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THIRTY-SECOND ANNUAL SYMPOSIUM OF TRINITY COLLEGE UNDERGRADUATE RESEARCH

TABLE OF CONTENTS

Poster #

Title

BIOLOGY

1. **REGENERATION OF NEW *PEARL* EYE MUTANT COLONY OF BEETLES**
Archana Adhikari '22, Joli A. Smith '22
2. **MAPPING POSSIBLE ENHANCER REGIONS OF *CAUDAL* GENE IN *TRIBOLIUM CASTANEUM* TO STUDY ITS INTERACTIONS WITH OTHER GENES BELONGING TO THE SEGMENTATION CLOCK**
Daniel S. Bauloye '20
3. **PREDATORS SELECT FOR HIGHER LEVELS OF BRAIN CELL PROLIFERATION IN TRINIDADIAN KILLIFISH, *RIVULUS HARTII***
Joshua Corbo '19
4. **ENVIRONMENTAL-DEPENDENCE OF INDIVIDUAL BEHAVIORAL PLASTICITY ACROSS POPULATIONS**
Marta Drausnik '22
5. **A MORPHOLOGICAL INVESTIGATION OF FOUR MESOPHOTIC ADDITIONS OF RHODOPHYTA TO THE FLORA OF BERMUDA**
Madalyn A. Farrar '19
6. **EXPRESSION OF MTOR AND TRIB3 IN OLIGODENDROCYTE CELLS**
Katie Lazur '20, Fumika Ando '21
7. **SPECIALIZATIONS FOR YOLK PROCESSING IN REPTILES**
Luisa Lestz '19, Madeline Barnes '20, Farahana Appiah '21
8. **NUTRIENT SENSING BY THE MECHANISTIC TARGET OF RAPAMYCIN**
Sameir Madden '19
9. **DETERMINING THE ROLE OF CDT1 GENE IN THE ENVIRONMENTAL RESPONSE OF ARABIDOPSIS**
Chloe Michalopoulos '19, Chatham Eldredge '19

Poster #

Title

10. **AMINO ACID FUNCTIONS IN THE JUXTAMEMBRANE REGION OF THE TRANSMEMBRANE SERRATE LIGAND AND THEIR EFFECTS ON SUBCELLULAR LOCALIZATION OF SERRATE PROTEIN.**
Duuluu Naranbat '19
11. **A MOLECULAR ASSISTED ALPHA TAXONOMIC (MAAT) STUDY OF WESTERN ATLANTIC SOLIERIACEAE (GIGARTINALES)**
Elias Peterson '19
12. **THE CONCENTRATION OF MERCURY IN THE BIOTA OF AN URBAN POND**
Hazel Robertson '19
13. **THE TOLL 10 GENE'S INVOLVEMENT IN CELLULAR MOVEMENTS DURING EARLY AND LATE SEGMENTATION OF *TRIBOLIUM CASTANEUM***
Kathryn A. Russell '22
14. **CLONING *ODD-SKIPPED* IN *TRIBOLIUM CASTANEUM***
Jeffrey Sagun '21
15. **SOCIAL BUFFERING OF THE BRAIN CELL PROLIFERATION RESPONSE TO TAIL INJURY IN WEAKLY ELECTRIC FISH, *APTERONOTUS LEPTORHYNCHUS***
Margarita Vergara '19, Joshua Corbo '19
16. **ITERATIVE TRIAL LIGATION OF CONSTRUCTS IN THE SERRATE JUXTAMEMBRANE REGION OF THE NOTCH SIGNALING PATHWAY**
Junyao Yuan '21, Zimo Huang '21

CHEMISTRY

17. **SYNTHESIS AND CHARACTERIZATION OF AN OPTICAL STIFFNESS SENSOR**
HuaYue Ai '21
18. **MEASUREMENT OF KINETICS AND SPECIFICITY OF PEPTIDE SUBSTRATE REPORTERS FOR PROTEIN KINASE B FROM *DICTYOSTELIUM DISCOIDEUM***
RJ Chadha '20, Sababa Anber '20, Misha Mehra '21, Kunwei Yang '17
19. **UTILIZING FLUORESCENT INDICATOR DYES TO EXAMINE REACTIVE OXYGEN SPECIES IN *D. DISCOIDEUM***
Jason S. Deck '21
20. **SYNTHESIS AND CONFORMATIONAL EVALUATION OF β -SHEET MODELS**
Uyen T Doan '21, Paul Handali '18

<u>Poster #</u>	<u>Title</u>
21.	STUDY OF THE ROLE OF TELOPEPTIDES IN THE BINDING OF OSTEOCALCIN TO TYPE I COLLAGEN Audrey Ettinger '20
22.	OPTIMAL LIPID COATING FOR SEPARATING PEPTIDE SUBSTRATES FOR PROTEIN KINASE B USING MICROCHIPS Jonathan Fan '22
23.	MEASUREMENT OF MTOR ACTIVITY USING A CUSTOM-MADE PEPTIDE SUBSTRATE REPORTER Daniel Feldman '21, Grigorii Kalminskii, Sameir Madden '19
24.	LIQUID-LIQUID EXTRACTIONS OF CARBON ACIDS Claire Grigglesstone '21
25.	SOLID PHASE PEPTIDE SYNTHESIS FOR MAKING LARGER β-SHEET PEPTIDES Anna Maria Imwalle '20
26.	TRITYL CATALYZED SYNTHESIS OF BISINDOLYLMETHANES FROM IMINES Vanessa Jones '19
27.	DETECTION AND DISCRIMINATION OF COUNTERFEIT PHARMACEUTICALS USING DIRECT ANALYSIS IN REAL TIME—TIME OF FLIGHT MASS SPECTROMETRY WITH MULTIVARIATE STATISTICAL ANALYSIS Jacqueline Kromash '19
28.	BISINDOLYLMETHANE SYNTHESIS VIA TRITYL CATION CATALYSIS Kelly Lucas '20
29.	SELECTIVE DETECTION OF SUPEROXIDE ANION: SYNTHESIS OF A NOVEL FLUORESCENT PROBE Olesya Martynova '20
30.	SPECIFICITY OF PEPTIDE SUBSTRATE REPORTERS FOR PROTEIN KINASE B FROM <i>DICTYOSTELIUM DISCOIDEUM</i> Misha Mehra '20
31.	ANALYSIS OF THE STRUCTURE AND SYNTHESIS OF (-)-LEUCONOXINE Jay Moran '19, Vanessa Jones '19
32.	ANALYZING THE CONFORMATION OF AN AMINO ACID DERIVATIVE OF 1,4-DIAMINO-2-BUTYNE WHEN COORDINATED TO TUNGSTEN IN A BIS-ALKYNE COMPLEX Maxwell Ogbiji '22

<u>Poster #</u>	<u>Title</u>
33.	ANALYSIS OF OPPOLZER'S SYNTHESIS OF (R)-(-)-MUSCONE Claire Pritchard '20
34.	OPTIMIZING THE REMOVAL OF ALDEHYDES FROM MIXTURES USING SODIUM BISULFITE Hanna Vescovi '21, Amodini Katoch '22

COMPUTER SCIENCE

35.	WITAM: SENIOR PROJECT ABSTRACT Brian Cieplicki '19
36.	THE EARLY NOTES APP Elijah Sian Hernandez '19
37.	CHAT-WITH-A-BOT Jin Pyo Jeon '19
38.	PLECTR - ON DEMAND TUTORING Andrew Lewis '19
39.	BIOKIT: AN APPLICATION FOR ANALYZING GENE EXPRESSION DATA Christopher LoBianco '19
40.	E-VENTORY: ONLINE INVENTORY SYSTEM FOR TECHNOLOGY IN PUBLIC SCHOOLS Selina Ortiz '19
41.	QUANTITATIVE FINANCE PLATFORM Samuel I. Oyebefun '19
42.	MENU SYSTEM USING DOMAIN DRIVEN DESIGN THEORY Yifan Peng '19
43.	COMPRESSION USING MASSIVELY PARALLEL PROCESSORS James Rodiger '19
44.	'ROBIN FOOD' - AN APP THAT CONNECTS FOOD DONORS TO VOLUNTEERS Simran Sheth '19
45.	TRINITY COLLEGE CAMPUS NAVIGATION APPLICATION Tess Starr '19
46.	P.A.T. – THE PORTABLE ARTISTIC TUTOR Clear Tavarez '19

<u>Poster #</u>	<u>Title</u>
47.	BANTAMBOT Ha Tran '19
48.	INCREASE PRODUCTIVITY RATE WITH THE OMODORO TECHNIQUE Binh Vo '19
49.	TRISTY MOBILE APP Genxing Zhan '19

