen fuel cell as an alternative fuel for a public transit system. In this study, a system includes the hourly process of renewable energy production, hydrogen conversion from renewable energy, hydrogen storage, and distribution of hydrogen to power public transits and to be sold to an energy grid for profit. System conditions are made unique to Mobile, Alabama, to study its feasibility, efficiency, economic gains, and environmental impact.

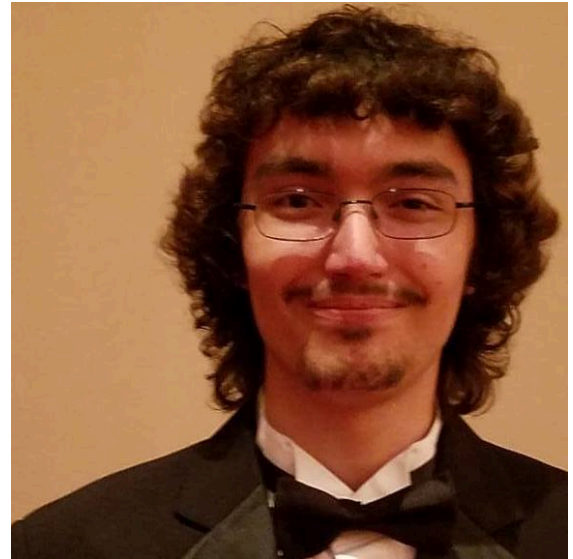
Peter Kohrman

Department of Music

Mentor: Dr. David Durant

**Department of Music,
College of Arts and Science**

Film Scoring: The Development of Convincing Digital Musical Mock-ups for the Purposes of Film and Other Media.



This project seeks to determine the methods, technologies, and compositional techniques required to produce music for media: film, video games, advertising, and more. Specifically, this project will focus on the creation of digital orchestral mock-ups by using sampled instruments, synthesizers, and live recordings. In order to be a composer for media in today's world, it is not enough to be just a composer or sound engineer/computer programmer; one must be the culmination of multiple, seemingly unrelated disciplines in order to attempt to succeed in today's competitive and demanding environment. Utilizing the skills and information gained over the course of this research, this project will culminate in the creation of a musical composition; the process will be documented from beginning to end—composition, realization (mock-up), and final production.

Caroline Kolakoski

Department of Meteorology

Mentor: Dr. Sytske Kimball

**Department of Earth Sciences,
College of Arts and Sciences**

Sea Breeze Analysis and Atmospheric Stability



Sea breezes are common in the Mobile Bay region during the warm season: May through October. Sea breezes can initiate strong and dangerous thunderstorms, but also provide approximately 25% of our total rainfall. The latter is important to agricultural activities in the region as well as water resource planning. While forecasters can predict when a given day may be conducive to thunderstorm formation, it is not possible to predict exactly when and where the thunderstorms will form that day. This research will aid in forecasting of potential thunderstorm formation more accurately. In this project, Mobile County sea breezes during the years 2006, 2007, and 2010 will be studied. Using radar images from the Mobile Doppler Weather radar (KMOB WSR-88D), days where sea breezes did and did not spark thunderstorms, will be identified. Differences in atmospheric stability parameters between the two categories will be compared. In this SURF project, radar data was analyzed with results shown in an excel document. Next computer code was written to read in this data, separate it into non-SB days, SB days, and convective SB days. From this the code calculated the averages over the years of 2006, 2007, and 2010 of the parameters: Cross Totals, Vertical Totals, Total Totals, and K Index for each of these three groups. As expected, it was found that convective SB days had averages that were closest to the thresholds, for thunderstorm formation, while days without a SB was the second closest and dry SB days were the least close. Over the next two years, the project will be expanded to include more stability parameters and at least 10 years of data. After the analysis is complete, a senior thesis will be written to discuss the findings.

Geri Langham

Department of Biomedical Sciences

Mentor: Dr. Martha Arrieta

**Department of Internal Medicine,
College of Medicine**

*Predictors of Successful Management of Diabetes in
Primary Care*



Background: In the US, Diabetes is the fifth cause of death among African-Americans. Alabama is one of the states with the highest rate of diabetes (prevalence = 16.1%). Of those affected, the majority are from ethnic minorities. The disease is associated with excess morbidity related to ischemic heart disease, stroke, end stage renal disease, blindness and amputations. Understanding factors that promote successful management of T2DM in primary care is important to formulate approaches leading to treatment compliance and reduction in acute and chronic complications from the disease. **Objective:** To investigate predictors of successful outcomes of treatment of type 2 diabetes mellitus (T2DM) in primary care clinics providing services to low resource population sub- groups. **Methods:** We evaluated data from a previous intervention study of outcomes of diabetes treatment(measured as change in Hemoglobin A1c -HbA1c levels)among patients randomly assigned to tele- or self-monitoring of blood glucose. Both groups received support from health care personnel. There were no significant differences in outcomes for patients in the intervention and comparison groups. Study findings suggested that close contact with health care personnel -as well as the provision of blood glucose monitoring supplies and practical support to patients- might explain the lack of significant differences in outcome between the two study arms. Given that only half of participants in the intervention and control groups improved their glycemic control, we used a case-control approach to explore demographic, behavioral, clinical, and practical support variables as predictors of successful diabetes management. **Results:** Among 182 participants in the intervention study, there were 95 patients (52%) who decreased (cases) and 39 patients who did not decrease (controls) their HbA1c level over the course of nine months. In addition, 48 patients were lost to follow up. Age younger than 65 years was a significant predictor of decreased HbA1c, however patients over 65 years of age were only 3.7% of the sample (OR = 11, 95%CI: 1.2 – 99.4). Contrary to expectation, neither education nor income were significantly associated with improved T2DM outcomes. There were no significant associations between behaviors (usual activity level and smoking) and clinical variables (duration of diabetes, body mass index, comorbidity) and decreased HbA1c. However, persons who did not habitually self-monitor their glucose status (SMBG) prior to participation in the intervention study were significantly more likely to decrease their HbA1c level when compared to persons who habitually SMBGd (OR = 2.9, 95% CI: 1.04 – 7.9). Interactions with study personnel (contacts to encourage compliance, to provide monitoring supplies and for general support -either individually or aggregated) did not show a significant association with decreased HBA1c levels.

Monica Lolley

Department of Exercise Science

Mentor: Dr. Jeremy Fletcher

**Department of Physical Therapy,
College of Allied Health**

*Effects of Incentives on Stage of Readiness to Change
for Physical Activity in College-Age Students*



Approximately 1 in 3 college age students in the United States are overweight and/or obese (Sparling, 2007). Contributing factors include a decline in leisure time physical activity, an increase in sedentary lifestyle and excessive caloric intake. Physical activity attitudes and practices adopted by young adults during their college years form the foundation for lifelong physical activity involvement (Young, et al., 2015). Stage of readiness to change is a “key predictor of students’ current physical activity habits” (Young, et al., 2015). Higher stages of change correspond to higher levels of physical activity (Womble, et al., 2014). Stage of readiness to change can also predict intention to use exercise facilities built on campus, provide highly effective exercise or physical activity programs for the college population, and determine the best marketing strategies for physical activity programs and facilities to target students (Young, et al., 2015). Therefore, the purpose of this controlled trial was to evaluate the effects of education alone and the effects of education plus incentives on stage of exercise readiness to change in college students enrolled in a physical education class. Of a population of 51 students, 17 students enrolled in the study. The control group was comprised of 9 students. At the beginning of the summer semester, 3 of the subjects in the control group fell into the Maintenance stage, 3 fell into the Action stage, and 2 fell into the Preparation stage. At the end of the summer semester, 4 of the subjects in the control group fell into the Maintenance stage, 2 fell into the Action stage, 2 fell into the Preparation stage, and 1 fell into the Contemplation stage. The incentive group was comprised of 8 students. At the beginning of the summer semester, 1 of the subjects in the incentive group fell into the Maintenance stage, 4 fell into the Action stage, and 3 fell into the Preparation stage. At the end of the summer semester, only 7 subjects completed the repeat questionnaire; however, 2 of the subjects in the incentive group fell into the Maintenance stage, 4 fell into the Action stage, and 1 fell into the Preparation stage. Limitations to this study include number of participants. Future studies will consider the use of incentives to increase subject recruitment.

Evan Mazur

Department of Civil Engineering, Music

Mentor: Dr. Stephanie Smallegan

Department of Civil Engineering (Coastal), College of Engineering

Barrier Island Impact by Hurricanes and the Parameters Governing Damage Due to Erosion



Barrier islands are landforms common along the U.S. Atlantic and Gulf of Mexico coasts that provide important ecological services. They also serve as the first line of protection against storm waves and surge for the mainland coast, causing them to be vulnerable to damage during storm events, such as hurricanes. In this study, the numerical model XBeach was used to evaluate the vulnerability of a barrier island to hurricane forcing. XBeach is a computer model that accurately simulates hydrodynamics (i.e. waves and surge) and the resulting morphological change (i.e. erosion) on barrier islands during storm events. The model uses a pre-existing topography grid created for Bay Head, NJ, a township located on a barrier island. First, a model using the storm forcing from Hurricane Sandy was used in order to learn coding skills with MATLAB and running simulations remotely using the Alabama Supercomputer. Then, a parameterized storm was simulated in order to develop a broader understanding of the research process. From this project, a method was created for developing model setups for additional parameterized storms. Model output parameters most relevant to assessing barrier island vulnerability were also identified.

Albert McCleave

Department of Math and Statistics

Mentor: Dr. Rajarshi Dey

Department of Mathematics and Statistics, College of Arts and Sciences

Population Change in the Wake of a Hurricane: a Spatial Temporal Study



This research studied the population changes of counties affected by hurricanes along the Gulf and Atlantic Coasts of the United States, from Texas to North Carolina, to determine if hurricanes have a significant impact on the growth rates of the counties that they affect. County population data was retrieved from intercensal estimates produced by the United States Census Bureau from 1970 to 2010, while hurricane data was collected from a combination of the HURDAT2 database, NOAA's website information, and a collection of published research on coastal population patterns. A comparison of the actual population of the landfall county one and three years after the hurricane to the time series projected population at those times showed no significant difference. A comparison of the population change one and three years after a hurricane of the landfall county with neighboring counties, defined by similar population size and poverty levels, also showed no significant difference after the hurricane. The coastal counties of Georgia, which experienced one to three hurricanes over the time period, had a significantly different population growth than the coastal counties of North Carolina, which experienced six or more hurricanes during that time. Due to similar demographics and geography but varying hurricane activity, further testing will be done to compare the growth rates of Georgia, South Carolina, North Carolina and Virginia. At this time, there is not enough data to conclude that hurricanes have a significant impact on the population growth rate of the county of direct landfall.

Mason Mesler

Department of CIS Health Informatics, Information Systems

Mentor: Dr. Brad Glisson

**Department of Information Systems and Technology,
School of Computing**

Examining Automotive Apps for Residual Data



Academicians and practitioners are increasingly becoming concerned with the security of automotive apps. Recent reports indicate that these apps are vulnerable to reverse engineering which potentially puts an individual's personal and vehicle data at risk. This research compliments previous efforts to examine residual data resident on mobile devices from security and forensics perspectives. Previous mobile device research has identified residual data artifacts as data that is comprised of information that could pertain to an individual's personal or device data such as contacts, text messages, GPS data, emails, and passwords. This research implements a controlled experiment to explore and identify residual data on mobile devices that is specifically associated with automotive interactions. The experiment examines automobile applications from fourteen (14) manufacturers. These Android apps interface with an automobile to acquire data like tire pressure, fuel levels, unlock/lock doors, and remote start. The data capture protocol for this experiment utilized XRY's logical and physical extraction capabilities. XRY is an industry accepted toolkit that is commonly used by law enforcement. Preliminary results indicate that two out of the fourteen (14) apps have pertinent residual data without parring to the vehicle that can be used to reverse engineer and assist in a security attack.

Errieol Milliner

Department of Physics

Mentor: Dr. Martin Frank

**Department of Physics,
College of Arts and Sciences**

NOvA Experiment Cosmic Ray Rejection Algorithm



The existence of the magnetic monopole has eluded physicists for centuries. The search for this particle is important because it would help explain why charge is quantized. As part of the international NOvA Collaboration, we use data from NOvA's high energy particle detector located in Ash River, MN to search for such monopoles. This detector is the first massive detector (14,000 tons) of its kind to be so close to the surface of the earth making it an ideal monopole detector. The first stage of the monopole search algorithm is to remove obvious non- monopole particles (e.g. cosmic-ray muons) from the data, this stage is known as clustering. In this poster, I will present a detailed study of the various elements that make up the initial clustering algorithm.

Anniestacia Miskel

Department of Civil Engineering

Mentor: Dr. Arka Pandit

Department of Civil, Coastal, and Environmental Engineering,

College of Engineering

Managing Urban Stormwater Runoff: Life-Cycle Environmental Impact and Cost Assessment



Uncontrolled urban stormwater runoff is one of the major challenges faced by the urban regions. Typical to old infrastructure systems, stormwater runoff is often mixed with municipal wastewater for treatment at the municipal wastewater treatment plant (WWTP). However, during high intensity rainfall events, this can overwhelm the capacity of the WWTP resulting in discharge of untreated wastewater along with stormwater runoff. This phenomenon is referred to as combined sewer overflows (CSOs), a challenge faced by over 800 cities in the US. A conventional way to address this challenge is through separate stormwater sewer systems (SSS), which often entails significant capital investment and environmental costs. With increasing concerns and uncertainties arising from a changing climate and an ever increasing urban population, the need for sustainable urban development has become a necessity. This research will explore alternative technologies for urban stormwater management, including Low-Impact Development technologies like bioretention basins, rain gardens, and SSS for their efficacy in quality and quantity control for stormwater runoff. This research will also quantify the environmental impacts and benefit-cost (including ecosystem service benefit-cost) of the alternative technologies over their entire life-cycle. The final deliverable will be a decision matrix for urban stormwater management based on the environmental and economic benefit-cost. This decision matrix will help the engineers, planners and designers to choose more sustainable alternatives for urban stormwater management.

Laurel Money

Department of Speech and Hearing Sciences

Mentor: Dr. Ishara Ramkissoon

**Department of Speech Pathology and Audiology,
College of Allied Health Professions**

*Determining the Relationship between Noise Exposure,
Secondhand Smoke, and Tinnitus in College-aged
Students*



The main goal of this research study is to evaluate whether noise exposure, secondhand smoke (SHS) exposure, and tinnitus are related with special focus on the auditory system in adolescents and young adults. A brief summary of the relevant literature indicates that tinnitus is correlated with secondhand smoke exposure and noise exposure. In this project, the primary action involves examining the relationship between tinnitus and noise exposure as well as exposure to secondhand smoke in college students and adolescents. Students at the USA and in surrounding high schools (N = 273) completed a survey about their health, hearing, noise, secondhand smoke exposure, and tinnitus previously. Some students (n=16) were excluded from data analysis because they currently smoke cigarettes, and our research aims to focus on nonsmokers. Implications for local noise ordinances and secondhand smoke ordinances may be indicated.

Ashleigh Moore

Department of Chemical Engineering

Mentor: Dr. Silas Leavesley

**Department of Chemical Engineering,
College of Engineering**

*The Use of Dye in the Development of Hyperspectral
Imaging Technologies for Endoscopy*



According to NCI's Surveillance, Epidemiology, and End Results (SEER) report, it was predicted that 1,688,780 people will be diagnosed with cancer in the year 2017 with a subsequent death rate of 40 percent. While modern-day medicine is able to treat the initial stages of many cancer patients, many deaths occur from the lack of early detection. The technique of Hyperspectral Imaging has become a primary area of interest in solving this problem, because the specialized imaging is able to display a potential abnormality resulting from minute changes in the chemical composition of a cell or tissue. Our research team has built a microscope that is able to detect several such components in live cells by utilizing exogenous fluorescent labels (also called fluorescent dyes) and separating the signals from each label using spectral imaging. The type of dye used for the sample is a factor in the increase of label detection. The goal of this project is to test the characteristics of the dyes individually, collecting spectral data that can be stored for future analysis. Armed with the ability to identify these components, we can then distinguish a cancerous cell from a healthy cell. The team's final goal is to translate this method to an endoscope that will detect cancerous lesions and lesion margins more accurately, thus enabling more effective surgical procedures

Sierra Nash

Department of English, History

Mentor: Dr. Nicole Amare

**Department of English,
College of Arts and Sciences**

*Continuation of "Overcoming Dyslexia: Helping
Dyslexic Children Love to Read "*



This project serves as a practical application of the research previously done on dyslexia and the effects of typeface choice on dyslexic readers. There is much debate and research regarding the validity of dyslexic-friendly fonts, specifically whether or not they have any real effect on reading comprehension. All studies, however, have been conducted using relatively short pieces of text, which is not how the fonts were designed to be used. By creating a novel in the dyslexic-friendly font, I hope to create a tool that can be used by researchers, teachers, and parents to aid in reading education and dyslexia research for children with dyslexia.

Renu Pandit

Department of Biomedical Sciences

Mentor: Dr. Michael Spector

**Department of Biomedical Sciences,
College of Allied Health**

*The Role of the BON-domain OsmY Protein in C-
Starvation-Inducible Stress Resistance and
Starvation-Survival*



Background: *Salmonella enterica* serovars (e.g., *Salmonella enterica* serovar Typhimurium or *S. Typhimurium*) cause more than a million cases of food-borne diseases with hundreds of deaths each year in the United States alone. Contamination of food/drink can occur at any point along the food chain from farm to table. Thus, *Salmonella* needs to be able to grow and survive in a variety of non-host (e.g., soil, water, food processing plants, slaughterhouses) and host (e.g, intestines, inside cells) microenvironments. For this, *Salmonella* must sense and respond appropriately to environmental stresses. One RpoS-regulated gene up-regulated in response to environmental stresses, such as hyperosmolarity, carbon (C-)starvation, desiccation and presence of antimicrobial peptides, is the *osmY* gene encoding the BON-domain protein OsmY proposed to function as a molecular chaperone and to stabilize membranes. C-starvation elicits the starvation- stress response (SSR) in *Salmonella*, which provides resistance to the effects of long-term C-starvation and other environmental stresses, e.g. acid pH, oxidative stress and antimicrobial peptides.

Methods: An *osmY* null mutant and its wild-type parental strain are grown in both non- limiting carbon (0.4% glucose; MS hiC) and limiting carbon (0.03% glucose; MS loC) medium to generate non-starved or log-phase cells (MS hiC cultures) and 5-h C-starved cells and 24-h C- starved cells (MS loC cultures). Log-phase, 5-h C-starved and 24-h C-starved cells are then challenged with/at (a) 15 mM hydrogen peroxide, (b) pH 3.3 or 0.109 mg/ml of polymyxin B (an antimicrobial peptide) each for a total of 60 min. For long-term C-starvation survival, mutant and wild-type cells are grown in MS hiC medium for 3-4 hours before being diluted 1:10 into MS no C medium; aliquots are removed at desired time points to assess cell viability (i.e., survival). Challenges are run at least 3 separate times (n = 3). A mean percent survival \pm SEM is calculated and appropriate data sets will be compared via a two-tailed paired t-test using Excel® and a p value of <0.05 is considered significant.

Results and Discussion: Results from this study are still being gathered and will be used to determine if OsmY plays a role in *Salmonella*'s SSR; allowing us to further define the functions needed for the SSR. Also, our findings will help us gain insight into some underlying mechanisms of damage resulting from various environmental stresses and how functions in the SSR may help prevent, repair or overcome them to allow for bacterial survival.

Monica Pasala

Department of Biomedical Sciences

Mentor: Dr. Aishwarya Prakash

**Department of Oncologic Sciences,
Mitchell Cancer Institute**

*The Structural Characterization of a Truncated
Variant of the Human NEIL2 DNA glycosylase*



Reactive oxygen species (ROS) are generated in human cells as byproducts of normal aerobic metabolism. ROS-induced oxidative stress triggers a cascade of essential protein-DNA interactions required for cell survival. Both nuclear and mitochondrial DNA (mtDNA) are susceptible to the harmful effects of ROS. MtDNA is not packaged into nucleosomes and is more prone to oxidative damage than its nuclear counterpart. The base excision repair (BER) pathway is involved in the repair of oxidized DNA damage. DNA glycosylases such as members of the endonuclease VIII (Nei)/ formamidopyrimidine DNA glycosylase (Fpg) family catalyze the first step of this pathway. In humans two Nei-like (NEIL) glycosylases, NEIL1 and NEIL2, are encoded by nuclear genes and translocated to both the nucleus and mitochondria. These glycosylases have overlapping substrate preferences but their precise roles in the mitochondria remain to be elucidated. The main objective of this project is to describe a role for NEIL2 and its truncated variants in the cleavage of oxidized DNA lesions generated in mitochondria and to study its interaction with protein partners that mediate other aspects of the repair process. Initial experiments indicate that NEIL2 is able to form complexes with other BER enzymes as well as with proteins involved in transcription. NEIL2 and its truncation variants will be expressed in *E.coli*, purified using column chromatography, and complex formation with mitochondrial proteins such as polymerase gamma will be performed using gel-filtration analysis followed by X-ray crystallization methods. Crystallization trials will be performed using standard vapor diffusion procedures in either hanging drop or sitting drop format. At the end of the project we hope to have successfully expressed, purified, and crystallized truncated variants of NEIL2

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|---|----------------------|
| <p><u>Javlyn Peebles</u></p> <p><i>Department of Pre-Nursing Program</i></p> <p>Mentor: Dr. Ajay Singh</p> <p>Department of Oncologic Sciences, Mitchell Cancer Institute</p> <p><i>Targeting Immunosuppressive Pathways in Pancreatic Cancer</i></p> | <p>Not pictured.</p> |
| <p>Pancreatic cancer is a highly lethal malignancy for which the survival rates have not improved over past several decades. Such a poor prognosis is largely attributed to the failure of currently available therapeutic modalities. Tumor microenvironment believed to play crucial role in pancreatic cancer overall outcome. Tumor microenvironment provides a favorable niche for the growth of tumor as a consequence of bi-directional tumor-stromal cross-talk. The tumor cells ‘corrupt’ the cells present in Tumor microenvironment so that these cells start supporting the tumor cells results in conditions conducive for the tumor growth and sustenance. It is not very clear that how the different components of tumor microenvironment involved in the progression of pancreatic cancer. In the present study, we demonstrated that co-cultured conditioned media obtained from pancreatic cancer cells with pancreatic stellate cells promotes the growth of macrophages. Further, the conditioned media induces the migration of macrophages. Importantly the conditioned media obtained from pancreatic cancer cells with pancreatic stellate cells co-culture were able to alter the macrophage phenotype to M2 type.</p> | |

Malaya Richard

Department of Psychology

Mentor: Dr. James Stefurak

Department of Psychology,
College of Arts and Sciences

***DOUBLE JEOPARDY: THE COMPOUNDING
RISKS POSED BY COMMUNITY POVERTY AND
FAMILY POVERTY AMONG JUVENILE
OFFENDERS***



The average cost of high-risk offenders as of 2009 is between 2.6 to 4.4 million dollars (Cohen & Piquero, 2009). It is estimated that around half of juveniles that are detained in secure facilities meet criteria for at least one mental health diagnosis (Grisso, 2008; Lyons, Baerger, Quigley, Erlich, & Griffin, 2001). Many mental health problems, such as mood disorders, can cause aggression and irritability that may lead to involvement in the juvenile justice system (Grisso, 2008). Community and family poverty are two commonly studied predictors of delinquency. Social disorganization theory states that disorganization within the community, including insufficient supervision and social ties, can predict delinquency. Social disorganization is often considered a characteristic of concentrated poverty (Sampson & Groves, 1989). There are populations who are affected by poverty more than others. In the U.S., the majority of children living in poverty are African American (Wight, Chau, Thampi, & Aratani, 2010). Primarily African American communities have higher crime rates as well, but Sampson (1997) found the true reason for this relationship could be due to the underlying poverty rates within primarily African American neighborhoods. Despite zip code poverty not emerging as a significant predictor, there may still be other factors within economically depressed communities that drive offending, such as access to mental health resources and peer influence within the community that may contribute to delinquency. The finding that having a serious mental health diagnosis, offending at an earlier age, and being male are all associated with greater offending is in-line with most prior research. These findings further highlight need for programs like mental health courts and early intervention programs that divert youth from early contact with juvenile courts and towards contact with well-matched social, educational, and mental health service providers. Also, youth offending earlier often have unique psychosocial deficits, relative to youth that offend later in life and youth who never offend at all, that must be met with intervention.

