2021 Ramaley Research Celebration

Program and Book of Abstracts

1:00 to 4:00 PM
April 14, 2021
East Hall of Kryzsko Commons
Virtual Poster Session I – 1:00 to 1:45 PM
Virtual Poster Session II – 2:00 to 2:45 PM
Virtual Poster Session III – 3:00 to 3:45 PM
Pre-recorded Oral Presentations – Viewable all day and into the future on OpenRiver

MAIN RESEARCH CELEBRATION LINK

Note: Instructions for student presenters can be found on page 3 of this program.

Welcome to the 2021 Ramaley Research Celebration!

The week of April 19, 2021 has been designated as <u>Undergraduate Research Week</u> and Winona State University is participating by hosting our annual Ramaley Research Celebration on Wednesday, April 14. The Ramaley Celebration is a highly anticipated event that features student presentations of their research accomplishments. At Winona State, undergraduate research is highly valued as an integral part of the educational process and the Ramaley Celebration is one way we recognize and affirm this. Furthermore, the wonderful diversity of the student presenters, the research projects, and the disciplines represented all provide a strong reminder of the distinctiveness and breadth of research across the entire WSU community.

With the restrictions placed on us because of the COVID-19 pandemic, this year's Celebration has moved totally online featuring both live posters, which will be hosted on the Zoom platform, and prerecorded oral presentations. Both the Zoom link and the oral presentations will be made available on April 14 at <u>https://openriver.winona.edu/wsurrc/</u>.

For our purposes, we define "research" very broadly as "an inquiry or investigation that makes an original intellectual or creative contribution to the discipline" (<u>Council on Undergraduate Research</u>).

The Research Celebration Organizing Committee owes thanks for their technical expertise to Ken Graetz, Tom Hill, and Adam Zanzig of TLT. The Celebration is made possible by funding provided by the WSU Office of Academic Affairs and we also thank the WSU Administration for its continuing support of student/faculty research through Research and Creative Projects grants to our students.

Thank you to WSU President Scott Olson, Faculty Senate President Jenna Chernega, and Provost Darrell Newton for their support and for the welcome messages that they graciously recorded, and which can be found at <u>https://openriver.winona.edu/wsurrc/</u>.

To all of our student presenters: Thank you very much for presenting at this year's celebration and congratulations on your accomplishments!

To the faculty mentors: Thank you for including students in your continuing research and creative scholarship!

To the rest of the WSU Community, please come online and examine the work of our student/faculty research teams and help us acknowledge and celebrate their accomplishments!

Sincerely,

The Celebration Organizing Committee:
Amanda Brouwer, Huh-Jung Hahn, John Holden, Kendall Larson, Thomas Nalli, James Schul

Instructions for Presenters

More Detailed instructions can be found at
https://libguides.winona.edu/c.php?g=1051679&p=8287269.

Oral Presentations

Use Kaltura Capture to record your 10-20 minute PowerPoint slide show or poster and upload the mp4 file to the Celebration Website using the instructions found at the above link.

Poster Printing

There is no need to print your poster for this year's virtual Celebration.

Poster Presentations

You will be assigned a poster number in the program which indicates the breakout room to which you have been assigned in the Celebration's Zoom Room. There will be a Zoom Room host who can assist you once you join by directing you to your breakout room where you will then share your poster.

You have been assigned to one of three poster sessions, Session 1 at 1:00-1:45 pm, Session 2 at 2:00-2:45 pm, and Session 3 at 3:00-3:45. Please join the zoom room from 5-10 minutes before the start of your session**.** You are expected to be online with your poster the entire 45 minutes during your assigned session.

Other

We strongly encourage you to check out other students' posters when you are not assigned to be presenting yours. Thank you for your participation and we look forward to seeing you at the Celebration!

Index of Posters

Poster Sessions: Session 1 - 1:00-1:45 PM.   Session 2 - 2:00-2:45 PM.   Session 3 -3:00-3:45

The first column tells you the breakout room you should go to in the Celebration Zoom Room

No.	Sess	Presenters	Dept.	Title	Page
1	2	Barthel, Emily F	CHEM	Determination of Relative Rate Constants for Iodine Atom Abstraction by Phenyl Radicals	12
2	1	Bessette, Lily M	CHEM	Accuracy of Energy Approximations of Proton Transfer Reactions of $NH_3(H_2O)_3$ Clusters Using Fragment Based Methods	12
3	2	Bradach, Randall S	CS	Testing Relative Performance of MERN, MEAN, and LAMP Web Development Stacks	17
4	2	Cassem, Alexander P	PHYS	Geometrization of Hawking Radiation via Ricci Flow	25
5	1	Choudhry, Abdullah M	CS	Comparing the Effectiveness of Diegetic vs Non-Diegetic Interface Designs for 3D Manipulation in Virtual Reality	17
6	3	Condon, Morgan J	BIOL	Identification of Parasites from Wisconsin and Minnesota Diving Ducks in the Winona Area	10
7	3	Dale, Jenna M; Reis, Megan E; Kruse, Taylor C; Carlson, Thomas J	PSY	Predicting COVID-19 Preventative Behaviors: The Self-as-Doer Identity and Beliefs in Control Methods	31
8	1	Fassbender, Brittany L	BIOL	Germination Methods of Native Plants	9
9	1	Feller, Alexander J	CS	Using JavaScript to detect and defend against web-based attacks.	18
10	1	Firl, Trevor C	CS	Using Support Vector Machine Learning to Predict Game Entity in a "Super Smash Bros. Melee" game	16
11	2	Frederick, McKinzie M; Hurley, David P; Schoeneman, Laura L	CHEM	Investigation of VRK1 Point Variants	14
12	1	Hedrich, Molly J	PSY	The Psychological Consequences of COVID- 19: What is the Experience for College Students?	33
13	3	Henkelman, McKenzie	BIOL	Developing a Multiplex PCR to Amplify *Borrelia burgdorferi* DNA in the Presence of Ixodes scapularis DNA	9
14	1	Holtz, Annamarie O; Welch, Alexis N	NURS	Caring for COVID-19 Patients: Turned Upside Down	24
15	2	Huang, Meiling	EDUC	The relationship between parental involvement and students' success	19
16	1	Josul, William H	CHEM	Synthesis and Characterization of MPS and MES capped CdSe Nanoparticles	15
17	2	Liu, Zijie	CME	Recycled Materials and Recycling Technology ***Moved to Oral Presentation Number 20***	21
18	3	Madsen, Clayton C	BIOL	Identification of *Borrelia burgdorferi* in Field-Collected Ixodes scapularis Ticks from SE Minnesota and West Central Wisconsin using Real-Time qPCR	9
19	1	Mikunda, Ryanne	ENGL	The Multifaceted Process of Language Attrition	22

No.	Sess	Presenters	Dept.	Title	Page
20	2	Mikunda, Ryanne	GSWL	The Acquisition of English Phrasal Verbs by Native Spanish Speakers	24
21	3	Millerhagen, Anna S	CS	Infiltrating Cloud Storage of IoT devices using Ransomware	17
22	2	Nowatzke, Natalie L	POLS	Relationship Among College Affiliation and Other Factors to Environmental Beliefs	26
23	3	O'Brien, Connor T	PSY	Attachment Predictors of Different Types of Aggression	29
24	1	Otten, Megan L	GEOS	Mapping and Analysis of Structural BMP's in the Root River Watershed, MN	23
25	1	Paulus, Margaret L	PSY	Parental Attachment, Self-Control, and Resilience: A Mediation Study	29
26	1	Pfaffenbach, Katrina A	PSY	Effectiveness of Promoting Organ Donation with Appeals to Reason and Emotion	28
27	2	Rachel, Savannah J	PSY	Parental Rejection, Emotional Dysregulation, and Peer Attachment	30
28	1	Stevensen, Ross M	BIOL	Relationship Between Pharyngeal Arch Ossification and Early Expiration in Tiger Salamanders.	11
29	1	Taylor, Simon R	GEOS	Geochemical Classification of the East Central Minnesota Batholith	22
30	1	Vielbig, Caelan J	PSY	Suicidal Ideation and Suicide Acceptance Among Age Cohorts	32
31	3	Dusbabek, Isabella J	CHEM	Chloride Monitoring Research	13
32	3	Khan, Nazmus S	BIOL	Influence of Myelin-Associated Glycoprotein on axon subtype specific sheath targeting	13
33	1	Shahrokhi, Alireza	CS	"Looks like its rush hour again" – How botted users have increased the traffic of websites.	16
34	2	Dantuluri, Sarvani	CHEM	Computationally Modeling Cys-Lite Variants of Haspin Kinase	NA
35	3	Hayenga, R Dylan	CHEM	Synthesis of 4-Trifluoromethylstyrene by Palladium Catalyzed Coupling of Vinyltrimethoxysilane	15

Index of Oral Presentations

No.	Presenters	Dept.	Title	Page
21	Miller, McKenna M	PSY	Personality and Career Study	30
22	Perron, Adrianna M; Lee, Gabrielle M	NURS	Efficacy of Intermittent Fasting as an Intervention for Weight Loss: A Review of Current Literature	25
23	Senchea, Kathryn	CHEM	*In Vitro* Demethylation and Hydroxylation of Tricyclic Antidepressants in Rat Liver Microsomes	14
24	Shahrokhi, Alireza	CS	"Looks like its rush hour again" – How botted users have increased the traffic of websites. ***Moved to Poster Number 33***	16

Abstracts Table of Contents by Department

ABSTRACTS

Biology

Developing a Multiplex PCR to Amplify *Borrelia burgdorferi* DNA in the Presence of *Ixodes scapularis* DNA
McKenzie Henkelman
Faculty Mentor: Kimberly Bates

Lyme Disease is caused by a spirochete bacterium (*Borrelia burgdorferi*). It is transmitted by ticks of the genus *Ixodes. Ixodes scapularis*, more commonly known as the black-legged tick or deer tick is capable of carrying and transmitting the bacteria *Borrelia burgdorferi* to humans and other mammals and is the species of ticks found in Minnesota and Wisconsin. Lyme Disease is a complex disease that causes a multitude of side effects both acute and chronic. It can affect multiple systems in the human body, including the cardiovascular and nervous systems. The prevalence of Lyme Disease in the Midwest is extremely high, yet lower than those in the North East. The goal of this research was to develop a multiplex PCR that could amplify *Borrelia* and *Ixodes* simultaneously in order to determine prevalence of infected ticks from 2005-2012. Amplifying a gene in *Ixodes* acted as a positive control, indicating DNA in the extracted ticks were viable. Multiple PCR protocols and primers were used but only one of the two genes consistently amplified. Future research will include a RT PCR that amplifies both genes.