ENGINEERING

50.	WEARABLE TELECOMMUNICATION SENSOR EMBEDDED GLOVE Alison Adamski '19, Yesenia Garcia Balbuena '19, Stacy Lam '19
51.	INVESTIGATING THE VEHICLE-TO-VEHICLE WIRELESS PROPAGATION CHANNEL Marios Bourtzonis '22
52.	TELELOCOMOTION: MAKING ROBOTS WALK Digesh Chitrakar '22, Isabella Yung '22
53.	RECONFIGURABLE ROCK CLIMBING WALL Zane Chitty '19
54.	BATTERY CHARGING BICYCLE ATTACHMENT Devon deFilippi '19, Ukuch Ligol '19, Paul Swetz '19
55.	DESIGN OF A FLYWHEEL-CONTROLLED INVERTED PENDULUM Lucas Duros '19, Gordon Hyduke '19, Jack McInnis '19
56.	INFUSION THERAPY DEVICE Hanna Engstrom '19, Shannon Phillips '19
57.	OBJECT DETECTION FROM CAMERA TRAP IMAGES USING EIGENBACKGROUNDS Justin Kim '19
58.	ENERGETICS AND DECAY OF ISOTROPIC TURBULENCE FROM AN OSCILLATING GRID Ike Njoroge '22, Kieran Neath '22, Ahmed Eldmerdash '20
59.	ON-STREET AND OFF-STREET PARKING AVAILABILITY PREDICTION USING PARKING AVAILABILITY DATA IN A LARGE URBAN AREA Muhammad Hassan Rashid '22

Poster #

Title

60. **RECONFIGURABLE MOBILE PLATFORMS**
Emilio Viteri '19, Joseph Orosco '19, Andrew Agard '19

ENVIRONMENTAL SCIENCE

61. **TOTAL MERCURY ACCUMULATION AND DISTRIBUTION IN HARTFORD COUNTY URBAN PONDS, FOCUSING ON BEACHLAND POND IN WEST HARTFORD, CT**
Shane McLaughlin '19
62. **ESTIMATING SNOW LEOPARD (*PANTHERA UNCIA*) ABUNDANCE IN NORTHERN AREAS OF PAKISTAN**
Kaelie Murray-Simmons '20, Alexandra Lao '19, Jane Provost '19
63. **DISCOVERING THE CAUSES OF INCREASED PYRRHOTITE DETERIORATION IN CONCRETE**
Jordan Stephan '22
64. **INVESTIGATING PYRRHOTITE CONTENT ACROSS CONNECTICUT GEOLOGY**
Alexis Zanger '19
65. **PRESENCE AND ACTIVITY OF LONG-TAILED BATS (*CHALINOLOBUS TUBERCULATUS*) IN THE HŪNUA RANGES AND ADJACENT PARCELS OF PRIVATE LAND IN AUCKLAND REGION, NEW ZEALAND**
Yunzhuo (Doris) Zhang '19

HEALTH FELLOWS

66. **SURVEY OF PATIENTS USING THE ED AT HARTFORD HOSPITAL FOR EMERGENT DENTAL NEEDS**
Roxana Alvarez '20
67. **THERAPIES FOR COGNITIVE DEFICITS ASSOCIATED WITH CHEMOTHERAPY FOR BREAST CANCER: A META-ANALYSIS**
Sababa Anber '20
68. **DEMORALIZATION IN MOVEMENT DISORDERS**
Julianna Armentano '20
69. **EXAMINATION OF PNEUMOCOCCAL VACCINATION STATUS IN RELATION TO DEMOGRAPHIC TRAITS AND EMERGENCY DEPARTMENT VISITS**
Ahmad Chughtai '20

<u>Poster #</u>	<u>Title</u>
70.	IMPROVING INTIMATE PARTNER VIOLENCE SCREENING AMONG FEMALE CAREGIVERS AT CONNECTICUT CHILDREN'S. Jennifer Durocher '19
71.	ESTABLISHING THE ROLE OF QUASI-DYNAMIC BALANCE IN CONCUSSION RECOVERY Anna Hackett '20
72.	IMPLEMENTING UNIVERSAL HIV SCREENING IN ADOLESCENTS: A QUALITY IMPROVEMENT PROJECT Avery Hayes '19
73.	AN EVALUTATION OF A FIREARM SAFETY INTERVENTION IN THE PEDIATRIC SURGERY CLINIC Kristina Kurker '20
74.	IMPACT OF AN ANTIMICROBIAL STEWARDSHIP PROGRAM ON PRESCRIPTION USE OF ANTI-INFECTIVES IN AN ACUTE CARE SETTING Angela Magardino '19
75.	STIGMA OF CHRONIC PAIN AMONG ADOLESCENTS AT SCHOOL Tulsi Sumukadas '20
76.	DIFFERENCES IN CORTICAL FRONTAL ALPHA ASYMMETRY BETWEEN HEALTHY AND ANXIOUS PATIENTS Pamela Ulloa-Franco '19
77.	A NEW CASE OF CONGENITAL LAMBERT-EATON-LIKE MYASTHENIC SYNDROME IN A CHILD Michael Zarra '19

NEUROSCIENCE

78.	ELECTROENCEPHALOGRAM AS A DIAGNOSTIC TOOL IN AQUIRED BRAIN INJURY Michael Zarra '19
79.	METHODS OF VIDEO EDITING IN THE STUDY OF SPEECH Anna Barnes '19, Lauren Barret '19, Francesca De La Cruz '19 Hunter Moore '21, Rachel Fox '21, Edson Zandamela '20
80.	PSYCHOMETRIC PROPERTIES OF THE MONTREAL COGNITIVE ASSESSMENT ACROSS PEDIATRIC SETTINGS Lori Berger MA'19

<u>Poster #</u>	<u>Title</u>
81.	NEUROLOGICAL DISCREPANCIES BETWEEN BIPOLAR DISORDER, SCHIZOPHRENIA, AND SCHIZOAFFECTIVE DISORDER Nat Bush '19
82.	MEASURING EFFECTS OF ACCULTURATION ON DIFFERENT FORMS OF MEMORY IN SPANISH SPEAKERS Laura Cadavid '19
83.	MANIPULATION OF CONSCIOUS AWARENESS USING CONTINUOUS FLASH SUPPRESSION AND VIRTUAL REALITY Patricia Gaitan '19
84.	DEVELOPMENT OF AN INTRAHIPPOCAMPAL KINDLING MODEL OF EPILEPSY Carter Jones '19
85.	INVESTIGATING THE EXISTENCE OF A PLASTICITY SYNDROME IN <i>HELISOMA</i> SNAILS AND A POTENTIAL LINK TO NEURAL COMPLEXITY Peyton Orloff '22
86.	NEUROPSYCHOLOGICAL FUNCTIONING IN SURVIVORS OF DOMESTIC VIOLENCE Chloe Ouchida '21, Olivia DeJoie '18, Anna Lee '20
87.	COGNITIVE REHABILITATION OF PROSPECTIVE MEMORY DEFICITS AFTER ACQUIRED BRAIN INJURY: COGNITIVE, BEHAVIORAL, AND PHYSIOLOGICAL MEASURES Meaghan Race MA '19, Gianna Barbadillo '21, Olivia White '20
88.	PSYCHOMETRIC PROPERTIES OF THE MEMORY FOR INTENTIONS SCREENING TEST (MIST)-SHORT FORM Meaghan Race MA '19, Kathryn Marsden '21, Olivia White '20, Dorothy Anika '22
89.	THE ROLE OF EMPATHY, CLINICAL TRAITS, AND EYE GAZE IN CONTAGIOUS YAWNING AND ITCHING Rachel Scheub '20, Taylor Sorenson '17, Anna Kate Luddy '20, Megan Durkin '20, Sierra Little-Gill '22
90.	EFFECT OF INFLAMMATION INDUCED BY COMPLETE FREUND'S ADJUVANT (CFA) ON COMPULSIVE BURYING BEHAVIOR IN C57BI/6 MICE Allison J. Wells '22, Suzanne N. Carpe '22
91.	DATA VISUALIZATION ANIMATION DEPICTING THE GROWTH OF SOCIAL MEDIA PLATFORMS OVER TIME Zach Yung '22

Poster #

Title

PSYCHOLOGY

92. **UNDERSTANDING SPOKEN WORDS: CAN ORAJEL AFFECT SPEECH INTELLIGIBILITY?**
Lauren Barrett '19, Anna Barnes '19, Hunter Moore '21, Edson Zandamela '20, Rachel Fox '21, and Franchesca De La Cruz '19
93. **MEANING-IMBUED ONSETS YIELD INCREASED EFFICIENCY IN PERFORMANCE-CONTINGENT REWARD TASK, BUT ONLY LATER IN TIME**
Devin Butler '19
94. **RELATIONS AMONG CULTURAL METACOGNITION, FUSION TEAMWORK, AND TEAM CREAIVITY**
Isabella Chen '19
95. **FOREIGN LANGUAGE LEARNERS' USE OF METACOGNITIVE STRATEGIES IN READING COMPREHENSION TASKS: EFFECTS OF SPANISH PROFICIENCY AND TASK LANGUAGE**
Olivia Curreri '19
96. **HOW FILMMAKERS HIJACK OUR EYES: THE EFFECT OF AVERAGE SHOT LENGTH (ASL) ON ATTENTIONAL SYNCHRONY**
Erin Gannon '19
97. **PRESCRIPTION STIMULANT MISUSE IN COLLEGE GRADUATES**
Megan McCarthy '19
98. **PARENTING SYLE AND CHILD TEMPERAMENT ARE ASSOCIATED WITH DISTINCT TYPES OF CHILD BEHAVIOR PROBLEMS.**
Phuong (Kelly) Nguyen '19
99. **THE RELATIONSHIP BETWEEN PARENTING STYLES AND CHILD ANXIETY WITH AGE AND GENDER AS MODERATING VARIABLES**
Sarah Vimini '19

BIOLOGY

1.