Breanna Riddle

Department of Civil Engineering

Mentor: Dr. Kevin White

**Department of Civil Engineering,
College of Engineering**

*Evaluation of Conventional Municipal Wastewater
Treatment Processes for Removal of Pharmaceuticals
and Personal Care Products*



Municipal wastewater is a combination of domestic, commercial, and industrial wastewaters collected typically in gravity sewers that transport the wastewater to central treatment facilities. As many sewers are old and leaky, it is common to experience storm water infiltration in sewers, often resulting in sanitary sewer overflows (SSOs) during high rainfall events. However, the exfiltration of sewage into shallow groundwater often goes un-detected, even if faulty sewers and SSOs are recognized. This project attempts to detect chemical constituents of raw wastewater in the shallow groundwater near the Three Mile Creek sewer main to prove that exfiltration of wastewater is occurring. Indicators of raw sewage include phosphorus, nitrogen, carbon, and a vast array of pharmaceuticals (from antidepressant drugs, anti-inflammatory drugs Antihistamines, and hydrocodone. Based on the analyzation of several water samples taken from a multitude of locations, it has been concluded that there is exfiltration occurring in Lagan park. In order to correct this issue, the point of infiltration must first be identified. Oncethe faulty pipe has been located, the cleanup process can begin to take place along with a rerouting of the pipeline while repair is underway. Even after the pipe is repaired, tests will need to be continued over the course of several months in order to ensure that the problem was resolved and that there is no further damage to any of the surrounding areas.

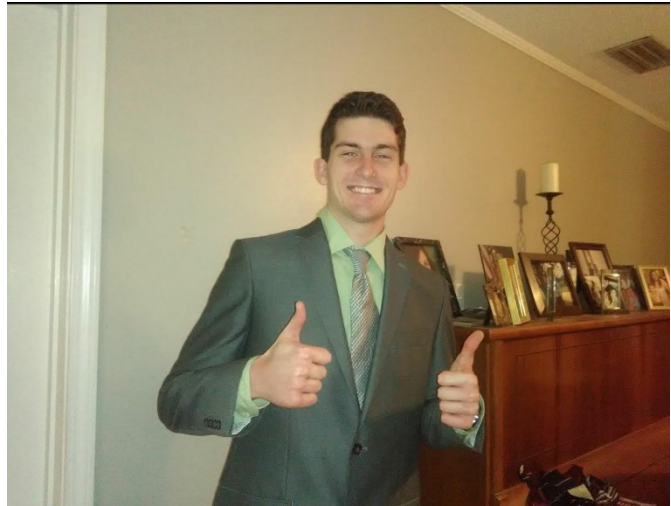
Austin Sanders

Department of Foreign Language, Marketing

Mentor: Dr. Jinhak Kim

Department of Marketing and Quantitative Methods, Mitchell College of Business

Personalized Restaurant Menu Recommender System Using Logistic Regression and Artificial Neural Network



Recent advances in machine learning and data analytics have led to astonishing successes in derivation of useful information that provides decision makers with significant implications. Recommender system, one of the most recognized achievements in the area, provides personalized recommendation on product selection by applying the user's profile into the tailored model. While considerable firms are taking advantages of the state-of-the-art technologies, it has not been successfully implemented in restaurant industry where recommendation of servers has significant effect on consumer's menu choice. However, most recommendations are made without considering the customer's characteristics. In this research, we aim to construct a restaurant menu recommender system using regression analysis that effectively provides a personalized menu recommendation. Our model will be constructed using the menu rating data of the restaurant, customers' information such as demographic profile, health profile, nutritional preference, and external information such as weather, companion, seating locations, and special menus.

Emily Shelton

Department of Speech and Hearing Sciences

Mentor: Dr. Brenda Beverly

**Department of Speech Pathology and Audiology,
College of Allied Health**

*An Evaluation of Instructional Methods of Speech-
Language Pathologists and Educators*



Educators have been shown to increase gesture use when teaching students who have difficulty with content (Alibali et al., 2013), but gesture use by speech-language pathologists (SLPs) is not known. Wesson (2016) found that educators significantly increased gesture frequency with a hypothetical audience of children with language impairment compared to a hypothetical audience of children who were typically developing. SLPs, however, showed no differences between audience conditions. Instead, the trend was for SLPs to decrease their use of gestures overall while increasing gesture-word redundancy (saying “on” when showing one hand on top of the other hand). Wesson’s findings were limited by low statistical power and unplanned differences between groups for age and years of experience. This project is an expansion of Wesson (2016). The number of participants will be increased from 12 educators and 12 SLPs to 24 educators and 24 SLPs matched for age and experience. First, participants are video-recorded teaching prepositions to two hypothetical audiences, kindergartners who are typically developing and kindergartners with language impairment. Gesture use is measured in three ways: total gesture rate; proportion of representational gestures (a gesture that shows its meaning such as 2 fingers to mean two); and gesture-speech redundancy. Additionally, interpretation of findings, particularly significant differences between participant groups for audience conditions, will be augmented with survey data from a new debriefing questionnaire created by this investigator to assess participants’ awareness of their gesture use. Findings can lead to improved preparation for SLPs and educators who increasingly serve together to meet the needs of children with diverse language learning.

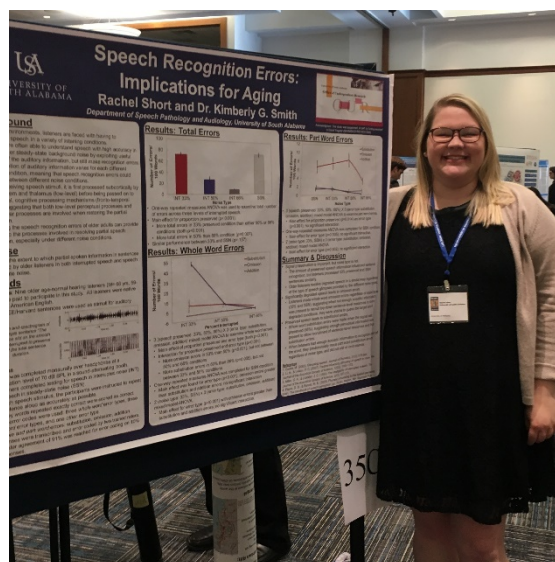
Rachel Short

Department of Speech and Hearing Sciences

Mentor: Dr. Kimberly Smith

**Department of Speech Pathology & Audiology,
College of Allied Health**

*Effects of Stimulus Presentation Timing and Response
Timing on Multimodality Sentence Recognition*



In everyday, natural environments, individuals are faced with having to understand both speech and text signals in degraded conditions. These conditions may not allow for either signal to be fully obtainable. Thus, by supplementing glimpses of speech information with visual cues (or supplementing text information with speech cues), degraded signals can be better comprehended. Multimodality processing of sensory stimuli has been shown to be advantageous in both normal and disordered populations, by enhancing signal detection and speech recognition (Lovelace, Stein, & Wallace, 2003; Miller & Licklider, 1950; Smith & Fogerty, 2015; Smith & Fogerty, 2016; Zekveld, 2008). However, several factors influence the success of processing multimodality information. Studies have found that responding to multimodality stimuli simultaneously is less beneficial than producing a delayed response, while presenting text slightly after speech is less beneficial compared to a simultaneous presentation (Smith & Fogerty, 2015, 2016; Zekveld, 2008; Lovelace et al., 2003). Despite these findings, the exact mechanism responsible for multimodality integration is still unknown. This study evaluated the effect of presentation timing of speech relative to text information, and response timing, delayed or simultaneous, on sentence recognition in unimodal and multimodal conditions. Nine younger adult listeners repeated or read aloud sentences presented to them; responses were coded for words correct. Significantly more errors were made for unimodal text compared to unimodal speech, likely due to the dynamic cues available in the speech signal compared to the static cues provided by text. Listeners were more successful with the delayed response compared to the simultaneous; the extra time allowed listeners to interpret the signals offline prior to eliciting a response. No main effect of presentation timing was found in the multimodal condition, suggesting that multimodality integration is more beneficial compared to unimodal processing regardless of signal presentation timing. However, continued data collection and analysis could provide more insight into the various presentation times and their effects on sentence recognition.

Benjamin Siu

Department of Chemical Engineering

Mentor: Dr. Kevin West

**Department of Chemical and Biomolecular
Engineering, College of Engineering**

Thermal and Thermophysical Properties of ionic liquids



In recent decades, ionic liquids have garnered large interest in research due to their unique beneficial properties: vanishing vapor pressures, low flammability, chemical inertness, large liquid ranges, and wide versatility. Coupled with their negligible vapor pressures and tunability due to their organic nature, they have extended uses within reactions, separations, bioprocessing, etc. Usage of ionic liquids for thermal energy storage, heat transfer and many industrial applications depends strongly on their ability to resist oxidation at high temperatures, though. Beneficially, a widely touted property for majority of ionic liquids has been thermal stability; however, this has been recently shown to be inaccurate. Previously considered stable ionic liquids- [EMIM][Tf₂N], for example- have been shown to decompose at temperatures at approximately 200°C when under long-term thermal stress; therefore, their use as high-temperature liquids is quite limited. To this end, peraryl phosphonium based cations coupled with a Tf₂N anion have been synthesized and demonstrated to be thermally stable at temperatures at least 300°C and higher with low appreciable mass loss. To further increase their applicability in industry, these phosphonium salts were altered by adding a phenoxyphenyl and other stable moieties to introduce asymmetry in the crystalline structure, thereby widening the liquidus range, while preserving their thermal stability. Thermophysical and thermal properties of these salts were characterized utilizing differential scanning calorimetry (DSC) to determine melting point, enthalpy of fusion, and entropy of fusion. Furthermore, long-term, high-temperature thermal stability studies of the species were performed. Additionally, their heat capacities were determined to compare them with common heat transfer fluids such as Dowtherm™ and Dynalene MS 1. Since a chief application of these salts is for heat transfer, exploring methods to further increase the heat capacity ought to be considered. Therefore, preliminary experiments with [(Ph)₄P][Tf₂N] and [(Ph)₃-p-Ph-O-Ph][Tf₂N] combined with excess aromatic molecules creates an aromatic-ionic liquid biphasic system. With this, preliminary liquid-liquid phase diagrams were constructed with these two salts and selected aromatics to explore their behavior. These initial studies along with synthesis of novel thermally stable salts can aid future work related to thermal energy storage and high-temperature reactions.

Luke Smith

Department of Mechanical Engineering

Mentor: Dr. David Nelson

**Department of Mechanical Engineering,
College of Engineering**

*Thermal Modeling With Therapeutic Cooling and
Interspecies Extrapolation for Tourniquet Use*



Exsanguination is a leading cause of death of soldiers in combat. The tourniquet is an effective device for reducing blood loss and morbidity in severe extremity injury. Soldiers carry tourniquets on the battlefield and wrap them tightly around an injured limb to stop bleeding before and during medical evacuation. In many cases, the tourniquet is left tightened for long periods before and during evacuation. Under standard protocols, the tourniquet is periodically loosened, restoring blood and preventing ischemic damage to tissue, especially muscle. Without reperfusion, the prolonged application can induce ischemic and reperfusion injury, complicating limb salvageability. Irreparable muscle tissue damage can begin as early as 45 minutes into tourniquet use, and complete necrosis can be expected within six hours. A method of slowing ischemia and reperfusion would allow for improved tissue salvage during longer transportations. Ischemic and reperfusion damage may be reduced by decreasing the temperature of the skeletal muscle tissue. Cooling has known medical applications, via intravascular catheters, evaporative nasal sprays, gel packs, and other devices, preserving myocardial and skeletal tissues during organ transplantations and subsequent to infarcts. Inducing hypothermia in skeletal muscle may reduce the damage associated with ischemia and reperfusion. Cooling limits the overabundance of Na^+ , H^+ , and Ca^{2+} within the cell, preserving mitochondrial resistance to reperfusion damage and reducing inflammation and acidosis. Hypothermia can alter signaling pathways in tissue, and confer benefits depending on when the cooling is initiated. Therapeutic hypothermia initiated before ischemia preserves ATP and activates heat shock protein 70, HSP70, which helps activate an anti-apoptotic pathway in the cells. Cooling during ischemia activates the Akt kinase and MAPK/ERK signaling pathways, accelerating cell protection from hypoxia and reperfusion. Hypothermia initiated during reperfusion can still reduce microvascular reperfusion damage. The magnitude and duration of induced hypothermia can also impact the preservation of tissue. We evaluated experimental results in varying ranges of hypothermia; from mild ($36-33^\circ\text{C}$), moderate ($32-21^\circ\text{C}$), and deep ($20-11^\circ\text{C}$), to profound ($<10^\circ\text{C}$) hypothermia. Protection increased starting from treatment of 34°C down to a minimum of 17°C . Treatment was most effective when cooling is achieved as early as possible in injury, but there are protective benefits to be found at any time during the ischemic-reperfusion process. Designing with an understanding of time-temperature dosages and how they vary experimentally can lead to better tourniquets to preserve tissue longer. We have yet to determine if the relation between tissue preservation and time-temperature dose can be modeled mathematically. Our next step will be evaluating potential dosages for varying anatomies and environments. We will collaborate with another institution to compare our predictions to cooling experiments on animals, such as rats, swine, canines, and sheep. Interspecies extrapolation will be needed to evaluate if the observations of heat transfer and therapeutic effects compare to those of humans.

William Swann

Department of Chemistry

Mentor: Dr. Larry Yet

Department of Chemistry,
College of Arts and Sciences

*Preparation of Imidazo[1,2-a]pyridine Ligands to
Overcome Difficult Chemical Reactions*



Developing new or more efficient methods of synthesis is a main area of focus in organic chemistry. Imidazo[1,2-a]pyridine phosphorus ligands are being investigated in cross-coupling reactions. Recent advancements show that, when paired with transition metals, electron-rich moieties allow for increased specificity and activation potential within previously difficult reactive mechanisms. Structural changes to the aforementioned scaffold were made with the addition of aryl groups bearing different functionality to the C-2 position of the heterocycle. Diphenyl-, di-tert-butyl-, and dicyclohexylphosphines were then added via halogenated intermediates to the C-3 position of each analog, creating highly varied ligands for use in future cross-coupling reaction studies.

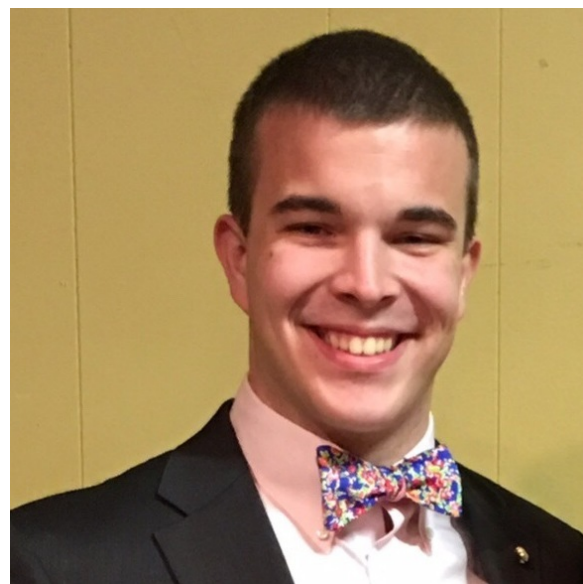
Braden Urban

Department of Exercise Science

Mentor: Dr. Shelley Holden

**Department of Health, Kinesiology, and Sport
College of Education**

*Development and Testing of a Nutritional Knowledge
Survey*



Parmenter and Wardle(1999) noted that few studies have used total nutrition knowledge as their primary measure. Instead surveys have used aspects of nutrition (diet –disease ratio, dietary recommendations, etc.). Further, many of the surveys used to measure nutritional knowledge vary considerably in length. That is, some use surveys contained up to 100 questions where others had only 20 questions. Zinn (2004) is also one of the few surveys that specifically measures sports nutrition knowledge. Regardless of whether instrument measures basic nutrition or sports nutrition knowledge, most of these instruments were developed outside of the United States. This poses a few problems that generally can fall to semantics. The vernacular is different in the United Kingdom, so words may be used that most Americans do not necessarily understand, for instance: grams vs. ounces or fiber vs. fibre. As miniscule as they may seem, these differences have to be accounted for and modified in order to truly make the survey clear and definitive to be testing the knowledge of the participant. The current survey is aimed towards studying sports nutrition knowledge of participants. Questions on the Sports Nutrition Knowledge Survey (SNKS) come from five areas which include: 1. General Nutrition, 2. Hydration, 3. Competition (Pre, During and Post) Nutrition, 4. Supplements and 5. Weight Control. The questions were designed to test the knowledge of all areas of nutrition that relate to sports nutrition.

Micaela Walley

Department of Communication, English

Mentor: Dr. Christopher Raczkowski

**Department of English,
College of Arts and Sciences**

Communicating with Contemporaries: A Chapbook



The primary goal of my creative project was to read and analyze the ideas, narrative preoccupations, and literary techniques of contemporary poets while preparing a chapbook of 15 poems. These poems are responses to what I read and are expansions of the creative work that I've already accumulated throughout my academic career. By reading collections of poetry, essays reflecting on the importance of poetry, and works of literary criticism that focused on the contemporaries uses of narration, sonic texture, and imagery, I was able to use their techniques in my own writing and gain an understanding of how contemporary poetry differs and develops from past eras of poetry.

Wayne Williams

Department of Geography

Mentor: Dr. Steven Schultze

**Department of Earth Sciences,
College of Arts and Sciences**

*Study on Feasibility and Viability of Growing Hops
(*Humulus lupulus*) in the Southern Alabama Region*



Humulus lupulus plants are a broad leaf vine plant that produces the hops needed for everyday production of beer. There are over 100 different varieties of hops, and thousands of different ways to combine and use them to make the many different varieties of beer we drink across the world today. In the U.S., hops are typically best grown in the Northwestern part of the country in Oregon and Washington State. This is possible due to the climate in that section of the country. The solar angles, time, and temperature just happen to coincide with each other to create the ideal conditions to grow hops. In the South, specifically at the 35 degree latitude line and below it is less than ideal to try and grow hops plants. The solar rays don't make the same kind of contact as that in the North, and the times of day are also not the same, resulting in many failed attempts at hop production in this region. This study sought out to look if it is feasible to still grow hops in the south, and the challenges that come along with it. Scientists at the University of Florida were able to replicate solar conditions of the Northwest by growing the hop vines at roughly a 30 degree angle, rather than the traditional method of vertical growth. We have replicated that part of his study, and the growing seems to be making forward progress at this point. The challenges at this point have been more directed at growing plants in general, rather than solar angles and time of day. By this meaning figuring out when and how much to water, how to fertilize, shading the plant correctly, etc. I believe we have seen positive, and promising results up to now, and believe if we can keep the plants in good health there will be a harvest.

VOLUNTEER RESEARCH INTERNSHIP (VIP) PROGRAM PARTICIPANTS

The OUR oversees volunteer internships (VIPs) designed to provide students with a meaningful, initial hands-on experience in their discipline. This is the correct way to apply for Shadowing experiences in the Departments of Chemistry, Biology and other departments. This is also the correct application for High School Students and other Community Members wishing to volunteer to do research at the University of South Alabama and its affiliates.

G. Angus-Barker

Department of Mechanical Engineering

Mentor: Dr. J. Kar

**Department of Mechanical Engineering,
College of Engineering**

An MRI-based Automated Myocardium Boundary Detection Technique using Displacement Encoding with Stimulated Echoes (DENSE) Images

Purpose: Displacement Encoding with Stimulated Echoes (DENSE) is a Magnetic Resonance (MR) elastography technique developed to encode phase information from myocardial tissue displacement, which occur during the mixing period of the sequence and is stored in the longitudinal magnetization direction for prolonged periods. While there exists a number of semi-automated algorithms for processing phase data in complex DENSE images, with displacements retrieved for Left Ventricular (LV) strain analysis, there remains a need for fast, sophisticated techniques that address myocardial segmentation in DENSE images. This study proposes a novel, automated technique for detecting myocardial boundaries, using the DENSE phase data and image quantization via thresholding, which can significantly expedite the strain computation process.

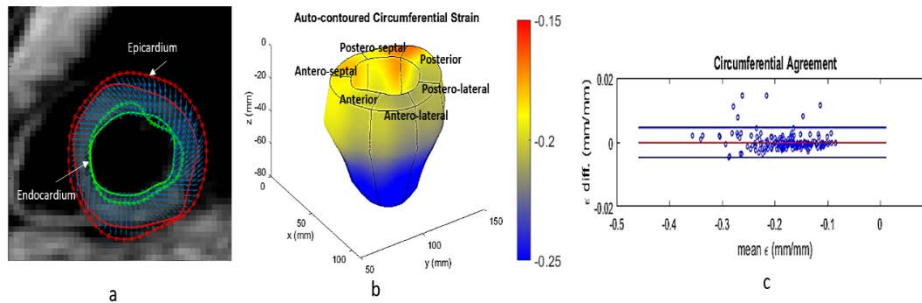


Figure 1. (a) Automated boundary detection in 2D slices assisted by temporal displacement analysis. (b) Circumferential strain map on 3D LV geometry reconstructed from automated contouring. (c) Bland-Altman agreement between circumferential strains from automated and manually contoured LV geometries.

Method: This detection algorithm has been primarily architected for auto-contouring the myocardial boundaries in short axis images (Figure 1a), based on both spatial and temporal increments, such that full 3D LV geometries can be reconstructed at discrete time-frames (points of image acquisition) during the cardiac cycle. Initially, a reference quantized image of the myocardium at end-diastole is created using an optimized threshold evaluation algorithm called multi-level Otsu’s Method. With this approach, discrete points on a bounding ellipse, initially formed to enclose the basilar (largest) myocardium, radially search for pixel-based image gradients (intensity differences) in the quantized image, essentially forming an edge detection scheme that distinguishes the myocardium from surrounding tissue or chest cavity. The formation of the reference boundary is followed by spatio-temporal searches for boundaries in subsequent time-frames, guided by each boundary point’s nearest-neighbor pixel displacements as obtained by unwrapping the phase images, and

also updated image quantization that detect changes in myocardial shape (Figure 1a). In this way, the morphology of myocardial boundaries can be tracked between end-diastole and end-systole in each 2D short-axis slice and full 3D LV geometries reconstructed [1]. The accuracy of the algorithm was tested by performing DENSE scans on N=12 healthy subjects, conducting myocardial boundary detection using the automated method and a manual contouring scheme for control data, reconstructing 3D LV geometries from both contouring types, and followed by LV chamber quantifications (myocardial wall thickness, Ejection Fraction (EF), LV mass and others), and computation of 3D myocardial strains (Figure 1b) using the Radial Point Interpolation Method (RPIM) [1]-[2]. Statistical analysis was then conducted, using Student's t-test to compare the results of chamber quantifications and Bland-Altman analysis to establish regional strain agreements between the two contouring methods.

