Welcome to the 2021 Works in Progress Symposium

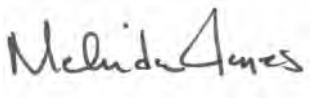
The Helen Hardin Honors College is proud to sponsor the 2021 Works in Progress Symposium. This annual event provides a means for undergraduate students throughout the University to share their research with the general University community and recognizes the significant contribution to research by University of Memphis undergraduates.

Providing undergraduates with the opportunity to engage in scholarly research is important to our students' educational experience and professional development. To the faculty mentors who have guided their students along the way, we thank you for ensuring UofM students have every opportunity to pursue undergraduate research.

Very special thanks are due to the faculty evaluators, who kindly provide feedback to the student presenters to better prepare their research projects for submission to professional conferences. We also thank our moderators for their assistance and support.

Over the past 19 months, the UofM community has witnessed the many challenges faced by our student scholars, as well as the fortitude with which they rose to the occasion. Thus, our greatest thanks go to the student presenters themselves for their strength and determination to pursue their research goals.

Welcome to the 2021 Works in Progress Symposium. We hope you will enjoy the conference and the students' presentations. Best wishes to all faculty, staff, and students who make this event possible.
Sincerely,



Melinda Jones, Ph.D.
Director

Acknowledgments

Faculty Evaluators

The Helen Hardin Honors College thanks the following faculty members for providing feedback to the student presenters:

J. Gayle Beck, Psychology
Jeff Black, Finance, Insurance, and Real Estate
Keith Bowers, Biological Sciences
Gary Bowlin, Biomedical Engineering
Joel Bumgardner, Biomedical Engineering
Ted Burkey, Biological Sciences
Micheal Clinton, Communication and Film
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Carl Herickhoff, Biomedical Engineering
Kathryn Howell, Psychology
J. Amber Jennings, Biomedical Engineering
Kenny Latta, Anthropology
Helen Sable, Psychology
Aaryani Sajja, Biomedical Engineering
Amanda Savage, History

Session Moderators

Thank you to the following individuals for serving as session moderators:

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Faculty Mentors

The Helen Hardin Honors College gratefully acknowledges the following faculty sponsors whose mentoring has contributed to the research produced by our presenters:

Amy Abell, Biological Sciences
James Aldeman, Biological Sciences
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Jeffrey Berman, Psychology
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Presentations (12:00 - 2:00)

	UC Ballroom A	Bluff (304)	Shelby (342)
12:00	**Katerina Baldree** Identity Practices of Russian-American Adoptees Mentor: Michael Perez, Anthropology		**Jehad Esmail** Comparison of Commercial Calcium Sulfates for Antibiotic Delivery in Periprosthetic Joint Infection Mentor: J. Amber Jennings, Biomedical Engineering
12:30		**Julia Strecker** Electrospinning Collagen Membranes for Wound Healing Mentor: Joel Bumgardner, Biomedical Engineering	**Ethan Wales** Chitosan-Elastin Electrospun Copolymer Membranes for Tunable Degradation Mentor: Joel Bumgardner, Biomedical Engineering
1:00	**Alan Pillow** Analysis of Aerosols and Particles Emitted by Speaking and Singing Mentor: Jeff Marchetta, Mechanical Engineering	**Samantha Hall** Analysis of In-Vivo Macrophage Polarization in Response to Raspberry Ketone-Loaded Chitosan Membranes for Guided Bone Regeneration Mentor: Joel Bumgardner, Biomedical Engineering	**Maegen Ellis** Alkyl-Coupled titanium for loading and Release of 2-Heptylcyclopropane-1-Carboxylic Acid Mentor: J. Amber Jennings, Biomedical Engineering
1:30	**Mackenzie Love** Chronic Cocaine Exposure and Withdrawal Differentially Alter Dopamine Transporter Functioning Mentor: Deranda Lester, Psychology	**Gary Leedom** Time-Domain NMR Quantification of Adipose Lipids in Nile Grass Rats on Time-Restricted Diets Mentor: Aaryani Sajja, Biomedical Engineering	
2:00	**Ashlee Sayger** Examining the Effect of Oxytcotin Administration on Cocaine-Induced Behaviors Mentor: Deranda Lester, Psychology	**Alexis Johnson** Machine Learning to Predict Estrus in Gilts and Sows with Infrared Imaging Mentor: Aaron Robinson, Biomedical Engineering	

Presentations (12:00 - 2:00)

	Memphis A (340A)	Memphis B (340B)
12:00	**Alex Beis** Comparing Market Centers and Retail Brokers by Using SEC Required Disclosures Mentor: Pankaj Jain, Finance	**Sarah Coleman** Is Leg Brightness an Indicator of Physical Condition in House Finches? Mentor: James Adelman
12:30		
1:00		**Sam Brackens** Do Adult Attachment Dimensions Moderate the Association Between Intimate Partner Violence Exposure and PTSD? Mentor: Gayle Beck
1:30		
2:00		

Presentations (2:30 - 4:30)

	UC Ballroom A	Bluff (304)	Shelby (342)
2:30	**Sophia Rouse** Germanic Emigrants' Influence on the City of Memphis, 1865-1880 Mentor: Susan O'Donovan, History	**Razan Sweileh** MAP3K4 Kinase Inactivation Leads to Fetal Growth Restriction in Murine Embryos Mentor: Amy Abell, Biology	**Kyra Brady** Effectiveness of Benzoic Analogs in Dispersion, Inhibition, and Eradication of Biofilms Mentor: J. Amber Jennings, Biomedical Engineering
3:00	**Bryn Berretta** Examining the Effects of Oxytcotin Administration on Dopamine Release Following Chronic Exposure to Cocaine Mentor: Deranda Lester, Psychology	**Hannah Anderson** Evaluating Neutrophil Physiological State Upon Template Interaction with Deconvolved Z-Stack Imaging Mentor: Gary Bowlin, Biomedical Engineering	**Christian Andre** SLA Printing Photocurable Chitosan to Formulate Hydrogel Mentor: Joel Bumgardner, Biomedical Engineering
3:30	**Anna Wiener** Dopaminergic Modulation of Decision-Making Guided By Delayed Punishment Mentor: Nicholas Simon, Psychology	**Juan Esparza** Automated Segmentation/Extraction and Characterization of Hepatic Steatosis and Correlation/Association with Histopathological Grades Mentor: Aaryani Sajja, Biomedical Engineering	**Solomon Mefsin** Computational Simulations of Transcranial Magnetic Stimulation: Potential Implication for Treatment of Phantom Limb Pain Mentor: Amy Curry, Biomedical Engineering
4:00		**Faizan Zafar** Simulation and Testing of AI/Autonomous Systems Mentor: Eddie Jacobs, Computer Engineering	

Presentations (2:30 - 4:00)

Memphis A (340A)

2:30 **Estefania Guerrero Viloria**

Development of Palladium Catalysts for Regioselective Functionalization of Simple Organic Molecules

Mentor: Timothy Brewster, Biomedical Engineering

3:30 **Madolyn Henderson**

Resolution of Cognitive Dissonance: A Study of Biblical Interpretation

Mentor: Brent Morgan, Psychology

4:00 **Megan Crowley**

The Effect of Therapist Attire on Client Perceptions of the Therapist

Mentor: Jeffrey Berman, Psychology

Memphis B (340B)

Samarth Vedante

In-vitro Evaluation of Anti-inflammatory Effect of Raspberry Ketone on RAW 264.7 cells