Germination Methods of Native Plants
Brittany Fassbender
Faculty Mentor: Amy Runck

The Indigenous Learning Garden is a learning space featuring plants sourced from Prairie Moon Nursery that come with recommended stratification methods. However, some varieties are difficult to germinate artificially, and this study aims to compare the recommended methods with altered conditions, such as shorter periods of germination or alternating temperatures, and natural exposure to ensure efficacy and improve future plantings. The seeds were either incubated or refrigerated in sealed bags with a moist coffee filter and checked weekly to ensure they did not dry out, rot, or begin sprouting. Results will be shared with Prairie Moon as needed so their germination recommendations can be updated. The process and data collection are ongoing.

Identification of *Borrelia burgdorferi* in Field-Collected *Ixodes scapularis* Ticks from SE Minnesota and West Central Wisconsin using Real-Time qPCR
Clayton Madsen
Faculty Mentor: Kimberly Bates

Borrelia burgdorferi, the bacteria that causes Lyme disease, is a spirochete that is present in field-collected *Ixodes scapularis* ticks. The current assays used to detect the spirochete mainly consist of fluorescent microscopy and traditional PCR, which requires amplification of two separate genes. These procedures are cumbersome, especially when trying to screen large sample sizes. In this study, a protocol was developed using real-time qPCR to detect *Borrelia burgdorferi* DNA with a much greater sensitivity. The reactions consisted of single reactions with the use of SYBRÒ Green to target and bind DNA with fluorescence. Primers targeting the *RecA* gene specific to *B. burgdorferi* was found to be the most effective in the qPCR detection with high success and clear results. Simultaneously, tick DNA was amplified using primers specific to the *Ixodes* ITS2 gene in order to confirm DNA viability. Further

optimization of these protocols are continuing so that 1000's of ticks collected between 2005-2012 in SE Minnesota and West Central Wisconsin will be tested for presence of Lyme disease.

Identification of Parasites from Wisconsin and Minnesota Diving Ducks in the Winona Area
Morgan Condon
Faculty Mentor: Kimberly Bates

Many different diving ducks in the Midwest are hosts to parasites like cestodes, trematodes, and nematodes. These parasites often live in the duck's gastrointestinal tract and use the duck's chyme and intestinal tissues to thrive. For this research, local hunters volunteered to donate diving ducks' carcasses they harvested. Ducks donated were cut open on the ventral side from esophagus to cloaca. Major organs were separated into bottles containing 0.85% saline, shaken, settled, and then the supernatant removed multiple times to isolate any parasites residing within the ducks' organs and tissues. Any parasites found in dissected diving ducks organ wash were picked through, identified using visual techniques, and stored in vials labeled accordingly. Staining of cestodes and trematodes was performed using Semichon's Acetocarmine stain. Stained parasites were mounted on slides to view under a microscope for morphological determinations. DNA was also extracted from cestodes, quantified and the 16s mitochondrial ribosomal gene was amplified using PCR, then direct sequenced.   Morphological and DNA sequence data revealed the cestodes to be *Diploposthe laevis*. Further research will determine the identification of numerous trematodes found in the ducks using both morphological and molecular techniques.

Influence of Myelin-Associated Glycoprotein on axon subtype specific sheath targeting
Nazmus Sakib Khan
Faculty Mentor: Jacob Hines

During development of Central Nervous System, oligodendrocytes wrap axons with myelin, which is necessary for rapid, efficient nerve impulse propagation. For reasons unknown, oligodendrocytes direct myelin to certain subtypes of axons, leaving others incompletely myelinated, or even totally unmyelinated. Previous studies demonstrated mice harboring Mag mutations showed improper sheath targeting of myelin to axons indicating that MAG is a possible facilitator of axon-glia communication.
In the present study, we tested the hypothesis that loss of mag decreases the proportion of myelin directed towards specific axon subtypes. To test this, we perturbed Mag function in zebrafish embryos using knockdown and knockout (KO) mutant analysis and observed changes in myelin sheath distribution in reticulospinal projection and dopaminergic projection neurons. Our results indicated that loss of mag caused significant decrease in the amount of myelin wrapping of reticulospinal projections, mainly due to fewer number of sheaths, and to a lesser extent, decreased average sheath length.
The results support the hypothesis that loss of Mag reduces the proportion of myelin directed towards specific axon subtypes by reducing the number of sheaths being made, and of the sheaths made, a reduced proportion of them were directed towards reticulospinal axons in comparison to control group. These findings advanced knowledge about adaptive myelination by showing that Mag influences sheath targeting amongst axon subtypes. Furthermore, Mag is the first protein discovered that affects sheath distribution across regions.

Currently, we are analyzing data for dopaminergic projection axon subtypes.

Molecular Identification of *Dictyocaulus* species Isolated from Cattle and Deer
Aftyn Hoffmann and Cora Geiger
Faculty Mentor: Kimberly Bates

The purpose of our study was to determine if there were molecular differences between *Dictyocaulus* species found in cattle (*Bos taurus*), white-tailed deer (*Odocoileus virginianus*), and red deer (*Cervus elaphus*). *Dictyocaulus* is a genus of nematode parasites found in the bronchial tree of different organisms including cattle and deer. This lungworm has been found to cause disease, specifically pneumonia and bronchitis in infected animals.[1] Molecular differences were determined by looking at the second internal transcribed spacer (ITS2) of ribosomal DNA. The second internal transcribed spacer (ITS2) is a region of the nuclear rDNA gene that is commonly used for phylogenetic analyses at both the genus and species levels. This region of DNA has been proven valuable in determining phylogenetic relationships using comparisons of primary sequences.[2] We used the ITS2 to determine phylogenetic relationships and genetic differences between different strains of *Dictyocaulus* that were found in cattle, white-tailed deer, and red deer from different geographical locations. The DNA samples were extracted using the chelex DNA extraction technique and then amplified using PCR followed by gel electrophoresis to determine if the ITS2 gene region were present in the samples. Amplified products were then cloned to create a large pool of the DNA region. The clones were then analyzed using PCR and gel electrophoresis to visualize and determine if the ITS2 gene was present. If the gene was present, the samples were sent off to be sequenced and analyzed to determine any genetic similarities or differences between DNA samples within the different host animals. To date, DNA sequences isolated from white-tailed deer harvested in Minnesota were identified as *D. eckerti* and DNA sequences from cattle in Wisconsin have been identified as *D. viviparus*. Future research will analyze worms isolated from cattle in Missouri, white-tailed deer from another region in Minnesota and red deer from New Zealand.

Relationship Between Pharyngeal Arch Ossification and Early Expiration in Tiger Salamanders.
Ross Stevensen
Faculty Mentor: Amy Runck

A significant proportion of tiger salamanders expire during or after metamorphosis, which researchers currently have no supported explanation as to why. It is thought that a possible factor in these losses is due to ossification of pharyngeal arches. The objective of this research is to observe if there is correlation between the expiration of a tiger salamander and the ossification of their pharyngeal arches during or after metamorphosis. This will be accomplished by dissecting and preparing the salamander before clearing and staining the bones and cartilage. Clearing and staining will use multiple solutions in varying concentrations. Pharyngeal arches will be measured for length and percentage of ossification once clearing and staining is complete. Data collection is currently in progress.
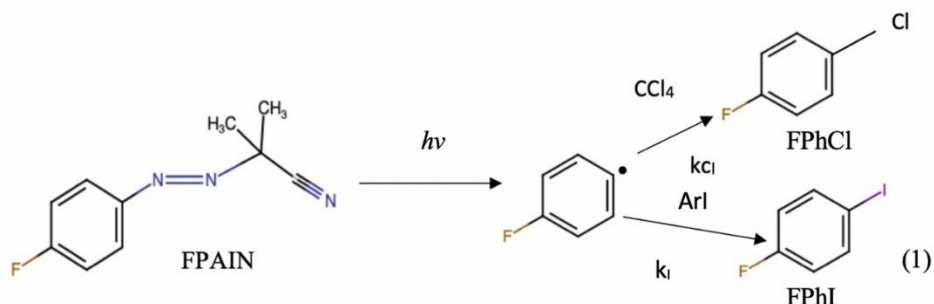
Chemistry

Determination of Relative Rate Constants for Iodine Atom Abstraction by Phenyl Radicals
Emily Barthel
Faculty Mentor: Thomas Nalli