REGENERATION OF NEW *PEARL* EYE MUTANT COLONY OF BEETLES

Archana Adhikari '22, Joli A. Smith '22

Faculty Sponsors: Terri A. Williams, Alice M. Vossbrinck

In order to investigate the control mechanism of segmentation in arthropods, we create transgenic beetles in the lab. We attach a fluorescent marker to our gene of interest and inject the eggs of the beetles. We use *pearl* eye mutant beetles to inject the gene. The *pearl* mutant beetles are important because these beetles lack eye pigment and thus we know the gene has been properly inserted since we can observe the color of a different fluorescent marker through the eye. Unfortunately, we have recently found some black eyed wild type beetles in the colonies of *pearl* eyed beetles. The *pearl* eyed trait is autosomal recessive character (Thomas, 1934), therefore the wild type black eye is dominant over *pearl* in hybrid offspring. It is important to keep *pearl* beetles in pure colonies because we want an all white eyed colonies so that we can select beetles out of that without screening them, and also when we conduct egg lays, we need to be sure that they are true breeding. In the genetic study that established the *pearl* eye was an autosomal recessive mutation, it was found that *pearl* eyed beetles may have a survival disadvantage compared to their black eyed counterparts. In the genetic crosses the ratio of *pearl* eye mutant was less than expected, which indicates a negative impact of the mutation in beetle. There is a risk of losing *pearl* mutant mixed in the same colony with wild type.

Therefore, to create a pure colony of *pearl* eye beetles, we regenerated the colony by first sorting out pupae from our mutant colony. We then sexed pupae under the dissecting microscope and placed males and females in separate flour jars so that they will remain virgin. Once they become adults, we observed their eye color then combined *pearl* eye males and females in a new jar and discarded ones with black eyes. In separating them, we were able to start a true breeding *pearl* eye colony, whose eggs now can be used for injection.

Reference:

Park, T. (1934). Observations on the General Biology of the Flour Beetle, *Tribolium Confusum*. *The Quarterly Review of Biology*, 9(1), 36-54. Retrieved from <http://www.jstor.org/stable/2808486>

2.

MAPPING POSSIBLE ENHANCER REGIONS OF *CAUDAL* GENE IN *TRIBOLIUM CASTANEUM* TO STUDY ITS INTERACTIONS WITH OTHER GENES BELONGING TO THE SEGMENTATION CLOCK

Daniel S. Bauloye '20

Faculty Sponsors: Alice M. Vossbrinck, Terri A. Williams, Benjamin Goldman-Huertas, Dr. Lisa M. Nagy

Most arthropods form their segments sequentially and they recently have been found to use a segmentation clock, a network of genes controlling an oscillating pattern of expression, analogous to that known in vertebrates. It is known that *Caudal* (*cad*) regulates the oscillations by both activating and modulating *even-skipped* (*eve*) expression, which in turn initiates the

clock (Choe et al. 2006, El-Sherif et al. 2014). Even though the *wingless* (*wnt*) signaling pathway is a regulator of *cad* expression (Choe et al. 2006), there is limited knowledge on how *cad* is regulated overall. Regulators of segmentation are significant in our understanding of the underlying mechanisms surrounding segmentation and in its evolutionary role and history in organisms from arthropods to vertebrates. Here, we investigate how the segmentation clock is regulated in *Tribolium castaneum* (*Tc*) by mapping predicted *Tc-cad* enhancer regions inside the first intron of the gene. We link this region to a reporter *via* Gateway cloning to discover its potential role in *cad* regulation. used PCR to attach attB sites to carry forward Gateway Cloning. Then, we inserted it into an expression clone containing the synthetic promoter mCherry by conducting the Gateway BP and LR Clonase reactions. We have verified with a restriction enzyme digest that we have inserted successfully our region and we are sending both of them for DNA Sanger sequencing to see if our region of interest was added accurately. If we obtain positive results from the sequencing we will be able to start injecting expression clones in *Tribolium* pupae to create a transgenic line containing our region of interest. If our 3kb *cad* piece is an enhancer region, we can use it in binding assays to find other elements that regulate the segmentation clock, such as transcription factors that bind to the enhancer. In addition, we can attempt to explain the variability in periodicity of the segmentation clock between its early and later segmentation stages (Nakamoto et al. 2015) and the short-germ segmentation which applies to *Tribolium* and the majority of arthropods (Choe et al. 2006).

3.

PREDATORS SELECT FOR HIGHER LEVELS OF BRAIN CELL PROLIFERATION IN TRINIDADIAN KILLIFISH, *RIVULUS HARTII*

Joshua Corbo '19

Faculty Sponsor: Kent Dunlap

Brain cell proliferation is an important form of brain plasticity that has been sparsely studied in natural populations. Killifish, *Rivulus hartii*, from the freshwater streams of Trinidad are a remarkable organism for understanding how brain plasticity is influenced by both internal and environmental factors. Through extensive ecological studies in the region, Trinidadian killifish have been used to determine how predation directly effects brain cell proliferation and brain size. In wild populations, waterfalls in the streams block predator movements upstream, thereby creating distinct populations of killifish – i.e., killifish living with abundant predators (high predators, HP) and killifish living with no predators (*Rivulus*-only, RO). In the present study, fish were caught in HP and RO locations from three replicate streams at a total of six populations. In a common garden study, the F1 population from the same RO and HP streams were reared in captivity under the same living conditions. Immunocytochemistry for proliferating cell nuclear antigen (PCNA) was performed on brains from both wild and common garden killifish to quantify the amount of cell proliferation in the forebrain and midbrain. In the wild, killifish from HP streams had significantly more cell proliferation throughout the brain indicating that predator presence enhances cell proliferation non-specifically. In captivity, fish derived from HP streams also had increased cell proliferation, showing that the population differences in the wild are likely due to intrinsic, evolved genetic differences among populations. This combined study suggests that predation has caused brain cell dynamics in RO and HP killifish to differ genetically, since the results from the common garden experiment paralleled the findings from the field study.

4.

ENVIRONMENTAL-DEPENDENCE OF INDIVIDUAL BEHAVIORAL PLASTICITY ACROSS POPULATIONS

Marta Drausnik '22

Faculty Sponsor: Benjamin Toscano

Both populations and individuals within populations may differ in behavioral plasticity, or the behavioral response to environmental change. This study will test whether behavioral plasticity, measured both across and within populations, depends on environmental context. We will sample six independent Connecticut populations of the snail *Helisoma Anceps* from habitats that differ in hydrological and predator regime variability. Three populations will be collected from permanent environments, such as lakes, streams or ponds, which are characterized by a relatively diverse and stable predator regime and a stable hydrological regime, whereas other three collected populations inhabit ephemeral environments, like vernal pools or ephemeral streams, that are identified by a less diverse and unstable predator regime and a hydrological regime which includes shifts between wet and dry phases. Individual snails will be assayed for both their responsiveness to predation risk (boldness plasticity) and responsiveness to a novel environment (exploration plasticity). These assays will be repeated over several weeks on individual snails to test for persistence of individual behavioral plasticity. We hypothesize that snails from permanent environments will be more responsive to predators, while the snails from the ephemeral environment will show higher exploration plasticity. Such results would establish a link between behavioral plasticity and environmental variability.

5.

A MORPHOLOGICAL INVESTIGATION OF FOUR MESOPHOTIC ADDITIONS OF RHODOPHYTA TO THE FLORA OF BERMUDA

Madalyn A. Farrar '19

Faculty Sponsors: Craig W. Schneider, Gary W. Saunders, Centre for Environmental & Molecular Algal Research, University of New Brunswick

Four species are added to the mesophotic zone benthic marine algal flora of the Bermuda islands: *Contarinia* sp. 1Bda, *Gloiocladia pelicana*, *Halarachnion louisianense* and *Halopeltis* cf. *willisii*. The deepwater collections were made by technical divers and submersibles. The four species were compared morphologically and anatomically with protologue descriptions and we present our results here. Molecular *rbcL* sequence data was compared with molecular records from North Carolina and the Gulf of Mexico in BOLD and GenBank to determine relatedness. *Halopeltis willisii* was presently known only in North Carolina and others are known from the sister warm temperate zone of the Gulf of Mexico. *Contarinia* sp. 1Bda has previously unrecorded morphological differences from *C. magdae* and *C. peyssonneliiformis*, the two species presently know in the Western Atlantic Ocean.

6.