Mentors: Joel Bumgardner, Biomedical Engineering

3:00 **Thomas Yates**

NMR Lipidomics of Myocardium in Rats fed with Time-Restricted High-Fat Diets

Mentors: Aaryani Sajja, Biomedical Engineering

Courtenay Weeks

COVID Transforming Mentorship for Students through Virtual Learning

Mentor: Joy Goldsmith, Communication

Alden Schmidt

Greta and Jane: A Discourse Analysis

Mentor: Joy Goldsmith, Communication

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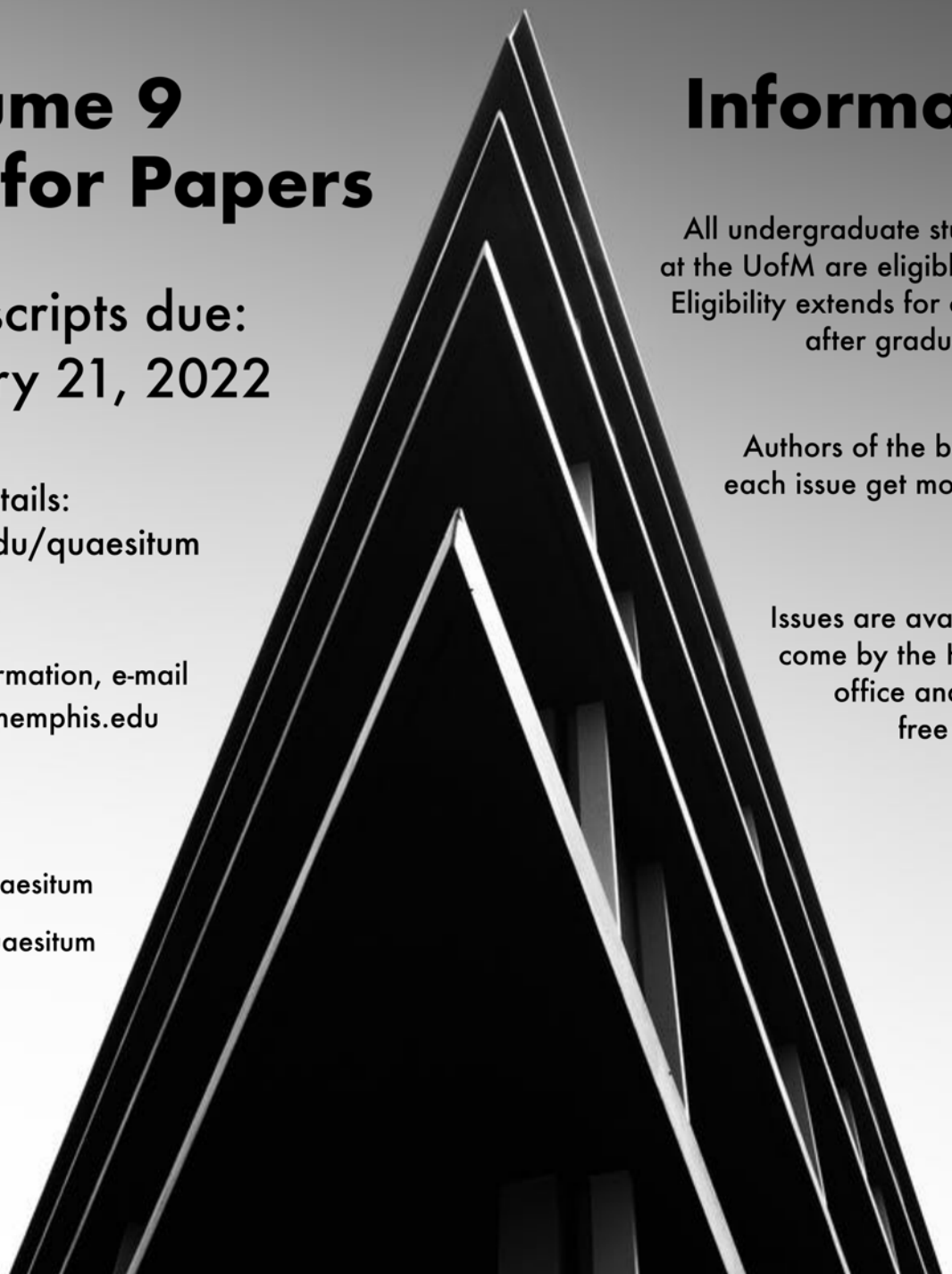

Information

All undergraduate students studying at the UofM are eligible for submission. Eligibility extends for one school year after graduation.

Authors of the best papers in each issue get monetary prizes!

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U of M

Abstracts

Engineering

Evaluating Neutrophil Physiological State Upon Template Interaction with Deconvolved Z-Stack Imaging

Hannah Anderson

Mentor: Gary Bowlin, Biomedical Engineering

Our knowledge regarding the neutrophil response on biomaterials, although increasing, is still limited. In this study, we will classify neutrophil degradation into four physiological states, with the final stage being NETosis, or the release of neutrophil extracellular traps. This study evaluated the quantification of these physiological states in response to collagen, fibrinogen, gelatin, and polydioxanone (PDO) electrospun templates of small and large diameter fibers with target diameters of 0.4-0.6 μm for small diameter and 1.5-2.0μm for large diameter. Fresh human peripheral blood neutrophils were used to produce an in vitro evaluation of these interactions at 3, 6, and 24 hours. It was hypothesized that time would most regulate the degree of neutrophil degradation. Large fiber diameter biomaterials were hypothesized to promote a neutrophil physiological state with less degradation and therefore be more conducive to tissue regeneration than smaller fiber diameter biomaterials. The electrospun biomaterials mean fiber diameters for the templates evaluated were 0.58 ± 0.2μm (small diameter) and 1.68 ± 0.2μm (large diameter). Deconvolved Z-stack fluorescent images of the neutrophil interactions were produced. Original MATLAB code was then applied to classify and quantify the neutrophil degradation stages. Non-parametric statistical analysis was conducted.In this preliminary data (n=3), collagen electrospun biomaterial caused the least traumatic neutrophil response, PDO templates caused a more traumatic neutrophil response than hypothesized, while gelatin and fibrinogen templates provided an unreliable response. This novel imaging technique in combination with the original MATLAB quantification of neutrophil degradation stages allows for a greater understanding of neutrophil biomaterial interactions. In future research, larger sample sizes and parametric statistical analysis can be conducted, which will lead the way for the next generation of regeneration templates.

SLA Printing Photocurable Chitosan to Formulate Hydrogel

Christian Andre

Mentor: Joel Bumgardner, Biomedical Engineering

Chitosan, a linear polysaccharide composed of randomly distributed D-glucosamine (deacetylated unit) and N-acetyl-D-glucosamine (acetylated unit), is obtained from the chiton exoskeletons of shellfish like crabs, lobsters, and shrimp. It is currently being used in different medications for blood pressure, high cholesterol, and wound healing. We are chemically modifying the amine group on the deacetylated unit of the chitosan with methacrylic acid to synthesize a photopolymerizable chitosan (N-MAC). We then add photoinitiators, such as Irgacure, to form a chitosan bio-ink that polymerizes under UV light. The ability to provide photocurable chitosan bio-ink (N-MAC), which can be used for Stereolithography (SLA) 3D printing, has exciting potential in the field of tissue engineering. We are investigating the effect of different parameters like concentration of N-MAC in solution, rheology (flow of matter), photocuring length of bio-inks, and the mechanical property of N-MAC hydrogels. We will investigate the cytotoxicity of both the photocuring process, and the photo-crosslinked hydrogels. Using SLA printing, N-MAC bio-ink can be processed into complex 3D hydrogel structures with high-resolution, high-fidelity, and excellent biocompatibility.