Phenyl radicals (Ph·) are efficient hydrogen atom abstractors, and this reaction may have biological significance. However, the rate constants for H-abstraction from biomolecules (k_H) by Ph· are predominantly not known. Previous work from the Nalli lab used the reaction of phenyl radicals with iodoarenes (lit $k_I = 1.0 \times 10^8$ M^{-1} s^{-1}) as a kinetic reference for measuring k_H. However, this literature k_I value we have come to realize is unreliable. My research used the photolysis of p-fluorophenyl-azoisobutyronitrile (FPhAIN) to make p-fluorophenyl radicals in the presence of CCl$_4$ and an iodoarene (ArI). The products, *p*-chloro- and *p*-iodofluorobenzene (eq 1) are measured using F-19 NMR, and the yield ratio allows the determination of the relative rate constant k_I/k_{Cl} (eq 2), which in conjunction with a well-established k_{Cl} gives k_I. The results are compared to those reported by Tanner, Reed, and Setiloane in a 1982 paper that was later retracted.

$$\frac{k_{Cl}}{k_I} = \frac{[FPhCl][ArI]}{[FPhI][CCl_4]} \quad (2)$$

Accuracy of Energy Approximations of Proton Transfer Reactions of NH$_3$(H$_2$O)$_3$ Clusters Using Fragment Based Methods
Lily Bessette
Faculty Mentor: Hannah Leverentz-Culp

The discipline of computational chemistry often requires the calculation of the total energy in a system. Traditionally, conventional quantum methods have been used to determine the totl energy of molecules, which become computationally more expensive as the size of the system increases. Fragment-based methods are often used to determine the potential energy of large molecules. Fragment-based methods including many-body (MB), electrostatically embedded many-body (EE-MB), and fragment molecular orbital (FMO) were employed to determine the energies of the steps in a proton transfer reaction of a NH$_3$(H$_2$O)$_3$ cluster. The program GAMESS was used for the FMO energy calculations and NWChem was used for the MB and EE-MB energy calculations. It was found that the energy of the proton transfer was best approximated by the FMO-3 method paired with the 6-31G* basis set with an error of 0.0820 kcal/mol. The method that proved to be the least accurate was the PA

paired with the 6-31G* basis set, with an average unsigned relative deviation of 10.808 kcal/mol. It was found that the 6-31G* basis set allows for greater accuracy in the FMO-2, FMO-3, 3B energy approximations. It was also determined that the use of the 6-311++G(2d,2p) basis set for the PA, EE-PA, and EE-3B methods reduced the error of the approximations.

Chloride Monitoring Research
Isabella Dusbabek
Co-Authors: BIOL 315 Environmental Biology students
Faculty Mentors: Neal Mundahl and Jeanne Franz

Chloride contamination in natural water sources significantly affects aquatic biota by interrupting their habitual osmoregulatory function, causing these organisms to have a reproduction, growth, and survival deficit. Not only does chloride contamination harm aquatic entities but it can negatively impact human health as well by increasing the possibility of kidney and heart disease/failure. A safely consumable level of this chemical is 250 mg/L, any specimen measured above this value is considered to be in an impaired state. Water samples were taken from both the large and small sections of Lake Winona at 12 specific locations over several weeks. Once the specimens were collected they were analyzed using two methods, a chloride ion selective electrode and chloride sensitive test strips. Examination of these samples revealed that there is a significant chloride contamination problem during the spring in Lake Winona.

Development of an Mst2 construct for future studies of conformational regulation
Elissa Mai
Faculty Mentor: Emily Ruff

The serine/threonine protein kinases Mst2 and Mst1 are key members of the Hippo pathway, a signaling pathway that regulates apoptosis by inhibiting the transcriptional cofactor yes-associated protein (YAP). Mst2 is phosphorylated at threonine-180, allowing it to phosphorylate large tumor suppressor kinases 1/2 (LATS1/2) which can then inhibit YAP. The conformation of Mst2, particularly at the activation loop, is predicted to change when it is activated by phosphorylation. We believe that the relatively small size of Mst2 may allow us to farther study its conformation using fluorescence-based techniques such as Förster resonance energy transfer techniques (FRET) as opposed to NMR spectroscopy or x-ray crystallography. Proteins can be labeled for these techniques using cysteine-maleimide crosslinking; a "Cys-lite" background is prepared, and cysteine residues are inserted at specific positions that can be labeled under typical lab conditions. Using a Quikchange Lightning site-directed mutagenesis kit, we have made a construct of the His-tagged Mst2 kinase domain with two cysteine labeling positions in a Cys-lite background to direct fluorescent donor and acceptor tags. We have validated a high-yield purification protocol and checked the folding of our construct using circular dichroism (CD), and the nucleotide binding of our construct using fluorescence-based thermal denaturation.

Exploration of Bisphosphine-supported Cu Trifluoromethylating Agents
Emily Jacob
Faculty Mentor: Joseph West

Copper-based trifluoromethylation has been previously accomplished using triphenylphosphine and, separately, 1,10-phenanthroline (*phen*) as stabilizing ligands. While both have been applied successfully,

only *phen* has proven efficient in catalytic testing, owing to the bidentate nature of the ligand. To date, no examples of copper-based trifluoromethylating agents utilizing bisphosphines as stabilizing ligands has been reported. We are currently exploring bisphosphine complexes of the form (*PP*)CuCF$_3$ (*PP* = bisphosphine ligand) both in catalytic tests as well as by synthesizing the presumed catalytic complexes. Monitoring of catalytic reactions is accomplished by19F NMR. Copper complexes are characterized by NMR (^{31}P{^{1}H},^{19}F,^{13}C{^{1}H}, and ^{1}H) and UV-Vis spectroscopies.

In Vitro Demethylation and Hydroxylation of Tricyclic Antidepressants in Rat Liver Microsomes
Samantha Moline and Kathryn Senchea
Faculty Mentor: Myoung Lee

Antidepressants are common prescription medications used to treat depression and anxiety. Most drugs are metabolized in the liver by enzymes that modify drugs to become more polar (i.e., through hydroxylation or demethylation). This modification allows for prescription medications to be excreted out of the body through urine or bile. As a future physician, I am interested in understanding how antidepressants are metabolized in the body. This study was done to determine the outcome of metabolism within three different antidepressants: Nortriptyline, Clomipramine, and Imipramine. These three drugs were mixed with rat liver microsomes and NADPH-generating system in phosphate buffer at pH 7.4. All samples were incubated for two hours at 37°C. Each sample was subjected to the compact mass spectrometer fitted with a C18 reverse-phase column. The future goal is to repeat these experiments using HPLC/CMS to separate the metabolites further. Using different drugs would also explain the outcome of metabolism a little further, such as if other drugs are demethylated and hydroxylated.

Investigation of VRK1 Point Variants
McKinzie Frederick, David Hurley, and Laura Schoeneman
Faculty Mentor: Emily Ruff

Vaccinia-related kinase 1 (VRK1) is a protein kinase that phosphorylates a variety of transcription factors and is associated with the regulation of cellular processing. The kinase activity of the VRK1 protein is largely controlled by the substitute folding of the C-terminal tail. Multiple point mutations in VRK1 are associated with degenerative neuromuscular disorders, including L195V, R89Q and Y213H. These mutations have been studied clinically in patients but have seldom been studied *in vitro* with purified proteins to determine changes in molecular activity and folding.

Y213 is located in the functionally important region of the kinase called the activation loop; it is hypothesized that the Y213H mutation may reduce kinase stability and/or substrate binding. R89 is located in the functionally important C-helix, and the R89Q mutation is hypothesized to cause an unstable C-terminal tail conformation in the inactive form of VRK1, resulting in VRK1 being active at inappropriate times during cellular division. L195 is located in the core of the protein near the active site, and the mutant L195V may facilitate interactions with ATP; this mutant has been previously associated with increased phosphorylation of VRK1, p53, and histone H3. *In vitro* experiments are needed to examine the molecular-level reasons why these mutations cause these known physiological effects.

VRK1 L195V, R89Q and Y213H mutations were made to plasmids containing a His-tagged construct of the VRK1 kinase domain. The point mutant proteins were purified and then analyzed by circular dichroism and thermal denaturation to determine their stability and nucleotide affinity. Protein modeling in PyMOL and other programs was used for the conceptual visualization of the kinase and its associated changes due to these mutations.

Synthesis and Characterization of MPS and MES capped CdSe Nanoparticles
William Josul
Faculty Mentor: Jennifer Zemke

Over the past several years, interest in nanoparticle-derived solar cells has increased. This is due to their low material cost, high-potential efficiency, and desirable and tunable optical properties. Using biphasic ligand exchanges, sodium 3-mercapto-1-propanesulfonate (MPS) and sodium 2-mercaptoethanesulfonate (MES) were successfully exchanged as ligands with oleic acid to create particles that have a higher propensity to move charge in a solar cell. MES and MPS were chosen as ligands due to being shorter and less insulating than oleic acid. The initial as-synthesized CdSe-OLA, and the nanoparticle products of the two ligand exchanges were confirmed by ^{1}H NMR, UV-Vis, and FTIR spectroscopy. These three nanoparticle products will be used further to synthesize potential thin-film solar cells.

One Step Synthesis of 4-Trifluoromethylstyrene by Palladium Catalyzed Coupling of Vinyltrimethoxysilane
Dylan Hayenga
Faculty Mentor: Robert Kopitzke

The research project is an organic/polymer chemistry research project based on producing a synthesis of 4-trifluoromethyl styrene in a single high-yield step. Fluorinated polymers are important due to their interesting properties of thermal stability, resistance to weathering, as well as it calls for easy processing. Polymers and copolymers based on 4-pentafluoro sulfuryl styrene are thus important to consider in applications and use, due to their significant properties. Synthetic precursors to 4-pentafluorosulfurylstyrene are quite expensive, therefore a high yielding single step route is desirable. We are attempting to develop this synthetic route using less expensive precursors based on the trifluoromethyl group, specifically 4-bromotrifluoromethylbenzene.