Results: Significant differences were not found between results of chamber quantifications, including wall thickness, which were 7.7 ± 1.3 mm and 7.8 ± 1.4 mm ($p = 0.71$), EF, which were 0.54 ± 0.05 and 0.54 ± 0.05 ($p = 0.79$), and LV mass, which were 40.9 ± 14.0 grams and 41.5 ± 13.8 grams ($p = 0.86$), for automated and manual contouring types, respectively. Neither were significant differences found from comparisons in global circumferential strains, which were -0.18 ± 0.05 and -0.18 ± 0.05 ($p = 0.98$), global longitudinal strains, which were -0.20 ± 0.09 and -0.20 ± 0.09 ($p = 0.99$), or global radial strains, which were 0.31 ± 0.11 and 0.30 ± 0.11 ($p = 0.81$), for the automated and manual contours, respectively. Figure 1c shows the Bland Altman agreement between regional (N=16 in each subject) circumferential strains, obtained with the two contouring methods, and similar biases were obtained for regional longitudinal and radial strains, both of which were 0.00 ± 0.05 .

Discussion and Conclusion: The similar results for LV chamber quantifications and 3D strains obtained from automated and manual contouring techniques, as well as the small biases from the Bland Altman analysis on the two methods, indicate that the proposed automated contouring scheme can be reliably applied towards rapid and accurate computation of LV parameters. An additional conclusion is that this fast, less manually intensive myocardial boundary detection technique can become clinically significant once its accuracy is demonstrated in studies on cardiac dysfunction.

References:

- [1] J. Kar et al., "Three-dimensional regional strain computation method with displacement encoding with stimulated echoes (DENSE) in non-ischemic, non-valvular dilated cardiomyopathy patients and healthy subjects validated by tagged MRI," *J. Magnetic Resonance Imaging*, vol. 41, no. 2, pp. 386-396, Feb. 2015.
- [2] J. Kar et al., "A validation of two-dimensional in vivo regional strain computed from displacement encoding with stimulated echoes (DENSE), in reference to tagged magnetic resonance imaging and studies in repeatability," *Ann. Biomed. Eng.*, vol. 42, no. 3, pp. 541-554, Mar. 2014.

Stephanie E. Bulls

Department of Biology

Mentor: Dr. Juan L. Mata

**Department of Earth Sciences,
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*Phylogenetic Insights into Amanita Mushrooms Found
in Southern Alabama*



The fruiting bodies of the mushroom genus *Amanita* include some of the most beautifully iconic as well as some of the most deadly toxic mushrooms. The genus is divided into two subgenera based on a chemical reaction of spores to Melzer's reagent. Spores turn purple (amyloid) in subgenus *Lepidella* or remain colorless (inamyloid) in *Amanita*. Additional morphological features place specimens into sectional levels within the two subgenera but overall all mushrooms are characterized by the presence of a combination a volva, annulus, and white spores. Many *Amanita* species are ectomycorrhizal, meaning they exist in a symbiotic relationship with the roots of plants such as the oak and pine trees found in the southeast United States. Little taxonomic research has been conducted in the southern United States and correct identification can be compromised by the usage of European nomenclature. Approximately one hundred *Amanita* taxa can be found in the Gulf Coast area, of which many are still undescribed in the literature.

Amanita specimens from southern Alabama and neighboring areas of Mississippi, deposited at USAM, have previously been keyed to species epithets using morphological characteristics. This study used molecular analyses of these specimens to clarify species epithets. Sequences of the internal-transcribed spacer unit (ITS) and the large subunit (LSU) of the ribosomal genome were obtained through DNA extraction and PCR. Sequences were edited for errors and then compared to sequences deposited in GenBank for possible matches. Two phylogenetic trees were produced which supported taxonomic classification at the sectional level. Results confirmed the species epithets given to some of the specimens. Three specimens with names proposed to be changed based on matches include: *A. citrina* to *A. lavendula*; *A. caesarea* to *A. jacksonii*; and *A. sinicoflava* to *A. diamoniocantans*. The specimens with high quality sequences that do not match with previously deposited GenBank sequences may represent described species that do not yet have sequences deposited in GenBank or may represent yet undescribed species.

Taylor Davis

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Expectancy Disconfirmation Theory and Police Use of Force



There is a significant amount of research reinforcing the idea that satisfaction with bureaucratic performance varies based on expectations. However, there is little experimental evidence supporting this model on more controversial areas of bureaucracy such as policing. In this study, we use an original experiment on police use of force to test how well the expectancy disconfirmation model predicts citizen satisfaction with police and their perceptions of fair treatment by the police. we survey a student sample (n=534) from 5 universities from different regions of the country on police use of force, citizen satisfaction with police, and fair treatment by police. We do not find evidence supporting EDT in this policy context. Expectations either have no effect in light of performance or the opposite of what EDT predicts. This research indicates that is important for scholars to continue testing the theory in different policy areas as to better understand when and under what conditions EDT is a useful framework.

| | |
|--|----------------------|
| <p><u>Lauren Lopansri, Madeleine Forbes</u></p> <p><i>Davidson High School</i></p> <p>Mentors: Drs. Richard Honkanen, and David Forbes</p> <p>Department of Chemistry College of Arts and Sciences</p> <p><i>Protein Phosphatase Inhibitors: An Analysis of Ester Functionalization</i></p> | <p>Not Pictured.</p> |
| <p>Metastatic cancers are the second leading cause of death in the U.S. With modern innovations in molecular biology and genomic sequencing, researchers are now developing targeted therapies that can selectively inhibit agents involved in the formation and propagation of human cancers. The regulatory role of serine/threonine phosphatase-5 (PP5) in signaling cascades controlling cell growth and metabolism makes it an attractive target for drug development. The overarching goal of this project is to synthesize selective, yet potent norcantharidin-based PP5 inhibitors. As co-crystal structures of PP5 in complex with these inhibitors revealed close contacts between the inhibitor bridgehead oxygen and both a catalytic metal ion and a non-catalytic phenylalanine residue, which is substituted by tryptophan in serine/threonine phosphatase-4 (PP4), it is hypothesized that by exploiting the grooves that exist in proximity to the active site, added contacts via covalently linked residues will offer enhanced selectivity without compromising potency. Given the ease in preparation of carboxy residues of norcantharidin, a series of systems were prepared and screened. Using PP5 IC50 baseline values of cantharidin and norcantharidin, confirmation of ester hydrolysis and poor affinity based upon ester functionalized residues were realized</p> | |

Jacob N. Letson

Department of Chemistry

Mentor: Dr. David R. Battiste

Department of Chemistry

College of Arts and Sciences

Isomer Distribution of Trimedlure



The Mediterranean fruit fly, or medfly, is a pest common to citrus fruits. The medfly deposits eggs into the skin of ripe citrus fruit and the larvae burrow into the fruit, ruining it for human consumption. Trimedlure, the tert-butyl ester of (4 or 5)-chloro-2-methylcyclohexane-carboxylic acid, is one of the most successful attractants discovered for the medfly to identify infestations and alert growers to spray for these invasive pests. Commercial Trimedlure is a mixture of four (4) isomers. One isomer (38.5-45.4% of the mixture) is the most highly attractive. Organic students learn hydrochlorination (HCl) of alkenes, sometimes catalyzed by Zinc (II) ions, is an easy general reaction to convert alkenes to other more complex products. The addition of HCl to trans-6-methyl-3-cyclohexene-1-carboxylic acid is not easy. The effects of time, temperature and the use of Zinc (II) ions on the isomer distribution of this reaction were investigated. Based upon the Nuclear Magnetic Resonance (NMR) data, high reaction temperature and long reaction time reduced the production of the desired isomer, the addition of zinc sulfate reduced the production of the desired isomer, while the addition of anhydrous zinc chloride appears to maintain a high level (47%) of the desired isomer while minimizing the level of the least attractive isomer. Further work is underway to explore these trends.

LOUIS STOKES ALLIANCES FOR MINORITY PARTICIPATION (LSAMP) PROGRAM

This program is aimed at increasing the quality and quantity of students successfully completing science, technology, engineering and mathematics (STEM) baccalaureate degree programs, and increasing the number of students interested in, academically qualified for and matriculated into programs of graduate study. LSAMP supports sustained and comprehensive approaches that facilitate achievement of the long-term goal of increasing the number of students who earn doctorates in STEM fields, particularly those from populations underrepresented in STEM fields. The program goals are accomplished through the formation of alliances. The University Of South Alabama Office Of Undergraduate Research is a proud partner with the University Of South Alabama College Of Engineering, Dean John Steadman, and the LSAMP Program. Students have worked closely with their faculty mentors in the College of Engineering. This year's participants will be presenting posters of their original, mentored research.

(LSAMP) PROGRAM PARTICIPANTS

Gaelyn Angus-Barker

Department of Mechanical Engineering

Mentor: Dr. Julia Kar

Department of Mechanical Engineering, College of Engineering

An MRI-based Automated Myocardium Boundary Detection Technique using Displacement Encoding with Stimulated Echoes (DENSE) Images

Kalyn Alfred

Department of Computer Engineering

Mentor: Dr. Sam Russ

Department of Mechanical Engineering, College of Engineering

Cubesat Software Infrastructure

Mitchell Appleberry

Department of Mechanical Engineering

Mentor: Dr. Greg Poole

Department of Computer Engineering, College of Engineering

Modification of the Mechanical Properties of Poly(methyl methacrylate) Using Imidazolium-Based Ionic Liquids

Logan Boyd

Department of Mechanical Engineering

Mentor: Dr. Hee Seok Kim

Department of Mechanical Engineering, College of Engineering

Heat-Vacuum System

Jadontae Gray

Department of Mechanical Engineering

Mentor: Dr. Carlos Montalvo

Department of Mechanical Engineering, College of Engineering

3-D Printed A-Motor Rocket

Samantha Gunn

Department of Chemical Engineering

Mentor: Dr. Silas Leavesley

Department of Chemical & Biomolecular Engineering, College of Engineering

Simulation and Optimization of a Hyperspectral Imaging Light Source

Alexander Walley

Department of Mechanical Engineering

Mentor: Dr. Carlos Montalvo

Department of Mechanical Engineering, College of Engineering

Design Build Fly Prop Testing for Thrust

William "Liam" Wilkenson

Department of Mechanical Engineering

Mentor: Dr. Carlos Montalvo

Department of Mechanical Engineering, College of Engineering

Mechanical Design of CubeSAT

ORIGINAL UNDERGRADUATE RESEARCH ARTICLES

This section represents original, peer-reviewed articles that were written by students while they were students at the University of South Alabama. They come from many disciplines, and reflect the diversity of what constitutes research, creative, and scholarly activities here at the University of South Alabama.

COMMUNICATING WITH CONTEMPORARIES: A CHAPBOOK BY: MICAELA
WALLEY

Introduction:

The primary goal of my creative project was to read and analyze the ideas, narrative preoccupations, and literary techniques of contemporary poets while preparing a chapbook of 15 poems. These poems are my original work, and are responses to the 34 books I read throughout the course of ten weeks. By reading collections of poetry, essays reflecting on the importance of poetry, and works of literary criticism that focused on the contemporaries uses of narration, sonic texture, and imagery, I was able to use their techniques in my own writing and gain an understanding of how contemporary poetry differs and develops from past eras of poetry.

The following is a sample of poems from my project, followed by a brief discussion of the books that inspired them.

Poem 1:

How Summer Comes

Displaced I
Order a margarita
Tired of petting strays and moving
Heavy boxes, propelling
Myself out of space
Unwanted
Goodbye, goodbye
Again, to visit
Grandmothers in wheelchairs
Next to the windows, they stare.
The birdbath is already dried up
Everything smells
Like piss and we scrub
The floors anyway, her feet
Shouldn't have touched
This ground.
At least she went how they wanted
Her to—yes
It was peaceful Lord Christ
You're the second person to say
You dreamed about me and woke up
To a Facebook invite
I am so dang excited

—an open ear, ready
She would tell me to
Make a knapsack
Of her things and throw them
If she could speak
Clearly, I do not care
It is 11:31am Monday
I'd make a t-shirt
That said "Please stop
Emailing me"
Across the boobies
If I could
Wear it all the time
There is so much of that now
Buzzed, googling
How to sew

Discussion of How Summer Comes: I titled the entire chapbook after this poem, because it represents the starting point of my project. I wrote this poem after reading works by Alice Notley. Notley is one of the most famous contemporary poets, known for her uncanny ability to touch on a ton of different topics using very short lines and oddly specific images from the everyday world that make her poems more accessible than typical, traditional poems. She's not the kind of poet who sits on top of a mountain and contemplates the meaning of life, but rather uses images from the everyday to better understand more specific topics, like womanhood or motherhood. This poem follows the readings of two of her poetry books—*Certain Magical Acts* and *Grave of Light*—and was also influenced by her thoughts on the craft in her book *Coming After: Essays on Poetry*.

Poem 2:

I Said Ion Instead of Ok

I said ion instead of ok
And I haven't forgiven myself yet

and with it, the task
of introducing science

which we stare at across the table
waiting for it to talk back.

When your grandmother
does not leave a room silently,

things seem damp, the space
between skin and fingernail.

What is the word hummingbird?
This is the third typo I've made

today. I want you to not call me
by accident. I want things like

poems to stop being small.
There are things I can do

and things I cannot like
have a baby or spell things

right and sometimes, I want
to do neither. So many

of those birds die a year
and their bodies are all

strewn at the door of
our bedroom. So much

destroys us, and so
little makes us ok.

Discussion of I said Ion Instead of Ok: This poem was written after reading Heather Christle's *What Is Amazing*. I grew very attached to how she was able to sneak in assertions without taking on an argumentative tone in her poems. In other words, you just believe everything she says because you have no reason not to. She, a lot like Notley, also stayed within the world of the "everyday" with her images, making her poems extremely accessible and relatable. I wanted this poem to reflect these same qualities that I found within her work. I specifically attempted this with my description of dampness as the space between skin and fingernail. This detail gets buried by the narrative, and most readers skim right by it—though it is my attempt at making an irreducible statement like the ones you would find in Christle's poems.

Poem 3:

Heavy In That Necklace

is his heart

fragile whatever

plucked from when he said

you are not like other girls.

Other women, your sisters,

those bitches before

did not love him

or only loved him

but did not let him

swallow them

Whole. You have always been

worth more

than dead things. Heavy

like your fathers fist, or something

that makes you forget.

Does he tip the waitress

even if she doesn't smile?

He gives it to you

because you want it

or you say you do

or he thought you did

or you said you didn't

or he said you did

and it's forgivable. It is
until it isn't. There's light
in whatever room you're in
even when the window is
closed. Even when he takes away
the window and shoves a wet towel
under the edges of the door.

Sheets stained, not ruined,
you lay in blood after he leaves.

I'm not saying he's always trying to kill
you, not saying he will even try once.
Just saying whatever hangs from your neck
can always be cut,

in whatever room you're in,
with your hand in light.

Poem 4:

In the Tub, the Spider

can have it. I forget I
want these things, anyway

forget I enjoy this restless
morning. This he can have it

in the evening. There is no reason

to cry. I am biting my own skin.

When his voice rises, my mother's
heart escapes me. I am panicking

in the sink, in the dog food
aisle at Walmart. I am convinced,

never convinced this is my body wanting
not wanting to die. He wants me

to die. His arms hold me at weird angles.
I just want to take a bath. I just want

these words to convince you. He crawls
on me when he is not there. By me,

he has touched and been touched. Behind
every curtain, every obscure shading of light,

I feel the cold and it is brand new and it is
filling all of my empty spaces. In the tub,

the spider can have it. The bathroom
has never been safe. I am always

locking the door, picking the rug off

the lint, wondering how much longer

can it possibly last. It can. I hold

my breath, tell him he can have

as the water and everything

in it escapes through the drain.

Discussion of Heavy In That Necklace AND In the Tub, the Spider: These poems were written after reading *Gurlesque: the new grrly, grotesque, burlesque poetics*. The Gurlesque anthology introduced to me poets like Dorothea Lasky, Catherine Wagner, and Ariana Reines. These poets interest me because they share the desire to breakdown the expectations of traditional poetic forms and contents (which were created by men) and make poetry into something that represents the realistic, varied experiences of women. This means that they are deeply invested in the complex physical, and emotional details of female embodiment and personhood that are left out of the often-idealized traditional poetry. They describe their experience of a generalized sexist culture and portray it with poetry that is dramatized and demands to be read out loud; however, their tone is strong enough to be heard even through ink. They are deeply interested in the body and the experiences of embodiment, which is often ignored within a patriarchal poetry's valuing of the mind over the body and the bodily. They utilize the shock factor of the grotesque to prove a point—it shouldn't be as shocking as it is for them to discuss their bodies and emotions in such ways.

Poem 5

Comets

broken rocket

broken rocket

 I am alone

 in your bedroom

 cold I am

 anxious when you are

 here no one in

your family has died

 yet your fish died

 but that doesn't count

 it's hard

to tell what makes you tick

 -le me when you think I am mad

 or lonesome I am

annoyed
but in love with how
your grandpa's breath tastes
like pretzels
the day continues
this way
in your bedroom
alone
and what if they all go at once
while you're at work or
otherwise
will I have to hold you
-r head up in the movies
I am not that strong
or get you water
when the names are caught
and dried
and holding onto
in the back
of your throat
how much longer do I get
to feel alone before I am
the fish you land on
from outer space
unbeknownst to them
sing a similar song

Discussion of Comets: This poem was written after reading Laura Solomon's *The Hermit*. The main technique I took away from Solomon's poetry was how she was able to connect and disconnect each line from the other. This is especially prevalent in her use of white space. Each line that she writes and the way they are spaced close or far away from each other maintains the capacity to be completely connected—even if they don't look like they would be at first glance. As the poem is read, all of her lines work together even as they jump from one idea to the next. Thematically, Solomon kept the idea of a romantic partner near, but then used this more traditional poetic convention as an occasion for addressing larger, more complicated ideas or emotions. I chose a similar tactic in my poem as well. Below is an excerpt from Solomon's poem, "White Flowers" which I stylistically stayed very close to. You can see this in the similar repetition of the first lines, and of course, the use of white space.

White Flowers (An Excerpt) By: Laura Solomon

perfect snow
perfect snow
you are eating

the hardest part of parmesan

it melts

you laugh

place a piece of ring in my mouth and say

you have to make it wonderful

to suck a bit

now you are falling asleep

you snore

your hair floats and gets stolen by angels you snore

as if snoring might wake you

might write you

a story

something to tell

in the morning

it's so hard to tell

angels from demons

this thought from that

everything

floating and gettings

stolen from your mouth

and mine... (cont.)

Final Poetic Statement:

Through this project, I learned that I'm particularly interested in utilizing line breaks and enjambments in my poetry to highlight my subject matter, and evoke a second and third meaning if at all possible. I am always

thinking of the materiality of language as well, and how the poem will sound out loud. I also aim for a natural building of speed by keeping in mind similar syllable counts and word placements. With this collection of poems, I experimented with the spacing of words and the different possibilities of unconventional structures that avoid the traditional stanza.

In most poems, you can find places that I am reflecting on poetry within the poem as well. I do this to parse through the complex relationship between poet and poem, and to also allow commentary on if the subject matter as either a comfortable or uncomfortable space for the poem's explorations. While most of my poems are first person, the lyrical "I" is expanded to being more than just one person. I am interested in exploring the usefulness of the lyrical "I" but also fragmenting it into something that is less recognizable.

With each poem in this chapbook, I took something that made me feel a certain emotion and wrote about it until I completely understood why I needed to. As a result, I feel that my poems stay mostly in the internal, moving from one line to the other as my thought process progresses; however, they always ground themselves in the world of the everyday as I found most of the contemporaries did as well.

Mentioned Texts:

Christle, Heather. *What Is Amazing*. Middletown, CT: Wesleyan UP, 2013. Print.

Glenum, Lara, and Arielle Greenberg. *Gurlesque: The New Grrly, Grotesque, Burlesque Poetics*. Philadelphia, PA: Saturnalia, 2010. Print.

Notley, Alice. *Certain Magical Acts*. New York: Penguin, 2016. Print.

Notley, Alice. *Coming After: Essays on Poetry*. Ann Arbor: U of Michigan, 2005. Print.

Notley, Alice. *Grave of Light: New and Selected Poems, 1970-2005*. Wesleyan University Press, 2008.

Solomon, Laura. *The Hermit*. Brooklyn, NY: Ugly Duckling, 2011. Print.

Expectancy Disconfirmation Theory and Police Use of Force

Taylor Davis

University of South Alabama

Abstract

There is significant research reinforcing the idea that satisfaction with bureaucratic performance varies based on expectations. However, there is little experimental evidence supporting this model on more controversial areas of bureaucracy, such as policing. In this study, I use an original experiment on police use of force to test how well the expectancy disconfirmation model predicts citizen satisfaction with police and their perceptions of fair treatment by the police. I surveyed a student sample (n=534) of 5 universities from different regions of the country on police use of force, citizen satisfaction with police, and fair treatment by police. I did not find evidence supporting EDT in this policy context. Expectations either have no effect in light of performance, or the opposite of what EDT predicts. This research indicates that it is important for scholars to continue testing the theory in different policy areas to better understand when, and under what conditions, EDT is a useful framework.

Background: Expectancy Disconfirmation Theory

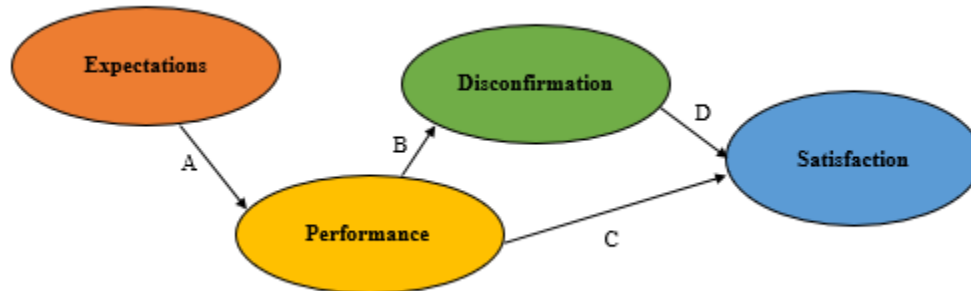
Expectancy disconfirmation theory (EDT) is a cognitive theory that explains how people's expectations can shape how they react or perceive an event or situation. EDT rests on the notion that satisfaction is deeply connected to performance relative to expectations. The relationship to performance and satisfaction is contingent upon expectations. For example, if there is weak performance, this will not affect satisfaction as much if there are weak expectations. If you have high expectations and performance is weak, those expectations will affect satisfaction more negatively. This is known as disconfirmation, when expectations do not match up with performance. In public administration literature, this theory appears robust when examining relatively mundane bureaucratic tasks like street cleanliness (Ryzin, 2013), but may be less predictive in more complex and potentially controversial bureaucratic tasks like policing (Petrovsky, León-Cázares, & Mok, 2017).

Figure 1 shows the relationship between expectations and performance. When expectations are met with performance (line A), those expectations are either confirmed or disconfirmed. Both options have an effect on satisfaction. When expectations are disconfirmed (lines B & D), that satisfaction is very different than when expectations are confirmed (line C).