EXPRESSION OF MTOR AND TRIB3 IN OLIGODENDROCYTE CELLS

Katie Lazur '20, Fumika Ando '21

Faculty Sponsor: Hebe Guardiola-Diaz

Oligodendrocytes are a type of glial cell located in the central nervous system that are responsible for producing the myelin sheath which allows for faster neuronal firing rates. Myelin production is a very metabolically expensive process, which requires the oligodendrocytes to be aware of how many nutrients are available to them. Previously, it has been demonstrated that the mammalian target of rapamycin (mTOR) is required for the later stages of maturation in oligodendrocytes. However, when mTOR is inhibited by rapamycin in the early stages of oligodendrocyte development, the oligodendrocytes are still able to fully differentiate. We recently demonstrated that mTOR is present at all stages of the OL lineage, with no significant difference at any of the stages. The goal of this research is to analyze the expression levels of the genes mTOR and Trib3 as oligodendrocytes age from progenitors to mature cells and as they are starved of leucine. Tribbles Homolog 3 (*Trib3*) is a pseudo kinase that has impaired catalytic activity. In previous research, *trib3* has been shown to be upregulated by cellular stress and serves as an important regulator of cell death, stress responses, cell differentiation and many other processes. Oligodendrocytes were cultured and the RNA was isolated at various stages of development. qPCR analysis was used to determine the expression of mTOR and Trib3 at days 0, 1, and 4 of development. For some samples, a starvation period of 2 hours was conducted before harvesting RNA to have samples that were deprived of leucine. The results indicate that as cells age both mTOR and Trib3 are upregulated and as cells were starved, there was a similar upregulation in both genes.

7.

SPECIALIZATIONS FOR YOLK PROCESSING IN REPTILES

Luisa Lestz '19, Madeline Barnes '20, Farahana Appiah '21

Faculty Sponsor: Daniel Blackburn

Microscope techniques have allowed us to visualize and better understand the methods by which various reptile species process yolk in the egg and provide nutrients to the developing embryo. Using scanning electron microscopy (SEM), light microscopy, and stereomicroscopy we examined yolk tissue at various developmental stages and noticed a pattern in yolk cellularization and the vascularization. In early stages, the yolk consists of free yolk spheres with few nutrient-rich, endodermal cells. As development continues, the endodermal cells proliferate, taking up large yolk spheres through phagocytosis and digesting them into smaller droplets within the cell. In late stage eggs, the yolk-filled endodermal cells proliferate around a network of blood vessels, forming “spaghetti strands”. These strands provide an efficient means to transport nutrients from the yolk to the growing reptile embryo. This unique pattern of yolk transport and uptake was discovered in several snake species, the lizard species *Sceloporus undulatus*, and the turtle species *Chelydra serpentina* and *Trachemys scripta*. Evidence from these varied reptile groups indicate that this feature of yolk processing is ancestral for reptiles. We are presently examining alligator egg samples to determine if they follow this pattern of yolk processing

8.

NUTRIENT SENSING BY THE MECHANISTIC TARGET OF RAPAMYCIN

Sameir Madden '19

Faculty Sponsor: Hebe Guardiola-Diaz

In the central nervous system, oligodendrocytes produce the myelin sheath, which allows for saltatory conduction of action potentials, leading to faster communication between neurons. Oligodendrocytes become myelin-producing cells only after transitioning through well-defined physiological and biochemical stages of development that make up the oligodendrocyte lineage. A recent study has shown that oligodendrocytes are unable to transition from the immature to the mature stage of development when the mechanistic target of rapamycin is inhibited. In an attempt to better understand the role of mTOR in oligodendrocyte development, this study investigates mTOR's ability to mediate cell growth by serving as a nutrient sensor. Leucine was chosen to study mTOR activation in the presence of amino acids due to its ability to phosphorylate mTOR in other cellular systems. Oligodendrocytes were cultured from neonatal rat pups and tested at day 4 after the onset of differentiation. Cells were stimulated with leucine with or without mTOR inhibitors and compared to control groups. Results were analyzed via western blotting. The preliminary results of this experiment do not provide any strong evidence that mTOR serves as a nutrient sensor in cultured oligodendrocytes. However, Graphical trends may indicate the presence of a leucine dependent upregulation of mTOR activity compared to control groups.

9.

DETERMINING THE ROLE OF CDT1 GENE IN THE ENVIRONMENTAL RESPONSE OF ARABIDOPSIS

Chloe Michalopoulos '19, Chatham Eldredge '19

Faculty Sponsor: Susan Bush

Much of a plant's ability to respond to and survive in different environments comes from its genetic makeup. *CDT1* is a gene that is found in many plants including the model plant *Arabidopsis*. In *Arabidopsis* plants, the function of the gene is unknown, but it is suspected to play a role in the response to environmental conditions given that a different version of the gene has been shown to be involved in aluminum tolerance in other species. In an attempt to find the function of this gene, wild-type and *cdt1* mutant *Arabidopsis* seedlings were grown on agar plates under light. In three separate experiments, seedlings were transferred to agar plates of varying pH, cadmium concentration, or aluminum concentration. Growth of wild-type and mutant seedlings within each variable was compared. Data from these experiments suggests that there is no difference between how the different *cdt1* mutants respond under pH variance or aluminum treatment in comparison to the wild-type genotype in the same conditions. Under cadmium treatment, differences were seen between the treatments, and how the genotypes responded to these treatments. Future work in this area will contribute to the knowledge of the plant genome and help scientists better understand the role of the CDT1 gene in environmental response. Understanding more about CDT1's response to environmental stressors could play a role in developing genetically modified plants that are optimized for specific growth conditions.

10.

AMINO ACID FUNCTIONS IN THE JUXTAMEMBRANE REGION OF THE TRANSMEMBRANE SERRATE LIGAND AND THEIR EFFECTS ON SUBCELLULAR LOCALIZATION OF SERRATE PROTEIN

Duuluu Naranbat '19

Faculty Sponsor: Robert J. Fleming

The Notch signaling pathway is a highly conserved cell-to-cell signaling system that is present in eukaryotic animals. This pathway plays a significant role during animal development. The Notch gene codes for a protein that functions as a receptor belonging to the single-pass transmembrane protein group. The Notch receptors can interact with ligands that are also single-pass transmembrane proteins of the Delta/Serrate/Lag-2 (DSL) family of ligands. The regulation of the Notch signaling pathway can be controlled through different types of interactions with ligands such as trans-activation and cis-inhibition. The trans-activation interaction occurs when the receptor and ligand proteins, present in neighboring cells, interact. Ligand-receptor interactions can also take place within the cell and on the cell surface, and the cis-interactions can reduce or inhibit the ability of a cell to receive an activating signal from neighboring cells. In activation of the Notch, ligands are trafficked through endocytosis and are often regulated by ubiquitin ligase. While it was found that Serrate, a ligand for Notch, is relevant for Notch activity, the importance of the specific localization of Serrate is much less well defined. We postulate that in order to successfully activate Notch, Serrate must be located on the cell surface, however, our data suggest that there may be other properties beyond Serrate localization on cell surface that dictate the activation of Notch. To test this, we analyzed the different locations of Serrate in cells expressing specific constructs, previously made in Fleming laboratory, with different amino acid lengths in the Juxtamembrane domain, a key component in the structure of Serrate for successful activation.

11.

A MOLECULAR ASSISTED ALPHA TAXONOMIC (MAAT) STUDY OF WESTERN ATLANTIC SOLIERIACEAE (GIGARTINALES)

Elias Peterson '19

Faculty Sponsor: Craig W. Schneider

This project involves the description of three novel species of red algae within the family Solieriaceae, one in the recently described genus *Eucheumatopsis* and two in *Meristotheca*. Using the chloroplast *rbcL* gene as a marker, as well as morphological characteristics, a novel red algal species found on the Florida coast of the Gulf of Mexico, *Eucheumatopsis sanibelensis* sp. nov., is shown to be distinct from *Eucheumatopsis isiformis* with a type locality in the eastern Caribbean Sea. Also using the chloroplast *rbcL* gene and morphological characteristics, a red algal species previously identified as *Meristotheca gelidium* in Bermuda is shown to be a novel species, *Meristotheca odontoloma* sp. nov. Another red algal species, collected at 60 m in the mesophotic zone off Bermuda, is shown via morphological differences and the chloroplast *rbcL* gene to be a novel species, *Meristotheca muriamans* sp. nov. The only previous collection of this species in Bermuda was identified as *Agardhiella ramosissima*.

12.

THE CONCENTRATION OF MERCURY IN THE BIOTA OF AN URBAN POND

Hazel Robertson '19

Faculty Sponsor: Amber L. Pitt

The accumulation of trace metals such as mercury within ecosystems is a major environmental and public health concern. The mercury concentration in the biota of an urban pond in Hartford, CT was evaluated. Tissue samples from Coontail plants (*Ceratophyllum demersum*) and Bluegill fish (*Lepomis macrochirus*) were collected and analyzed for mercury concentration. Mean mercury concentration (\pm SD) in plants was 0.044 (\pm 0.003) ppm (n = 54). Mean mercury concentration (\pm SD) of sampled Bluegill was 0.199 (\pm 0.054) ppm (n = 7). Mean mercury concentration (\pm SE) of fish ($x = 0.199 \pm 0.05$ ppm) was significantly greater than that of plants ($x = 0.044 \pm 0.003$ ppm, $t = 25.895$, $df = 59$, $p = 2.2e-16$). The results of this study indicate that both plants and fish uptake and accumulate mercury. Moreover, mercury concentrations magnify through the food web, as upper trophic level organisms (Bluegill) possessed greater mercury concentrations than lower trophic level organisms (Coontail plants). There was less accumulation and magnification of mercury in the urban pond than was observed in lakes and streams in other studies, indicating that the characteristics of an urban pond environment influence mercury availability.

13.