The goal of our proposed research is to develop a relatively low cost, high yielding synthetic route to 4-trifluoromethylstyrene. This polymer when produced in high yield will be able to provide further exploration for new polymer structures based on 4-pentafluorosulfurylstyrene, and will be used to compare properties with sulfuryl pentafluoro polymers. A search of the literature shows that coupling alkoxyvinylsilanes via palladium catalyzed reaction may yield promising results. Based on the literature, we are going to attempt traditional synthesis of this key intermediate from 4-bromothiophene.

Computer Science

Using Support Vector Machine Learning to Predict Game Entity in a "Super Smash Bros. Melee" game
Trevor Firl
Faculty Mentors: Ming Ma, Sudharsan Iyengar, and Mingrui Zhang

Over the years fighting games have gotten more refined as in-game character mechanics have grown significantly more complex. With software advancements, players of the popular platform fighting game *Super Smash Bros. Melee* (SSBM) are able to save replay files of matches and extract metadata from previously played matches. Information from matches can be used to train classification models to predict aspects of the game such as the character played. With a diverse cast of characters to choose from, each character has a unique move set to use during a match. However with the complex nature of the SSBM in-game environment on top of the multi-player element of the game, the ways in which a character can be controlled is nearly limitless. With a refined metagame of many characters, but the dynamic ability of the game environment, this poses as a clash between the predictability of certain characters and the mind games of the human player. Nonetheless, this project aims to show the predictability in different characters within a SSBM match, using information and metadata extracted from previous replay files of matches to train a Support Vector Machine learning model.

"Looks like its rush hour again" – How botted users have increased the traffic of websites.
Alireza Shahrokhi
Faculty Mentors: Mingrui Zhang and Sudharsan Iyengar

The main purpose of this paper is to discuss the ideas about how botted users are affecting websites. The problem that comes when bots take over websites is that these botted users cause so much traffic that websites cannot scale well enough. Websites after the holidays see a mass decrease in the number of users on their sites. However, this year and with years to come this has changed where we will see an increase. It is estimated that the number of bots on a website through the year is about 35% of all traffic. In this paper I will discuss that we have increased this number and will see a sharp increase with years to come.

A Comparison of Bioinformatics Packages BioPython and BioConductor
Michael Desch
Faculty Mentors: Shimin Li and Amy Runck

This research focuses on the comparison of BioPython and BioConductor, two open-source software packages for bioinformatics analysis in Python and R programming languages, respectively. A review of both packages is presented that includes the execution style, dependencies, and a subset of optimal tasks for each package. The primary contribution of this research is to determine whether any significant differences exist in each of Memory and Run-time performance between these packages when executing analysis pipelines that are as equivalent as possible within each package. A Variant Call Format (VCF) data set is used as input into each analysis pipeline and consists of Single Nucleotide Polymorphism (SNP) data for six populations of Keeled Treehopper (*Entylia carinata)*, totaling 100 organisms and across 18,318 loci. The resulting measurements of Memory and Run-time performance are visualized and examined. A conclusion provides available evidence-based recommendations with regard to using either or both packages for specific use-cases.

Automatic Polyp Detection in Gastroscopy using Deep Learning
Himanshu Bhushan
Faculty Mentor: Ming Ma

Polyp detection in gastroscopy has attracted much researchers' attention over the past few decades. Early detection and removal of polyps plays a crucial role in gastric cancer prevention. However, it is a challenging task for physicians to detect various types of polyps. To facilitate this process, we propose to use a deep learning based method for automatic polyp detection. The proposed method employs the YOLO model that is based on the convolutional neural network (CNN). The model is trained and tested in a dataset of 758 images obtained during gastroscopy. Out of these 758 images, 606 images were used for training and 152 were used for testing. Experimental results show that the proposed method achieved 85%-95% image precision on the testing dataset. With the Intersection Over Union (IoU) being 0.5, the mean area precision (mAP) ranged from 81%-92%. The trained model can detect the polyps on 10 testing images in 0.226 seconds. This demonstrates that the proposed method can help physicians efficiently detect the gastric polyp and has the potential to be applicable in clinical practice.

Comparing the Effectiveness of Diegetic vs Non-Diegetic Interface Designs for 3D Manipulation in Virtual Reality
Abdullah Choudhry
Faculty Mentors: Mingrui Zhang and Sudharsan Iyengar

Virtual Reality is becoming more and more prevalent in many domains. Along with this, VR technology has become increasingly advanced. VR Interfaces; however, still require further research to determine how they impact user experience and presence in virtual environments. In this paper, we explore the time-efficiency of two UI patterns in a virtual environment, Diegetic and Non-Diegetic UI, for completing tasks related to 3D manipulation in order to determine which is the more effective form of UI for said tasks. We use a between-participants design and ask participants to complete specific tasks using the two UIs, measuring the time taken for each task.

Infiltrating Cloud Storage of IoT devices using Ransomware
Anna Millerhagen
Faculty Mentor: Eric Wright

Security is necessary for all areas of computer science. The expanding world of IT is IoT devices. There are many smart devices in our daily lives such as smart speakers, smart light bulbs, smart watches, doorbell cams, security systems, smart smoke alarms, smart cars, and many more. The need for security in these devices is critical. Any one of these devices could be the weak link to a security breach. These devices are all enabled and communicate through cloud services. They interact with various devices from different vendors all operating to provide the user with the best possible experience. The cloud authentication between devices could lead to a possible inflatable vulnerability. This paper explores the possible weakness and seeks to exploit them to understand the how to better prevent the attacks in the future. The aim of this paper is to infiltrate a device with known security weaknesses and access the cloud through the weak device. Then the final process would be to access a more secure device that holds more user data through the previously infiltrated cloud. For this project smart lightbulbs and a google nest mini were the devices and an SDK was used to simulate a cloud.

Testing Relative Performance of MERN, MEAN, and LAMP Web Development Stacks
Randall Bradach
Faculty Mentors: Mingrui Zhang and Sudharsan Iyengar

The goals of the following research project are as follows. To completely answer the question, "Which web development stack is most efficient and powerful?". This is an important question to answer as it affects every website created today. Finding the best web development stack is incredibly important as it can pre-determine how successful the future of the website you develop will be. The scope of this article pertains to web development as a whole, and specific combinations of different web development technologies. The combinations of web development technologies are known as "stacks". The three being compared include the MERN (MongoDB, Express, React, NodeJS), MEAN (MongoDB, Express, Angular, NodeJS), and LAMP (Linux, Apache, MySQL, PHP) stacks. The method of analysis revolves around testing the time complexities of the stacks with multiple large database queries, using computationally intensive algorithms. After running database queries involving large quantities of data, and measuring the time intervals for each stack's performances with those queries, experimental results will be compared against each stack.

Using JavaScript to detect and defend against web-based attacks.
Alex Feller
Faculty Mentors: Mingrui Zhang and Sudharsan Iyengar

JavaScript and C are two very popular languages in the world of coding. This paper will be studying the effectiveness of JavaScript in preventing cyber-attacks, and its use in web-based code. It is one of the vulnerable aspects for cyber-attacks, solutions are available to prevent such attacks in web-based security. It is also gaining importance in cyber-attacks against websites, and we will compare JavaScript with C with respect to preventing cyber attacks.

Education

Mental Health Support in Primary Grades
Natalie Jasnoch
Faculty Mentor: James Schul

This study analyzes how primary school teachers can integrate a classroom environment in which fosters positive mental health growth. This project collected teacher, administrative member, and parental insight on current mental health integration in the classroom in one school district. The findings indicate that society as a whole is not educated to the degree necessary in mental health. Implications of this study, including varieties of approaches toward creating the best potential environment toward promoting positive mental health growth, are discussed.

The relationship between parental involvement and students' success
Meiling Huang
Faculty Mentor: James Schul

Parents are the children's first teacher, what they do will form and facilitate children's overall developments. Thus, having a good quality of parental involvement is important. Teachers and parents should work together to form a consensus of expectations on both students' behaviors and academic work, then parents can better support their children on both school-related work and parent-child interactions. This study interviewed teachers, school administrators, and parents to help answer the question: What is the relationship between parental involvement and students' success? Findings and implications of this qualitative research will be discussed.

Engineering

Block Accelerated Fatigue Testing of Reinforced Thermoplastics
Sara Johnson
Faculty Mentor: Eric Kerr-Anderson

Fatigue is progressive damage resulting from repetitive fluctuations in material stresses and strains. It is the most common method of failure for engineering systems and is, therefore, the subject of extensive study in this field. The characterization of fatigue performance in materials is a vital part of product design, particularly in the automotive and aerospace industries where parts are subjected to demanding applications and high lifetime expectations. Traditional fatigue testing is expensive, time-consuming, and requires stable laboratory conditions – disturbances such as power outages or earthquakes can instantaneously invalidate data from a weeks long test. The concept of additive fatigue damage is well-known and states that the same percentage of cycling to failure generates the same amount of internal damage, regardless of the applied loading. This offers an interesting opportunity to significantly reduce the testing time required to characterize a material's fatigue performance. This is done by consuming a high percentage of the material's lifetime at high loading (low cycles) before transferring to a lower loading and extrapolating the data to calculate the total number of cycles to failure at this reduced load. In this study, the results of accelerated fatigue testing of reinforced thermoplastic composites are compared to a traditional fatigue background curve in order to evaluate the validity of fatigue testing methods engendered by cumulative damage theory.