Effectiveness of Benzoic Analogs in Dispersion, Inhibition, and Eradication of Biofilms

Kyra Brady

Mentor: J. Amber Jennings, Biomedical Engineering

Biofilms occur when bacteria attach to a surface and are a major contributing factor to infection. Biofilm-based infections can have devastating consequences, including failures of implants, medical complications in patients, and even death. What makes biofilms so complex is their resistance to antibiotics and immune cells due to a number of factors. One contributing factor is the secretion of extracellular polymeric substances (EPS) which increases the bacteria's antibiotic resistance as well as the ability of bacteria to attach to surfaces such as tissues and implants. An additional factor is that these complex biofilms use quorum sensing as a means of cell density control in a biofilm, thereby promoting bacteria to spread extensively. The lowered metabolism of biofilms, however, is likely the most influential factor to their resilience, with dormant cells being unaffected by antibiotics. Antibiotics are currently the major form of treatment against bacteria, but they are becoming increasingly ineffective against biofilms as a result of certain bacteria's increasing tolerance to existing antibiotic treatment. In preceding studies, a fatty-acid known as cis-2-decenoic acid (C2DA) and an analog of this compound, 2-heptylcyclopropane-1-carboxylic acid (2CP), have shown the ability to disperse and inhibit biofilms by increasing membrane permeability; One feature that contributes to their success is the cis-like conformation of the head group. The present study examines the structure-activity relationship of disubstituted benzoic-acid analogs to disperse, inhibit, and eradicate biofilms in the presence of antibiotics. These analogs are the ortho-, meta-, and para- director forms of methyl 2-(pentyloxy)benzoate (M2PB). Though the exact mechanism by which these analogs affect biofilms is unclear, the cis-like orientation of the M2PB analog could increase its ability to permeate the biofilm membrane. To analyze the benzoic-acid analogs, this study consists of a series of dispersion, inhibition, and eradication assays followed by analysis for the presence of planktonic and biofilm bacteria using BacTiter Glo. The bacteria of focus are S. aureus, A. baumannii, and P. aeruginosa. To date, a dispersion assay using S. aureus has shown promising results for the ortho- director benzoic-acid analog (M2PB) with lower amounts of bacteria present in the biofilm and higher amounts of planktonic bacteria. Interestingly, a lower concentration of M2PB has shown to be the most effective thus far, but further tests will determine if this observation is consistent for lower concentrations of M2PB with other bacteria. If

the present study is successful, translational research could include studies of various antibiotics in conjunction with the most promising benzoic analog. In addition, various delivery systems could be studied for the analog such as coatings, injectable depots, and nanotechnology, which may be clinically useful to prevent or treat infections.

Alkyl-Coupled Titanium for Loading and Release of 2-Heptylcyclopropane-1-Carboxylic Acid

Maegen Ellis

Mentor: J. Amber Jennings, Biomedical Engineering

Implantation surgeries have a substantial risk of post-operative complications due to infection caused by bacterial biofilm formation. Bacterial signaling molecules such as cis-2-decenoic acid (C2DA), produced by Pseudomonas aeruginosa, cause dispersion of not only its own biofilms but also those of other microorganisms including Staphylococcus aureus. However, C2DA has a cis- structure which makes it susceptible to isomerization and degradation in aqueous, acidic, and oxidative environments which would limit its use for long-term biofilm control. The cyclopropanated analog of C2DA, 2-heptycyclopropane-1-carboxylic acid (2CP), locks the signaling molecule into the bioactive cis-like configuration that is stable and has increased bioactivity in biofilm inhibition and dispersal compared to C2DA. Coating biomaterials with 2CP prior to implantation may help to prevent complex biofilm infections on these surfaces and reduce adverse consequences of infections during the healing process.Titanium coupons were washed with soap, acetone, and ethanol in separate 10 min washes with sonication. Coupons were placed in a 5M sodium hydroxide solution and incubated at 60°C for 24 h. After washing, coupons were treated with 2% (v/v) of either decyltrimethoxysilane (DTMS) or hexyltrimethoxysilane (HTMS) in ethanol. Silanated coupons were rinsed in ethanol to remove non-adhered silane and dried in a 110°C oven overnight. Coupons were then either loaded with ~2035 μM of 2CP in 100% ethanol or left unloaded. Concentration of 2CP in the eluates for days 7, 14, 21, and 28 was measured using a Free Fatty Acid Fluorometric Assay Kit. Antimicrobial assays will be performed to observe biofilm formation on 2CP-coated coupons and bacterial growth in surrounding media. Biofilm growth will be quantified using Bactiter Glo viability assays and live-dead staining. Average release of 2CP from the unsilanated titanium control group was 82.35 μM (day 7), 89.13 μM (day 14), 86.04 μM (day 21), and 85.90 μM (day 28). For the titanium-DTMS group, the average release concentrations for day 7, 14, 21, and 28 were 91.58, 108.01, 189.33, and 134.23 μM. The titanium-HTMS group average release concentrations were 85.44, 86.53, 72.89, and 71.87 μM. The HTMS and DTMS groups both fluctuated each 7 days, the same as the control group. Results of this project could lead to coating of ceramics or polymers or other metal implants such as stainless steel with the signaling molecule and 2CP to reduce the risk of post-operative infections.

Comparison of Commercial Calcium Sulfates for Antibiotic Delivery in Periprosthetic Joint Infection

Jehad Esmail

Mentor: J. Amber Jennings, Biomedical Engineering

The main purpose of this study was to analyze calcium sulfate loaded with different antibiotic combinations to determine the rate of which the antibiotics/antifungals (amphotericin B and Voriconazole) are released, and if enough is released to inhibit fungal growth. The questions of this project will be if the groups properly release therapeutics and if the therapeutics are active throughout the process. Calcium sulfate (CS) is typically used as a bone void filler or for bone grafting procedures. At the surgeon's direction CS may be loaded with antibiotics and antifungals to avoid post-surgery complications such as infections. CS has a high biocompatibility and resorbable nature, ensuring full drug delivery over a period of several weeks as the material completely resorbs. It is hypothesized that the antifungal and antibiotic (amphotericin B and/or Voriconazole) will be released at a slow enough rate to inhibit bacteria and fungi. Different formulations of Synthecure CS beads are to be prepared according to manufacture instructions and were divided into 3 groups:

Group 1: Synthecure + vanc + tobra liquid + amphotericin B
Group 2: Synthecure + vanc + tobra liquid + voriconazole
Group 3: Synthecure + vanc + tobra liquid (control)

Beads that are to be mixed with antibiotics need to be added prior to mixing. 1 Gram of vancomycin and 1.2 grams of Tobramycin will be added to each 10 cc kit. An elution media will then be prepared by adding 25% bovine serum to 75% phosphate buffered saline. CS beads with and without antibiotics will be added to 100ml of elution media. Samples will then be taken on days 1, 3, 7, 10, 14, 21, 28, 35, and 42. Drug concentration will be measured by using high performance liquid chromatography. For samples with amphotericin, we will use acetonitrile-acetic acid water (52:4.3:43.7) as it is a solvent with a 1ml/min flow. To achieve separation, liquid chromatography on a reverse-phase C18 column will be used for less than 12 minutes. A detection of 406nm will be used to monitor the sample. For samples with Voriconazole, a combination of acetonitrile and water (7:3) will be used as the solvent with a 1ml/min flow and a detection of 255nm. The solution will be passed through C18 column. To determine Antibiotic/antifungal activation throughout the experiment, the Kirby-Bauer test will be conducted. The information obtained in this experiment could help doctors properly know what concentration of antifungals and antibiotics to add with CS, how long they would be active, and the rate at which the drugs metabolize. Future research could be done to obtain rates of release for other antifungals/antifungals, or if other factors affect the rate and degradation of the therapeutics such as amount of CS implanted into the patient.