THE TOLL 10 GENE'S INVOLVEMENT IN CELLULAR MOVEMENTS DURING EARLY AND LATE SEGMENTATION OF *TRIBOLIUM CASTANEUM*

Kathryn A. Russell '22

Faculty Sponsors: Terri A. Williams, Lisa Nagy, UArizona

Cell movements are known to play a significant role in the embryo elongation of the red flour beetle *Tribolium castaneum* during abdominal segmentation. In *Drosophila*, Toll receptors have a demonstrated role in convergent extension, a method of elongation by which rows of cells merge together by intercalation, extending the tissue. In *Drosophila*, Toll receptors are a link between pair-rule genes which are expressed in discrete stripes and the actual effector molecules causing the cell movements. A recent study demonstrated a role for Toll receptors, specifically Toll 10, in *T. castaneum*, however the intercalary behavior of cells in *T. castaneum* is less orderly than in *Drosophila*, which may reflect a difference in underlying mechanisms. It is known that there are differential amounts of cell movement in early versus late *T. castaneum* segmentation, but it is not clear how cell movement is affected by the differential expression of Toll 10 during these times. A section of the Toll 10 gene was isolated and copied using PCR, and then, using a Strataclone Cloning Kit, the isolated section of the Toll 10 gene was ligated into pSC-A plasmids and transformed into *E. coli* bacterial cells for storage. Sanger sequencing results confirmed that the correct insert size had been taken up by the bacteria. This insert will be used to make double-stranded RNA, which will be used for knockdown of the Toll 10 gene. Live imaging of knockdowns will allow us to observe the Toll 10 gene's effect on elongation and cell intercalation during early and late segmentation when compared to wild type *T. castaneum*. This will allow us to investigate the role of Toll receptors in intercalation during elongation in *T. castaneum* and compare how that varies during early *versus* late elongation.

14.

CLONING *ODD-SKIPPED* IN *TRIBOLIUM CASTANEUM*

Jeffrey Sagun '21

Faculty Sponsors: Terri A. Williams, Alice Vossbrinck

Some of the most diverse taxa on earth are segmented. The regulation of segmentation has been actively studied in the red flour beetle *Tribolium castaneum*, but cell behaviors producing elongation as segments develop are not well known. Elongation in *T. castaneum* is discontinuous in early versus late embryo elongation and elongates progressively, which differs with the model system *Drosophila*. The pair-rule gene *odd-skipped* is a segmental patterning gene that forms part of the segmentation clock in *T. castaneum*. Pair-rule genes are known to be upstream of effector molecules that drive germband elongation in *Drosophila*. It is unclear on how the processes that cause elongation versus those that cause segment patterning are linked in *T. castaneum*. Here, we will use RNA interference (RNAi) to uncover candidate downstream effector molecules targeted by *odd-skipped* to investigate how *T. castaneum* embryos elongate. By amplifying *odd-skipped* from *T. castaneum* DNA through polymerase chain reaction, we cloned the *odd-skipped* gene to be used for RNAi. In future work, we will knock down *odd-skipped* activity in *T. castaneum* embryos by injecting double-stranded RNA into the embryos. We will then compare transcriptomes between wild-type and RNAi knockdowns of the *Tc-odd* mutants at two different time points to identify candidate effector molecules involved in cell movements and further investigate the gene network that controls tissue elongation.

15.

SOCIAL BUFFERING OF THE BRAIN CELL PROLIFERATION RESPONSE TO TAIL INJURY IN WEAKLY ELECTRIC FISH, *APTERONOTUS LEPTORHYNCHUS*

Margarita Vergara '19, Joshua Corbo '19

Faculty Sponsor: Kent Dunlap

Social interactions can mitigate the damaging effects of threatening stimuli, a phenomenon termed 'social buffering'. In two different forms of social buffering, social interactions reduce stress-induced decreases in brain cell proliferation and enhance recovery from somatic injury. However, the positive effects of social interactions on the brain cell proliferation response to somatic injury have not been extensively examined. Here, I investigated the social buffering of the brain cell proliferation response to tail injury in weakly electric fish, *Apteronotus leptorhynchus*. I asked two major questions: 1) Does social interaction mitigate the decrease in brain cell proliferation caused by simulated predatory tail injury? 2) Does the timing of social interaction relative to injury alter this social buffering response? I mimicked predatory injury through experimental tail amputation, exposed fish to paired interactions that varied in timing, duration, and recovery period, and measured cell proliferation (PCNA+ cell density) in the forebrain and midbrain. In experiment 1, focal fish were either isolated (n= 7) or paired (n= 6) for 4 d prior to tail amputation and were allowed short-term recovery (1 d). In experiment 2, we examined the effect of social interaction during only the pre-amputation or both the pre- and post-amputation phases. Focal fish were isolated for 4 d before being exposed to one of three different social contexts: a) pre-amputation social pairing (n= 8), b) pre- and post-amputation social pairing (n= 5), and c) tail amputation and isolation (n= 5). In experiment 3, we examined the effect of social interaction during only the post-amputation phase. Focal fish were isolated for 4 d before being exposed to one of three different social contexts: a) tail amputation and social pairing (n= 10), b) tail amputation and isolation (n= 7), and c) social pairing only (n= 7).

In both experiments 2 & 3, tail amputation was followed by long-term recovery (7 d). Social interaction either before or after tail amputation mitigated the negative effects of tail injury on brain cell proliferation. This buffering effect occurred after short-term (1 d) or long-term (7 d) recovery following amputation. In all experiments, social buffering was specific to the forebrain and did not occur in the midbrain. However, social interaction both before (4 d) and after (7 d) tail amputation produced an even greater buffering effect in both the forebrain and midbrain.

16.

ITERATIVE TRIAL LIGATION OF CONSTRUCTS IN THE SERRATE JUXTAMEMBRANE REGION OF THE NOTCH SIGNALING PATHWAY

Junyao Yuan '21, Zimo Huang '21

Faculty Sponsor: Robert J. Fleming

The Notch signaling system is a conserved cell communication pathway that plays significant roles in the development of most of vertebrates. The Fleming lab has identified a 65-amino acid long juxtamembrane segment that is essential for Serrate to activate the Notch receptor. In order to find out more about the unique functionality of this 65-amino acid sequence, we have been trying to shorten the segment and assay the ability of the modified Serrate construct to activate Notch. DNA ligation is an important technique required to generate the modified Serrate forms. The Fleming lab has been experiencing severe difficulties when attempting ligations designed to make the Serrate constructs. Since the ligation technique has failed to produce viable constructs, we have been performing extensive control experiments to determine the underlying cause of this problem. Because there is no substitution for the ligation technique, the lab is still applying maximum attention to increase ligation productivity.

CHEMISTRY

17.

SYNTHESIS AND CHARACTERIZATION OF AN OPTICAL STIFFNESS SENSOR

HuaYue Ai '21

Faculty Sponsor: Lindsey Hanson

Metal nanoparticles have unique optical properties due to their interaction with visible light, and these optical properties are tunable by changing their size, shape or refractive index of its surroundings. These properties, along with the small size, make nanoparticles good candidates for sensors that can detect a change in the stiffness of their surroundings and report it as an optical signal. In this work, we investigated gold nanorods (AuNRs) as candidates for optical stiffness sensors. AuNRs were synthesized using CTAB and NaOL as capping ligands and were then surrounded by a shell of soft, thermoresponsive pNIPAm (poly (N-isopropylacrylamide)) based hydrogel. Different cross-linking ratios (5:1, 10:1, and 20:1) were used during polymerization of the hydrogel. Upon heating the beads, a shift of the AuNR plasmon peak was observed due to the increase in refractive index of the collapsed hydrogel. Matrices were fabricated by embedding beads in a larger polyacrylamide (PA) gel. Concentration of bisacrylamide was varied in order to change the stiffness of the outer PA gel. The data was collected and analyzed using MATLAB. Future research will focus on synthesis of matrix substrates with different beads and development of a mathematical model, which will infer the stiffness of surroundings from the amount of shift in the spectrum.

18.

MEASUREMENT OF KINETICS AND SPECIFICITY OF PEPTIDE SUBSTRATE REPORTERS FOR PROTEIN KINASE B FROM *DICTYOSTELIUM DISCOIDEUM*

RJ Chadha '20, Sababa Anber '20, Misha Mehra '21, Kunwei Yang '17

Faculty Sponsor: Michelle L. Kovarik

Protein kinase B (PKB) is a signaling protein that is highly conserved across eukaryotes and responsible for processes such as motility and stress response. Several peptide substrate reporters have been developed to measure the activity of PKB in mammalian cells. Our goal is to determine whether reporters developed in mammalian cells are adaptable to evolutionarily distant species. *Dictyostelium discoideum* is a social amoeba and commonly-used model organism that is evolutionarily distant from human cells. Upon starvation, *D. discoideum* cells aggregate into a multicellular form by chemotaxis toward cAMP. The binding of cAMP activates phosphoinositide 3-kinase (PI3K) followed by PKB. Our previous work showed that reporter stability is similar in human and *D. discoideum* cells. Currently, we are evaluating the kinetics and specificity of three reporters for PKB from *D. discoideum*. First, we are comparing the kinetics of phosphorylation by human or *D. discoideum* PKB *in vitro*. Seven concentrations (2-50 μM) of the peptides were prepared with enzyme. For human cells, results followed Michaelis-Menten kinetics with K_M values of ~ 20 μM for VI-B, ~ 30 μM for AP-I and ~ 10 μM for Crosstide. We are currently obtaining more precise values for human enzyme and beginning to study the *Dictyostelium* version of the enzyme. Second, we are determining the specificity of the three reporters for PKB in *D. discoideum* lysates. In a physiological test, we found that phosphorylation activity peaked 15-45 s after stimulation with cAMP, as expected for PKB. In a pharmacological test, the cells were treated with cAMP and the PI3K inhibitor LY294002. Phosphorylation was highest for with cAMP stimulation and decreased substantially but not completely with LY294002 treatment. Finally, we are pursuing immunoprecipitation experiments to further check the specificity of the substrates for this enzyme.