Carbon Ascensus Tree Climbing Stick
Jacob Franck, Zijie Liu, Max Mader, and Tanner Williams
Faculty Mentor: Keith Dennehy

The purpose of the Carbon Ascensus project is to create an ultra-light, high performance tree climbing stick. Hunters will be able to hike further and climb higher with this product. The design is simple to use and incorporates high performance materials well suited for the high -performance hunter. The Carbon Ascensus achieves this by being constructed of 70% composite materials by weight. This makes the design stronger and lighter, with features never before seen in a tree climbing stick. The steps are

constructed from carbon fiber using an epoxy system along with PVC core and the shaft is made with several layers of carbon fiber braid and epoxy resin. The only metallic parts are the three fasteners and bolts and the aluminum standoffs. Testing will confirm the mechanical properties of the part meet the requirements of the Treestand Manufacturing Standard (TMS).

Design and Fabrication of a BMW Downforcer
Zach Alboreo, Sean Coleman, Casey Cooper, Trevor Oberg, and Zach Oberg
Faculty Mentor: Keith Dennehy

The Downforcer is a splitter made for any E36 generation BMW. The E36 is a popular platform with both track day and amateur racing enthusiasts. Hobby racing has increased in popularity in recent years. Many of the clubs are based on a specific car manufacturer. One of the more popular car styles is the E36 BMW. The goal of this project is to design and fabricate a front splitter increasing downforce thereby improving the handling and track mobility of the car.
The splitter is a sandwich construction consisting of carbon fiber fabric and epoxy resin outer layers and a honeycomb core. This allows for a lightweight product with exceptional mechanical properties. The product has a dual plane design which honors previous classic BMW's. The design process allowed for a highly engineered part and some aesthetic flare.

Fatigue, Impact, and Static Properties of CFR Thermoplastic Composites
Joseph Garber
Faculty Mentor: Beckry Abdel-Magid

For the last decade continuous fiber reinforced thermoplastic composites (CFRTPC) have been inching their way into the composites' marketplace as viable materials worthy of attention and respect. Known as thermoplastic tapes, organo-sheets and CFRTP, they are finding application in various industries ranging from sporting goods to aerospace. Their appeal is in their light weight, corrosion resistance, low-energy transportation and storage, and recyclability. Their mechanical properties along the fibers rival those of thermoset reinforced polymers. In addition, the advent of imidized materials and advanced engineering thermoplastics makes CFRTP true competitors in lightweight and high temperature applications.

The goal of this project is to expand on previous studies on optimization of CFRTP in terms the effect of fiber content and type of matrix material on impact, tensile and compressive properties. The focus of the proposed study will be on three major areas: drop weight impact properties, compression after impact properties and open-hole tensile and compression properties. All three areas are of interest in aerospace and other applications. Materials to be investigated include GF/PET, GF/PPS, CF/PPS, GF/PA6, CF/PA6 and CF/PA12 from Celanese and GF/PP from Avient. Samples are fabricated at WSU and tested at WSU using the Instron fatigue, impact, and static test equipment.

KyPack: The Design and Fabrication of a Foldable Composite Kayak
Lucas Derbyshire, Joe Garber, Sara Johnson, and Grace Tobin
Faculty Mentor: Keith Dennehy

The KyPack is a solution to a problem faced by many adventurous apartment dwellers, small car owners, and frequent travelers: they would like to purchase a kayak but have no space to store or haul it. Manufactured from fiberglass, carbon fiber, and waterproof silicone-coated polyester fabric, the KyPack is a lightweight, foldable watercraft which can be quickly assembled and disassembled for easy storage and transport. The kayak folds down into a thin rectangle that is fitted with carrying straps. It can then be unfolded and assembled on any beach or shoreline and used as a typical kayak. At the end of the day the user can simply break it down, fold it back into the packed shape, and carry it off like a backpack. The design of the KyPack allows for a variety of people to be able to use it while not having to worry about the hassle that comes with the use of bulky traditional kayaks. The goal of this project was to create a consumer product that reaches millions while highlighting the remarkable properties of composite materials. This was done by designing a kayak from scratch, tailored to the performance goals of people in this market. Currently, the design is being fabricated for testing and qualification. The next benchmark will be refining the design based on the test results and preparing for market.

Recycled Materials and Recycling Technology
Zijie Liu
Faculty Mentors: Beckry Abdel-Magid and Paul Schmitt

This paper reviews the state of technology in recycling coal fly ash, metal, glass, plastic, and composite materials. Recent estimates indicate that more than 33 million tons of plastic are discarded each year, of which 6.5% are recycled and 7.7% are burned. Similar amounts of materials are discarded every year, including glass, metal, and fly ash. Due to the negative impact of landfill and combustion technologies on the environment, these two methods have gradually been abandoned. The current requirements for recycling are not to pollute the environment, not to sacrifice the properties of materials obtained from recycling, but rather harness materials that can be widely used in various industries and consumer goods. Reusing discarded metals, glass, plastics, fly ash, and composite materials into building materials not only helps to treat wastes that are nowhere to be placed, but also allows the materials to play multiple roles after their initial design application. This article focuses on the basic characteristics of raw materials, the technical methods of recycling, the applications, properties, and prices after recycling these five materials.

The CUB: The Carbon Ultralight Basket
Spencer Fick, Dylan Hayenga, David Owens, Josh Schattner, and Austin Sueverkruepp
Faculty Mentor: Keith Dennehy

The Carbon Ultralight Basket (The CUB) is a composite portable disc golf basket used for everyday disc golfing. The CUB is unique due to its carbon fiber reinforced polymer matrix, making it lighter and more durable than its metal counterparts. The CUB has a great strength to weight ratio. In turn this improves the portability of the basket when compared to other market options. The product is durable and easy to use which makes it a solid choice for beginner to professional disc golfers. The carbon fiber also provides a unique appearance that is unlike anything on the market. This carbon fiber finish is also not as susceptible to weathering as traditional disc golf baskets.

English

The Multifaceted Process of Language Attrition
Ryanne Mikunda
Faculty Mentor: Ethan Krase

This research project defines and examines the many factors that influence the process of language attrition, which is an individual's loss of skill in a language that is not caused by a medical condition, i.e., is non-pathological. To begin, this study offers a brief history of first and second language attrition to establish language attrition's role in both the fields of second language acquisition and minority language loss. This history also outlines the parameters under which language attrition is studied, and the required conditions that precede it. The most important precursor is the intersection of two languages that eventually causes a dominance shift. Next, the project divides the process of language attrition into three categories: psycholinguistic functions, personal characteristics of the language user, and variables of the surrounding social context. These sections are provided for clarity of discussion, although the multifaceted and overlapping nature of certain factors is addressed. Finally, this project explores implications for teaching, as an educational setting is often where the interaction of two languages occurs or is prolonged. Educators must understand the process of language attrition in order to make conscientious pedagogical decisions for language learners.

Geoscience

Geochemical Classification of the East Central Minnesota Batholith
Simon Taylor
Faculty Mentor: Stephen Allard

The East Central Minnesota Batholith (ECMB) is a series of granitic plutons exposed along the Sauk river valley near St. Cloud Minnesota. The currently accepted understanding of the processes that generated these plutons relies on the location and age of emplacement. The location of the ECMB is within a terrain that was accreted onto the North American continent during the Penokean orogeny between 1875 to 1835 Ma (Van Schmus, 1976). However, the granites within the ECMB are younger than that having ages between 1772 Ma and 1783 Ma (Holm et al., 2005), similar to ages for the Yavapai orogeny occurring approximately 150 km to the south. To explain how plutons of this age could be intruding so far north of the deformational boundary, Holm et al. (2005) propose an emplacement model where the cold and dense tectonic plate subducting under the continent during the Yavapai orogeny sank causing decompression of the crust and magma generation. The research presented here uses whole-rock geochemical analysis for major, trace, and rare-Earth elements to interpret the tectonic environment for the emplacement of the ECMB in hopes to better constrain the model for tectonics in this region at the time of the Penokean and Yavapai orogenies.

Whole rock geochemistry for major elements (ICP-AES), REE and trace elements (ICP-MS) was determined for 15 samples collected from 7 distinct intrusions across the batholith. These data were compared using several classification plots including Harker diagrams, MALI, Fe-index, aluminum saturation index, alkalinity index, feldspar silica saturation index (Frost et al., 2001; Frost and Frost, 2008). And the trace element discrimination diagrams (Pearce et al., 1984). Petrographic analysis on thin

sections from 10 of these granite samples was performed to determine mineral assemblage and modal abundance.

Whole-rock geochemical data indicate that the samples of the suite range from quartz monzonite to granite, are calc-alkalic to alkalic, largely ferroan and metaluminous with Fe-index and ASI increasing with silica content. Alkalinity index and feldspar silica saturation index classify the samples as being metaluminous and silica saturated. The geochemical patterns of the ECMB appear most similar to the Caledonian style post orogenic granites seen in Scandinavia (Frost and Frost, 2008).