Automated Segmentation/Extraction and Characterization of Hepatic Steatosis and Correlation/Association with Histopathological Grades

Juan Esparza

Mentor: Aryani Sajja, Biomedical Engineering

The prevalence of non-alcoholic fatty liver disease (NAFLD) has increased to up to 25% of the world population, with one-third of NAFLD population progressing to non-alcoholic steatohepatitis (NASH), which can lead to scarring of the liver. The current gold standard for NAFLD diagnosis is liver biopsy, where pathologist use an ordinal visual grading system such as fat clinical research network (CRN) ranging from 0 to 3 to assess the severity of steatosis. However, this process is tedious, inaccurate and suffers from intra- and inter-reader variability. An automated and reproducible method that provides a continuous measure to quantify the amount of fat in histological slides is crucial to detect NAFLD at an early stage. Although other studies have automated the quantification of fat fraction (FF), to our knowledge, no study has described fat droplet (FD) characteristics and their relationship with pathologists' grade. We hypothesize that

the relationship will help to learn about the changes in FDs as the disease progresses and ultimately aid in understanding the progression of the disease. In this study, a human cohort of potential NASH candidates had liver biopsy and were histopathologically graded by an experienced pathologist. FDs were segmented automatically using morphology and size. Morphology was described with radius and circularity, and distribution was described with nearest neighbor (NN) distance and regional anisotropy. NN distance was the shortest distance amongst other fat droplets. Regional anisotropy was the fat percentage per biopsy area. Fat to hepatocyte ratio (FHR) was estimated as number of affected hepatocytes, which was similar to the pathologists' process of obtaining Fat CRN scores. Spearman correlation (rho) and regression analysis were used to analyze the relationship between properties of FDs with FF, and FHR respectively. Regression analysis and Spearman correlation yielded relationship between measurements and FF, both being cardinal and computational, and measurements and pathologist grades, being ordinal. Radius (R2=0.83, p=0.65) and regional anisotropy (R2=0.66, rho=0.69) had positive linear relationship, circularity (R2=0.48, rho=-0.32) had negative linear relationship and NN distance (R2=0.81, rho=-0.818) had negative exponential relationship with FF. Assuming pathologist Fat CRN as a standard, conventional FHR thresholds were 57.35% accurate whereas ROC AUC FHR thresholds were 75.53% accurate. In conclusion, our study demonstrates that FF was a major contributor in the pathologists' decision in assigning Fat CRN scores based on the Spearman correlation.

Analysis of in-vivo Macrophage Polarization in Response to Raspberry Ketone-loaded Chitosan Membranes for Guided Bone Regeneration

Samantha Hall

Mentor: Joel Bumgardner, Biomedical Engineering

Guided bone regeneration is used to enhance bone growth and treat alveolar bone loss. There are many ways to carry out the guided bone regeneration (GBR) process. Electrospun membranes are gaining popularity as a tissue engineering tool, and nanofibrous electrospun membranes made from chitosan have shown promise for enhanced GBR due to biocompatibility, degradation, pro-healing properties, and a high surface area to volume ratio. A key strategy that can be implemented to facilitate the healing process is the promotion of macrophage polarization. As wound healing occurs, macrophages polarize along a spectrum from a pro-inflammatory phenotype (M1) to an anti-inflammatory phenotype (M2). Raspberry ketone (RK) is a natural phenolic compound that possesses antioxidant and anti-inflammatory properties. In previous in-vitro research, RK has shown promise in accelerating macrophage polarization. In this study, electrospun chitosan membranes (ESCMs) were used to locally deliver RK to an in-vivo bone defect site using a rat calvarial model. ESCMs were loaded with 250 µg or 0 µg RK. Membranes from each treatment group were implanted into rat calvarial defects for 8 rats (n=8). Membranes and surrounding tissues were extracted in serial sections and immunohistochemically stained at 1, 2, and 4 weeks using individual markers for M1 (iNOS), M2 (CD206), and total macrophages (CD68). Images of the stained tissues were obtained, and the percent-stained area was quantified using NIH ImageJ. On average, the 250 µg RK treatment group had greater overall macrophages compared to the 0 µg RK treatment group at week 1. The 250 µg RK treatment group had fewer overall macrophages at weeks 2 and 4 when compared to the 0 µg RK treatment group. The 250 µg RK treatment group had fewer M1 and M2 macrophages at week 1 and greater or similar M1 and M2 macrophages at week 4 when compared to the 0 µg RK treatment group. At week 2, the 250 µg RK treatment group had less M1 macrophages and more M2 macrophages than the 0 µg RK treatment group. These results indicated that ESCMs loaded with 250 µg RK have potential for facilitating macrophage polarization in bone defects. However, for future work, further dose dependent analysis will be done using 100 µg RK and 500 µg RK.

Machine Learning to Predict Estrus in Gilts and Sows with Infrared Imaging

Alexis Johnson

Mentor: Aaron Robinson, Biomedical Engineering

Detection of estrus or standing heat is one of the most critical components of a successful swine breeding program. Estrus is defined as a period of sexual receptivity and ovulation during which the female will accept the male and is capable of conceiving [Belstra]. Specifically, during estrus the gilt or sow experiences physiological and hormonal changes that results in the production of eggs in preparation for fertilization by a male pig. Of particular interest are the measurable temperature changes resulting from estrus event and which physical parts of the pig provide the strongest indication of its occurrence. Historically, the vulva, the anus, the ears have received the most attention. This work summarizes a research study utilizing infrared imaging and labeling of the vulva and anus of the gilts and sows to identify more accurate predictions of when the estrus cycle begins and while estrus is occurring. The population size for Group 3 is 18 sows, and the vulvar skin temperature of the gilts and sows are digitally infrared thermography imaged for ten days (10 Sept - 20 Sept) for specific time intervals each day. Determining when a gilt or sow is in estrus will benefit farmers because it will, in turn, save money for breeding programs, knowing definitively when estrus is occurring or will occur depending on the vulvar skin temperature. In the future, we will be able to accurately predict in real-time the estrus cycle activity or inactivity in a gilt or sow.

Time-Domain NMR Quantification of Adipose Lipids in Nile Grass Rats on Time-Restricted Diets

Gary Leedom

Mentor: Aaryani Sajja

Lipidomics is the identification and quantification of lipids in a biological sample to further examine the disease biomarkers, nutrition, and more. Proton nuclear magnetic resonance spectroscopy (1H NMR) is an analytical technique that can be used to identify the lipids found in a certain sample by detecting hydrogen atoms in a sample as a reference point. Adipose tissue samples from Nile grass rats were extracted and separated into lipids and aqueous layers, and the lipids layer was quantified by obtaining spectra of each sample, and a program, CRAFT (complete reduction to amplitude frequency table), was used to convert the time-domain FID to a frequency amplitude table which allowed the fatty acids to be quantified in each sample. Adipose tissue was collected from male and female rats that had differing high fat diets where some ate in the morning, evening, or all day. The adipose tissues from the rats with high fat diets had similar fatty acid concentrations in them. The average concentration of omega-3 and triglycerides found in the group of rates that ate all day were 1.12 millimolar and 25.94 millimolar respectively. The group that ate in the evening had the concentration of 1.15 millimolar of omega-3

and 27.48 millimolar of triglycerides while the group that ate in the morning had the concentration of 1.06 millimolar of omega-3 and 20.62 millimolar of triglycerides. There were no statistical differences between these groups detected by one-way ANOVA. This information can be used to further study the effects and benefits of a high fat diet and intermittent fasting.

Computational Simulations of Transcranial Magnetic Stimulation: Potential Implication for Treatment of Phantom Limb Pain

Solomon Mesfin

Mentor: Amy Curry, Biomedical Engineering

Recent studies have shown that repetitive transcranial magnetic stimulation (rTMS) is a safe and effective therapy for some patients with phantom limb pain (PLP). It is reported that around 63% of the patients with amputation experience PLP. This type of treatment is preferable as it is a noninvasive, one-person operation which only takes a few minutes for one session. During the procedure, a magnetic coil is placed near the scalp and electric current is delivered to the coil, resulting in a magnetic field that induces a secondary electric field in the brain. This secondary electric field activates neurons in the brain. While rTMS may be an effective treatment for PLP, it is possible that differences in brain anatomy between individual patients may be an important factor when selecting the site and orientation of the stimulation coil to produce a desired location and spatial distribution of cortical activation in the brain. The purpose of this research is to investigate how to tailor the treatment for specific patients which includes the site of stimulation over the scalp and orientation of the coils using a computation model of the human brain.