Expectations are seen as the base line for this theory. Those expectations can be influenced by many factors. Expectations can be based on normative feelings or past experience with a public service, for example. Everyone has different opinions, which can make ultimate satisfaction of the same public service vary. One illustrative example of this theory is Greg Ryzin's (2013) dark theatre scenario. He uses the analogy of people who walk out of a dark theater needing to readjust their eyes to the light while everyone not in the movie theater faces no such readjustment. The adjustment is the difference in opinion or expectation. Those just coming out of the theatre may see the world a little differently for a few minutes (Ryzin, 2013). This difference informs their expectations, which in turn affects overall satisfaction of a service. Another study focuses on how attitudes toward the police can influence performance ratings (Gerber, 2017). These attitudes are attributed to particular political ideologies, and are used to help explain why people perceive the same situation contrarily. Some other researchers call expectations a frame of reference or referent. With this definition, most align with the baseline concept (Jacobsen, 2014; Morgeson, 2012).

This theory originated in marketing and consumer satisfaction, but has become popular in areas of political science and public management. With many new ways to communicate, researchers use this theory to better understand how the public views public institutional performance. What makes this theory so interesting is the subtractive nature of the disconfirmation (Ryzin, 2013). Disconfirmation does more than show citizen dissatisfaction with a particular public service. It also sheds some light on how citizens may expect public service to be in the first place. Although there are many studies using EDT to measure public satisfaction, few center around policing and police use of force. One study finds that even when people are given the same experimental frames they perceive police performance differently (Braga, 2014). This follows Ryzin's example of the dark theatre. This concept also holds with the varying reactions of the viral videos of police force. Even though the footage is the same, people seem to see very different situations.

Figure 1. Expectancy Disconfirmation Theory



Police Use of Force

Public managers often focus narrowly on the crime rate as a basis when trying to measure police performance. Citizens' positive perception of police is also an important outcome, however, given police reliance on citizen cooperation to provide security. I chose to study citizen satisfaction with police use of force considering it is still an understudied area in public administration research. With this focus, I expect to see a difference in the satisfaction rate contingent on different combinations of expectation and performance. Some other factors influence why certain groups would rate the police in a positive or more negative light as well. Researchers find questions of police legitimacy, prior experience with the police, and normative feelings about police use of force shape citizens' perception of the police (Braga, 2014; Hawdon, 2008; Jackson, et al., 2012).

The media in particular can make an impact on how people perceive police use of force (Donovan & Klahm IV, 2015). Not everyone has had direct contact with police. Citizens draw from many different sources to get information (Olsen, 2015). Sometimes that information is from the daily news, which is more subjective than most think. Others get their information through TV shows surrounding law enforcement. The semi-realistic nature of the TV shows, paired with the unrealistic practices and arrests of the police officers on the shows, "inform" viewers that police use of force is normal and police always get the bad guy. This misinformation makes the idea of police use of force in the real world normal and almost warranted, even when the offender is neither hostile nor dangerous

(Donovan & Klahm IV, 2015).

To combat this misinformation and regain the trust of citizens, some researchers say public managers should focus on keeping the citizenry properly informed (Ho, 2017). In their study of hospital patients' satisfaction, Ho and Cho (2017) conclude that more sources of information help to lessen negativity bias. This means that if public managers give more information, people are more likely to be satisfied because they have a rounder view of an issue, rather than just their experience with a particular public service. Another study focuses on public satisfaction of the Affordable Care Act, more commonly known as Obamacare. In this study, researchers found that party identification plays a strong substantive role in overall satisfaction of the legislation (James, 2017).

Minority satisfaction of the police is also frequently studied. According to Arthur and Case (1994), minority groups are usually more critical of the police when compared to other groups. This gap in satisfaction remains even after controlling for education, income, and occupation (Arthur & Case, 1994). There are also major differences with respect to gender. When compared to males, females are not as satisfied with police performance (LaGrange, 1989). Conversely, men are usually more approving of police use of force or excessive force (Johnson, 2009).

Hypothesis

Looking at the strong experiments that support Expectancy Disconfirmation Theory, I want to test if this theory will hold for other areas of public management. Police use of force is a controversial and very polemical topic, and this area of research lacks decent tests of the theory in this context. Maybe this lack stems from the intense controversy surrounding problems of police excessive use of force. Also, satisfaction may be more difficult to measure when expectations or performance may outweigh the other.

Hypothesis 1: Satisfaction with police use of force will vary with expectations while holding performance constant.

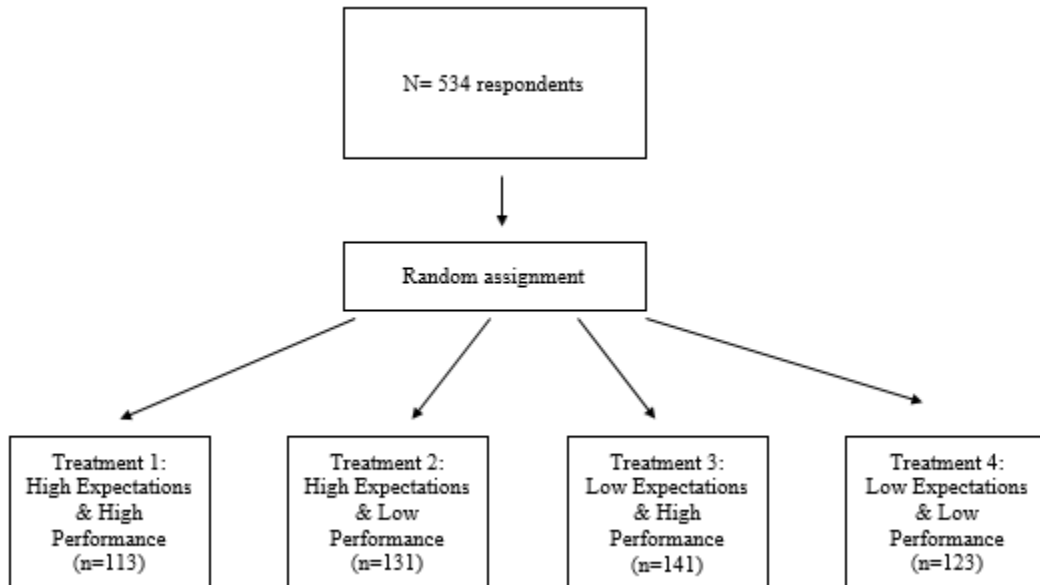
Hypothesis 2: Satisfaction with police use of force will vary with performance while holding expectations constant.

Methods & Research Design

I used a survey of a student sample (n=534) from 5 universities in different regions of the country on citizen satisfaction of police use of force and fair treatment. Respondents were randomly assigned into four separate experimental frames. Each frame induces either a high or low expectation and performance. For expectations and performances, respondents read the given paragraphs and answered questions about satisfaction with the police and their perceptions of fair treatment. This experimental design was adapted from Ryzin's (2007; 2013) work with expectancy disconfirmation theory and street cleanliness. Figure 2 is a graphical representation of the experimental design (Ryzin, 2013). Respondents rated police on an interval scale of 1 to 7 with questions based on the treatments given. These questions had language about police use of force and fair treatment with race in mind. To test the EDT hypotheses, I ran Ordinary Least Squares Regressions of the frame conditions (High Expectation & High Performance, High Expectation & Low Performance, Low Expectation & High Performance, Low Expectation & Low Performance) on the two dependent variables. I also included models with a full set of covariates that may predict satisfaction with police and perceptions of police performance.

From the two hypotheses, I expect respondents' satisfaction to vary with different expectations and performances to confirm the expectancy disconfirmation theory. I predict a negative effect of receiving the high expectations and low performance frame when compared to the base category of receiving a low expectations and low performance frame. This implies a positive effect of getting the low performance and high expectations frame in comparison to the high expectations and high performance frame. Figure 2 indicates the numerical breakdown of the manipulations. With 534 respondents, the distribution of each frame is roughly equal, and since this is an experiment with random assignment, I can expect strong internal validity. Table 2 reports the treatment manipulations for expectations and performances along with the numerical breakdown of how many respondents received each. Careful attention was given to make the frames as equivalent as possible while only varying information necessary for the intended experimental manipulation. All four frames provide information from the same study and the pairs of frames (for expectations and performance) are introduced with identical phrasing. Information from a common study of police use of force is then manipulated providing more flattering facts for the high frames and more critical findings for the low frames.

Figure 2. *Experimental Design*



Frame Introduction: What follows is a description of the results from national research on police use of force. Please read carefully.

| | |
|--|--|
| <p>High Expectations (n= 244) <i>Based on legislation passed in the 1990s, every three years since 1999, Justice Department researchers study the incidence of police contact with citizens. A major part of this research is the Police-Public Contact Survey which asks tens of thousands of ordinary citizens about their experience with law enforcement. Between 1999 and 2011, reported use of force by the police declined by 3.6 million cases. Furthermore, since 2002 use of force by the police decreased by 15%. African Americans reported an even greater decline of about 25%. When asked about the legitimacy of traffic stops, respondents reported no racial bias, as African Americans were just as likely to claim stops by white officers were legitimate as stops by black officers.</i></p> | <p>Low Expectations (n=265) <i>Based on legislation passed in the 1990s, every three years since 1999, Justice Department researchers study the incidence of police contact with citizens. A major part of this research is the Police-Public Contact Survey which asks tens of thousands of ordinary citizens about their experience with law enforcement. African American drivers were 30% more likely be pulled over by the police for traffic violations and 40% more likely to be given a ticket. Additionally, in the period between 2002 and 2011, they were more than twice as likely as the average citizen to be targeted with use of force or the threat of force by the police. When compared to Whites, the discrepancy is even more severe, as African Americans were three times as likely to experience the threat or use of force as their White counterparts.</i></p> |
| <p>High Performance (n=257) <i>The most recent results from the Police-Public Contact Survey were made widely available to the public in 2014 based on data collected in 2011. Last summer a prominent economist released a more current study on race and police use of force and his results were somewhat surprising given much of the news over the past three years. From the year 2000 to 2015, African Americans were no more likely than Whites to be the victims of police shootings. The researcher also found that in situations when lethal force may be justifiable, police officers were in fact about 20% less likely to shoot African American suspects than White suspects.</i></p> | <p>Low Performance (n=255) <i>The most recent results from the Police-Public Contact Survey were made widely available to the public in 2014 based on data collected in 2011. Last summer a prominent economist released a more current study on race and police use of force and his results were not surprising given much of the news over the past three years. From the year 2000 to 2015, African Americans were considerably more likely than Whites to be the victims of police use of force. They were 15 to 25% more likely than Whites to experience forceful treatment in otherwise similar situations, including being pushed to the ground, having a weapon drawn on them or being handcuffed.</i></p> |

Results & Data

Table 2. Fair Treatment by Police

| | Fair Treatment | Fair Treatment |
|---------------------|----------------------|----------------------|
| High High | 1.380 ^{***} | 1.239 ^{***} |
| | (6.58) | (6.69) |
| High Low | 0.170 | 0.170 |
| | (0.84) | (0.97) |
| Low High | 1.006 ^{***} | 0.925 ^{***} |
| | (5.09) | (5.40) |
| Democrat | | -0.178 |
| | | (-1.05) |
| Republican | | 0.490 ^{**} |
| | | (2.64) |
| Female | | -0.369 ^{**} |
| | | (-2.92) |
| Police Mistreatment | | -0.734 ^{**} |
| | | (-2.72) |
| Crime Victim | | -0.211 |
| | | (-0.94) |
| White | | 0.488 ^{**} |
| | | (3.25) |
| Ideology | | 0.306 ^{***} |

| | | |
|----------|----------|----------|
| | | (5.74) |
| Constant | 3.179*** | 1.924*** |
| | (22.02) | (6.49) |
| <i>N</i> | 504 | 496 |

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3. Satisfaction Rate of Police

| | Satisfaction | Satisfaction |
|------------|--------------|--------------|
| High High | 1.143*** | 1.023*** |
| | (5.36) | (5.37) |
| High Low | 0.288 | 0.253 |
| | (1.40) | (1.40) |
| Low High | 0.647** | 0.570** |
| | (3.21) | (3.23) |
| Democrat | | 0.00671 |
| | | (0.04) |
| Republican | | 0.535** |
| | | (2.80) |
| Female | | -0.436*** |
| | | (-3.37) |

| | | |
|---------------------|----------------------|-----------------------|
| Police Mistreatment | | -1.111 ^{***} |
| | | (-3.98) |
| Crime Victim | | -0.201 |
| | | (-0.87) |
| White | | 0.508 ^{**} |
| | | (3.26) |
| Ideology | | 0.286 ^{***} |
| | | (5.17) |
| Constant | 3.303 ^{***} | 2.058 ^{***} |
| | (22.33) | (6.72) |
| <i>N</i> | 495 | 486 |

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4. *Fair Treatment by Police'*

| | |
|----------|-----------------------|
| | Fair Treatment |
| Low High | -0.374 |
| | (-1.84) |
| High Low | -1.210 ^{***} |
| | (-5.84) |
| Low Low | -1.380 ^{***} |
| | (-6.58) |
| Constant | 4.559 ^{***} |
| | (29.99) |
| <i>N</i> | 504 |

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.01$

Table 5. Satisfaction Rate of Police'

| | Satisfaction |
|----------|--------------|
| Low High | -0.496* |
| | (-2.41) |
| High Low | -0.855*** |
| | (-4.07) |
| Low Low | -1.143*** |
| | (-5.36) |
| Constant | 4.445*** |
| | (28.90) |
| N | 495 |

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Results

Based on the results from the OLS regressions reported in Tables 2-5, I do not find evidence supporting the Expectancy Disconfirmation Theory. When comparing the effect of High Expectations & Low Performance with Low Expectation & Low Performance (the base category) in Table 2 with fair treatment, I expect the coefficient to be negative and statistically significant, because the high expectations should create greater disconfirmation and hence disappointment. The coefficient, however, is not significantly different from zero. This is true as well for satisfaction in Table 3. The coefficient for High Expectations and Low Performance is not statistically significant, and so I fail to reject the null hypothesis that there is no effect of high expectations. For the models shown in Tables 4 & 5, I changed the base category to High Expectations and High Performance. The Low Expectations, High Performance pairing should have a positive effect, but the coefficient is negative and significant for the satisfaction dependent variable, and insignificant for fair treatment.

I also include models with covariates to measure how certain groups rate the police in satisfaction and treatment. When looking at race in Tables 2 & 3, whites assess the police significantly higher than non-whites ($p < 0.01$). This is consistent with expectations, given minorities' historically tense relations with police. Women also rate the police lower than males, *ceteris paribus*. I also look at other predictive factors of citizen satisfaction with police, like ideology, and past treatment or victimization. With ideology, I find no real difference when rating

police. However, past victims of a crime or police mistreatment in both coefficients in fair treatment and satisfaction are negative and are not statistically significant. This suggests victims' prior experience with police has a negative effect on their overall satisfaction with police.

Conclusion

These results suggest more controversial areas of public administration like policing may not follow the cognitive intuitions of EDT. There are multiple factors that play into citizens' perceptions of the police that may be hard to model. This makes it more difficult to measure and isolate if hypothetical expectations and performance will produce results that confirm this theory. Perhaps expectations and performance do not condition overall satisfaction in the same way they do for street cleanliness, etc. Expectancy disconfirmation theory may not be a good framework for predicting satisfaction in this area, and others of a similar nature. Satisfaction of police performance in use of force and fair treatment is more intensely felt when compared to other areas of public management like street cleanliness. In addition, the lower number of respondents and more traditional pool of college students may not be representative. More research is needed on more controversial areas of bureaucracy to see whether Expectation-Disconfirmation Theory is limited to certain areas of public management with lower stakes for citizens than policing.

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DEFINING A MONUMENT: CLAUDE MONET'S GRANDE DÉCORATIONS AND THEIR FAILURE TO POST-WAR FRANCE Tiffany Hester

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Abstract

In July of 1914, Claude Monet began working on his final masterpieces from his Water Lilies series known as the Grandes Décorations that are now displayed at L'Orangerie in Paris France. Generating the idea for these works almost twenty years prior to this time, and spending the last decade painting them, Monet intended them to be arranged in a circular room, where the viewer could use the space for reflection and meditation. He wanted these panels to represent his legacy and as an epilogue to the Impressionist era. What he did not intend was for these works to become a memorial for the Great War, given to the Government of France on the day of Victory, but this is exactly what happened. The following article explores the creation of these panels, their dedication and failure as war memorials in post-war France, and their continual neglect in research concerning war memorials. This article has found that war memorials are products of the culture in which they are produced, and the public has a continual choice in how their past is represented through these monuments. In conclusion, discussing these paintings' sole role in the history of art and modernism reflects the public's decision that they do not adequately fulfill their roles as war memorials.

On 12 April 1922, Claude Monet, through the aide of Georges Clemenceau, signed a contract with the French government to donate nineteen panels of his *Grandes Décorations* paintings to France as a monument of peace after their victory over the Germans in the Great War. As part of the agreement, France supplied the structure that would permanently house these massive paintings of water lilies. Despite Monet's reputation, these works were ignored by most of the population in Paris, allowing the paintings to obtain water damage and go without repair after being lodged with shrapnel in an air raid during the Second World War. It was only after the 1950s that Monet's *Grandes Décorations* began to receive some attention in the art community. Widely discussed for its decentralized composition—an art technique surpassing his time—Monet's works received the attention they deserved. What continued to be ignored, however, was discussion of its role in representing the Great War. There is a simple answer to this: Claude Monet's *Grandes Décorations* are not recognized as a monument to the Great War in scholarly writing because of Monet's intention, the content of the work, the timing of its reveal to the public, and its divergence from other war monuments. While its existence as a memorial does provide insight into a small group of people in France during the war, it does not connect to a broader range of people, or expand people's knowledge about the war. It is an example of how an object can have the name of a war memorial, but not serve the purpose of aiding the population's remembrance of the war.

When Claude Monet set out to paint his Water Lily series, he did not intend for them to be used as a memorial for the Great War. The first documentation of his idea for this project can be dated as early as 1898, from a newspaper article featured in *La Revue Illustrée* by Maurice Guillemot titled "Claude Monet". Guillemot described a clear picture of Monet's works: "Imagine a circular room in which the dado beneath the molding is coved with [paintings of] water, dotted with these plants to the very horizon, walls of a transparency alternately green and mauve, the calm and silence of the still waters reflecting the opened blossoms." Around this time, Monet had won the unofficial title of France's National Painter from critics for his series of paintings of France's country side. However, the way France handled the embarrassment of the Dreyfus Affair caused Monet to cease these paintings, and he began working on motifs closer to home. At the beginning of the nineteenth century, when he started working on his Water Lily paintings, the deaths of several family members and close friends, along with his awareness of developing cataracts, put a new emphasis on these paintings. He realized that he did not have much time left (either by the entire loss of his eyesight or his own death) to complete his work, which put pressure on the artist to produce his work to perfection—his last paintings completed to his own ambitious standards. Whether Monet was fully aware of it or not, he was creating his legacy.

The events that escalated into Monet's *Grandes Décorations* can be traced to the purchasing of his home near Giverny in November of 1890. Monet quickly began to uproot the produce bearing land surrounding his home and transform it into flowerbeds that would provide the artist with inspiration for his work. While his gardens took root, he began several series of

paintings with motifs that Monet found around his property: haystacks, poplars, the Seine river, and the cathedral of Rouen. Only three years later Monet purchased the land that would become the home of his water lily pond, after being inspired when he saw a hybrid species of water lilies for sale in one of his gardening catalogues. While renovating his newly purchased land, Monet continued to roam the countryside near his home with several canvases that would soon provide him with celebrity status as a painter of France.

Monet's painting series were warmly welcomed by his critics in various shows from the late 1890s. Georges Lecomte, an art critic, exclaimed that Monet was "...one of the crowning jewels of our epoch," after witnessing the Mornings on the Seine and Normandy Coast series in 1898. Similarly, another art critic, Raymond Bouyer, stated that "Monet is one of our greatest national painters; he knows the beautiful elements of our countryside whether harmonious or contradictory," after a show in December 1899 at Durand-Ruel's gallery—Monet's primary art dealer during his career. These statements are not surprising, considering the French people's attachment to their landscapes. As Romy Golan explains in his work *Modernity and Nostalgia: Art and Politics in France Between the Wars*, landscape paintings become popular once more after the Great War because of the existing connection of landscape painting to the cultural identity in France. Even though Golan wrote about French art after the Great War, he was clear to state that artists working after the war returned to this motif because of its existing tradition in French art. In connection to Monet, his particular choices for his motifs included works that represented the labor of French men, as represented by the haystacks and poplar. Monet also depicted well-known landmarks, such as the Seine River and Rouen Cathedral. Thus, it can be asserted that Monet, whether intentional or not, was painting an underlying patriotic theme in these works that had won him this unofficial title.

Monet's national stature as a thriving painter made him a celebrity of his day. However, his patriotic paintings would cease as the century came to a close. After his painting *Mornings on the Seine*, Monet did not return to the French countryside to inspire his work. There are two interpretations explaining Monet's reclusion into his gardens. The first one is the more simple and obvious reason: Monet was simply waiting for his gardens to mature, becoming as lush and vivid as possible before painting them. This would end his need to work outside his property. However, Paul Hayes Tucker provides another look into the reasons for his attention moving away from patriotic driven motifs, and instead to images of his own garden; this interpretation revolves around Monet's interest in the Dreyfus affair.

The Dreyfus Affair was a dividing issue for France at the end of the 19th century. In December of 1894, Captain Alfred Dreyfus, an artillery officer of Jewish decent for the French army, was accused of selling military secrets to the Germans. The nation was split in two; some people believed Dreyfus was being wrongly accused, while others believed that Dreyfus was guilty. In this case, Dreyfus was a victim of anti-semitic feelings that were felt throughout the nation, even in key members of the Impressionist group, such as Manet and Renoir. After

Dreyfus was convicted and sent to Devil's Island, his family rallied together support against his false conviction. Among his supporters was the reporter Émile Zola, who wrote the article "J'Accuse" for George Clemenceau's newspaper La Justice. This article helped to encourage other supporters to become public with their belief of Dreyfus' false conviction.

Claude Monet was one of the names on the petition to retry Dreyfus' case; he also wrote to Zola personally congratulating him for his courage in writing the article. As Tucker explained, this is one of the first times that Monet goes public with political matters. This course of action is not surprising, as, outlined in Philip Nord's *Impressionists and Politics*, Monet was forward with thoughts on issues such as women's rights, equality, and the republic of France. Yet, even Nord explained that Monet, though good friends with the politician Clemenceau who held similar views, did not typically discuss these feeling publicly. It is clear that Monet felt passionately about this trial, which is why he put his name on that petition.

Throughout the re-trial of Dreyfus and the trial against Zola, Monet consistently sent words of reassurance to Zola that he was standing on the right side of justice. During the trial of Zola, Monet expressed frustrations to his friend Geoffroy about not being able to attend the trial due to illness. Monet kept up with this trial until Dreyfus was found guilty a second time and Zola was tried, found guilty, and fled for London. The affair ended with Dreyfus being pardoned by France, but still carrying the embarrassment of his dishonor. It is no wonder that Monet did not return to the countryside motifs, as his trust in France's justice was ruined by the events that unfolded during this affair. Tucker expressed that after the results of the Dreyfus Affair, Monet continued his work focusing on either his own garden or lands outside of France.

Monet's work between the Dreyfus Affair and the beginning of the Great War can be interpreted using three major exhibits between 1904 to 1912 as milestones that led Monet to paint his *Grandes Décorations*. These exhibits help to define Monet's direction with his work in the pursuit of creating his legacy. They also show how Monet continued to push his art to the limit. The first show from May 1904 featured the painting series he completed in London. As Tucker explained, Monet was not merely taking advantage of motifs that he saw while visiting his son, Michel. Instead, he was trying to rival the greatest painters in London using their own scenery against them. Monet was successful, winning praises from critics in both Paris and London, who exclaimed his works were on the same level as Joseph Mallord William Turner (a British artist whom Monet greatly admired). This exhibit shows that Monet was always seeking to improve his own status as an artist—not just a painter to the nation of France, but a name known worldwide.