19.

UTILIZING FLUORESCENT INDICATOR DYES TO EXAMINE REACTIVE OXYGEN SPECIES IN *D. DISCOIDEUM*

Jason S. Deck '21

Faculty Sponsor: Michelle L. Kovarik

Reactive oxygen species (ROS) are produced as byproducts of aerobic respiration, in which oxygen is used to convert glucose to ATP. ROS can be used to investigate the responses that an individual organism has to a stimulus, therefore, we can determine trends in heterogeneity within a population. Using rotenone, a mitochondrial inhibitor, we cause an accumulation of ROS in healthy *D. discoideum* cells. By varying the rotenone dose, we should be able to see a correlation between the mitochondrial function of the cells and the amount of ROS they produce as a result of stress. To test this hypothesis, 8,000,000 cells were incubated in 0, 2, 10, and 100 μM of rotenone to elicit ROS production. These cells were then treated, in several experiments, with a constant concentration of dyes: 2,3-Bis-(2-Methoxy-4-Nitro-5-Sulfophenyl)-2H-Tetrazolium-5-Carboxanilide (XTT), Rhodamine 123, or 2',7'-dichlorodihydrofluorescein diacetate (DCFH₂-DA). XTT, which measures mitochondrial function, resulted in absorbance values of 0.081 ± 0.005 rfu, 0.063 ± 0.012 rfu, 0.048 ± 0.033 rfu, 0.205 ± 0.046 rfu, showing that mitochondrial function was diminished as the concentration of rotenone increased. Rhodamine 123 was used to investigate the membrane potential of mitochondria; it was found that as the rotenone concentration increased, Rhodamine 123 accumulation in mitochondria increased (1985.7 ± 1600

rfu, 2849.9 ± 2500 rfu, 5704.2 ± 2700 rfu, 6241.7 ± 2000 rfu). In the DCFH₂-DA trials, no trend was found in the fluorescence of this dye, and further investigation is needed. We plan to use these results to better analyze the heterogeneous, individual, responses that a population *D. discoideum* provides when subject to a stimulus.

20.

SYNTHESIS AND CONFORMATIONAL EVALUATION OF β -SHEET MODELS

Uyen T Doan '21, Paul Handali '18

Faculty Sponsors: Timothy P Curran, Joanne L Stewart, Department of Chemistry, Hope College, Holland, MI

The use of organometallic compounds in modeling protein secondary structures could be useful in gathering information about how the three-dimensional shapes of proteins influence their biological properties. In exploring the conformational behavior of peptides, if a metal-based model system for β -sheets were developed, the metal could be used as a spectroscopic probe for assessing the biological site of action. Previous studies in the Curran laboratory have discovered that a cyclic tungsten bis-alkyne complex (complex 1) adopts one robust, air stable conformation in solution. This complex holds the two alkyne ligands parallel to each other and separated by a distance of approximately 3.5 Angstroms – the same distance separating the two peptide chains in a β -sheet. We have proposed this organometallic ferrocene-tungsten ring system will place the two peptides linked to the two alkyne sites in close-enough proximity to adopt a β -sheet structure via formation of intramolecular hydrogen bonds. To test this hypothesis, peptide derivatives of 1 (complexes 3 and 4) have been synthesized and analyzed as β -sheet models. In 3, the peptide linked to the bimetallic ring system is mono-glycine, while in 4 the peptides are di-glycine. DFT calculations have been done on 3, and the results show that the peptides do adopt a β -sheet conformation. This poster will detail the preparation of these complexes, and information about their conformational behavior obtained using ¹H NMR spectroscopy, mass spectrometry, and X-ray crystallography to confirm the DFT calculation results.

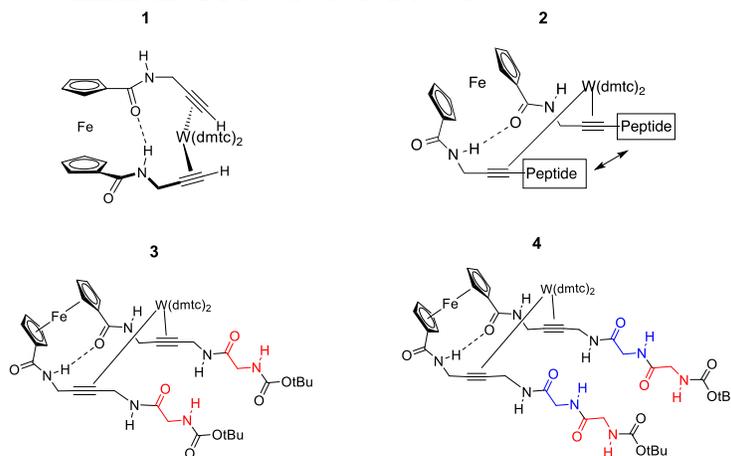


Figure 1. Three complexes studied in this research project.

21.

STUDY OF THE ROLE OF TELOPEPTIDES IN THE BINDING OF OSTEOCALCIN TO TYPE I COLLAGEN

Audrey Ettinger '20

Faculty Sponsor: Richard Prigodich

Bones have long strands of collagen fibers separated by gap regions that contain hydroxyapatite crystals. The fibers are composed of helical tropocollagen molecules. At the ends of the tropocollagen molecules, there are short non-helical telopeptides that protrude into the gap region. Osteocalcin is a protein found in bone that binds tightly to calcium ions in the crystalline hydroxyapatite. In the crystal structure of osteocalcin alpha-helices with many acidic residues are what bind to hydroxyapatite. However, there is a structurally undefined, free, and unstable N-terminus. Previous research in the Prigodich Lab found that collagen is bound to osteocalcin on this N-terminus, but it is still unknown where osteocalcin binds on the collagen protein. Because of their presence in the gap region, the telopeptides on collagen were tested for their binding to osteocalcin. The goal was to remove telopeptides on bovine type 1 collagen, and observe if osteocalcin still bound to atelocollagen. Bovine telocollagen and bovine atelocollagen were purified using dialysis with ammonium bicarbonate buffer and freeze dried at low temperatures and low pressure. Atelocollagen was tested for its binding properties with osteocalcin using spectrometry at 280nm, after adding a collagen pellet, vortexing, centrifuging, and extracting the supernatant. Ultimately the spectrometry results indicated no binding between the two proteins because of a steady absorbance, suggesting that telopeptides will be necessary on the collagen for binding osteocalcin. Telocollagen will next be tested in the same way for its binding to osteocalcin, and compared to literature and the atelocollagen binding.

22.

OPTIMAL LIPID COATING FOR SEPARATING PEPTIDE SUBSTRATES FOR PROTEIN KINASE B USING MICROCHIPS

Jonathan Fan '22

Faculty Sponsor: Michelle L. Kovarik

The fluorescently labeled peptide substrate reporter VI-B is designed to measure the activity of protein kinase B. Previous study has shown the effect of different loading methods of peptide substrate reporter into *Dictyostelium discoideum*, but the optimal conditions for measuring protein kinase B activity using the reporter in this unicellular organism are poorly understood. This work examines the effect of supported bilayer membrane (SBM) coatings on the separation of the peptide substrate reporter VI-B from its phosphorylated form, p-VI-B. The SBMs can either be neutral, positively charged, or negatively charged, and the direction and the magnitude of electroosmotic mobility can be tailored in a predictable manner by controlling the lipid composition of the SBMs. To determine the optimal lipid coating composition, microchannels coated with SBMs are used to separate VI-B and p-VI-B electrophoretically. To construct the microchannels, the cured PDMS was irreversibly sealed to a cover glass using plasma oxidation, and silicon tubing reservoirs were also plasma sealed to the device. The microchannels were filled with small unilamellar vesicles, which spontaneously fused to form SBMs. During the experiment, flow through each of the channels was controlled with an electrode, which applied voltage during gated injections and separations. Solutions of unmodified VI-B (1 μ M) and p-VI-B (1 μ M) were loaded into the channel to examine the effect of SBM coating on the electrokinetic mobility of each peptide. The combination of 50% 1-palmitoyl-2-oleoyl-*sn*-glycero-3-

ethylphosphocholine (positively charged) and 50% phosphatidylcholine (zwitterionic) molar ratio lipids enabled both the unmodified VI-B and the p-VI-B to migrate toward the detector in anodic electroosmotic flow. Future work includes the separation of potential fragments of VI-B that may form inside the *Dictyostelium discoideum* cells using microchips and the examination of the effect of pH on the separation. In long term, the optimized separation conditions in this work will be used to do single-cell analysis of *Dictyostelium discoideum*.