In-Vitro Evaluation of Anti-inflammatory Effect of Raspberry Ketone on RAW 264.7 Cells

Samarth Vedante

Mentor: Joel Bumgardner, Biomedical Engineering

Oral bone defects can occur due to infection, trauma, periodontal disease, and tooth decay due to poor hygiene. These conditions typically result in some degree of bone loss that would normally anchor teeth in the mouth. In such cases, dental implants cannot be used until adequate bone has regrown. Guided Bone Regeneration (GBR) membranes are clinically used as a barrier that prevents soft tissue infiltration into an area where bone growth is desired. Some GBR membranes have shown potential in decreasing inflammation and increasing healing in regenerating bone sites. However, such membranes can be modified beyond their natural properties with other molecules that will enhance the time and healing response of the bone defect. Electrospun chitosan membranes (ESCM) have shown potential for local drug delivery due to the high surface area of nanofibers. My study focuses on in-vitro testing the anti-inflammatory properties of a naturally occurring polyphenol known as raspberry ketone (RK). This work aims to evaluate effects of RK released in cell culture media on growth and macrophage polarization of RAW 264.7 cells, a macrophage-like cell. Lipopolysaccharide (LPS) will be used to induce inflammatory response to imitate bacterial presence in cells. The degree of inflammation will be assessed by measuring pro-inflammatory and anti-inflammatory cytokines and DNA content will be measured to account for cell variability.

Analysis of Aerosols and Particles Emitted by Speaking and Singing

Alan Pillow

Mentor: Jeff Marchetta, Mechanical Engineering

The COVID-19 pandemic has significantly impacted professional practices such as dentistry, speech pathology, and music education as well as avocational practices such as athletics and other extracurricular activities because they typically involve close, face-to-face contact. A major obstacle these activities face is the transmission of disease due to aerosolized particles emitted from the oral cavity while breathing, speaking, and singing. A lack of data exists concerning the extent of exposure to aerosolized particles in relevant scenarios. This research aims to meet this need by investigating the quantity of particles exhaled while speaking, singing, and breathing. To accomplish this, a set of specific vocal exercises and activities were performed by 21 volunteer participants to generate the airborne droplets associated with each activity. Images of these particles were captured using a high-speed optical camera and a ND-YAG laser, then analyzed numerically using computer software. This data collection took place in Spring/Summer 2021. The resulting data sets are being analyzed to determine average peak particulate emission values for each vocal exercise, as well as relative emission from one type of vocal exercise to another. Data extraction and analysis is ongoing and will be used to verify computational models for vocal airflow and to develop correlations between physical characteristics and particulate emission levels.

NMR Lipidomics of Myocardium in Rats Fed with Time-Restricted High-Fat Diets

Thomas Yates

Mentor: Aaryani Sajja, Biomedical Engineering

Obesity and diabetes have emerged as two major health concerns worldwide with western diet being one of the prevalent attributing factors. Individuals who are obese are also at a higher risk of developing cardiovascular disease. Intermittent fasting diets such as time-restricted feeding (TRF) have been shown to be effective in deterring obesity and diabetes by reducing the overall caloric intake among individuals. The purpose of this study is to quantify metabolites using nuclear magnetic resonance (NMR) spectroscopy in heart muscle of rats that are fed with standard chow and different time-restricted dietary protocols: high fat ad libitum (HF-AD), high fat morning TRF (HF-MOR), and high fat evening TRF (HF-EV) and compare the lipid metabolic profiles between the different diets. In this study, CRAFT, a Bayesian analysis approach was used to create “fingerprints” or regions of interest (ROI) for different lipid resonances and quantify the amplitudes and lipid concentrations. A two-way ANOVA followed by post-hoc analysis performed on the data revealed significantly lower values of total fatty acid and unsaturated fatty acid concentrations for HF-MOR, HF-EV, and chow diets in comparison to HF-AD. There was also a notable interaction for the linoleic acid (omega-6) concentrations between males and females in the HF-MOR group, with males having higher values compared to females ($p = 0.012$). Hence, our results show that the high-fat intermittent fasting diets can improve some lipid metabolic profiles compared to ad libitum high-fat diets. Also, our study showed that the females demonstrated more protection against omega-6 fatty acids compared to males for the HF-MOR diet. In conclusion, our study showed some positive lipidomic effects of high-fat intermittent fasting diets on the myocardium compared to ad libitum high-fat diet

Electrospinning Collagen Membranes for Wound Healing

Julia Strecker

Mentor: Joel Bumgardner, Biomedical Engineering

Found in various connective tissue, bones, skin, and more, collagen is the most abundant protein in the body of mammals and plays an essential role in the protection and structure of the body. We can extract collagen from the tails of rats to perform various experiments to study its properties. This is done by stripping away the outer layer of the tail and pulling the bundles of collagen from the bone and then putting it through a purification process. Once purified collagen has been obtained, it can be electrospun by charging and ejecting a collagen solution through a spinneret under a high-voltage electric field and to solidify it to form a nanofiber filament that can then be used in the body for purposes such as wound healing and drug delivery. The parameters that we need to consider in order to do this are the concentration of the spinning solution, the voltage applied while spinning, the syringe needle gauge, the flow rate applied, and how far away the collector is from the syringe tip. When the optimal spinning parameters are found, these solutions can have things added to them in order to do different things with the spin. We are currently adding ferromagnetic Fe3O4 nanoparticles to the fibers in order to try and align the fibers in parallel during the spin.

Chitosan-Elastin Electrospun Copolymer Membranes for Tunable Degradation

Ethan Wales

Mentor: Joel Bumgardner, Biomedical Engineering

Chitosan is a naturally derived polysaccharide that has shown promise in a variety of applications due to its biocompatibility, pro-healing, and antimicrobial characteristics. In previous research, electrospun chitosan membranes have been used as drug delivery vehicles to deliver simvastatin for guided bone regeneration. In drug delivery applications, material degradation rate is an important factor to consider. As the material degrades, its particulates and the loaded drug will be released into the environment. Tunable degradation would allow for materials with the capabilities to control the timing of drug elution in vivo allowing for possibilities like extended-release delivery. To preserve the chitosan nanofiber structure, the material is treated after fabrication to increase hydrophobicity and limit fiber swelling in aqueous environments. The hydrophobicity of the current electrospun chitosan membrane may be reducing its degradation rate. A common technique in tissue engineering is the combination of different polymers to achieve a copolymer material that can benefit from diverse material properties. Historically, elastin has received attention as a biomaterial being used to improve bioactivity in tissue engineering applications. Elastin is also a natural polymer, found in abundance throughout the human body in the extracellular matrix, and is known for its unique, elastic mechanical properties. It is also hydrophilic, in contrast to treated electrospun chitosan, which enables increased water infiltration and thus degradation. The aim of this work is to determine the effect of elastin incorporation on the degradation rates of electrospun chitosan membranes. Membranes (n = 4) will be made with 5.5(wt)% chitosan (70%DDA, Primex, Iceland) and will either include 4(wt)% elastin (ES-12, Elastin Products Company, Inc.) in chitosan-elastin (CE) membranes or no elastin in chitosan (C) membranes. All membranes will receive hydrophobic TEA/tBOC treatment. Membrane discs will be punched, and weight of each disc recorded pre-degradation and will be used to compare degradation over time. Discs will be placed in lysozyme/PBS (300μg/mL) solution for 1, 2, 3, and 4 weeks. At each timepoint, membrane discs will be removed from media and dried in a desiccator for 48 hrs. Future work will include assessing the effect of elastin concentration on degradation rate as well as the usage of elastin-like-polypeptide in place of naturally derived elastin. .