It is of no surprise that his next show would reclaim his own nation. By the time the second major exhibit opened in May 1909, the Impressionist movement had started to fade. Fauvism and Cubism were taking center stage, and most painters from the Impressionist group were deceased. Not allowing the Impressionist era to be considered *passé*, Monet launched a full

show of his Water Lilies series that deeply embraced the Impressionist style, but still featured something new. These paintings revealed images where the surface of the water took up most of the canvas, bobbing with water lily flowers and reflections of the clouds and surrounding foliage; a marriage of earth, water, and sky on the same surface. The absence of a clear horizon line, dividing earth and sky, made these paintings' space more decorative than plastic. This is a major turning point in Monet's style, and the decorative space of these paintings put Monet's work on the brink of abstraction. In defense of this abstraction, Monet stated that his works were "embracing the visual world and the power of art to suggest the beauty of nature." With this show, Monet proved that the Impressionist era was not over and was still on top of the avant-garde, ever pushing painting to the next level.

The last exhibit by Monet before he committed to his *Grandes Décorations* series came with tragedy. At this point, Monet had experienced the deaths of his close friends and fellow Impressionist artists. These losses, however, could never prepare him for the death of his wife, Alice Hoschedé, on 19 May 1911. Her death left Monet in a period of depression so severe that he felt he could not return to painting. After a long break from painting, he slowly merged back into his work, continuing work on pieces he had started in Venice while vacationing with his wife in 1908. Finished mostly in his studio by memory—a break from the Impressionist tradition of painting *en plein air* that Monet did not like to commit—he exhibited the series in May 1912. Despite how often this city has been portrayed in artwork since the Renaissance period, Monet was still able to bring new life to these redundant motifs. As Tucker explained, this is the last challenge for Monet; he made an old motif new again. However, this was not the end that Monet wanted, and not the legacy that he wanted to leave behind, for he feared he was, as stated by Tucker, "pandering to public taste instead of elevating it."

Monet was not able to enjoy his praise from the Venice show for long, as new woes were waiting for him shortly after the exhibit. When attempting to paint again, Monet realized that he was unable to see clearly out of his right eye. Shortly after this realization, he was diagnosed with double cataracts by a doctor in Paris whose recommendation was surgery. Fearing an operation would do more damage to his eyesight, Monet sought a second opinion and was put on a treatment that slowed the deterioration of his eyesight. While he was seeking treatment for his cataracts, his eldest son from his first marriage, Jean, died from illness on 10 February 1914. Monet's sorrow during these times is represented in letters to his close friend and periods of inactivity with his artwork. Monet contemplated retiring from art once again, but he did not want the Venice series to be his last works. With the convincing of his friend Clemenceau, Monet began working on his *Grandes Décorations* project.

By June of 1914, Monet was back to work on his *Grandes Décorations*. Once again, the artist was challenging himself to new limits. Huge, mural size paintings, in the new abstract, decorative style, were being created by the mature Impressionist painter. Not only were the size of the canvas and composition of the paintings difficult for Monet, but he did not always have

access to work directly in front of nature, as he preferred, because he could not stand the brightness of the sun. This provided Monet with new insight to his own work: the idea of meditation and reflection about the effects of nature in its absence. It was during his work on these paintings that the greatest tragedy would befall France. On 3 August 1914, Germany declared war on France, forcing France into what would become the Great War. Not only was France forced into this war, but they were defending against an invasive army, fighting all the battles on their own soil. This war not only permanently changed the landscape of France, but also changed France's glorification of young men fighting in battle. Much would change as a result of this war.

The Germans invaded the north-eastern region of France, coming within miles of attacking Paris. Monet was isolated at Giverny (the German forces coming within a mere fifty miles away from his home), with his son and step-sons in the trenches, and most of his remaining family seeking refuge farther west and south. He refused to leave the property for his own safety, repeating several times that he would rather die with his artwork by the hands of the enemy than run. To support the French troops, he donated artwork for fundraisers and vegetables to hospitals, all while he continued to work on his *Grandes Décorations*. While his country was at war, the aging artist kept the culture of France alive through his painting, becoming for Clemenceau "a living symbol of the national cultural heritage that was at stake." France was undeniably the leader of art before the war, and both men sought to keep this cultural attribute secure throughout and after the war.

Monet never did see enemy troops, as defenses held around Paris. France and its allies were able to push the Germans back into a defeat, but not without a price. Much of the north-eastern landscape was drastically changed by the modern warfare; many towns lay in ruins. The destruction of Rouen Cathedral prompted the government to extend a commission for Monet to paint the ruins of the building, as a juxtapose to a painting he did of the same building about two decades before. Nothing came of this offer because of a shift in political leadership (namely, Clemenceau being replaced) before the contract for the commission was settled. Wanting to provide something for the day of Victory, Monet reached out to Clemenceau expressing his wish to donate two panels of his extensive *Grandes Décorations* series.

Instead of choosing two panels, Clemenceau convinced Monet to donate his entire *Grandes Décorations* series. This greatly benefited Monet, who was having difficulty selling the large paintings. Not only would Monet find a home for his paintings, but he would be able to choose the room design at France's expense. An agreement was made between France's government and Monet for France to renovate the l'Orangerie to Monet's specifications, and Monet would donate the eighteen panels to France. France held up their end of the bargain, but when it came time for Monet to deliver the panels, he had difficulty finishing his work to his own standards. Only after Monet's death on 5 December 1926 did France received their panels. The l'Orangerie opened 17 May 1927, but by this time much had change in France.

Initial problems with Monet's donations are evident when considering the process of how they became monuments of peace. The most apparent of these problems is that Monet did not intend for his *Grandes Décorations* to be used as a memorial. In line with this argument, his intention for this work was for it to be his legacy, the definition of his work. For this reason, the content of the paintings did not have to be specific, but for a memorial there are (at times) specifications for what is appropriate for the memorial to be successful. Monet's use of water lily motifs and favoring the decorative spacing that was more popular in eastern-style artwork were content not welcomed after the Great War. Even though there is something to be said about Monet sticking to his work and not reverting to a style more pleasing to the populace after the war, it was not the best time for France to receive such artwork—especially under the guise of a monument. These factors caused Monet's donation to be unpopular as both a work of art and a war memorial in post-war France.

As mentioned before, Monet did not intend for these paintings to become monuments of peace for the Great War. While these images are connected to the war because many of them were painted during the war, their relationship to one another ends there. In short, these images would have been produced whether there was a war or not. The idea for these images, printed in Maurice Guillemot's article in *La Revue Illustrée*, was conceived long before the invasion of Germany. It is also clear that Monet worked on these paintings knowing they were going to be his last works for the world to judge. As Tucker explained, Monet did not want his last works to be his Venetian painting series; Venice was too overworked and popular of a motif for him to be satisfied with retiring at that point, even though he was financially stable enough to retire. Further explained by Stuckey, Monet began working feverishly in late May and early June of 1914 with the realization that he did not have much time left before he either lost his eyesight or perished. In both accounts, it is clear that Monet knew this would be his last series of paintings, and thus his paintings were more internally driven than externally influenced.

Stating that Monet did not intend for these paintings to be a war memorial is not to say that he was impartial to the war. He, as well as his fellow artists and countrymen, was distraught over the destruction of Germany's invasion. He supported the troops in the way that he could: auctioning paintings, being active in fundraisers, sparing extra food to local hospitals, and signing petitions. Even Monet's refusal to leave his home or send his artwork to safekeeping is a representation of his patriotic defiance against the German troops just outside of the northeastern side of Paris. Thus, when Monet was approached in 1918 to paint the ruins of Rouen Cathedral, he was excited to be able to contribute his artwork to the republic of France that continued to stand. Considering the few moments when Monet took a political stance, once against the government of France during the Dreyfus affair and once supporting the preservation of France during the Great War, it is clear that Monet felt strongly about showing support to his country through his own talents. When this offer dissolved in a change of political leaders, Monet still wanted to provide something as a monument to the victory of France, thus asking Clemenceau to

come choose which panels he would donate. While this gesture could be said to come from good will and patriotic sentiments, the following deal between Monet and the French government could be seen as self-serving for Monet to have his legacy in a permanent fixture and under the government's protection.

There are several reasons why it would have been more appropriate if Monet had been able to complete a painting of the ruins of Rouen Cathedral for his donations rather than his water lily paintings; the chief complaint being that the content matter of the Cathedral ruins would have been more related to the war. Also, Monet became an acclaimed painter to the nation of France from his painting series of French landscapes, during which his series of the pre-war Rouen Cathedral was painted. The ruins of Rouen Cathedral represented the heritage and resilience of France, according to Tucker. Romy Golan further explained that images depicting France's landscape (specifically, the war-torn country of the northeast) were at the height of popularity in art during the 1920s. Thus, the foreign motifs featured in Monet's *Grandes Décorations* were not the most ideal choice for a monument to the war, nor popular in artwork at the time. Even Tucker's defense for Monet's work that it is still French landscape, created by a French man, painted in a distinguished French style is not enough to ease the tension of these foreign motifs representing France's victory. It is admirable to Monet that he did not falter in his work, choosing to create what he believed in to elevate the taste of the population, and being aware of his role in modern French art and the *avant-garde*.

The timing of Monet's *Grandes Décorations* also hurt the credibility of his memorial. While a monument does not have a time limit to be erected, the amount of time that lapsed can affect how the public responds to it. With the intention and content of the work not relating directly to the war, the donation so soon after the war made it difficult for grieving families to accept broader interpretations or other people's views of war experience. This memorial is meaningful to Monet because he painted it in defiance of Germany's invasions, not letting the fear of them drive him away from his home. Clemenceau found meaning in Monet's works because he was the heritage Clemenceau was trying to protect, according to Stuckey. These are strong patriotic sentiments that got both men through the war, but these images do not visually represent the lives that were lost at war or the sense of nationalism represented in artwork at the time. Landscape paintings grew in popularity during the 1920s in France, but only specific types of landscape paintings were accepted to heal the nation's morale. According to Golan, the *avant-garde* painters, who previously pushed the limits on painting style, began to revert to technically sound landscape paintings. These paintings represented the traditional French landscape from masters before them, and helped to ease the shell-shocked community. Thus, Monet's boarder-abstract, foreign motif paintings were too much for the French people to handle at that time.

These reasons explain why Monet's works did not receive much recognition at the time of their opening. It also shows why many scholarly writers researching war monuments dedicated to the Great War tend to over-look Monet's donation. The *Grandes Décorations* are

better suited for discussions concerning Monet's role in art history, which is what Monet initially intended for the pieces; he wanted them to challenge the conventional artwork of his time. The content and execution of his paintings succeed in this goal, and the timing of his pieces challenged what was popular in the French Salon. In this role, the paintings are quite successful; however, as monuments, they are too abstracted from how the war was traditionally represented.

Monuments in France about ten to twenty years after the Great War had a different priority than Monet's *Grandes Décorations*. They were public sites for mourners to gather, remembering the ones they lost and the ones who secured their cultural identity. The very name of these memorials, which in French are called "monuments aux morts" (monuments to the dead), differs with the English ambiguous phrase of "war memorials." These monuments aux morts had a specific purpose for the people of France, something that Monet's painting did not represent, and they occupied public spaces that could not avoid being seen, unlike the *Grandes Décorations*. Monuments aux morts took on a distinctive shape within the first few decades after the Great War, and Monet's donations did not serve the public the same way that these monuments helped a nation to grieve and to heal.

A further distinction must be made between what Americans call "war memorials" and the French call "monuments aux morts." Annette Becker, a researcher in both French and American war memorials, best explained this difference in her article "Monuments aux Morts Après la Guerre de Sécession et la Guerre de 1870-1871: Un Legs de la Guerre Nationale?". Though in this article she discussed the Franco-Prussian War and the American Civil War, both nearly forty years before the Great War, her explanations of the difference between the American and French treatment of war memorials surpasses this period. In her article, Becker explained simply that in French, "monuments aux morts" insists on the dead, whereas the English phrase "war memorials" can encompass more war-related matters. In this sense, Becker continued, American war memorials focus instead on the origin of the death of soldiers, the war itself, which can be represented using different imagery.

In the American idea of "war memorials," Monet's works could be more accepted as a memorial to a certain aspect of the war, such as the preservation of the culture or the defiance of a man not leaving his home from threat of the enemy inching closer. France, however, did not accept this broader representation of monuments, especially during the beginning of the 20th century. This is also not necessarily the natural progression of war memorials, with memorials usually representing the soldiers who fought in the war first, progressing to battlefields and mass graves, and concluding with monuments that support various factors and political motives of the war. Not only is this progression outlined in Becker's article, but also in Jay Winter's book *Sites of Memory, Sites of Mourning*. Winter specifically explains that the first purpose of monuments erected shortly after the Great War were public spaces for families to mourn. Statues of the *poilu* (the French nickname for the foot soldiers in the Great War) were prominent in towns near major battlefields, and statues featuring the grieving families also became more relevant

throughout the area—this being a newer invention of the 20th century according to both Becker and Winter. It is only after time had passed and eases the grieving families that monuments with broader meanings can be more accepted to the public.

In France, however, it took the nation longer to heal than usual, due to the threat of their culture being dismantled by the lengthy, invasive war and the destruction that modern warfare brought. As Golan explained, the use of photography capturing the destroyed towns and villages caused much of the population to take pilgrimages to famous battlefields. This resulted in these battle grounds, as well as sites of mass graves, becoming monuments themselves. Golan continued to explain that the destruction of Cathedrals during the war was alarmingly high, using this as evidence that the Germans were trying to destroy parts of distinctly French architecture. It is understandable why the government of France would have commissioned Monet to paint the ruins of the Rouen cathedral as a monument to the Great War. Even though this would not have been fitting for a true monument aux morts, it would have certainly been more fitting as a representation of the Great War than the Grandes Décorations. It also would have fit in with the period when these ruins were becoming sites of pilgrimages, and could have possibly been distributed as personal collections for people's homes, as Winter explains that miniatures of monuments (typically statues) often stood in many people's homes. However, this is not the case, and thus the Grande Décorations represent the war, and the painting of the ruins never existed.

There is no way of telling if paintings of the Rouen Cathedral ruins would have been well received by the mourning population of France. Though it better represents the Great War than the Grandes Décorations, it is still a far stretch from a typical representation of a monument aux morts. While it would be more fitting in the second wave of monuments that were created from the ruins of battlefields, it is still not a brick and mortar statue or building occupying public space. Even represented in a salon or museum, it would have to be a choice for people to go view the paintings, not a permanent fixture that occupied public space the way that statues of the pouli still occupy today.

In comparison to the role monuments aux morts served during post-war France, and when considering the Rouen Cathedral painting, the Grandes Décorations seem further from their duties as a monument to the French during this time of mourning. Particularly, it most certainly does not act as a monuments aux morts that the French insist on, and could be the reason why Georges Clemenceau was so keen to call it a monument to peace. This would help to convince the French government that it was a monument worth government protection, while explaining why the content matter did not fit with the standard monument aux morts. However, this was not enough for the people of France to accept it as a monument, as shown by how the Grandes Décorations were forgotten until the 1950s, and its lack of dominance in scholarly research concerning monuments. Indeed, most scholarly writing on Monet's paintings are found under the

category of art history, and their influences on the progression of the avant-garde and Modernism.

The difference in terminology aside, another reason why these paintings were rejected by the French populace is evident in the content: these paintings were not intended to be used as a monument and thus their imagery is atypical of monuments aux morts. There are no images that directly paid respect to the dead in the way that the poilus statues served. Along with these poilus statues, significant battlefields from the war also became war memorials. However, since Monet's home in Giverny was fifty miles away from the closest battle, this does not provide sufficient credentials for this location, nor the work produced there, to assume the role of a memorial. Thus these works represent neither of the two common monuments aux morts to arise in post-war France: poilu statues nor battlefields.

The Grandes Décorations fell out of memory for its lack of credentials as a monument aux morts; however, these paintings also did not fit with what the French wanted from their artwork. As Golan explains, landscape painting took on a specific shape after the war. Most avant-garde painters reverted to traditional, almost academic, landscape paintings of the post-war North-Eastern region. Foreign motifs fell out of style, as well as abstract forms. Thus, the Grandes Decorations, which pushed the line of abstraction ever further, as well as the presence of the Eastern motif of water lilies, caused Monet's paintings to be rejected by society during this time of mourning. Tucker defined Monet's style as representational of French art by stating that Monet "also wanted to make sure that his unmistakable French Impressionism was going to dominate the evident non-western aspects of his motif." This is a powerful statement, but it was lost on the grieving people of France so soon after the Great War. Thus, Monet's gift fell out of memory. Years after l'Orangerie opened, the panels received damage from a leaking sky light and shrapnel from bombings during the Second World War. It is evident that the paintings did not receive the proper protection from the elements, and their lack of repair shows this lack of care.

There is also evidence that Monet's interest pertained more to his own priorities than to truly giving a gift of a monument to the government of France. While it was Clemenceau who convinced Monet to use those panels, Monet still greatly benefited from the transaction. He saw his vision to completion: his panels in an oval shaped room specially made for his works. His paintings are to never be removed from that space. If this was not enough to sway the painter, his contract also included a sizable sale of an older work of his to a museum. Thus, while Monet wanted to donate his artwork to the government of France on the day of Victory, he also greatly profited from the transaction. Not that monuments should be created out of the charity of the artist; Winter explained that monument making is a business that requires some sort of political action and some sort of payment. In some examples given by Winter, monuments are either commissioned by the government using tax-payers' money, or raised by donations from the public. In the case of Monet, even though the paintings were free, the renovation of the building

that they were to be installed in was not. Monet not only benefited from this transaction, but he did so from taxpayer money used for the renovation of the building, and possibly continual payment for upkeep of the building and preservation of the panels.

Monet's works hold a significant place in art history, but they fail at their duties as a monument aux morts. They represent what Clemenceau wanted to protect during the war, and they represent the angst of an elderly artist's persistence in his craft, feeling that it was his duty to his country to continue with his work. That is where the connection to the war (besides the actual coincidence of the two occurring at the same time) ends. Since monuments created shortly after the war, as Winter defines, serve the purpose of public sites for the country to mourn, it is clear that a monument, even one to peace, that only truly serves two men cannot handle being the representation of the war to the rest of the public.

It is evident that the public has a considerable amount of control in the representation of their history. This is present in direct contact—giving donations to a monument or in their involvement with design contests that are held to choose these monuments—or indirect contact—the apparent forgetfulness that Monet's works suffered for nearly thirty years after the war. This contact can also be demonstrated in the public choosing to visit the L'Orangerie, since it does not occupy public space like outdoor monuments. The public can also represent separate groups of people, from the mass population of France to scholars writing about monuments and their role in representing history. When it comes to the question of who determines how their history is represented, this mass public will always be the decision makers.

However, it is important to remember that the public does change over time, and their opinions about how their past is represented changes with it. Monuments, while holding several purposes throughout their time, are representations of the culture and public memory in the time they are produced. This is certainly true in the uneasy situation that America's Civil War memorials find themselves in now, the most notorious being the case of the Robert E. Lee statue in Charlottesville, Virginia. At the time of its creation, the public opinion of the Civil War was vastly different than today (and public opinions about the Civil War still vary through the country). Indeed, this point in history could represent the public's transitioning into a new public memory of the war. In either case, the reason why now, almost a hundred years later, this war memorial is in debate is a part of the public that did not have a voice before, now do. For a part of the public, this is not how they want their past to be represented, and they are making their voices heard after so many years of suppression. Thus, as the public changes, so can the representations of its past.

In the case of Monet, a few select people were the ones who arranged the use of the *Grandes Décorations* as a monument to peace. They had money, power, and connections, and thus commenced in the way they chose. However, the *Grandes Décorations* failed to give France's people a public place of mourning that they needed after such a devastating war, and so

they ignored it, allowing it to be damaged, until rediscovered and praised for its contributions to art in the 1950s. Scholars' writings about monuments and their role in society do not often include the Grandes Décorations as part of their discussion. Yet these panels, while they may not hold their worth as a monument, do hold value in art history.

Memorials are certainly representations of history, but they speak more on the culture creating them. By studying monuments, one can decipher the mourning practices of that culture, as well as their political views on war, soldiers, heroes, battles, and other aspects of their history. It is also clear, with Monet's donation as an example, that even when the government commissions or creates a monument without the public's consent, they still have a choice in what part of history that piece represents. While Monet's Grandes Décorations serve as a fine example of Monet's legacy, a tribute to the Impressionist era, and the dawn of modernism, it shall remain in the pages of art history books and not as a true monument aux morts to France.

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1 INTRODUCTION

For a prime p and a positive integer n , let $v_p(n!)$ denote the largest integer k such that p^k divides $n!$, the factorial. We call this the *valuation of p in the factorial*. Legendre's theorem [Leg97] states

$$v_p(n!) = \sum_{i=1}^{\infty} \left\lfloor \frac{n}{p^i} \right\rfloor. \tag{1}$$

Another formulation of this involves the sum of the p -adic digits of n ; its digits in base p . We denote this sum as $s_p(n)$. It states

$$v_p(n!) = \frac{n - s_p(n)}{p - 1}. \tag{2}$$

This fact indicates a linear relationship between n and the valuation of a fixed prime p with an "error" involving the p -adic digit sum. Recall that the binomial coefficient for positive integers can be defined as

$$\binom{n}{k} = \frac{n!}{k!(n-k)!}.$$

For example, if we wanted to compute the valuation of three in $49!$, we would first find 49 in base three: $49 = (1211)_3$. Its digit sum is $1 + 2 + 1 + 1 = 5$. So, $v_3(49!) = (49 - 5)/(3 - 1) = 22$. This means that the largest power of 3 that will divide $49!$ is 3^{22} .

Directly from Legendre's theorem follows Kummer's theorem [Kum52], which says, for positive integers n and k with $0 \leq k \leq n$, the valuation of p in the binomial coefficient $\binom{n}{k}$ is

$$v_p\left(\binom{n}{k}\right) = \frac{s_p(n-k) + s_p(k) - s_p(n)}{p - 1}. \tag{3}$$

Equivalently, this is the number of carries that occur when k is added to $n - k$ in base p .

2 q -ANALOGS

A q -analog on its most basic level is a generalization involving a parameter/variable q such that, when q approaches 1, we recover the original object. This definition allows for many different q -analogs, as it does not indicate that a q -analog of an object is *the* q -analog.