Mapping and Analysis of Structural BMP's in the Root River Watershed, MN
Megan Otten
Faculty Mentor: Dylan Blumentritt

Spanning almost 1,700 square miles over six different counties (Dodge, Filmore, Houston, Olmsted and Winona) in southeastern Minnesota, the Root River Watershed is one of the state's largest watersheds draining into the Mississippi River. The Root River Watershed is within the Driftless area, which has a unique set of characteristics that present certain challenges when it comes to watershed mapping and management. The Driftless area, consisting of Paleozoic limestone, dolostone and St. Peter sandstone, is characterized by its karst features and highly incised, heavily forested valleys. Soil erosion and farm field runoff are two of the Minnesota Pollution Control Agency's (MPCA) main concerns in the watershed due to the bedrock geology, steep slopes, and large areas of farmland. The Minnesota Department of Agriculture estimates that 44% (280,000 tons) of the Root River's sediment load comes from bluff-top farm fields. The excess sediment and nitrates in the watershed's streams have been affecting not only the ecosystems in the immediate area, but also many ecosystems downstream on the Mississippi River, leading to the Gulf of Mexico. These negative impacts can potentially be reduced by the construction of structural Best Management Practices (BMPs), like Water and Sediment Control Basins (WASCOBs), pond dams, terraces, and grassed waterways.

In 2019, the MPCA commissioned the Root River Watershed Structural BMP Mapping Project, aimed at mapping BMPs in the Root River Watershed and calculating the area of land being treated, by using both LiDAR-derived topographic data and satellite imagery. All WASCOBS and pond dams in the Root River Watershed were mapped and given a confidence level based on their shape and condition. The area treated by the BMPs was found by calculating the watersheds for each feature, which were then field checked to ensure the accuracy of the watersheds. Currently, about 19% (190,000 acres) of the Root River watershed is being treated by WASCOBs and pond dams. Pond dams are generally evenly distributed among the watershed's farmland while WASCOB distribution is restricted to the moderately flat areas of farmland in the watershed. The areas that would benefit from more BMP construction have moderate-high risk of soil erosion, large amounts of farmland, and a low density of existing BMPs. This inventory, along with identified risk areas will be used by watershed managers as guidance for future BMP construction projects.

Global Studies and World Languages

The Acquisition of English Phrasal Verbs by Native Spanish Speakers
Ryanne Mikunda
Faculty Mentor: Covadonga Sanchez Alvarado

This project investigates native Spanish speakers' acquisition of English phrasal verbs (PVs). A PV consists of a verb and preposition that function as a verb, e.g., *pick up*, *think about*, and *go on*. Prior research shows that because PVs are polysemous and idiomatic, they are difficult for learners of English as a second language to acquire (Moore Hanna, 2012; Garnier & Schmitt, 2016; Rovira Diaz, 2017). Additionally, the English concept of a PV does not exist in Spanish. To better understand how native Spanish speakers acquire PVs, this study examines whether an earlier age of first exposure to English and whether time spent in study abroad increase learners' usage of PVs. It is hypothesized that younger learners have an advantage due to the critical period hypothesis (Lenneberg, 1967) and that study abroad increases exposure to idiomatic language, including PVs. To test these hypotheses, ten corpus essays (from the Written Corpus of Learner English) by native Spanish speakers are analyzed for PV usage. These ten essays comprise two groups, early and late exposure to English, and the authors represent a range of time spent in study abroad. For comparison, five essays written by native English speakers (from the Louvain Corpus of Native English Essays) are analyzed. This study concludes that early exposure to English supports acquisition of PVs and that study abroad does not always favor acquisition. Further findings show that L2 learners of English tend to avoid PVs, using them with less variety and frequency than native English speakers.

Nursing

Caring for COVID-19 Patients: Turned Upside Down
Alexis Welch and Annamarie Holtz
Faculty Mentors: Susan Zeller and Lydia Lazzara

The novel SARS-2-Coronavirus (COVID-19) has   flooded the healthcare system, affected many, and puzzled healthcare professionals on how to care for patients with COVID-19. Qualitative research was found by conducting monthly reviews of literature (ROL) since July of 2020 through January 2021, to determine current best practices in the treatment and management of COVID-19 patients with respiratory distress. Interviews with healthcare professionals were also conducted to understand first-hand experiences and techniques found effective in their practice. From the interviews and ROL, a prominent theme found in effective treatment of respiratory distress is the use of prone positioning (PP). PP is analyzed from a nursing perspective, including evidence, implications, and identification of possible complications to educate nurses. Research suggests PP compared to supine, creates open space and a shift in pressures to different places in the lungs allowing improved oxygenation. From expert clinician experience, PP has been effective in some patients, both sedated and conscious, if tolerated. PP requires up to 16 hours of laying prone to be the most successful, however any amount of time in PP has shown benefits. Being in PP for this length of time has brought concerns of facial edema, increased risk of blood clots, and risk of disruption of medical interventions. As COVID-19 is an emergent disease and continues to be researched, there is an importance to the continuation of reviewing current data and best practices published to guide the nursing care of COVID-19 patients with respiratory distress.

Efficacy of Intermittent Fasting as an Intervention for Weight Loss: A Review of Current Literature
Adrianna Perron and Gabrielle Lee
Faculty Mentor: Heather Schmidtknecht

Obesity is a paramount contributor to disease in the United States. Current recommendations for weight loss or weight management are effective with unyielding implementation, although many struggle with adherence. In frustration with traditional methods to lose weight, individuals often turn to unreliable, expensive, and gimmicky methods and products. While some methods work, many are ineffective, unsustainable, and unsafe. Intermittent fasting (IF) has been a topic of interest in popular media as well as research, with new data published incessantly. The purpose of this literature review was to explore the efficacy of IF for weight loss. Four databases were searched using keywords. Twenty-nine articles met inclusion criteria for this literature review. The results of the literature review grossly indicated IF is effective for weight loss but no more effective than calorie restriction (CR). However, data suggests IF may generate greater fat loss than muscle loss in comparison to CR, which may produce health benefits beyond weight loss. In addition, data indicated IF may be useful for glycemic control, which could increase the applicability of IF to the care of those who struggle with glycemic control and insulin sensitivity. IF may be an advantageous tool to offer patients who have difficulty maintaining an appropriate body mass index (BMI) and for whom CR was not efficacious. IF presents a viable alternative to CR for weight loss with promising potential for disease prevention and management; however, close monitoring may be required for those at risk for hypoglycemia. More research is needed with larger participant numbers and long-term analysis to fully appreciate the health benefits of IF.

Physics

Geometrization of Hawking Radiation via Ricci Flow
Alexander Cassem
 Faculty Mentor: Andrew Ferstl

In 1982, Richard S. Hamilton formulated Ricci flow along manifolds of three dimensions of positive Ricci curvature as an attempt to resolve Poincaré's Conjecture. However, it took until 2006 by Grigori Perelman to resolve the conjecture with Ricci flow. Since then, research in pure mathematics on Ricci Flow increased exponentially, and people began to apply it towards physics. For example, Ricci flow has been found to be the Renormalization Group flow of the bosonic string and sigma model. However, Ricci flow's analogous counterpart being the heat equation, makes it appear to have more applications. For this reason, we have studied the implication of Ricci flow as being the geometrization of Hawking Radiation, or black hole evaporation. Ricci flow behaves as the evolution of the metric along a parameter λ. It is equal to negative the Ricci tensor (if not normalized), or stated as $\partial\lambda g = -Ric(g)$. We choose λ to be t for time, and see how the metric evolves under time. In this presentation, we will explore the difficulties with this approach, including the consequences of Birkhoff's theorem, a conformal transformation of the metric, Ruppeiner's methods of relationship between curvature and thermodynamics, and direct manipulation of the flow parameter λ.

Political Science

Impact the Increased Risk COVID-19 has on the Mental Health of Ethnic Minorities
Danielle Baca
Faculty Mentor: Gretchen Michlitsch

Ethnic minorities are already at an increased risk of contracting COVID-19 due to the numerous disparities within the system as a whole, their mental health should not be suffering too. How could their mental health not suffer though when there is a 0.7-1.9 greater chance of them contracting COVID-19, a 1.1-3.7 greater chance of being hospitalized, and a 1-2.4 greater chance of them dying compared to white, non-Hispanic people, according to the CDC. On top of this, they have to deal with the disparities within the health care system. This causes ethnic minorities to be provided with less and worse health care if they did need it during the pandemic at which they are at a heightened risk of morbidity and mortality. How are they supposed to truly trust their access to health care services while also facing the challenges of trying to merely receive equal treatment among the less than adequate health care services that they are provided? How are they truly supposed to trust this system at all when stacked with disparities within occupation, education, income, wealth gaps, and housing? A system that modern ethnic minorities must be at a constant battle with in order to try a merely receive basic human rights. With all of this stacked against them it is no wonder the mental health of ethnic minority groups are deteriorating during the ongoing COVID-19 pandemic.

Relationship Among College Affiliation and Other Factors to Environmental Beliefs
Natalie Nowatzke
Faculty Mentor: Kara Lindaman

The objective of this research is to determine and define the relationship among student's college within Winona State University and other demographic factors, to their beliefs and aptitudes regarding the environment. This was accomplished by a survey disturbed to students, asking demographic questions and the New Ecological Paradigm (NEP) scale. The NEP scale is a previously created set of fifteen questions, which aims to measure individual's environmental concern and attitude. These questions were asked with a rating scale of answers, measuring level or agreement or disagreement. Data collection and analysis is still currently underway. However, it is hypothesized there will be correlations to new paradigm views in students in science related colleges and those having taken an environmentally related course. The roles of gender, socioeconomic status, and year in school will also be analyzed.