Simulation and Testing of AI/Autonomous Systems

Faizan Zafar

Mentor: Eddie Jacobs, Computer Engineering

The purpose of this project was to report on state-of-the-art practices and conduct simulations, using MAVS (Mississippi State University's Autonomous Vehicle Simulation Library), centered around the testing of algorithms and systems related to autonomous navigations and the testing of potentially catastrophic low probability events. To achieve this a survey of academic literature in the area was conducted along with a thorough study of MAVS with which simulation-based testing was performed. The literature survey found challenges facing the field relating to large state space, driver out of the loop, non-deterministic software, stochastic results, labeled data acquisition (for machine learning), and the inductive learning process. Some of the state-of-the-art solutions that were discovered include, phased expansion of requirements, subsystem aggregation, stochastic approach to testing results, fault injection, monitor/actuator architecture, fail-operational system design, synthetic data generation, cognitive instrumentation, and adversarial testing. MAVS was found to be a powerful off-road simulation tool with capabilities in areas from high-fidelity sensor simulations to autonomy simulations based on a lidar occupancy grid and path planning algorithm. Whitebox statement coverage testing for these systems were conducted for the A* path planner and lidar occupancy grid. Then, autonomous navigation exploratory testing simulations were conducted related to obstacle avoidance. Lastly, low probability event testing such as heavy rain and moving obstacle avoidance were conducted. Overall, the growing area of autonomous systems necessitates increased effort in software testing to meet the needs of rapidly developing new technology and its significant new challenges.

Physical and Applied Sciences

Development of Palladium Catalysts for Regioselective Functionalization of Simple Organic Molecules

Estefania Guerrero Viloria

Mentor: Timothy Brewster, Chemistry

Cross-Coupling are reactions where new carbon-carbon bonds can be made using transition metal organometallic reagents" (Bruice). Traditionally, it involves a leaving group and has a high degree of regioselectivity. The reaction only occurs at the site of the leaving group rather than having to pick a specific C-H bond. Where the goal of our project is to figure out a way to get the same level of regioselectivity as is obtained in cross-coupling reaction without the need for a leaving group. This is hard because any molecule will have a lot of C-H bonds and we need to pick one out specifically. "C-H activation has been an effective method for the synthesis of complex molecules. Chemical transformations that involve the functionalization of these bonds are efficient when they proceed with a degree of selectivity

using a directing group or also called coordinating ligands" (Patra). Even though regular C-H activation is not specific, produces unwanted side products, and has elevated separation costs, the palladium catalysts that we are working on allow for regioselective reactions of simple organic molecules (Ricks). The tethers I have been working with have been designed by Dr. Brewster and a postdoc in the lab, Dr. Tanei Ricks. Where I have been responsible for the synthesis and testing of the catalysts this summer, specifically the synthesis of 4-azidomethyl-phenol, 4-pyridyl-triazole-phenols or also called 4-TriPy, and the attachment and deprotection of a protected directing group aldehyde to 4-TriPys. In the first step, we transformed the 4-hydroxymethyl-phenol to the 4-azidomethyl-phenol, where we replaced the alcohol on our base product with an azide. Then, we did an Azide-Alkyne Cycloaddition Reaction or Click Chemistry to obtain the 4-pyridyl-triazole-phenol backbone. "It is a term introduced by K. B. Sharpless in 2001" (Click Chemistry Azide-Alkyne Cycloaddition) that is used to describe reactions that are rapid, reliable, produce a high yield, are easy to perform, and with essentially complete generality" (Crabtree). Once we had our 4-pyridyl-triazole-phenol, we attached our directing group, the protected aldehyde, to it. Then we deprotected the aldehyde using a ratio of 7:3 glacial acetic acid and water. Right now, we are working on the attachment of our substrate, the aniline.

Social And Behavioral Sciences

Identity Practices of Russian-American Adoptees

Katerina Baldree

Mentor: Michael Perez, Anthropology

Russian-American adoptees exist within complex, intersectional cultural and emotional processes within family, peer, professional, and academic relations. With adoption rates of Russian children to American households peaking in the 1990s to early 2000s and succinctly being cut off with the 2013 Russian ban on American adoption (i.e. America as a "receiving" country). Adoption research grows but remains limited concerning Russia specifically, which is why this research seeks to fill this niche for the hundreds of thousands of Russian-American adoptees. Adoptees navigate numerous interactions of differing views on one's role as an adoptee, one's feelings towards their birth and adoptive families, feelings of belonging, identity, and more, although one's position as an international adoptee introduces more nuanced processes of thought related to nationality and heritage. For adoptees, certain steps may be taken to address and potentially resolve unmitigated feelings of displacement, abandonment, separation, uncertainty, amongst general explorations and questions surrounding identity. Identity, what it means for adoptees, how it is translated into real world practices and actions, and how it is upheld or discouraged by crucial support networks is the focus of this research. Using qualitative research methods alongside narrative analysis of a handful of Russian-American adoptee's stories, this research approaches adoption literature with adoptees at the forefront. This transcends popular discourses revolving around childhood development, providing a platform for more active reflection of the adult adoptee. This research considers the motivations behind partaking in identity confirming practices such as learning one's birth tongue, making a trip to Russia, seeking out and/or contacting biological family members, and partaking in adoption-centered forums, and how this all reflects on deeper perspectives of kinship and identity, past, present, and future. The research also embraces an authoethnographic stance, presenting the researcher's own identity as an adoptee as one that can be reflected upon and analyzed throughout the completion of the research. The research encourages contextual analyses, particularly seeing as that many Russian-American adoptees, adopted in the peak years, are in young or middle adulthood, a time generally fraught with identity exploration and searching. The research in this work positions adoptees as agentive influences on adoption, kinship, and cultural systems, encouraging reflection on the part of other adoptees as well as other members of the adoption triad.

Examining the Effects of Oxytocin Administration on Dopamine Release Following Chronic Exposure to Cocaine

Bryn Berretta

Mentor: Derranda Lester, Psychology

Oxytocin is being researched both clinically and preclinically as a possible treatment option for psychostimulant use disorder. Behavioral studies in rodents have shown that oxytocin administration can reduce effects of psychostimulants. Furthermore, a previous study from our lab showed that subchronic oxytocin administration decreased the dopaminergic response to a psychostimulant. These previous findings were observed in psychostimulant-naïve mice. The present study aimed to expand on our previous study by examining the effects of oxytocin administration on dopamine functioning in mice that have been exposed to chronic cocaine (20 mg/kg i.p. daily for 8 days). After chronic cocaine exposure, one group of mice received the oxytocin treatment (1 mg/kg i.p. for 6 days) while another group of mice were administered saline. Altogether mice were separated into three experimental groups: cocaine-oxytocin, cocaine-saline, and saline-saline. The day following the final injection, in vivo fixed potential amperometry was used to quantify VTA stimulation-evoked dopamine efflux in the nucleus accumbens (NAc) of anesthetized mice before and after a challenge injection of cocaine (20 mg/kg i.p.).

Do Adult Attachment Dimensions Moderate the Association Between Intimate Partner Violence Exposure and PTSD?