For instance, there are numerous q -analogs of 6 that appear depending on the object. The following polynomials all have the property that they equal 6 when $q = 1$:

$$\begin{aligned} [6]_q &= 1 + q + q^2 + q^3 + q^4 + q^5 \\ \binom{4}{2}_q &= 1 + q + 2q^2 + q^3 + q^4 \\ [3]_q! &= 1 + 2q + 2q^2 + q^3. \end{aligned}$$

The first object is a natural q -analog of the positive integers:

Definition 2.1 (\$q\$-Number) Let n be a positive integer. Then the q -number of n is

$$[n]_q = 1 + q + q^2 + q^3 + \dots + q^{n-1}. \tag{4}$$

This q -analog arises very naturally in q -calculus [KC02]. Recall the definition of the derivative of a function $f(x)$:

$$\frac{d}{dx}(f(x)) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}.$$

Quantum calculus uses such differential operators, but without taking the limit. For instance, the h -calculus operator d_h is defined to be $d_h(f(x)) = f(x+h) - f(x)$, which results in

$$\frac{d_h}{d_h x} f(x) = \frac{f(x+h) - f(x)}{(x+h) - x} = \frac{f(x+h) - f(x)}{h}.$$

The limit as h approaches zero gives the usual; derivative. The q -calculus uses the operator d_q defined to be $d_q(f(x)) = f(qx) - f(x)$. Hence,

$$\frac{d_q}{d_q x} f(x) = \frac{f(qx) - f(x)}{(qx - x)} = \frac{f(qx) - f(x)}{(q-1)x}.$$

Again as q approaches one the ordinary derivative is recovered. For example, take $f(x) = x^2$. The q -derivative of this is

$$\begin{aligned} \frac{d_q}{d_q x} x^2 &= \frac{(qx)^2 - x^2}{(q-1)x} \\ &= \frac{(q^2 - 1)x^2}{(q-1)x} \\ &= \frac{(q-1)(q+1)}{q-1} x \\ &= (q+1)x. \end{aligned}$$

Notice that the q -derivative of x^2 is $[2]_q x$ by our definition of a q -number. This is true in general and is the generalization of the power rule,

$$\frac{d}{dx} x^n = nx^{n-1}.$$

That is,

$$\begin{aligned} \frac{d_q}{d_q x} x^n &= \frac{(qx)^n - x^n}{(q-1)x} \\ &= \frac{(q^n - 1)x^n}{(q-1)x} \\ &= \frac{q^n - 1}{q-1} x^{n-1}. \end{aligned}$$

Realizing that the fraction is a geometric sum,

$$\frac{q^n - 1}{q-1} = 1 + q + q^2 + \dots + q^{n-1},$$

which is exactly the q -analog $[n]_q$ that we established earlier, and so, for a positive integer n ,

$$\frac{d_q}{d_q x} x^n = [n]_q x^{n-1}.$$

Notice that the expression $(q^z - 1)/(q - 1)$ works for any complex number z , meaning it can be used to define a q -analog of any complex number. It is in the special case when z is a positive integer that we obtain the sum as above. Observe that taking k q -derivatives of x^n yields

$$\frac{d_q^k}{d_q x^k} x^n = [n]_q [n-1]_q [n-2]_q \cdots [n-k+1]_q x^{n-k}.$$

This suggests that a natural q -analog of the factorial $n!$ is

$$[n]_q ! = [n]_q [n-1]_q \cdots [1]_q, \tag{5}$$

which does return $n!$ when q approaches 1. From this, it is natural to define the q -binomial coefficient $\binom{n}{k}_q$ as

$$\binom{n}{k}_q = \frac{[n]_q !}{[k]_q ! [n-k]_q !}. \tag{6}$$

In light of the discussion of Legendre's theorem, it is natural to consider the q -factorial in a similar manner; however, the "primes" in the q -numbers are slightly different from the ordinary primes.

3 CYCLOTOMIC POLYNOMIALS

Like positive integers, polynomials with rational coefficients factor uniquely. Recall that for a positive integer n , a complex number z is called an n^{th} root of unity if $z^n = 1$. The number z is also called *primitive* if there is no other $m < n$ such that $z^m = 1$. Some of the "primes" are the cyclotomic polynomials, defined as follows:

Definition 3.1 (Cyclotomic Polynomial) *The n^{th} cyclotomic polynomial is the unique monic polynomial that has exactly the primitive n^{th} of unity as its roots.*

The first few are

$$\begin{array}{llll}
 \Phi_1(x) = x-1 & \Phi_5(x) = 1+x+x^2+x^3+x^4 & \Phi_9(x) = 1+x^3+x^6 & \\
 \Phi_2(x) = 1+x & \Phi_6(x) = 1+x-x^2 & \Phi_{10}(x) = 1+x-x^2+x^3-x^4 & \\
 \Phi_3(x) = 1+x+x^2 & \Phi_7(x) = 1+x+x^2+x^4+x^6 & \Phi_{11}(x) = 1+x+x^5+x^{10} & \\
 \Phi_4(x) = 1+x^2 & \Phi_8(x) = 1+x^4 & \Phi_{12}(x) = 1+x^2-x^4 &
 \end{array}$$

Notice that for a prime p , the p^{th} cyclotomic polynomial actually equals the q -number $[p]_q$; however, the same is not true for composite numbers. These polynomials are irreducible, which means that they are "primes" for the q -numbers. The following well known result will allow us to see how the q -numbers factor:

Lemma 3.2 *Let n be a positive integer. Then*

$$x^n - 1 = \prod_{d|n} \Phi_d(x). \tag{7}$$

Now we can obtain our factorization.

Lemma 3.3 *Let n be a positive integer greater than 1. Then*

$$[n]_q = \prod_{\substack{d|n \\ d \neq 1}} \Phi_d(q). \tag{8}$$

Proof. Our definition of a q -number $[n]_q$ says

$$[n]_q = \frac{q^n - 1}{q - 1}.$$

Also, since $\Phi_1(q) = q - 1$, equation (8) follows directly from equation (7).

It is important to note that each factor of a q -number $[n]_q$ appears only once in its factorization (8). For instance, $12 = 2^2 \cdot 3$. In contrast,

$$[12]_q = \Phi_2(q)\Phi_3(q)\Phi_4(q)\Phi_6(q)\Phi_{12}(q).$$

Now that we have "prime" factors for the q -numbers, we can ask a similar question to Legendre. Take $16!$ and consider the valuation of 3. By Legendre's theorem, $v_3(16!) = 6$. The exponent of $\Phi_3(q)$ in $[16]_q!$, however, is 5.

4 A q -ANALOG OF LEGENDRE'S AND KUMMER'S THEOREMS

In this section we discuss a q -analog of Legendre's and Kummer's theorems. They give the valuation of a cyclotomic polynomial $\Phi_d(q)$ in the q -factorial and the q -binomial coefficient, respectively. In analogy with Legendre's theorem, say that the d^{th} cyclotomic polynomial $\Phi_d(q) = \Phi$ so that v_Φ is the valuation of $\Phi_d(q)$.

Theorem 4.1 *Let n and d be positive integers greater than one. Then,*

$$v_\Phi([n]_q!) = \left\lfloor \frac{n}{d} \right\rfloor. \tag{9}$$

Proof. By equation (8), we know that a particular cyclotomic polynomial $\Phi_d(q)$ divides a q -number $[n]_q$ only if d divides n . Furthermore, this cyclotomic polynomial divides $[n]_q$ only once. Then, this cyclotomic polynomial will divide $[n]_q!$ as many times as there are multiples of d in $2, 3, \dots, n$. This is n/d .

Surprisingly, this result is far simpler than the classical theorem! This, of course, is a consequence of equation (8). This factorization accounts for all divisors of a number as opposed to just the prime divisors that the ordinary factorization considers. Moreover, the factorization of the q -numbers distinguishes between repeated factors. For instance, we know that $8 = 2^3$, but $[8]_q = \Phi_2(q)\Phi_4(q)\Phi_8(q)$; it distinguishes between each successive two. As before, a q -analog of Kummer's theorem follows:

Corollary 4.2 *Let n , k , and d be positive integers with $d > 1$ and $0 \leq k \leq n$. Then,*

$$v_{\Phi_d(q)}\left(\binom{n}{k}\right) = \left\lfloor \frac{n}{d} \right\rfloor - \left\lfloor \frac{k}{d} \right\rfloor - \left\lfloor \frac{n-k}{d} \right\rfloor. \tag{10}$$

Proof. Applying equation (9) to equation (6) gives the desired result.

Finally, let us discuss how to obtain the classical results when $q \rightarrow 1$. Note that we can only consider primes since Legendre's theorem is not true for composite numbers. We need the following result about the cyclotomic polynomials:

Lemma 4.3 *Let d be a positive integer. Then,*

$$\Phi_d(1) = \begin{cases} 0 & d = 1 \\ p & d = p^k \\ 1 & \text{otherwise} \end{cases} . \tag{11}$$

Proof. The first case is apparent since $\Phi_1(q) = q - 1$. If a prime power p^k divides a number n , then by equation (8) we will obtain the cyclotomic polynomials $\Phi_p(q), \Phi_{p^2}(q), \dots, \Phi_{p^k}(q)$ in the factorization of $[n]_q$. It follows by induction on k that each of these cyclotomic polynomials must reduce to p when $q \rightarrow 1$, since $[n]_q$ must reduce to n . Because of this, it follows that the product of all of the non-prime power cyclotomic polynomials in the factorization of $[n]_q$ must be 1, since all of the prime factors of n are accounted for by the prime power cyclotomic polynomials.. Similar to before, each of these factors must then be 1 by induction on the number of factors that are not prime powers.

If d is a prime power, then equation (9) gives the number of multiples of d from 1 to n . Notice that the sum of all such prime powers is exactly equation (1). Together with the fact that $\Phi_{p^k}(1) = p$ for any prime p and $k \geq 1$, we must obtain equation (1) from equation (9) when $q \rightarrow 1$.

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The Accuracy of the Depiction of Psychological Issues in Motion Pictures Across Cinematic

History

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Introduction

Technology is pervasive. Technology is featured in virtually every facet of our lives in modernity. Technology is evil. Technology is good. Technology has the seeds sown for both our destruction and our transcendence. If any of the aforementioned is even remotely true, the study of technology is warranted. If the study of technology is then so warranted, it would perhaps be a good starting point to ask what the study of technology is. We will explore this initial question by consulting a division of the American Psychological Association that deals specifically with the domain of media and technology. APA's Division 46, The Society for Media Psychology and Technology, describes the overarching goal of the division as "... to advance the science of psychology in the research, use and development of media and technology." (APA Division 46, 2017). Division 46 also endeavors to

"... encourage and expand public knowledge through accurate dissemination of information about the impact of the media and technology on human behavior and through the development of media and technological literacy programs essential to participating fully in a digital society."

Based upon the above definition we have a starting block from whence to consider an epitome of popular culture since the 20th century – movies. Movies, films, motion pictures, or flicks have come to form a staple of the Western entertainment diet. Gone are the days where one had to march over to the colosseum and watch, under the blazing sun, how poor brutes would be pitted against each other in a battle to the death for the entertainment of bloodthirsty consumers. Today, one can remain solitary in one's chamber and explore vast and distant worlds from an enormous number of perspectives. Movies can serve us in a potent capacity to teach us about the

spirit and the culture of a people. It would therefore only make sense to understand the manner upon which films interact, challenge, and change its onlookers. Exactly that is what this paper sets out to do. More specifically, the paper will examine the behaviours of characters who (according to an article by Whitbourne, 2012) showcase prime characteristics of various psychological afflictions and then compare the characteristics observed with standards of diagnoses, as laid out by the DSM-V, to determine whether the character is accurately portraying the affliction in question. Three movies will be drawn from each of the following eras: 1874-1960, 1961-1999, and 2000-present. All of the movies in question have received an Oscar – either for best picture or for the actor/actress depicting the mental affliction. This paper then seeks to compare whether psychologically-based movies have improved in the accuracy of the depiction of various mental afflictions over the course of time or not. The research of this paper hopes to shed light on whether popular media is presenting information in an accurate manner to the public. Should the paper find poor portrayals of afflictions, a call will be made upon moviemakers to accept more responsibility in providing the public with more accurate depictions of various mental illnesses. The hope herewith is that unnecessary stigma would be reduced and those afflicted with the various illnesses would be treated more humanely as a result of the empathy fostered by the movies.

The Early Years of Movies: 1876 – 1960

This period represents a much longer period of years than the other eras which will be looked at later. The reason for this is that since the first motion picture was made in 1876, humanity took a good bit of time to gain appreciation for movies. Not only that, but filming technology had to improve to a greater degree before longer and more lifelike movies could be

made. Another reason for so long a period is that the first Academy Awards were presented in 1929 – one of the criteria for being included in this paper is that the movies had to receive a “Best Picture” or “Best Actor/Actress” academy award. From this era the paper will investigate “*Gone with the Wind*”, “*The Best Years of Our Lives*”, and “*The Three Faces of Eve*.”

Gone with the Wind

The first movie that will be considered in this era is *Gone with the Wind* which premiered in 1939. Vivien Leigh, who portrayed Scarlett O’Hara, received an Academy Award for Best Actress in a Leading Role for this film. According to Whitbourne, 2012 Scarlett O’Hara exemplifies the characteristics of a Narcissistic Personality Disorder (NPD). Caligor, Levy, & Yeomans (2015) characterizes NPD as “Individuals with narcissistic personality disorder may be grandiose or self-loathing, extraverted or socially isolated, captains of industry or unable to maintain steady employment, model citizens or prone to antisocial activities”. A YouTube clip (melanienix335, 2016) from the movie was examined and O’ Hara shows the following behaviour: compliment a man on his hair, remarks to her friends about the attractive man may “break her heart”, expresses her own jealousy by limiting a man’s interactions with other women, compliments another man who is a suitor of one of her friends, expresses confidence in her ability to get who she wants, expresses affection for a adult male twins, but in a way that gets them to follow her and give her more attention, is seen surrounded by a large group of men – all battling for her attention, plays men off against each other to see who would give her the attention she desires. According to the diagnoses laid out by the American Psychiatric Association, 2013 in the DSM-V, it would appear as though Scarlett conforms to criteria A 1. (a), B (b), C, D. For diagnosis of NPD criteria A through E must be met. However, criteria E

cannot be determined from the clip as we have no knowledge of whether O'Hara is using medication or not. Whatever the case may be, the depiction of NPD in *Gone with the Wind* is largely accurate

The Best Years of our Lives

The second movie that will be considered in this era is "The Best Years of Our Lives" which premiered in 1946. The movie received the academy award for Best Picture in 1946. According to Whitbourne, the movie deals primarily with Post-Traumatic Stress Disorder (PTSD). Specifically, the movie explores the adjustment of US soldiers returning from World War 2 service back in regular society. PTSD is, according to the National Institute of Mental Health (n.d.), "... a disorder that develops in some people who have experienced a shocking, scary, or dangerous event." A YouTube clip (Evan Bennett, 2016) from the movie was examined and the following behaviour was observed from the veterans: veteran A orders a burger in a diner, A removes a newspaper and starts to read it, Homer (another veteran) enters the scene and greets the server and asks what happened to Butches, Homer does not care what the server brings him, but then asks for a chocolate sundae, Vet A and Homer start to converse, Vet A moves closer to Homer, Homer tells Vet A about his hooks (he lost his hands during the war), Homer displays the use of his hooks, Vet A praises Homer's courage, Vet A questions the worth of Homer's sacrifice, Homer questions his questioning, Vet A laments the decisions of Washington to bring the US into the war, the server asks Vet A to leave based on his questioning of the government's motives, Vet A remarks that ignorant people all seem to have an opinion of the war, Vet A leaves, Homer follows and questions Vet A's motives, Vet A merely wants

others to “read the facts”, Homer takes offense to Vet A’s naming of soldier’s “suckers”, Vet A and Homer starts to jostle, the server knocks Vet A down with a punch in the face, a large crowd gathers around Vet A who is lying on the ground, the server is fired, Homer picks up a US flag pin that lay on the ground. According to the diagnoses laid out by the American Psychiatric Association, 2013 in the DSM-V, it would appear as though Homer did not conform to much of the diagnostic criteria. Homer did experience the war first hand, but this particular clip shows no indication of intrusive recollections from the war or avoidance of stimuli associated with the war. The only aspect of PTSD that we do see in Homer’s behaviour is quickness to react with aggression to a person questioning the war effort. Based upon the above information, PTSD is not particularly actively portrayed in this movie; however, the clip in question may have focused more on the reactionism of a PTSD sufferer rather than the intrusive recollection aspect of PTSD.

The Three Faces of Eve

The last movie from the early years of cinema that will be considered is *The Three Faces of Eve* which premiered in 1957. Joanne Woodward, who portrays Eve, won the academy award for best actress in a leading for this movie. The movie sets out to depict Dissociative Identity Disorder (DID), a popular affliction for thriller and horror movies, according to Whitbourne. DID is, according to Huntjens et al, 2016’s wording of the DSM-V, “DID is considered to be characterized by the presence of two or more distinct identity states, in which patients experience sudden alterations in the sense of self and agency.” A YouTube clip (mjoran23best1, 2011) was examined that contained a scene from the movie where we Eve is seen showcasing multiple personalities. The following was observed: the clip starts where a man explains that multiple personality disorder (as it was known then) is a rare affliction and that Eve has a struggle of two

personalities within her (Eve White and Eve Black), Eve White is shown talking to a psychologist, she complains of a headache she had, during her headache she lost consciousness, we are shown that Eve Black tried to strangle her daughter whilst she lost consciousness, another scene appears where Eve Black is suddenly attracted to the psychologist who is treating her after “transforming” from Eve White (in spite of being married), Eve Black is allergic to her nylon clothing (Eve White is not), the psychologist hypnotizes Eve White and then a third personality, Jane, emerges, Jane does not know the psychologist, Jane does not know who she is, the clip ends where a young Eve is forced to kiss the dead body of her mother at a funeral. According to the diagnoses laid out by the American Psychiatric Association, 2013 in the DSM-V, it would appear as though Eve conforms to all of the criteria for DID. The only questionable criterion is the final one which requires the different personalities to not be brought about by a chemical substance or another psychological state. We cannot say with certainty whether she is using any medication, however, the fact that she could be hypnotized to bring about a new personality may be an indictment against the portrayal of DID in this movie. Overall, this movie does a good job in presenting DID, in spite of some technical errors

The Middle Years: 1960 to 1999

This era of movie-making saw the wide scale adoption of colour and a broadening of the audience to an international market of consumers which lead to new demands on the movie industry to produce a larger variety of films. Once again, three movies will be investigated in this section: *One Flew Over the Cuckoo’s Nest*, *Rain Man*, and *The Silence of the Lambs*.

One Flew Over the Cuckoo’s Nest

The first movie we will consider from this era premiered in 1975 and won the academy award for best picture. The movie is based off a novel of the same name by Ken Kesey (published in 1962) who described the living conditions of prison mental health hospitals in the United States in the mid-20th century. This section will be a departure from other sections, as this section will consider how well the movie depicted the state of mental health institutions instead of a particular affliction. A YouTube clip (Alexandru Mortimer, 2013) was examined to consider the depiction of the prison mental health institution. Herein we see that: A patient is shown asking for cigarettes from a psychiatric nurse, the windows are barred to prevent patients from escaping, the nurses are shown to be particularly authoritarian in enforcing their rules on the patients by Ms Ratched shouting at one of her patients for standing up from a chair, various rooms are separated from each other by bars, a token economy of cigarettes are found in the ward, Mr McMurphy used cigarettes as something with which the patients could gamble with, the gambling resulted in the head nurse to reduce cigarette rations and losing bathing privileges, guards are present in the meeting room and are called in to restrain a patient who goes into a fit after being burnt by a cigarette, Mr McMurphy breaks a glass window to gain access to cigarettes that one wailing patient is requesting, MrMurphy is punched by one of the guards and subsequently knocked to the floor, one of the patients comes to McMurphy's aide, but both him and McMurphy are restrained by a squadron of onrushing guards who were called in by the nurse, the hospital walls and floors are all white, all the staff members and patients wear white. The accuracy of the depiction of the prison mental health institution in this movie will be compared to how mental health institutions were generally run during the 1950s and 1960s when the original novel, which the movie was based off of, was published. The following comparison will make use of Abnormal Psychology by Hooley, Butcher, Nock, & Mineka (2017) as a

reference. Ever since the practice of institutionalizing patients began, “asylum” was a name given to mental health institutions. The use of the term asylum is telling, as the conditions in these early mental health institutions were inhumane and cruel patients. Patients were placed on display for patrons to watch as entertainment. During the 1940s the US saw a revolution occur in mental health settings as the plight of mental health patients were brought to light. A movement of deinstitutionalization began which sought to get patients out of hospitals and back into the society. A drawback of this was that some people had been in mental health institutions for so long that they did not know how to adjust to live in regular society. Whatever the case may be, *One Flew over the Cuckoo’s Nest* appears to portray the conditions in asylums quite accurately, although not perfectly. It would seem as though the movie, in part, is trying to make a call upon the public to help bring about reform in overly authoritarian and inhumane asylums which there were still many in operation at the time of release of the movie.

Rain Man

The second movie from this era which will be considered is *Rain Man* which premiered in 1988 and won academy awards for best picture and best actor in a leading role for Dustin Hoffman who portrayed Raymond Babbitt. The film, according to Whitbourne, sets out to depict Autism Spectrum Disorder in the form of Raymond Babbitt. People with ASD often have these characteristics:

- “Ongoing social problems that include difficulty communicating and interacting with others
- Repetitive behaviors as well as limited interests or activities
- Symptoms that typically are recognized in the first two years of life

- Symptoms that hurt the individual's ability to function socially, at school or work, or other areas of life" (NIMH, 2016)

A YouTube clip (SteveM92FS, 2008)) was examined and the following was found: Raymond shows repetitive behaviour by flipping through a mechanical jukebox catalogue, Raymond recalls numbers from the jukebox catalogue upon request from Charlie, Raymond also is able to name the exact number of toothpicks from a toothpick box, Raymond speaks in short sentences, Raymond does not look Charlie in the eyes, Charlie sees that Raymond knows exactly which cards are left in his hand after dropping random cards from a stack of cards, Charlie takes Raymond to a casino to gamble with the idea that Raymond will "count cards" for Charlie to win hands easily, when riding an escalator, Raymond stares intently at its movement, Charlie and Raymond goes on to play Blackjack, Raymond proves to be a tremendous asset by winning numerous hands for Charlie, Raymond remains unemotional during big hand wins. According to the diagnoses laid out by the American Psychiatric Association, 2013 in the DSM-V, it would appear as though Raymond Babbitt conforms quite well to the general criteria for diagnosis. Raymond shows repetitive behaviour, fascination with particular objects, deficits in social interaction/emotionality, restricted communication, and savantism in the form of numbers. There are a few concerns with Raymond's depiction, the one being that he is relatively unfazed by the bright lights and tremendous stimulation a Las Vegas casino brings. He seems to respond well to commands, which is not always prevalent in those afflicted with autism. In all likelihood, Raymond does not fall into level 3 of disability, as he would not have been able to function as well as he did in the scene. Finally, the movie might be sending out a worrying message that individuals with autism can be exploited to make lots of money quickly - this is a tad socially

irresponsible. In sum, Raymond does depict autism quite well, however, too much of a door for exploitation has been left open as some may want to take advantage of a person with autism's natural gifts in numbers.

The Silence of the Lambs

The final movie from this period that will be considered is the Silence of the Lambs. The Silence of the Lambs premiered in 1991 and, according to Whitbourne, depicted antisocial personality disorder (APD) in the form of Hannibal Lecter portrayed by Sir Anthony Hopkins. The Silence of the Lambs won multiple academy awards, including best picture and best actor in a leading role. APD is defined as “Antisocial personality disorder (APD), a pervasive disorder with onset prior to age 15 characterized by breaking the law, lying and manipulation, impulsive and irresponsible behavior, anger, and aggression” (American Psychiatric Association, 2013). A YouTube clip (Movieclips, 2013) was examined to lay out the behaviour showcased by Hannibal Lecter. The following was found: Lecter greets Starling and perceptively knows her association with a police officer, he requires her credentials and asks her to stand closer to him (he is behind bars in a police cell), Lecter is disappointed that officer Crawford sent a trainee to examine him, he tends to order her around (tell her to sit), he enquires of what someone said of him, he has a keen sense of smell. According to the diagnoses laid out by the American Psychiatric Association, 2013 in the DSM-V, it would appear as though Hannibal Lecter conforms quite well to the characteristics of APD, in spite of the brevity of the video clip. He shows the ego-centrism and goal-directed behaviour typical of the condition as well as lack of empathy, hostility, and callousness. We are not shown any behaviour of his that is particularly destructive; however, Lecter is imprisoned for cannibalism therefore his destructive behaviour is assumed due to his

imprisonment. The only diagnostic criteria which is not entirely clear from the clip is whether Lecter is under the influence of a drug or other mental state/affliction that could potentially lead to behaviour which is characteristic of APD. Whatever the case may be, *The Silence of the Lambs* is not only worthy of Oscar-acclaim, but also psychologically sound as the movie depicts APD quite accurately. It should be noted that cannibalism is not typical of APD, however.