Students' Views and Feelings Towards Law Enforcement
Lauren Blevins
Faculty Mentor: Kara Lindaman

Recent events involving police, including the death of George Floyd, have led to an intense dispute among Americans over police conduct. Feelings that individuals have towards law enforcement may be shaped through interactions that they have with police. Others may be influenced by interactions that others have experienced, whether that be their friends, what they have witnessed, or what they have

seen on television. Studies such as the Brunson and Pegram, Etkins, Smith and Hawkins, Weitzer and Tuch, and Worden and McLean all share similar results, which can be expected in this research involving college students. The studies have shown the impact that negative interactions (directly or indirectly) have on negative feelings towards police. Specifically, Brunson and Pegram demonstrated that "study participants who reported positive police experiences were more likely to rate officers favorably, compared to those who described their interactions as negative" (Brunson and Pegram). All of these studies provide excellent information, but they were all conducted prior to the events that occurred in 2020 and none were found to show an interest in college students. The data in this new study were obtained through a short survey that was sent out to Winona State students. The survey included questions regarding individual interactions with police and the feelings, attitudes, and comfort levels that resulted, along with questions regarding what students would like to see changed with law enforcement. Based on the findings of the Brunson and Pegram, Etkins, Smith and Hawkins, Weitzer and Tuch, and Worden and McLean, it is expected that college students will yield similar results including things such as relation between experiences and how an individual perceives law enforcement.

Works Cited:
1. Brunson, Rod K., and Kashea Pegram. "'Kids Do Not So Much Make Trouble, They Are Trouble': Police-Youth Relations." *The Future of Children*, vol. 28, no. 1, 2018, pp. 83–102. *JSTOR*, www.jstor.org/stable/26641548. Accessed 1 Mar. 2021.
2. Ekins, Emily E. "Policing in America: Understanding public attitudes toward the police. Results from a national survey." *Results from a National Survey (December 7, 2016)* (2016).
3. Smith, Paul E., and Richard O. Hawkins. "Victimization, Types of Citizen-Police Contacts, and Attitudes toward the Police." *Law & Society Review*, vol. 8, no. 1, 1973, pp. 135–152. *JSTOR*, www.jstor.org/stable/3052811. Accessed 10 Feb. 2021.
4. Weitzer, Ronald, and Steven A. Tuch. "Race and Perceptions of Police Misconduct." *Social Problems*, vol. 51, no. 3, 2004, pp. 305–325. *JSTOR*, www.jstor.org/stable/10.1525/sp.2004.51.3.305. Accessed 28 Feb. 2021.
5. Worden, Robert E., and Sarah J. McLean. "Police Legitimacy." In *Mirage of Police Reform: Procedural Justice and Police Legitimacy*, 42-68. Oakland, California: University of California Press, 2017. Accessed March 1, 2021. http://www.jstor.org/stable/10.1525/j.ctt1w8h1r1.7.

The Impact of COVID-19 on Winona State University Students' Income
Josie Groebner
Faculty Mentor: Kara Lindaman

The COVID-19 pandemic has created economic instability for people across the United States, including college students. A study of job loss in New England in May 2020 found that young adults ages 16-24 experienced an employment loss of 27% from Mid-March to Mid-April 2020 (Fogg and Harrington). Much of the research conducted regarding college students and COVID-19 focuses on the psychological impacts with finances and the economy as contributing factors (Cohen et al.). Sparse research has been undertaken regarding the employment levels of young adults. Limited attention focuses on studying the financial impact that COVID-19 has had on college students, leaving room to examine the changes in personal income felt by college students. This study determines how negatively COVID-19 and the restrictions have impacted students' income at Winona State University. A survey, distributed in Winona State University official Facebook groups, asks questions about changes to employment, income, and assistance from the federal government and university. This study's findings are essential to groups that

advocate for more significant aid for college students throughout the pandemic and after. These findings are also important in the context of the economic downturns and how college students are adversely affected.

The Socioeconomic Effects of COVID-19 On Women
Piper Hatlestad
Faculty Mentor: Kara Lindaman
The differentiated impacts of the COVID-19 pandemic has shown a disproportionate amount of socioeconomic disadvantages faced by women. These effects are exacerbated by various intersectional identities such as race, disability, ethnicity, socioeconomic class, and age. This study will examine the socioeconomic influence of gender inequality during the pandemic and will discuss the subsequent effects of these disparities for decades to come. The data was collected from a sample of students at Winona State University and analyzes the effects based on a survey conducted that addresses their employment history, income level, their current and expected future financial security, as well as their socioeconomic status throughout the pandemic timeline.

Psychology

Effectiveness of Promoting Organ Donation with Appeals to Reason and Emotion
Katrina Pfaffenbach
Faculty Mentor: Amanda Brouwer

The need for organ donors is consistent and enduring; every day in the United States, 17 individuals die waiting for a transplant, and while 90% of U.S. adults state they support donation, only 60% are registered donors (Health Resources & Services Administration, 2021). Organ donation promotional campaigns are routinely done in the realm of public health, yet the most effective approach remains disputed. In this study, separate appeals to reason and emotion were explored to provide a better understanding of how different types of promotion affect attitudes and misconceptions of organ donation. It was hypothesized that since the majority of participants were from a university setting, that a rational video, one providing information about organ donation and addressing misconceptions, would increase positive attitudes more than an emotional video across time. Participants were 131 individuals (M= 22.02, SD= 7.87) who answered questions about their views on organ donation before and after watching either an educational or emotional organ donation video. A 2x2 mixed design ANOVA was computed to test whether there were differences in attitudes before and after watching the videos and whether those differences were the same or different for each video group. Results indicated that there were main effects of feeling more educated ($F(1,125) = 55.51$, $p < .001$), decreased "ick" factor ($F(1,125) = 10.79$, $p = .001$), increased beliefs that other people should register as donors ($F(1,7.61) = 10.79$, $p = .007$), and decreased medical mistrust ($F(1,125) = 13.92$, $p < .001$) after watching the videos. Additionally, there was an interaction effect found for education ($F(1,125) = 13.60$, $p < .001$). After watching the video, the educational group reported feeling more educated (M=6.47, SE= 0.11) than those who watched the emotional video (M=5.949, SE= 0.12: $t(125)$=3.28, $p < .001$). For those who watched either video, there was a significant increase in knowledge after watching the video (Educational: $t(125)$=8.20, $p < .001$; Emotional $t(125)$=2.57, $p = .01$). The number of individuals who were not previously registered and agreed to be registered organ donors also increased after watching the

videos (c2(N=127), =5.14, *p* =.016). No significant changes were observed for overall views on organ donation, perceived benefit, bodily integrity, or the "jinx" factor. These results give insight on how organ donation campaigns regardless of approach can positively influence some attitudes, but potentially not significantly affect others. The attitudes that were impacted by education were feeling educated, the "ick" factor, believing other people should register, as well as medical mistrust. An educational video increased feeling educated more than that emotional video, but both groups increased across time. Therefore, whether the approach was rational or emotional did not seem to matter for this population of primarily college students.

Keywords: promotional appeals, reason versus emotion, organ donation, education, attitudes about organ donation.

Attachment Predictors of Different Types of Aggression
Connor O'Brien
Faculty Mentor: Robert Casselman

Research has shown a relationship between parental and peer attachment and aggressive behavior (Gallarin & Alonso-Arbiol, 2012; Malonda, Llorca, Mesurado, Samper, & Mestre, 2019). Gomez and Mestre (2007) found that insecure mother and father attachment was positively associated with aggression. Maldona et al. (2019) found that secure parental attachments were negatively correlated with verbal and physical aggression. This study also showed that peer attachment influenced prosocial behavior, which helped decrease aggressive behavior. Given this finding, parental attachment may be a more robust indicator of aggression than peer attachment. Li et al. (2015) also found that secure parental attachment was negatively associated with indirect aggression. Some studies have found that insecure maternal attachment had a stronger relationship with aggression than insecure paternal attachment (Earl & Burns, 2009; Maldona et al., 2019). The present study seeks to further examine the differential effects of parental and peer attachment on different types of aggression (physical, verbal, anger, and hostile). Given the results of these studies, our hypotheses are: 1) insecure parental and peer attachments will predict higher levels of general aggression, 2) parental attachments will be stronger predictors of aggression than peer attachment, and 3) insecure mother attachment will be a stronger predictor of aggression than insecure father attachment. Given that it is unclear how predictive the attachment variables will be with different types of aggression, we sought to examine these relationships in an exploratory manner in a young adult sample. Data analysis will be completed by February 2021.

Parental Attachment, Self-Control, and Resilience: A Mediation Study
Maggie Paulus
Faculty Mentor: Robert Casselman

Self-control theory has received extensive empirical attention in the past decade, but most studies have not tested its arguments about the effects of parenting on self-control and adolescent's ability to be resilient in a time of high stress. However, many current and past research has found an association between secure parental attachment and high resilience in adolescents, but self-control may be a salient variable for elucidating this relationship. Schaan and Vögele (2016) found that factors such as resilience have long-term consequences of parental divorce in young adults. In line with resilience, self-control can also mediate the relationship between parental attachment and resilience. Hsieh and Sek (2007)

examined 291 adolescents living in single parent families in Taiwan, found that those adolescents respondents showed that several concerns in the areas of resilience (effective coping, parental protection from being hurt by parental divorce) and adaptation (problems in with low self-regard and low self-control) were identified throughout their findings. It is possible that insecure parental attachment leads to decreased self-control. Additionally, Wright and Beaver (2005) suggest in their research that parents are the sole contributors for either fostering or thwarting low self-control in their children, thus there can be implications about self-control mediating the relationship between parental attachment and a child's resilience. Based on the literature, our hypotheses are: 1) Secure parental attachment will predict an increase in self-control; 2) Self-control will predict psychological resilience; and 3) Self-control will mediate the relationship between parental attachment and resilience.