Sam Brackens

Mentor: Dr. J. Gayle Beck, Psychology

Intimate partner violence (IPV) is a social epidemic, with 33% of women experiencing sexual, physical, or psychological IPV in their lifetime. Research has noted associations between the severity of IPV and severity of posttraumatic stress disorder (PTSD) symptoms. PTSD is a disorder defined by the DSM-5 by four symptom clusters: (1) intrusive thoughts, dreams, or reactions related to the traumatic event (2) avoidance of internal or external stimuli related to the traumatic event (3) negative alterations in mood or cognitions, and (4) marked heightened arousal and reactivity. Attachment processes have been shown to be associated with PTSD, as insecure attachment is related to higher levels of PTSD and secure attachment to lower levels of these symptoms. Attachment processes are defined as anxious (insecure; fear of rejection and abandonment), dependent (insecure; comfort with being emotionally and mentally dependent on their partner), and close (secure; comfort with being emotionally and physically close with their partner). To date, two studies have explored the moderating role of attachment on the relationship between IPV and PTSD. Scott and Babcock (2010) noted that at high levels of both anxiety and dependency, there was a significant positive association between severity of IPV exposure and PTSD severity. La Flair et al. (2015) did

not note a significant interaction between anxious/avoidant attachment and IPV in their model examining PTSD. Given the discrepancy in prior studies, the current study will build on this literature by using improved methodology, to examine if attachment processes moderate the association between severity of IPV exposure and severity of PTSD. Participants included 111 women who experienced IPV and were no longer romantically involved with their abuser; ages ranged from 18 to 65 (M = 37.48, SD = 13.33). The sample was 51.4% White, 37.6% Black, and 12.6% other ethnicities or missing. Participants completed measures as part of their involvement in the Athena Project. The Conflict Tactics Scale-Revised and the Psychological Maltreatment of Women Inventory were used to assess severity of IPV. The Posttraumatic Checklist for DSM-5 was used to measure PTSD symptoms. The Revised Adult Attachment Scale was used to measure the three attachment dimensions. Three regression analyses were conducted, in which anxiety, dependency, and closeness served moderators of the association between IPV severity and PTSD severity. In the anxiety model, a significant interaction was noted. Simple slopes indicated that at low levels of anxiety, there was a significant positive association between levels of IPV and PTSD. This association was not found at high levels of anxiety attachment. For both the dependency and closeness models, main effects were noted such that higher levels of IPV exposure were associated with increased PTSD severity. Results will be discussed in light of current models of PTSD, with emphasis on interpersonal processes.

The Effect of Therapist Attire on Client Perceptions of the Therapist

Megan Crowley

Mentor: Jeffrey Berman, Psychology

This study will analyze the effects of two types of clothing on perceived therapist credibility, therapist empathy, and therapeutic alliance. This experiment attempts to provide research and evidence for the suggestions made in clinical handbooks or manuals about the recommended attire for therapy sessions. The specific goal here is to examine the effects of informal and formal attire on client ratings of perceived therapist credibility, therapist empathy, and therapeutic alliance to analyze whether therapist attire impacts client perceptions about the therapist. Participants will submit ratings of these aspects after viewing videos of a therapist interaction in either clothing condition.

Resolution of Cognitive Dissonance: A Study of Biblical Interpretation

Madolyn Henderson

Mentor: Brent Morgan, Psychology

Research shows that people's personal beliefs sometimes overrule the teachings of their religion (Andrew K. T. Yip July 1997). When there is a disconnect between an individual's personal beliefs and the teachings of the religion that they follow, cognitive dissonance occurs. Cognitive dissonance is when an individual holds one or more conflicting beliefs. There is often discomfort or stress due to this mental conflict. People that interpret the Bible more literally, might have more cognitive dissonance (Falade, Bankole A., and Lars Guenther September 2020). This is because, if taken literally, the Bible goes against many Christian's personal beliefs. Biblical interpretation might be used to resolve the dissonance generated when an individual's personal beliefs are in conflict with scripture (Rodriguez, EricM January 2010). However, beyond homosexuality and Christianity, there is little research into whether interpretation is a method of resolving cognitive dissonance. The current study is looking at whether Christians' are more likely to resolve their theistic dissonance by: changing their opinion about the wrongness of a behavior, changing their opinion about the bible's correctness, or by using interpretation to make scripture align with their personal beliefs.

Chronic Cocaine Exposure and Withdrawal Differentially Alter Dopamine Transporter Functioning

Mackenzie Love

Mentor: Deranda Lester, Psychology

The mesolimbic dopamine pathway, often referred to as the reward pathway, consists of dopamine cell bodies in the ventral tegmental area (VTA) that project to limbic regions, particularly the nucleus accumbens (NAc). Cocaine increases extracellular dopamine concentrations by blocking dopamine transporters (DATs), consequently inhibiting dopamine reuptake. The aim of the present study was to determine the effects of chronic cocaine exposure and withdrawal on dopamine release and reuptake. Male C57BL/6J mice were randomly divided into three experimental groups: chronic cocaine exposure (cocaine at 20 mg/kg i.p. daily for 7 days), chronic cocaine exposure plus a withdrawal period (same chronic cocaine dosing then 7 days of saline injections), and no cocaine exposure (control with saline injections in place of cocaine). In vivo fixed amperometry was used to measure VTA stimulation-evoked dopamine release and reuptake in the NAc of anesthetized mice. Dopamine release was determined by measuring the magnitude of the stimulated response, and dopamine reuptake was quantified by measuring the synaptic half-life of dopamine. The synaptic half-life of dopamine indicates the amount of time needed for dopamine reuptake and is, therefore, a measure of DAT functioning.

Dopaminergic Modulation of Decision-Making Guided By Delayed Punishment

Anna Wiener

Mentor: Nicholas Simon, Psychology

Effective decision-making requires evaluation of the rewards and consequences associated with each available option. Critically, negative outcomes often occur later in time, leading to underestimation, or "discounting", of these delayed consequences. To investigate sensitivity to immediate vs delayed punishment during cost/benefit decision-making in rats, we developed the Delayed Punishment Decision Making Task (DPDT). In brief, rats choose between two levers, one resulting in a single-pellet reward, and the other resulting in a three-pellet reward accompanied by a mild foot shock punishment. The shock is initially delivered immediately following a decision; as the session progresses, punishment is preceded by a systematically increasing delay (0, 4, 8, 12, 16 s). On average, rats increase choice of the punished option as delay increases, indicative of discounting of delayed punishment. Here, we tested the effects of systemic administration of dopaminergic drugs on sensitivity to delayed punishment in male and female adult rats. We observed that cocaine, a dopamine and norepinephrine reuptake inhibitor, caused a dose dependent reduction in choice of delayed but not immediate punishment. Interestingly, this effect was more pronounced in females than males. Selective D1 dopamine receptor activation or blockade did not affect decision-making making,

whereas D2 dopamine receptor activation reduced punishment discounting comparably to cocaine. D2 dopamine receptor blockade had no effects on punishment driven decision-making. Collectively, these data demonstrate that dopamine transmission modulates sensitivity to delayed punishment, and this is likely regulated by D2 dopamine receptor activation.

Greta and Jane: A Discourse Analysis

Alden Schmidt

Mentor: Joy Goldsmith, Communication

In this capstone, I delve into two speeches. I use Greta Thunberg's "How Dare You" speech and Jane Goodall's "How Humans and Animals can Live Together" TED Talk in order to understand how these two successful women create a persuasive argument for their in-person audiences on the increasing risk from the environmental crisis. Both women formulate an arc, Jane's is a slow simmer of information, connecting her audience with animals and the earth. Greta immediately gets to the point, saying "We'll be watching you." People laugh and clap but her message quickly begins to encourage a feeling of urgency as she continues into statistics and generational burdens, concluding with "The world is waking up and change is coming whether you like it or not." While these two speeches are very different, they both are successfully persuasive to their audiences. This is due to the incorporation of feeling. A person will not participate in changes and calls to action if they do not feel it within themselves as necessary or in their best interest.