The Recent Years: 2000 to Present

This section will consider motion pictures that are most likely fresher in the contemporary moviegoer's mind than the movies from previous sections. This era saw a tremendous uptick in resources, especially technological resources, for moviemakers. The digitization of the movie industry certainly changed the business to some degree. We will consider "*A Beautiful Mind*", "*Black Swan*", and "*Still Alice*".

A Beautiful Mind

The first movie from the 2000s that we will consider is "*A Beautiful Mind*" which premiered in 2001 and won an academy award for best picture. This film follows the life of the eminent economist, John Nash, who suffered from schizophrenia – particularly paranoid schizophrenia. According to the DSM-V, 2013 paranoid schizophrenia is earmarked by delusions, hallucinations, disorganized speech, disorganized/catatonic behaviour, and/or negative symptoms. At least two of these symptoms must be present for at least a month for a diagnosis to be made. A YouTube clip (BlackView HD, 2015) from the film was examined and the following behaviour was noted: Mrs Nash stumbled upon a shed where John said he worked with governmental intelligence agencies, however, she discovers that it was all an illusion instead finding a shed full of newspaper clippings about events in politics, it seems as though John was

trying to find patterns in newspaper articles from which he would get information to help governmental intelligence agencies, John placed his child in a bath and left as “Charles” was watching the baby, Charles is not real, Alicia takes the baby from the bath and exclaims that no one is watching over the baby, John says the only reason why he can see Charles and Alicia not is because a cloaking serum was injecting into his bloodstream that allows him to see Charles, a governmental agent (imaginary) appears that wants John to kill her, the agent puts a gun to Alicia’s head, John rushes and pushes him and her away from each other, Alicia is outraged and leaves the scene, his imaginary college friend and daughter appear in a scene, John experiences a flashback and comes to an epiphany of his hallucinations, he realizes that they are not real and explains this to Alicia. Based on the diagnoses laid out by the DSM-V, John conforms very well to the criteria for paranoid schizophrenia. John is seen experiencing hallucinations in the form of his imaginary friends and delusions in the sense that he thinks he is working for government intelligence. We do not see him speaking or acting in a disorganized fashion, however. Regardless, as far as Hollywood movies go, *A Beautiful Mind* does an excellent job at portraying the struggles and the realities of paranoid schizophrenia.

Black Swan

The penultimate movie that will be considered is *Black Swan* which premiered in 2010 wherein Natalie Portman received an academy award for best actress in a leading role for her depiction of Nina, a ballerina who, according to Whitbourne, suffers from Other Specified Schizophrenia Spectrum and Other Psychotic Disorder. The movie is seen as a metaphor for the professional performing arts industry where the striving for perfection can lead performers to

experience near psychotic states This disorder is defined as “a person shows significant distress or impairment in social, occupational or other important areas of functioning due to psychotic symptoms that do not meet the full criteria for a [schizophrenic](#) or other-[psychotic disorder](#) diagnosis” (Medina, 2016). In simpler terms, this disorder can be seen as being just below the threshold of diagnosis for psychoticism, yet, the afflicted will be living with many of the symptoms of psychoticism. An individual afflicted with this disorder falls in a grey area of clinical psychology which is stressful for both patient and clinician. A YouTube clip (Micaela Locacciato, 2016) of the movie *Black Swan* was examined and the following was found: Nina, clearly distressed, enters a dressing room where Black Swan comments on her “rough start”, Nina drives Black Swan into a mirror and onto the ground, Black Swan strangles Nina, Nina reaches for a shard of glass and stabs Black Swan in the abdomen whilst proclaiming that it is her turn to be Black Swan, her eyes are seen turning red, during the ensuing struggle, Black Swan’s face becomes Nina’s – especially after she is stabbed, Nina has a veil of darkness surround her when she is strangled by Black Swan, Nina drags the lifeless body of Black Swan into another room and proceeds to stage. To be diagnosed with other specified schizophrenia spectrum and other psychotic disorder one must conform to one of four symptoms. Nina showcases characteristics of the third category of the diagnosis which is attenuated psychosis syndrome. She does experience hallucinations, but in general does not lose contact with reality to the extent and for as long as those who suffer from full-blown psychosis. Based on the criteria, it is clear that *Black Swan* portrays other specified schizophrenia spectrum and other psychotic disorders quite well. It should be noted, however, that this diagnosis does fall into a grey area of clinical psychology where someone experiences symptoms of a particular disorder, but are not

quite at the level warranting diagnosis. The film therefore has to strike a fine balance between not overblowing the symptoms, and also not underrepresenting the symptoms. .

Still Alice

The final motion picture which will be examined before the all films will be discussed is *Still Alice* which premiered in 2014. Julianne Moore won the academy award for best actress in leading role for her depiction of Dr Alice Howland, a linguist, who suffered from Early-Onset Alzheimer's disease. Familial Alzheimer's disease is an Alzheimer's diagnosis that occurs before the age of 65. Alzheimer's disease:

“Alzheimer's disease is a common cause of dementia causing as many as 50 to 70% of all dementia cases. In fact, Alzheimer's is a very specific form of dementia. Symptoms of Alzheimer's include impaired thought, impaired speech, and confusion.” (Alzheimer.net, 2017).

In the DSM-V, the word dementia (which describes the cognitive decline symptoms of Alzheimer's disease) was replaced by the term Major Neurocognitive Disorder (American Psychiatric Association, 2013). A YouTube clip (Curzon Film World, 2015) of *Still Alice* was examined and the following was found: Alice is found by John on a chair paging through a photo album which, according to her, are photos of her childhood, John reminds her that they are about to run, Alice asks John questions about when her children are coming to visit her and when John is to go to a conference (she already asked these questions before), Alice gets up from her chair and remarks that she must urinate before running, she is shown walking about the house unable to find the lavatory, she is clearly distressed about not finding the lavatory. The character of Dr. Alice Howland conforms quite well to the diagnostic criteria of the DSM-V. Alice is shown to

be quite forgetful of basic location cues as well as information that were recently presented to her. She has yet to show major loss of memory as she still remembers her family members and her early childhood memories. She is also still able to perform various self-care tasks, something that tends to decline with the progression of Alzheimer's. *Still Alice* does a stellar job of presenting Early-onset Alzheimer's to moviegoers. The painful deterioration of memory and cognitive function are poignantly explored through the discontinuation of Alice's faculty position and gradually losing her basic functional skills.

Discussion

Now that all the motion pictures have been individually analyzed for how well the characters afflicted with various mental afflictions conformed to DSM-V diagnostic criteria, let us consider how the various eras outlined in this paper presented various mental illnesses. Looking back at the first era, it seems as though the films, in general, did a good job of presenting the various mental illnesses. Considering the dearth of technology available to produce special effects during the early years of film, many of these films had to rely more on dialogue, plot, and character development to entertain moviegoers. If anything, films in early cinema were more akin to books as a bad storyline could not be covered up by explosions and flashy graphics. The problem with this phenomenon for a study such as this is that one could hardly then study a complex, long-term disorder such as PTSD in the span of a four or five minute clip. The study recognizes this major limitation and therefore conclusions drawn from this analysis should face careful scrutiny. Whatever the case may be, the first three films in this paper does a good job of depicting mental afflictions without having to resort to needless sensationalism or alarmism. If anything, Scarlett O'Hara's narcissism seems to work quite well for her, at least in the sense that she gets a large amount of male attention. The male attention

might be better explained by her attractiveness; however, in *Gone with the Wind* we do find a positive interplay between narcissism and the environment. In fact, the amount of attention Scarlett receives must be a dream for a narcissist! It should be noted that narcissists might not be as amiable and popular as Scarlett is in this film. The film might be presenting narcissists in too good of a light. In *The Best Years of Our Lives* I admit that the clip selected might not be the best to make a valid PTSD diagnosis from, however, the film does depict the struggle returning veterans face from individuals who does not grasp the suffering veterans face in wartime. Homer's punch of Vet A was likely aggression that was triggered by suppressed feelings of sadness, grief, horror, etc. from experiencing wartime cruelties. This is indeed a more Freudian interpretation of PTSD, however, it should be noted that during the 1940s Freudian psychology was king and therefore psychodynamic interpretations of past events seemed logical. The film does a good job exploring what it is was like for veterans returning from warfare, but does not depict PTSD as well – potentially causing some alarm by Homer's aggression. *The Three Faces of Eve* does a good job of exploring dissociative identity disorder, in spite of the paucity of knowledge on what was then known as Multiple Personality Disorder. The biggest problem that I found *The Three Faces of Eve* was that Eve's personality was changed by hypnosis. This does not seem to be supported in the literature and rather reflects a bit of artistic liberty which the moviemakers took in creating that particular scene. Not only that, this may be seen as a notion by moviemakers that psychologists have special mystical powers, considering that he suddenly changed Eve's personality where no one else was able to do anything to her fickle state of personality. Overall, this era does a respectable job considering that they were not aware of the knowledge we are aware of today. Yet, each film made at least one significant blunder that detracts from the accuracy of portrayal.

The middle years featured a greater ability for filmmakers to use special effects and thus detract from storytelling and character development. Yet, these films were not victims of the overuse of special effects and cliché clickbait storylines. *One Flew over the Cuckoo's Nest* was a truly remarkable film in terms of how it presented the issue of living conditions in mental health institutions. The issue of living conditions in mental health institutions already received a good bit of attention in professional literature, but this film and its book brought the issue to a mainstream audience. The film does fall into the trap of overly dramatizing the mental afflictions that some of the patients face, but not necessarily to an unreasonable degree. The film certainly makes an indictment against the authoritarian climate of mental health institutions and asks the viewer to reassess the way we treat mental health patients. The basis of Raymond's autism in *Rain Man* is shown quite well in the film. He likely did not suffer from a severe form of autism spectrum disorder or else he would not have functioned as well as he did, however, whether someone is mildly afflicted with autism or severely there are certain characteristics which should be evident. My biggest issue with *Rain Man* is how Charlie exploited Raymond's numerical prowess to win lots of money at a casino. Granted, it is possible that an individual who is afflicted with autism might be inclined to use their mathematical abilities for monetary gain, I am worried that this might send a wrong message to the public. Some may use this as fodder to exploit an autistic person's savantism in a particular area for personal gain. However, it could also be said that the film is actually trying to avoid this from happening in society by showing Charlie and Raymond's deteriorating relationship as a result of the exploitation. *The Silence of the Lambs* proved to be a motion picture that did a good job of presenting Antisocial Personality Disorder. It should be noted, however, that the film may inadvertently send a wrong message about APD sufferers. It may be surmised that all APD sufferers are tremendously evil

people who does not and cannot be helped. Although APD is difficult to treat, it is not impossible to treat (Hooley et al., 2017). In fact, as a society we should make more effort with helping APD sufferers as APD sufferers face a danger of becoming criminals at a higher rate than the general population if no intervention is applied. All that said, there certainly are APD sufferers, such as Hannibal Lecter, who become dangerous criminals in society. This film seeks to explore those individuals and does a tremendous job of just that. Overall, this era does a good job of presenting the various mental health issues although at times they border on being socially irresponsible in presenting the issues at hand. This era probably presents mental health issues more accurately, though more sensationally, than the previous era.

Since the 2000s a number of psychologically-based movies have been made. A good number of them won academy awards, including the three that have been considered in this paper. *A Beautiful Mind* is certainly among the cream of the crop of psychological movies. The movie does skirt with sensationalism, yet, it should be noted that someone suffering from schizophrenia does experience a sensational existence which is quite a radical departure from the sensations experienced by an unaffected person. Not only does *A Beautiful Mind* represent the disorder in an accurate manner, it also shows the struggles that family, friends, loved ones, and colleagues face when living with someone afflicted with a mental illness. A final positive point about *A Beautiful Mind* is that it shows that, even though at times extremely challenging, it is possible to live and thrive with schizophrenia. It is in no way a death sentence of the social or working sort. *Black Swan* is another film that is excellent in its depiction of the struggles of achieving perfection in a high pressure environment. Even though the disorder of psychoticism depicted in *Black Swan* is in a diagnostic and clinical grey area, *Black Swan* to some degree highlights the challenge that individuals face when not quite suffering from an illness that is

clinically significant, yet a disease that still makes their own life challenging. The film also points out the tremendous pressure that performing artists face on a regular basis. One can almost ask whether such high pressure environments are conducive for certain borderline diagnoses to form. As a result of asking questions such as the one before and tackling the grey area of borderline diagnosis, *Black Swan* stands out as landmark in the history of psychological movies. Due to the nature of what *Black Swan* explores, it does fall prey to the danger of being sensational rather than accurate. *Black Swan* does display some supernatural effects which would not be prevalent to an onlooker, but which hits far closer to home to the experience of an actual sufferer of the disease. Finally, *Still Alice* is worthy of all the accolades it received; not just Oscar awards, but it is also worthy of praise from the psychological community. The story of Dr Alice Howland is tremendously ironic as she dedicated her life to studying language, yet loses that which she has valued so deeply over the course of her life. The film explores this poignant subject by showing her motor, cognitive, and memory decline over the course of the film. The decline in those areas gradually leads to her loss of autonomy and loss of self. Not only are we shown the struggle that she faces internally in losing herself, we see also how her losses affect the lives of those closest to her. Rarely in life do we completely shoulder our problems alone – it is indeed with those closest to us that oftentimes shoulder an equal amount of pain. *Still Alice* does not fall prey to sensationalism, but yet still provides for a deep, poignant exploration of so difficult a subject. All in all, *Still Alice* provided the most accurate portrayal of all of the mental health issues explored in this paper. As a whole, this era did a brilliant job of portraying mental health issues accurately, even though various movies did skirt with sensationalism.

Conclusion, Limitations, and Future Directions

The goal of this paper was to discover how accurately major Hollywood films depict mental health issues and whether movies have improved in their accuracy over time. I will postulate, based on the evidence in this paper, that the movies explored in this paper all portrayed mental illnesses quite accurately and we did indeed see an improvement in the accuracy of depiction across the span of time although the element of presenting diseases in a dramatic way (rather than an accurate way) slowly crept into films over time.

The paper has some severe limitations which will limit claims of validity, reliability, and generalizability. The method of selecting movies was based on Oscar winners. It could be that there are significant portrayal differences between Oscar winning movies and non-Oscar winning movies. Oscar winning movies are also not necessarily the most watched or widespread movies. A major assumption of this paper is that movies can serve as lynchpins to cause cultural and ideological shifts in a society. A sufficient number of people must watch a movie for it to cause a cultural shift, if the assumption is even correct. The selection process of movie clips from YouTube was quite arbitrary; based more upon richness of content (number of actions or words spoken) and convenience rather than quality of content (in terms of diagnostic markers) alone. Also, clips alone cannot reveal the entire character development of a movie; therefore, the paper makes generalizations of movies based on clips from the movies. The method of behaviour analysis was simply to describe overt behaviour onscreen and then compared to diagnostic criteria. I am by no means a qualified behaviour analyst or a diagnostician and therefore my assertions should face the requisite scrutiny. Finally, because this paper is qualitative and features no quantitative data, the comparisons between various eras and movies must be understood in terms of a qualitative comparative method rather than numbers.

With all the limitations in this paper, one must wonder whether this paper warrants any attention whatsoever. That is an important concern, but I will note that a single study with the scope of this one has never been done before (at least based on a quick Google Scholar search). A goal, therefore, of this paper is to stimulate interest and questions from readers to the extent that readers may choose to further research in this field of psychology. For one, a good selection process should be used to garner movies for the study. A future study should preferably examine the entire movie in a holistic way (plot, behaviours, emotions, milieu, etc.) and not merely a clip. A future study should have a qualified behaviour analyst who examines these elements. A future study should also have a qualified clinical psychologist who would be able to make accurate diagnoses based on the behaviour analyst's observations. There is good reason for science to understand the issue of accuracy of depiction of mental illnesses in popular media as the reactions of the general public to movies may affect where funding goes. For example, the ALS Ice bucket challenge provided for a major uptick in money that has gone to researching ALS. A movie that reaches a wide audience and poorly portrays a mental illness may reduce public interest in a disease and therefore funding will be lost. By less funding, those afflicted by a certain disease will have to suffer for longer and face greater, unnecessary, and unavoidable stigma – this is what we wish to avoid in the study of the psychology of media and technology.

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SYNTHESIS OF PT/CERIA CATALYSTS FOR THE WATER-GAS SHIFT REACTION USING
SUPERCRITICAL DEPOSITION MIKAYLA WALTERS

Christy Wheeler West

May 2017

ABSTRACT

Catalysts containing Pt and ceria on alumina support are important in environmental and energy applications, as they efficiently convert CO, C_xH_y, and NO_x to less harmful CO₂, H₂O, and N₂. They are particularly useful for the water-gas shift reaction, which oxidizes CO in the presence of H₂O to form CO₂ and H₂ in fuel cells for power generation. Dispersion of the active metal sites is key in evaluating catalyst activity, and is defined as the fraction of metal atoms that are exposed on the surface. A promising synthesis for these catalysts is SCD. This technique leaves metal precursors on the surface, which are reduced to highly dispersed Pt in post-adsorption treatments, leaving homogeneous distributions of surface nanoparticles. The proposed mechanism for SCD on oxides in CO₂ is that adsorption occurs via ion-exchange, and the hypothesis of this work is that exposure to scCO₂ affects the nanostructure of deposited materials, and that a sample prepared via incipient wetness then exposed to scCO₂ will show the same structure as one prepared by SCD of the precursor. The effect of exposure to scCO₂ on the nanostructure of deposited materials was studied. Catalysts were synthesized using incipient wetness impregnation (sample 1), SCD (sample 2), and incipient wetness followed by exposure of adsorbed precursors to scCO₂ (sample 3). Dispersion measurements using CO pulse titration indicate that sample 2 was the most highly dispersed catalysts, followed by sample 1, then sample 3. This is not consistent with the hypothesis, and the proposed explanation is that the adsorbed Pt precursor on the surface of sample 3 agglomerated into large particles due to elevated temperature conditions during CO₂ exposure. After reduction, the Pt metal particles were also larger, explaining the low dispersion values. Future work could include investigating the effects of temperature, viewing the catalysts under STEM, and performing WGS reaction testing.

INTRODUCTION

Platinum (Pt) catalysts on ceria (CeO_2 , Ce_2O_3) supported by alumina (Al_2O_3) are important in environmental and energy applications. They efficiently convert carbon monoxide (CO), hydrocarbons (C_xH_y), and nitrogen oxides (NO_x) to less harmful carbon dioxide (CO_2), water (H_2O), and nitrogen (N_2).¹ Such catalysts are especially useful for the water-gas shift reaction (WGS) (Equation 1).²



Researchers are currently investigating hydrogen (H_2) fuel cells for the power generation and transportation industries. Fuel cells convert chemical energy to electrical and thermal energy in only a few steps, which makes them a low-emission substitute for internal combustion engines. To generate H_2 for use in fuel cells, C_xH_y such as methane, methanol, petrol, and diesel can be reformed to yield CO and H_2 . The WGS reaction can subsequently be used for fuel processing to increase the H_2 content³ and to decrease the amount of CO in the fuel, which, if left untreated, poisons the fuel cell catalyst. This H_2 fuel combines with oxygen (O_2) from the air to produce electricity, with heat and H_2O vapor as the sole by-products.⁴ Thus, materials which catalyze this reaction are worthy of study.

Pt/ceria catalysts are desirable over other types of catalysts for the application of fuel cells. Pt/ceria catalysts selectively oxidize CO to CO_2 , without oxidizing H_2 .³ In a study of methanol fuel cells, a Pt/ceria catalyst showed greater catalytic activity than Pt, Pt/ TiO_2 , and Pt/ SnO_2 .⁵ One study found that oxygen exchange takes place on ceria, and that the presence of Pt increases the reduction of ceria by CO at 300-650°C.⁶ Ceria-based catalysts have better thermal stability⁷ and allow the catalyst to operate over a larger range of temperatures (175 – 300°C).⁴ Thus, a combination of Pt and ceria is desirable for the WGS reaction.

Dispersion of the active metal sites is key in evaluating catalyst activity, as it measures the efficiency of use of metal atoms. It is defined as the fraction of total metal atoms that are exposed on the surface of the supported metal nanoparticles. Different reactions require catalysts with various degrees of metal dispersion and

different particle sizes, which is largely influenced by the method of catalyst preparation. The WGS reaction requires a highly-dispersed catalyst, which relates to a small particle diameter. Diameters for effective supported metal catalysts range from 1.5 – 8 nm.⁷⁻¹¹ There are many common catalyst synthesis techniques which can be used, but most of them have limitations. Liquid-phase impregnation techniques (wet impregnation and co-precipitation) can lead to large particles and inefficient catalytic activity.^{4,7,12-16} Deposition-precipitation methods slightly improve this, but challenges in effectively controlling catalyst properties remain.¹⁶⁻¹⁸ The sol-gel technique produces catalysts found to be useful in reactions other than the WGS reaction.^{16,19} Chemical vapor deposition produces desirable catalysts; however, this method has its own complications, most importantly high vacuum.^{7,13,20} Supercritical deposition (SCD), on the other hand, produces useful catalysts with ease. Mobility of the particles during the post-adsorption treatment leads to well-dispersed Pt nanoparticles,¹² which have more homogeneous distributions and smaller particle sizes than catalysts prepared with other methods.^{9,10} These smaller Pt particles are more efficient at catalyzing the oxidation of CO.⁷

SCD is a relatively new method of depositing metal nanoparticles onto supports that has gained a lot of attention in recent years.^{12,21} A supercritical fluid (SCF) has a temperature and pressure above the critical values for the particular fluid. At the critical point, gas density is equal to liquid density. SCFs have thermal and physical properties in between those of a liquid and those of a gas, thus providing an environment similar to a gas while allowing solution-based processes to occur. In this environment, there is no surface tension, and gases are completely miscible. Such an environment lends itself to catalyst synthesis. Near-liquid densities allow SCFs to dissolve metallic precursors well, and gas-like viscosities and diffusivities remove limitations due to mass transfer.¹¹ No liquid waste is created – only CO₂ vapor – and the substrate contains no solvent residue.¹²

In SCD, metal nanoparticles are synthesized by a metal precursor dissolved in an SCF and a reducing agent (H₂). Supercritical carbon dioxide (scCO₂) is often used due to its non-toxicity, recyclability, and minimal waste.¹⁰ First, the metallic precursor is dissolved in the SCF of choice. Next, it is adsorbed onto the proper support. The precursor must then be reduced to the metal form of the element with a neutral oxidation state.⁹ Typical

precursors include those used in CVD,¹¹ such as platinum acetylacetonate and platinum dimethyl cyclooctadiene (Figure 1).

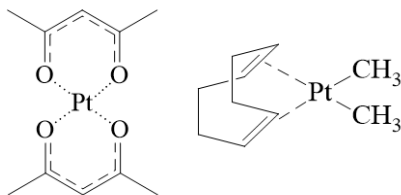


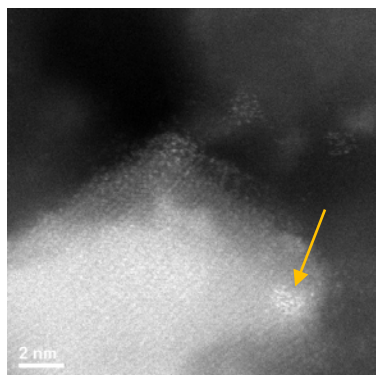
Figure 1. Organometallic precursors for SCD of supported metals.