Parental Rejection, Emotional Dysregulation, & Peer Attachment
Savannah Rachel
Faculty Mentor: Robert Casselman

Research has consistently found a relationship between parental rejection and adult peer attachment and aggression (Joss et al., 2020). Casselman and McKenzie (2014) found that mother and father rejection contributed to the adult's attachment in a sample of 610 undergraduate psychology students. Emotional dysregulation may be a noteworthy variable for explaining this relationship. Carlo et al. found positive correlations between emotional dysregulation and adult peer attachment (2011). It is possible that parental rejection leads to emotional dysregulation, which then results in insecure adult peer attachment and aggression. Hank et al. (2016) also found that there is a positive correlation between emotional dysregulation and attachment avoidance. The present study sought to extend the literature by examining emotional dysregulation as a mediating variable in the relationship between parental rejection and insecure peer attachment in a college sample.

Based on the literature, our hypotheses are: 1) mother and father rejection will predict insecure peer attachment; 2) Emotional dysregulation will predict insecure peer attachment; and 3) Emotional dysregulation will mediate the relationship between parental rejection and insecure peer attachment. Data collection with a college student sample (*N*=244) will be completed by March 31st.

Personality and Career Study
McKenna Miller
Faculty Mentor: Amanda Brouwer

Background. Success is a goal that many people strive for. It is important to understand which factors such as personality traits lead to success and if success in an academic setting can predict success in a career setting. This is because being a successful individual can lead to both physical and psychological benefits. If someone can learn about how to become more successful, they can acknowledge their strengths and weakness and implement changes into their life. Therefore, it was hypothesized that greater academic success will predict greater career success. Furthermore, there will be a significant positive correlation between academic success and conscientiousness and there will be a significant positive correlation between career success and conscientiousness, and extraversion. Lastly, there will be a significant decrease in career success during COVID-19 than before COVID-19.

Methods. Participants (N = 353, MAge = 45.69, SD = 15.98) completed an online survey, answering questions about academic success, career success (before and during COVID), and personality. A linear regression and correlations were computed to understand the relationship between these variables. A paired samples t-test was performed to determine career success before and during COVID.

Results. A positive and significant correlation was found between academic success and extraversion, agreeableness, conscientiousness, open mindedness, and career success (both before and after COVID). A negative and significant correlation was found between academic success and negative emotionality. A positive and significant correlation was found between career success (before and after COVID) and extraversion, agreeableness, and conscientiousness. A negative relationship was found with negative emotionality. Career success during COVID (but not before COVID) was positively associated with open mindedness. Career success was significantly lower during COVID (M = 3.80, SD = 0.83) compared to before COVID (M = 3.93, SD = 0.80, t(218) = 2.50, p = .01).

Discussion. The data suggests that academic success can predict career success. The results also build on previous research and supports the hypothesis that different personality traits are correlated with both academic success and career success. This information contributes to a clearer understanding of the predictive qualities of success. Personality factors such as being outgoing, compliant, and responsible are associated with more academic success and career success. This could be due to the social aspect of success and what other people value. Individuals who are more extroverted and agreeable may be more likely to build social connections and do what is expected of them. By acknowledging how one's success in school and one's personality can influence success in the workforce, people may be able to put effort into developing successful skills and traits that will lead them to success in the future. The affect that a pandemic has on career success should be taken into account as well. The results show that during COVID, career success was reported to be significantly lower than before COVID, possible due to the stress of a massive change in society and lifestyle.

Keywords: academic success, career success, personality

Predicting COVID-19 Preventative Behaviors: The Self-as-Doer Identity and Beliefs in Control Methods
Jenna Dale, Megan Reis, Taylor Kruse and Thomas Carlson
Faculty Mentor: Amanda Brouwer

Introduction: The COVID-19 pandemic has posed a serious threat to the health and safety of people worldwide. It has had a profound physical and psychological toll, requiring many lifestyle changes. People suffering from pandemic-related anxiety tend to exhibit elevated levels of mental health concerns. To slow the spread of COVID-19, the CDC recommends wearing masks, social distancing, good respiratory hygiene, and vaccinations, but such behaviors require motivation. Previous research indicates that certain attitudes about the disease (i.e., greater perceived susceptibility and severity, more anxiety, greater trust in authorities and the efficacy of recommended behaviors) are associated with greater adherence to recommended behaviors to control the disease, but more work is needed. The self-as-doer identity, a motivational identity which suggests a person will engage in behaviors that they identify with even when the behaviors are difficult, has been shown to predict health behaviors like physical activity and healthy eating and may also predict COVID-19 related behaviors, but researchers have yet to explore this idea. Therefore, we hypothesized that the self-as-doer identity for COVID-19 recommended behaviors would predict engagement of COVID-19 recommended behaviors over and above perceived susceptibility and severity of the disease, anxiety about COVID-19, trust in authorities, and efficacy of recommended behaviors.

Methods: Participants (N=174, Mage = 19.87, SD= 1.86) answered survey questions focused on attitudes about COVID-19 such as perceived severity and susceptibility, anxiety related to COVID, perception of intervention, and trust in authorities. Participants also completed a measure of self-as-doer identity for COVID-19 recommended behaviors. Data were analyzed using a hierarchical linear regression where attitudes about COVID-19 were entered in the first block and self-as-doer identity was entered in the second block.

Results: Self-as-doer identity predicted an additional 21% of the variance in COVID preventative behaviors over and above severity and susceptibility beliefs, anxiety about COVID, trust in authorities, and belief in control methods, ($\Delta R2$=.210, F(1,144)=94.16, p<.001). Only the self-as-doer identity (b=.61, t(149) = 9.70, p < .001) and beliefs in control methods (b=.17, t(149) = 2.96, p = .004) individually predicted the practice of COVID-19 preventative behaviors.

Discussion:
The self-as-doer identity predicted COVID-19 behaviors beyond the known attitudes of this disease. As such, the self-as-doer could be used as a new tool to motivate health behavior engagement for COVID-19 preventative behaviors. In this model, the only other predictor was the belief in control methods. Certain populations may be more willing to exhibit preventative behaviors due to believing their actions will prevent the spread. Future researchers could address the correlational nature of this study by testing a cause-and-effect relationship between the self-as-doer identity and COVID-19 health behaviors.

Suicidal Ideation and Suicide Acceptance Among Age Cohorts
Caelan Vielbig
Faculty Mentor: Amanda Brouwer

Young people experience suicide ideation at high rates, 11.8%, and suicide is the second leading cause of death from age 10 to 34. The rates of suicide have increased by 35% for all age groups from 1999 to 2018. Reasons for young people being at high risk of suicide could be due to rising use of social media and the internet, personality traits, or cultural contexts. However, less is known about how differing attitudes could influence ideation, and whether there is an interaction between age and attitudes. Participants (N= 302, *M* = 36.79, *SD* = 16.66) were recruited through Amazon MTurk, Winona State University, and Winona community organizations. They were asked to complete an online survey. Their data were used to measure the relationship between age and ideation, attitudes about suicide and ideation, and the interaction between age and attitudes about suicide. Significant results were found for the three hypotheses. Attitudes about suicide were found to be related to increased ideation. Results also indicated that younger individuals have higher rates of ideation. There was also a significant interaction between young age and suicide acceptance. This would indicate that greater acceptance of suicide among young people is associated with greater ideation than it is for older people. That may indicate greater risk for young people with accepting attitudes towards suicide, but more research is warranted.

The Psychological Consequences of COVID- 19: What is the Experience for College Students?
Molly Hedrich
Faculty Mentor: Trisha Karr

The coronavirus disease, also known as COVID- 19, undoubtedly changed the lives of many American citizens after its initial impact in the United States back in March 2020. A specific proportion of the U.S. population that is often overlooked regarding economic and emotional disparities is that of college students. COVID- 19 has brought about even more changes and issues on top of the preexisting ones that college students already must endure. The purpose of this study was to consider the many variables of college students living during a pandemic. Participants from a Midwestern university completed a series of online surveys measuring demographics and mental health. Hierarchical multiple regression models were used to assess the ability of psychological factors (affect, resilience) to predict symptoms of depression and anxiety after controlling for the influence of life transitions. For both the depression and anxiety models, the total amount of variance explained was 50%, $p < .05$. Findings showed that despite the experience of challenging life transitions, college students were protected by resilience and positive affect relative to their reported depression and anxiety scores. This study further highlights the importance of maintaining protective factors for managing depression and anxiety, especially when living during a pandemic.

Bupropion effects on sign- and goal-tracking.
Paige Johnson
Faculty Mentor: John Holden

In classical conditioning, sign-tracking is a near ubiquitous tendency of organisms to approach/contact of a conditioned stimulus (CS) signal for an appetitive unconditioned stimulus (US), whereas goal-tracking is the approach/contact of the location where the unconditioned stimulus is to be delivered. In a previous study, we hypothesized that amphetamine administration would increase sign-tracking and decrease goal tracking, but instead amphetamine administration decreased sign tracking and increased goal tracking. We performed this study on to see if the antidepressant bupropion (which has similar effects) would decrease sign-tracking in a similar way. With this we predicted that the sign-tracking would decrease, and goal tracking will increase under bupropion. Across a number of measures, we found that bupropion administration decreased sign-tracking and increased goal-tracking in a manner similar to amphetamine. In future studies we hope to explain the paradox of why administration of a dopminergic drug seems to reduce sign-tracking (a dopminergically-driven behavior) so dramatically.