23.

MEASUREMENT OF MTOR ACTIVITY USING A CUSTOM-MADE PEPTIDE SUBSTRATE REPORTER

Daniel Feldman '21, Grigori Kalminskii, Sameir Madden '19
Faculty Sponsors: Hebe Guardiola-Diaz, Michelle L. Kovarik

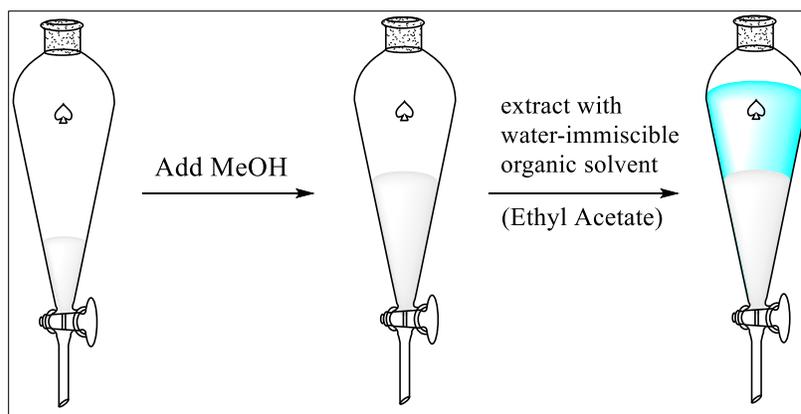
mTOR, known as the mechanistic target of rapamycin, is a serine/threonine kinase that forms two complexes, mTORC 1 and mTORC 2. These complexes are involved in regulating anabolic processes, such as cellular growth and proliferation, and conserved catabolic processes, such as autophagy. The goal of this project is to measure the activity of mTOR using a custom peptide substrate reporter. A peptide substrate reporter is a fluorescently labeled peptide sequence, 3-20 amino acids in length, that can be acted upon a certain enzyme of interest. The reporter sequence, 6FAM-WYYAGSPHNY, was formulated using a proteomic data set indicating conserved amino acid residues near the phosphorylation sites of native mTOR substrates. We optimized the capillary electrophoresis buffer to separate fluorescent fragments of the unmodified reporter to distinguish the phosphorylated peak from the fluorescent fragment peaks. The ability to resolve all fluorescent fragments of the reporter is important for *in vivo* experiments, where peptidases could cleave the reporter into its fluorescent fragments. Additionally, the active 1362-end kinase domain of the mTOR enzyme was obtained from Millipore Sigma, and we confirmed mTOR activity toward the peptide substrate reporter using capillary electrophoresis. Future experiments using custom-made mTOR peptide substrate reporter will study mTOR activity in transfected cells which have been manipulated to enhance mTOR protein expression.

24.

LIQUID-LIQUID EXTRACTIONS OF CARBON ACIDS

Claire Grigglesstone '21
Faculty Sponsor: Cheyenne Brindle

The removal of carbon acids from organic mixtures is challenging due to the low polarity of the C-H bond. Thermodynamically the process of removing the hydrogen is favored, but kinetically the process is very slow. Comparatively, the removal of a hydrogen from an O-H bond is kinetically fast and thermodynamically favored due



to the greater polarity of the bond. The greater partial charges present in O-H bonds allows for easy liquid-liquid extractions of carboxylic acids and phenols. In the case of amines, they pick up a hydrogen to become a positively charged molecule. These molecules can be removed through a routine method using acid-base reactions to alter their solubility, enabling them to enter the aqueous layer. Recently, the extraction of aldehydes and ketones has been achieved in our group by using a water-miscible solvent to increase the contact between the aldehyde or ketone and the base. This enables the aldehyde or ketone to overcome the kinetic barriers it faces and enter the aqueous layer. However, there are no easy ways to perform a liquid-liquid extraction on a molecule such as diethylmalonate, which has a pKa of 12.9. This research aims to provide a recoverable way to remove molecules such as this one. The key component is the addition of methanol, which is a water-miscible solvent. Methanol will mix with the aqueous layer and aid in increasing the interacting between the carbon acid and base, allowing the carbon acid to overcome kinetic barriers it and enable it to enter into the aqueous layer. To determine if methanol increased removal, two trials were conducted. In both cases, a control substrate, p-anisaldehyde, and carbon acid were added in equivalent molar amounts. The control substrate remains in the organic layer, thus allowing for the percent removal of the carbon acid to be calculated from ¹H NMR data using integration values. The first trial was conducted without the addition of methanol and the second was conducted with the addition of methanol. Results have shown that diketones are easily extractable without the addition of methanol due to enol tautomerization. Work has been conducted on synthesizing substrates with appropriate pKa's for testing including diethylmethylmalonate and 1-phenylindene. Thus far, those of appropriate pKa have proven to be successfully extracted. Further testing will aim to provide conclusive results and potentially determine a specific pKa range that can be extracted. During testing, a surprising result of ester hydrolysis occurred between benzoyl butyrate, the initial control substrate, and methanol. This resulted in a change in the control substance. Investigations will be conducted on the ester hydrolysis in the future.

25.

SOLID PHASE PEPTIDE SYNTHESIS FOR MAKING LARGER β -SHEET PEPTIDES

Anna Maria Imwalle '20

Faculty Sponsor: Timothy P. Curran

The Curran lab focuses on developing a model system for studying β -sheets using organometallic chemistry in order to study their behavior. One long term goal of this research is to study the effects of amyloid proteins, which are any misfolded proteins that are mostly β -sheets (i.e. Amyloid B – the protein involved in the progression of Parkinson's Disease). In order to efficiently and quickly synthesize peptides for these studies, solid phase peptide synthesis (SPPS) will be used as a synthesis method. In particular, we will use the Merrifield method for SPPS which results in high yields of pure product in a timely manner. The Merrifield method consists of first attaching an amino acid to a solid support polymer, protecting the basic amino terminal with a protecting group (preventing a reaction with itself), coupling of additional amino acids, and lastly removed from the solid polymer support for analysis.

As of now, the effectiveness of the Merrifield method is being studied by synthesizing a short peptide strand and analyzing the reaction yield and product purity. So far a high yield and excellent purity for the target peptide have been obtained. The next step in this work is to use the SPPS method to that adopt β -sheet structures.

26.

TRITYL CATALYZED SYNTHESIS OF BISINDOLYLMETHANES FROM IMINES

Vanessa Jones '19

Faculty Sponsor: Cheyenne Brindle

The use of multiple single addition reactions to produce a single large product is an important technique for building molecular complexity. We large products called bisindolylmethanes from the sequential addition of two different indoles to an imine, using triarylmethyl cation catalysis. This requires the synthesis of imines from aldehydes. The imines are produced by adding different types of aldehydes to paranitroaniline. The solids produced from this reaction were then recrystallized to purify. Nuclear magnetic resonance was used to confirm the purity of the resulting imines. These imines can then be used to create single addition products. The conditions of these reactions must be optimized to produce the highest percentage of single addition product. Both temperature and concentration of solvent are altered. Once these conditions are optimized they can be used to conduct a one-pot two-step synthesis for bisindolylmethanes. Current work on this project has included characterization of the products produced. Some single addition products and bisindolylmethanes must be remade.

27.

DETECTION AND DISCRIMINATION OF COUNTERFEIT PHARMACEUTICALS USING DIRECT ANALYSIS IN REAL TIME—TIME OF FLIGHT MASS SPECTROMETRY WITH MULTIVARIATE STATISTICAL ANALYSIS

Jacqueline Kromash '19

Faculty Sponsor: Janet Morrison

Counterfeit pharmaceuticals are increasing in both popularity and availability, with internet sellers offering low prices, fast delivery, and discreet purchasing of medications without the need for a doctor's prescription. In addition to significant revenue losses for pharmaceutical companies, these drug 'fakes' pose dangerous health risks to consumers, since their composition is varied and unregulated. Sildenafil citrate, a prescription medication used to treat erectile dysfunction, is one of the most commonly counterfeited drugs worldwide. This study employs direct analysis in real time—time of flight mass spectrometry (DART-TOFMS) combined with multivariate statistical analysis for the determination of sildenafil citrate tablet authenticity, and evaluates the potential of this methodology for distinguishing illicit manufacturing source.

The rapid ambient ionization associated with DART, combined with the inherent high mass accuracy of TOFMS, suggest the suitability of this technique for high throughput screening of pharmaceutical authenticity by eliminating the need for sample preparation and chromatographic separation. In this study, mass spectra were obtained on authentic sildenafil citrate tablets and 85 pills obtained in ten separate counterfeit drug seizures. The DART-TOFMS chemical signature data were processed using multivariate statistical methods including Support Vector Machine (SVM) analysis. Mass spectra for a blind sample set of unknown tablets were obtained and classified into groups using this method. This study poses a potential method for identification of manufacturing source of counterfeit pharmaceuticals.

28.