Left: Platinum acetylacetonate. Right: Platinum dimethyl cyclooctadiene.

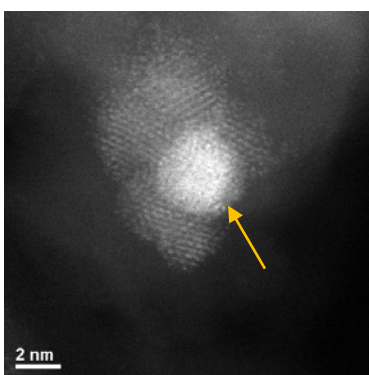
As discussed previously in this paper, SCD has the potential to accomplish synthesis of Pt/ceria catalysts for fuel cell applications much better than wet impregnation, deposition-precipitation, urea co-precipitation-gelation, sol-gel synthesis, and CVD. In a study on hydrogenation catalysts, SCD catalysts were eight times more efficient in their activity than those prepared by wet impregnation.¹⁰ SCD is a superior method to CVD due to a number of factors. It requires no carrier gas, only the main solvent to dissolve the precursor. It typically operates under pressures around 10 to 30 MPa, as compared to 10^{-4} MPa for CVD. Thus, concentrations of the precursor can be 1000 times greater in SCFD than in CVD, which leads to a high rate of deposition.¹³ In SCD, one can change pressure and temperature to adjust the power of the solvent,¹¹ instead of being limited to a specific range.

SCD is useful for preparing supported nanoparticles for catalytic applications,¹¹ specifically Pt/ceria catalysts for use in the WGS reaction. Other methods for preparing catalysts are too complicated or produce particles too large in size. SCD, on the other hand, produces highly dispersed Pt/ceria catalysts useful in the WGS reaction. SCD is a simple,¹⁰ sustainable and economically efficient technology²¹ which lends itself to mass production.¹⁰ Although promising in the laboratory, this technique must be investigated further and scaled up for practical use in industry.

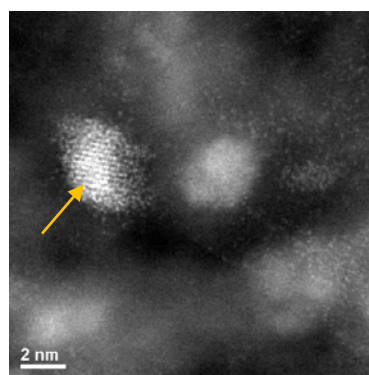
In the Wheeler lab, we are currently studying deposition of Pt and ceria on alumina using scCO_2 . The mechanism by which ceria promotes the activity of Pt is not fully elucidated, but it is clear that the interaction between the two is important.^{23,24} The extent of promotion depends upon the area of contact between Pt and ceria.^{25,26,27} Thus, it is essential to manufacture catalysts with intimate contact between Pt and ceria. This further has the effect of stabilizing metal particles and keeping dispersion high. We have found that exposure to CO_2 causes ceria to be atomically dispersed, but after calcination, ceria clumps up around Pt (Figure 2).²⁸



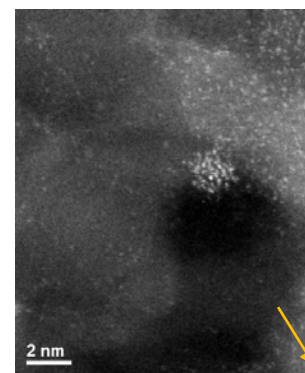
A. Crystalline ceria

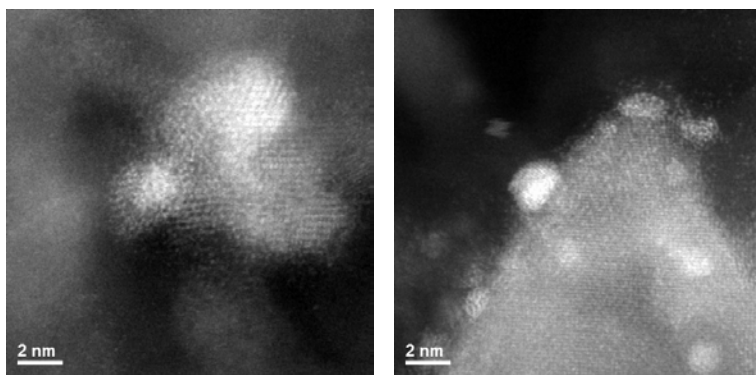


C. Crystalline ceria with large Pt



E. Crystalline and dispersed ceria





B. Atomically-dispersed ceria

D. Crystalline ceria encapsulating Pt

F. Pt nucleated on ceria

Figure 2. TEM images of catalysts prepared under different conditions.

Pretreatment here refers to exposing ceria/alumina pellets to H_2 at $300^\circ C$ to obtain more Ce^{3+} than Ce^{4+} . Pt was added to all catalysts by SCD in CO_2 . Arrows in Figure 2 point to Pt nanoparticles. Figures 2.A/B show a sample not calcined or pretreated, which exhibits both crystalline and atomically-dispersed ceria. This sample had the smallest Pt particles (most <1 nm). Figures 2.C/D show a calcined sample with crystalline ceria particles clustered around Pt with larger crystalline Pt particles, and not as much atomically-dispersed ceria. Average particle size was around 3 nm.²⁸ Figures 2.E/F show a sample calcined and pretreated. 2.F shows Pt nucleated on ceria, which means there is less contact between Pt and ceria. The average particle size was around 1.4 nm.²⁸ The pretreatment had the effect of depositing more Pt where the ceria was, but ceria did not encapsulate Pt. This catalyst was otherwise similar to the sample shown in 2.A/B (2.E). The catalyst in figure 2.C/D showed the highest reaction rate, implying that calcining alone is the way to produce the most efficient catalyst. Although the first (2.A/B) and third (2.E/F) samples had smaller Pt particles, which should be better for the WGS reaction, the second (2.C/D) sample with the largest particles performed better because it had the most intimate contact between Pt and ceria.

The proposed mechanism for SCD is that adsorption occurs via ion-exchange, as shown in Figure 3. It is thought that, in the presence of CO_2 , the surface oxygen attacks the central carbon and the proton binds to one oxygen, generating a surface bicarbonate. When the

precursor appears, ion exchange occurs between Pt^{2+} and 2H^+ to deposit one Pt ion at a time. The hydrogen ion forms acetylacetone with the remainder of the precursor.

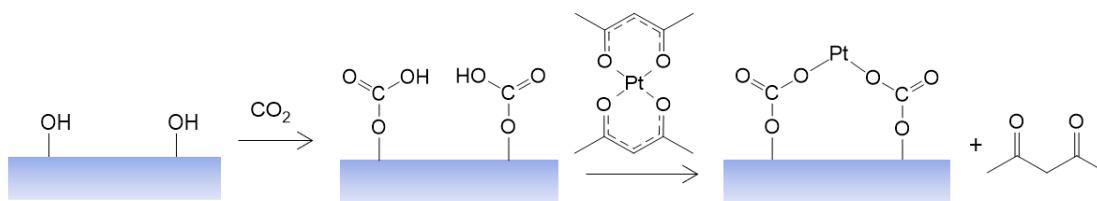


Figure 3. Steps in the proposed ion-exchange mechanism of adsorption, in this case showing a surface bicarbonate intermediate.

The hypothesis of this work is that exposure to scCO_2 affects the nanostructure of deposited materials, and that a sample prepared via incipient wetness then exposed to scCO_2 will show the same structure as one prepared by SCD of the precursor. In incipient wetness, the precursor molecule will be adsorbed onto the alumina surface and available to participate via the same mechanism as if it were added in the supercritical phase. This paper will explore the effects of scCO_2 on Pt ceria catalysts synthesized by different means.

EXPERIMENTAL METHODS

MATERIALS

The Pt precursor, platinum(II) acetylacetonate (Acros Organics, 98%), and the ceria precursor, cerium(III) chloride heptahydrate (Acros Organics, 99%), were used as received. Catalyst supports were 1/8 inch diameter high-surface-area γ -alumina pellets (Alfa Aesar). Research grade CO_2 (Airgas) was used for SCD.

CATALYST PREPARATION

A specified amount of the ceria precursor (enough to achieve desired Ce weight % of 5%) was deposited onto γ -alumina pellets using incipient wetness impregnation. A known mass of ceria precursor was dissolved in deionized H_2O . The solution was added drop-by-drop on a known mass of pellets until saturated. The pellets were

dried overnight, and the process was repeated until all of the solution was used up. The pellets were calcined in air at 400°C for 4 hours.

For sample types 1 and 3, the Pt precursor (enough to achieve the desired Pt weight % of 0.5) was dissolved in methanol and deposited onto γ -alumina pellets using incipient wetness impregnation in the same fashion. At this point, sample type 1 was calcined in air at 300°C for 8 hours. Sample type 3 was exposed to scCO_2 using the same experimental apparatus as that used for sample type 2, except that no further Pt precursor was added to the vessel before pressurization, as it was already supported on the alumina pellets.

For sample type 2, the Pt precursor was deposited using SCD. The experimental apparatus for the deposition is shown in Figure 4. A 500-mL 316 stainless steel Parr reactor was used. A K-type thermal couple, pressure indicator, vent line, and rupture disk assembly are fitted to the reactor. The reactor was placed inside a temperature-controlled heating jacket with a magnetic stirrer.

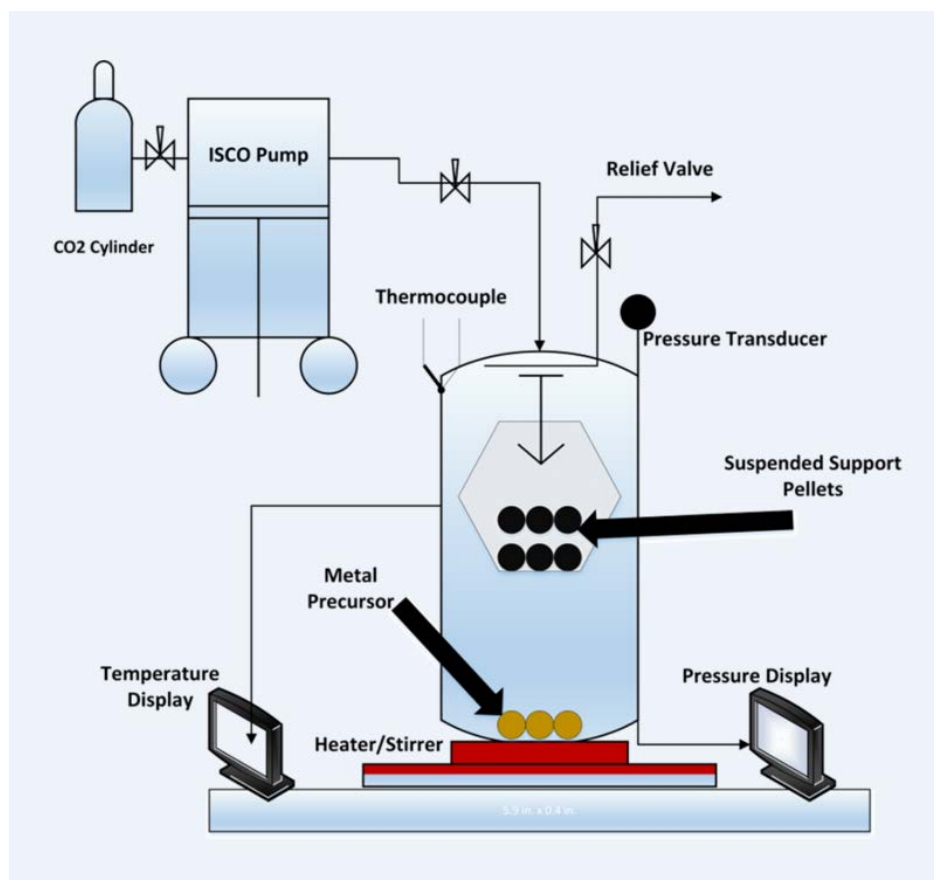


Figure 4. Experimental apparatus for SCD.

For each deposition, enough Pt precursor to produce 0.5 wt% Pt was placed in the bottom of the reactor with a magnetic stir bar. According to reported solubility values, the amount of precursor used is soluble in $scCO_2$ at the conditions used.²⁸ Catalyst pellets (ceria/alumina) were placed in a mesh basket suspended at the top of the reactor so as to prevent contact between the solid precursor and the support. The vessel was sealed and the air was flushed from the reactor with CO_2 from a high-pressure syringe pump (ISCO Model 500D). The vessel was slowly heated and pressurized to $60^\circ C$ and 140 atm. It was held at this condition for 20 hours. The vessel was then vented (4 atm/min) and cooled to room temperature.

Table 1 summarizes how Pt was added to the experimental samples. Three of each type of sample were prepared for a total of nine samples, numbered as 1.1, 1.2, 1.3 for sample 1; 2.1, 2.2, 2.3 for sample 2; and 3.1, 3.2, 3.3 for sample 3.

Table 1. Addition of Pt to experimental samples.

| Step | Sample 1 | Sample 2 | Sample 3 |
|-------------|-------------------|-----------------|-----------------------------|
| 1 | Incipient wetness | SCD | Incipient wetness |
| 2 | Calcine | Calcine | Expose to scCO ₂ |
| 3 | Reduce | Reduce | Calcine |
| 4 | | | Reduce |

CATALYST CHARACTERIZATION

Elemental analysis was performed using atomic emission spectroscopy (Agilent 4100 MP-AES) calibrated with appropriate single-element standards for 1.1, 2.1, and 3.1. Halfway through experimentation this equipment became unavailable. For samples 1.2, 2.2, 3.2, 1.3, 2.3, and 3.3, atomic absorption spectroscopy was used (PerkinElmer GFAAS). Approximately 100 mg of catalyst was digested in 6 mL each of hydrochloric acid (HCl) (1 M) and nitric acid (HNO₃) (1 M). The mixture was stirred at 200 °C for 48 hours to allow the material to fully digest. Samples were then diluted to appropriate concentrations and elemental analysis was performed.

Catalysts samples underwent temperature-programmed reduction in a Quantachrome ChemBET chemisorption analyzer. Each sample (0.1-0.3 g) was crushed and loaded into a quartz U-tube. Constant flow of 5% H₂ in N₂ was used for reduction. Temperature ramps were set at 10°C/min. A cold trap with liquid N₂ removed any condensable reduction products formed. The uptake of H₂ was measured over a temperature range of 40-500°C.

Following reduction, CO pulse titration was conducted on each sample. The samples were heated to 200°C under 5% H₂ in N₂ flow for 2 hours to ensure complete reduction, followed by a helium flush to remove chemisorbed H₂. The sample tube was then immersed in a dry ice-ethanol bath to reduce the sample temperature

to -78°C , which suppresses CO spillover and reduces falsely high measurements.¹ CO was pulsed in 50 μL increments.

RESULTS & DISCUSSION

CATALYST COMPOSITION

Nominal catalyst compositions were 0.5% Pt and 5% Ce. AES and AAS gave Pt and Ce (only Pt for AAS) compositions, as shown in Table 2.

Table 2. Sample composition.

| | Sample Set | Value |
|------|------------|-------|
| % Pt | 1 | 0.184 |
| | 2 | 0.28 |
| | 3 | 0.188 |
| % Ce | 1 | 4.5 |
| | 2 | 3.25 |
| | 3 | 3.26 |

TEMPERATURE-PROGRAMMED REDUCTION

TPR scans for all catalysts are given in Figure 5. These catalysts include all three types mentioned earlier. All TPR scans show two distinct regions of H_2 consumption. These peaks represent two separate surface phenomena.^{29,30} All three samples show a lower temperature peak, which corresponds to the reduction of platinum oxide (PtO_2) to supported Pt metal nanoparticles. The presence of CO_2 in samples 2 and 3 causes a higher-temperature peak, likely due to the decomposition or reduction of formates formed when CO_2 interacts with the alumina. The presence of methanol as the incipient wetness solvent in samples 2 and 3 has also been

found to cause a high-temperature peak. The maximum reduction rate occurs around 300°C for all samples, and this indicates that all samples have a strong metal-support interaction.

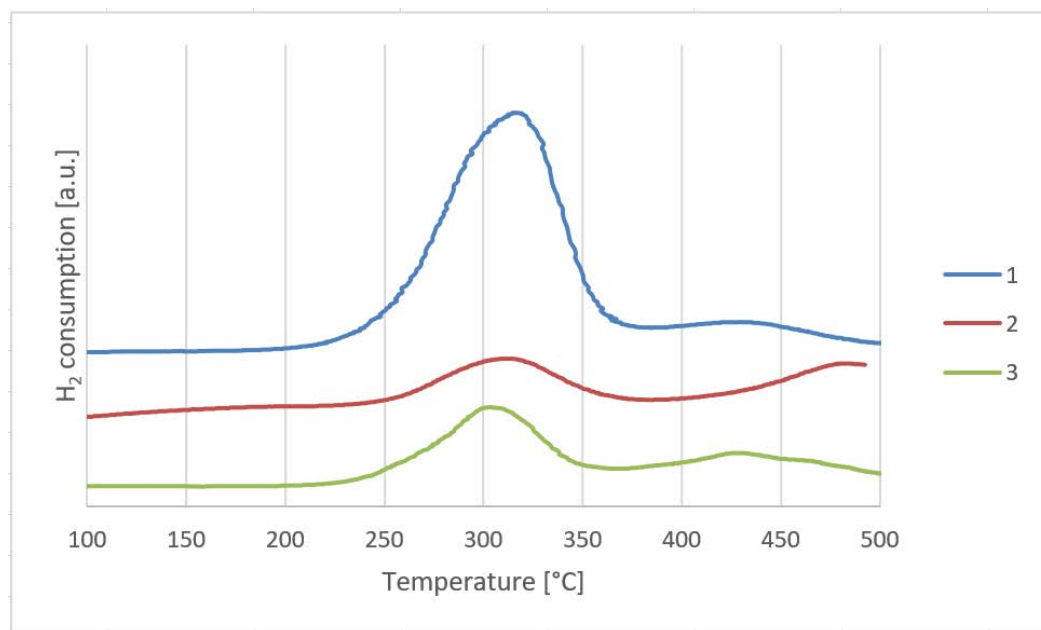


Figure 5. TPR scans.

PT DISPERSION

The dispersion of Pt on the support surface was evaluated using CO pulse titration. Sample results are shown in Figure 6. CO adsorbs to Pt on the catalyst surface in a 1:1 ratio. The number of molecules that do not pass through the system is equal to the number that adsorbed onto the surface, which allows the number of exposed Pt atoms to be deduced. As per the figure, CO was pulsed in 50 μ L increments until three peaks of the same height were obtained. These were used as calibration peaks to find the amount of CO adsorbed on the surface and calculate the dispersion.

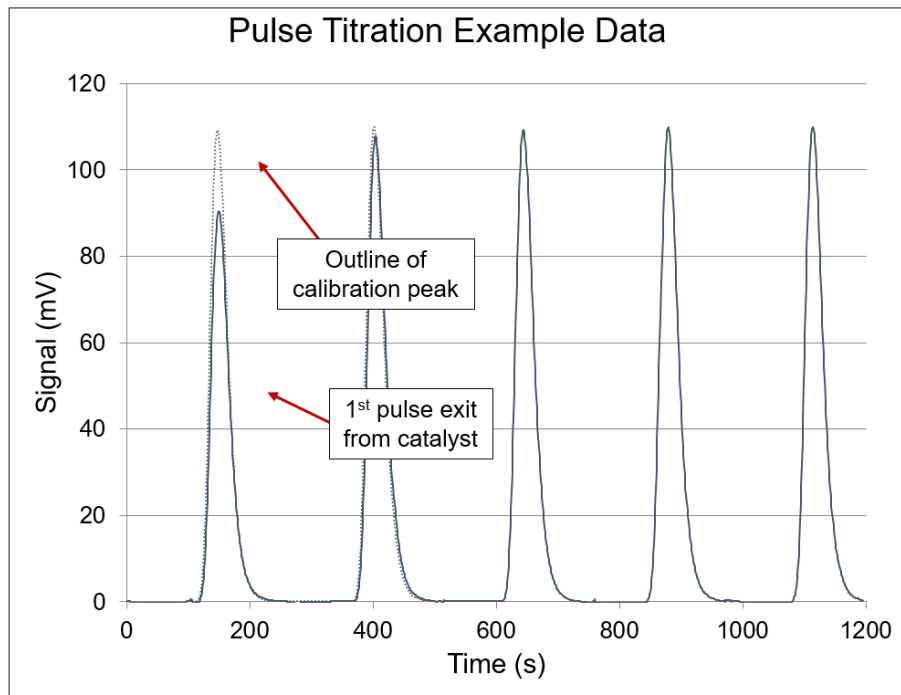


Figure 6. Sample pulse titration data.

Dispersion values are provided in Table 3 along with the corresponding average crystal diameters. The catalyst produced by SCD (2) had the highest metal dispersion, followed by the incipient wetness sample (1), then by the exposed incipient wetness sample (3). The reverse trend is observed for the crystal diameter.

Table 3. Sample dispersion.

| Sample Set | Average Dispersion | Average Crystal Diameter (nm) |
|------------|--------------------|-------------------------------|
| 1 | 26 ± 12% | 1.7 |
| 2 | 94 ± 15% | 0.4 |
| 3 | 16 ± 9% | 3.5 |

The hypothesis of this work was that exposure to scCO₂ affects the nanostructure of deposited materials, and that a sample (3) prepared via incipient wetness then exposed to scCO₂ would proceed by the ion-exchange mechanism and show the same structure as one (2) prepared by SCD of the precursor. However, dispersion was lowest and average crystal diameter highest for sample 3, even lower than that of incipient wetness alone (1).

Sample 3 had dried-up acetylacetonate on the surface before being exposed to scCO₂. Instead of adsorbing according to the mechanism in Figure 3, the new proposed explanation is that the high-temperature deposition conditions (60°C) increased the surface mobility of the Pt precursor, enabling it to agglomerate into large particles. After reduction, the resulting Pt metal particles were larger, explaining the low dispersion values.

CONCLUSION

The hypothesis of this work was that exposure to scCO₂ affects the nanostructure of deposited materials, and that a sample (3) prepared via incipient wetness then exposed to scCO₂ would proceed by the ion-exchange mechanism and show the same structure as one (2) prepared by SCD of the precursor. However, the trend in dispersion values does not seem to confirm this theory, as sample 3 had a lower dispersion than sample 1. The new proposed explanation is that the dried-up Pt precursor on the surface of sample 3 agglomerated into large particles due to the high-temperature deposition conditions (60°C). After reduction, the Pt metal particles were larger as well, explaining the low dispersion values.

Future work could include investigating the effects of temperature by exposing the incipient-wetness catalyst (3) to cold CO₂ and observing the resulting dispersion. This would give further insight into the true surface mechanism of the catalyst and whether or not the high temperature conditions were responsible for the observed

phenomena. Observing the catalyst under scanning transmission electron microscopy would be highly beneficial in confirming structural properties. Finally, reaction testing could be performed to see which catalyst is most efficient for the WGS reaction.

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A MESSAGE FROM ALAN F. CHOW

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I have mentored student research for many years, taking students to regional conferences to present their works. I have had many conversations related to publishing an online journal for student research for the better part of a decade. When Dr. Shelley-Tremblay brought up the concept last summer I jumped at the chance to participate, because I strongly feel that this is one of those things we are supposed to do at the University. I look forward to assisting this editorial staff in creating a quality publication, so that USA students will have a platform to show their work to the community and the world. We plan to develop and grow JOURACA to meet the needs of the undergraduate research students.

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