COVID Transforming Mentorship for Students through Virtual Learning

Courtenay Weeks

Mentor: Joy Goldsmith, Communication

This project is about how COVID19 has changed student participation in mentorship through online learning. In this project, mentorship is defined as students receiving assistance from their professors and faculty members through office hours and tutoring. This project investigates how the procedure of toffice hours and tutoring has shifted due to the pandemic and online learning. Results will be presented in students' perceptions on this recent change, and the measures that could be established will be discussed to improve mentoring through virtual learning.

Examining the Effect of Oxytocin Administration on Cocaine-Induced Behaviours

Ashlee Sayger

Mentor: Deranda Lester, Psychology

Although cocaine use is a continuing problem, with 5.5% of the US population between the ages 18-25 having used cocaine in the past year (2019 SAMHSA data), there is currently no FDA-approved pharmaceutical treatment available for stimulant use disorder. Oxytocin is a neuropeptide that is naturally produced by the hypothalamus and released both peripherally and centrally. Oxytocin is known to play a role in reward, stress, bonding, as well as cognitive and memory processes. Clinical and preclinical studies are also showing promise for the use of oxytocin in addiction treatment. For example, oxytocin has the potential to show a reduction in cocaine-seeking behaviors and nicotine-induced withdrawal effects in rodents. The present study aimed to determine the effects of chronic oxytocin administration on behaviors associated with drug reward and withdrawal in mice that will be exposed to chronic cocaine. It is hypothesized that the mice that receive the oxytocin treatment will exhibit decreased cocaine-induced locomotor activity and will spend more time in the center compared to saline-treated mice. These results would indicate that the oxytocin treatment decreased the rewarding effects of cocaine and reduced occurrence of behaviors associated with anxiety. Studies such as these are necessary to help determine the potential therapeutic use of oxytocin in addiction recovery programs.

Life And Health Sciences

Is Leg Brightness an Indicator of Physical Condition in House Finches?

Sarah Coleman

Mentor: James Adelman, Biological Sciences

Among numerous animal species, the foundation for choosing a mate is often associated with physical characteristics, such as coloration, which can indicate survival or reproductive potential. Although bright, noticeable colors, like reds and yellows, are often studied in such contexts, it remains unclear whether subtler colors, like browns and greys, also play a role in signaling mates. To determine if brown and grey coloration correlate with fitness in a species that also displays well-known red and yellow signals, I examined the leg color of house finches (Haemorhous mexicanus) after different experimental infections with a bacterial pathogen, Mycoplasma gallisepticum, which causes seasonal epidemics in this species. I used spectrometry to determine whether leg brightness (visible and UV spectra) differed between finches inoculated with a control buffer, a low dose of a low-virulence isolate, a high dose of a low-virulence isolate, or a low dose of a high-virulence isolate. My results indicate that house finches from different populations show different changes in leg coloration with infection. First, birds infected with the high-virulence isolate showed lighter legs when compared to the control birds. In addition, within low-dose, low-virulence treatment, finches from AL had lighter legs when compared to finches from CA. These results suggest that subtle greys and browns could indicate infection status, and thus survival potential, in a species known to signal using coloration. However, because these birds were tested following infection, further work is needed to investigate whether such relationships are predictive of performance during infection, which would be a better indicator of survival probability. Nevertheless, my work suggests that subtle coloration could play a heretofore unacknowledged role in signaling survival probability, with the potential to influence mate choice.

MAP3K4 Kinase Inactivation Leads to Fetal Growth Restriction in Murine Embryos

Razan Sweileh

Mentor: Amy Abell, Biological Sciences

Fetal growth restriction (FGR) occurs when the fetus does not grow to its full, genetic potential. FGR causes life-long complications, including immune deficiencies and neurological issues. The leading cause of FGR is placental insufficiency; the placenta is the communication channel between the mother and the growing fetus. The placenta is composed of mature trophoblast cells that highly express the mitogen-activated

protein kinase kinase kinase 4 (MAP3K4). This kinase phosphorylates its downstream substrates to regulate cellular functions and induce physiological responses for proper development. Kinase inactivation of the Map3k4 gene results in embryonic lethality. Surviving kinase-inactive mice show reduced growth during aging. We hypothesized the complications in adults were due in part to disruptions during gestation. Subsequently, this current study examined mouse embryos at 13.5 days of development. Heterozygous MAP3K4 kinase-inactive mice (Map3k4WT/KI) were crossed, and embryos were isolated and genotyped for the Map3k4 mutation using polymerase chain reaction (PCR); further, fetal livers and fetal placentas were isolated for examination. Embryonic crown to rump length, liver size, and placental area were measured using Adobe Photoshop. Through Western blotting, we measured the phosphorylation of the insulin-like growth factor 1 receptor (IGF1R) and the insulin receptor (IR), which control survival and proliferation. We found that kinase inactive MAP3K4 embryos (Map3k4KI/KI) had reduced embryonic length, placental size, and weight compared to wild-type MAP3K4 placentas (Map3k4WT/WT). Phosphorylation of IGF1R and IR was reduced in Map3k4KI/KI placentas. Although fetal liver size was reduced, the p value = 0.0535 did not reach statistical significance. The findings indicate that inactivation of MAP3K4 affects placental development resulting in reduced embryonic length, placental size and weight. Reduced activation of IGF1R and IR leads to FGR. Future studies will focus on examining the placenta to understand the molecular mechanisms controlling the pathology of FGR.

Liberal and Fine Arts

Germanic Emigrants' Influence on the City of Memphis, 1865-1880

Sophia Rouse

Mentor: Susan O'Donovan, History

During the nineteenth century, Germanic people from modern-day Germany and surrounding countries including Austria, Belgium, the Netherlands, Poland, Sweden, and Switzerland integrated into Memphis. By 1865, Germanic emigrants had begun to transform Memphis as their new home. Despite being outnumbered by Irish emigrants, between 1865-1880 through religious, educational, and political involvement, Germanic emigrants enriched Memphis to further establish the city. After the Civil War, Memphis transformed their public school system as education-related legislation developed across Tennessee. Germanic Memphians aided in the establishment of public schools and public education in Memphis during the formational years of the Shelby County Board of Education. While integrating into the City of Memphis Germanic Memphians founded churches that created communities within the larger city. Although some German churches had parochial schools, Germanic Memphians still served on the Board of Education and as teachers to help advance the school system in their new home. The integration of Germanic emigrants into Memphis remained present during the yellow fever epidemic of 1878. While many Germanics and fellow Memphians fled from Memphis during the yellow fever epidemics in the 1870s, some Germanic political leaders, school board members, business owners, and religious leaders remained in Memphis to help lead the city through the disease. Although not on the official Board of Health, Germanic emigrants worked within their community to maintain a Germanic identity as they established the Hebrew Hospital Relief Association and worked with the Howard Association. Germanic influence helped to establish Memphis during the late 19th century and expand the city after the Civil War. By studying Germanic emigration in a city where Irish emigration have been the main focus, more insight to Memphis' economic, political, and social histories is offered.

Business

Comparing Market Centers and Retail Brokers by Using SEC Required Disclosures

Alex Beis

Mentor: Pankaj Jain, Finance

This paper consists of two observations, one regarding market makers and SEC Rule 605 (formerly 11Ac1-5), the other regarding retail brokers and SEC Rule 606 (formerly 11Ac1-6). Using Security and Exchange Commission (SEC) Rule 605 and Rule 606 disclosures, this paper examines execution quality among order types, order sizes, and specific stocks. I find that on a ratio basis (the cumulative number of shares of covered orders executed with price improvement / the cumulative number of covered shares) the market centers with lower covered shares tend to perform better than the larger market centers. I also examine payment for order flow (PFOF) among popular retail brokers and their routing practices. I find that popular retail brokers are not always the best option in terms of the amount they are receiving in payment for order flow.