BISINDOLYLMETHANE SYNTHESIS VIA TRITYL CATION CATALYSIS

Kelly Lucas '20

Faculty Sponsor: Cheyenne Brindle

Trityl cations are organocatalysts that can be used in the synthesis of complex products. These catalysts serve as Lewis acids and are electrophile activators that increase an electrophile's reactivity toward a desired nucleophile. Due to the tunable nature of trityl cations, it is possible to tune their reactivity by alternating their aryl substituents. This allows for variability in stability of the cation and its reactivity toward a desired substrate. We create the complex products of non-symmetrical bisindolymethanes from the addition of two different indoles to an imine with the aid of a trityl cation, crystal violet. In order to start this reaction, an imine with a desired "R" group must first be synthesized from an aldehyde and p-nitroaniline. Following this reaction, the product obtained is recrystallized for further purity. Once this purity is confirmed via HNMR, the imine can then be used in the synthesis of the bisindolymethane. To synthesize this product, an indole is added to the imine to create a single addition intermediate. It is possible to then add a different second indole to create the non-symmetrical bisindolymethane in a "one-pot, two step synthesis" fashion. Future work on this project will focus on synthesizing and increasing the scope of possible non-symmetrical bisindolymethanes.

29.

SELECTIVE DETECTION OF SUPEROXIDE ANION: SYNTHESIS OF A NOVEL FLUORESCENT PROBE

Olesya Martynova '20

Faculty Sponsors: Cheyenne Brindle, Michelle L. Kovarik

Superoxide anion has been linked to various pathological diseases, such as malignant tumors and coronary disease. Detection of the superoxide radical in living cells in real time via fluorescence spectroscopy can help in prevention of these illnesses. However, superoxide is not fluorescent, so an indicator probe must be synthesized to react with the radical to make it detectable. Current work toward the synthesis of the fluorescent probe DBZTC (2-chloro-1,3-dibenzothiazolincyclohex-ene) is being optimized to allow for an efficient route to this molecular probe. The optimization involves improving the purity of the intermediates and enhancing the yield. The first step of the synthesis is the production of (E)-2-Chloro-3-(hydroxymethylene)cyclohexene-1-carboxaldehyde using a version of the Vilsmeier-Haack reaction. The structure and purity of this intermediate has been confirmed with ¹H NMR and GCMS. The second step of the synthesis involving the formation of an N,S-acetal to form the complete superoxide probe structure is currently underway.

30.

SPECIFICITY OF PEPTIDE SUBSTRATE REPORTERS FOR PROTEIN KINASE B FROM *DICTYOSTELIUM DISCOIDEUM*

Misha Mehra '20

Faculty Sponsor: Michelle L. Kovarik, Funding by the NSF award #1615482

Cell signaling pathways are complex networks that involve many different molecules, feedback loops, and redundancies. These complexities are difficult to disentangle, but high efficiency

capillary separations are a useful tool in meeting this challenge. We are using micellar electrokinetic chromatography (MEKC) to investigate the specificity of three peptide substrate reporters (VI-B, AP-I or Crosstide) and conclude which is most specific for protein kinase B (PKB) in the social amoeba, *Dictyostelium discoideum*. When *D. discoideum* cells are starved, they produce cAMP, which results in aggregation of the amoebae via the PI3K-PKB signaling pathway. The activity of PKB can be measured using peptide substrate reporters, which are fluorescently-labeled 8-15 amino acid sequences. We hypothesized that the addition of cAMP would increase phosphorylation of reporters specific to PKB and the addition of LY294002, a PI3K inhibitor, would reduce phosphorylation of reporters specific to PKB. Optimized MEKC conditions were used to separate the unmodified peptide substrate reporters from enzymatic products, including the phosphorylated reporters. The VI-B peptide was separated in 15 mM borate and 100 mM SDS at pH 11.4, while AP-I and Crosstide separations used 100 mM borate, 100 mM SDS at pH 7.7. As expected the (+cAMP –LY294002) treatment had highest phosphorylation. Crosstide and AP-I had higher percent phosphorylation than VI-B. To further assess specificity, we are comparing phosphorylation of the reporters at two points in social development. PKB has two isoforms – PKBA (expressed early in social development) and PKBR-1 (expressed later in social development). PKBA is PI3K-dependent, while PKBR-1 is not, making PKBA more susceptible to LY294002 than PKBR-1. Further work is being done to compare the two social development times.

31.

ANALYSIS OF THE STRUCTURE AND SYNTHESIS OF (-)-LEUCONOXINE

Jay Moran '19, Vanessa Jones '19

Faculty Sponsor: Cheyenne Brindle

Leuconoxine is a common biologically active monoterpene indole alkaloid found in several *Apocynaceae* species. Magnus Pfaffenbach and Tanja Gaich in 2015 published the total synthesis of (-)-Leuconoxine through a photoinduced cyclization cascade. The macrocyclization/transannular cyclization process produces three of the four rings of the diaz[5.5.6.6]fenestrane skeleton in one single operation. This operation is unprecedented and provides more insight into the synthesis of Leuconoxine. Several key steps in the mechanism are discussed to show how the total synthesis was completed. An analysis of the final product involved ^1H and ^{13}C spectroscopy (NMR) to understand the molecular structure.

32.

ANALYZING THE CONFORMATION OF AN AMINO ACID DERIVATIVE OF 1,4-DIAMINO-2-BUTYNE WHEN COORDINATED TO TUNGSTEN IN A BIS-ALKYNE COMPLEX

Maxwell Ogbiji '22

Faculty Sponsor: Timothy P. Curran

When isolated from their native protein, peptides adopt multiple conformations. It has been well observed that peptides play an important role in the discovery of new drugs to treat diseases like Alzheimer's disease and HIV infection. The three-dimensional shape of a peptide is related to its biological activity. Therefore, the aim of this experiment is to discover ways to hold flexible peptides to only one solution conformation. To accomplish this, alkynylpeptides will be prepared, and then constrained by coordination of tungsten to the alkyne moiety. In the case of

this experiment, the organometallic-peptide complex that would be formed would be a bis(alkyne) complex. The target molecule was prepared starting from 1,4-dichloro-2-butyne. The two chlorines were converted to amines by reaction with NH_3 , and the resulting diamine was acylated with Boc-Ala-Osu. The prepared alkynylpeptide was purified using flash chromatography and its structure was confirmed using ^1H NMR spectroscopy and mass spectrometry. It was observed that the compound adopted a C_2 -symmetric turn conformation having two intramolecular hydrogen bonds, as had been reported earlier. The alkynylpeptide was reacted with $\text{W}(\text{CO})_3(\text{dmtc})_2$ in order to form the tungsten bis-alkyne complex. The mass spectrum of the crude product indicated that the desired complex had been formed, but the ^1H NMR spectrum showed impurities. Efforts to purify the target molecule are underway. Further work is required to determine if the alkynylpeptide derivative will retain its turn conformation when coordinated with tungsten.

33.

ANALYSIS OF OPPOLZER'S SYNTHESIS OF (R)-(-)-MUSCONE

Claire Pritchard '20

Faculty Sponsor: Cheyenne Brindle

Wolfgang Oppolzer and Rumen N. Radinov published a total synthesis of (R)-(-)-muscone in 1993 using catalyst-directed 1-alkenyl/aldehyde addition to create a macrocycle. An analysis of the mechanisms involved in this synthesis, and the ^1H and ^{13}C spectroscopy used to validate the structure of a key intermediate and enantiopure ligand are presented.

34.

OPTIMIZING THE REMOVAL OF ALDEHYDES FROM MIXTURES USING SODIUM BISULFITE

Hanna Vescovi '21, Amodini Katoch '22

Faculty Sponsor: Cheyenne Brindle

Sodium bisulfite reacts with aldehydes to create a charged adduct, allowing the aldehyde to be removed from mixtures in liquid-liquid extractions. The effectiveness of sodium bisulfite at removing aldehyde contaminants in various mixtures decreased with a change in the source of the bisulfite. Various adjustments to solutions of sodium bisulfite were made in order to optimize the percent removal of aldehyde contaminants. Two hypotheses were examined: 1) aging causes the release of sulfur dioxide and a concomitant change in pH and 2) the equilibrium of metabisulfite with bisulfite causes different batches to behave differently. Hypothesis 1) was tested by examining the effect of the pH of sodium bisulfite solutions on the removal rate of a model aldehyde. Hypothesis 2) was tested by varying the polarity levels to impact the solubility of metabisulfite and by evaluating the effect of water. The results showed that neither of the two hypotheses were responsible for the discrepancy between the previously examined sample of bisulfite. However, it was observed that the removal rate was sensitive to pH and that the polarity and water content had a marked effect on the physical properties of the process.

COMPUTER SCIENCE

35.

WITAM: SENIOR PROJECT ABSTRACT

Brian Cieplicki '19

Faculty Sponsor: Ewa Syta

Loneliness among senior citizens in the United States affects approximately 8 million seniors and is known to play a major role in the development of depression for many. English as a Second Language (ESL) learners, who have extremely high levels of understanding and proficiency, struggle to reach a point of flawless communication in English. They have difficulty finding high quality help in improving their language ability. Witam is an Android application that will serve to help each of these groups of people by addressing the aforementioned issues simultaneously. Witam will connect senior citizens and advanced ESL learners to facilitate the establishment of communication between members of these two groups. Their conversations will help resolve the issue of loneliness by providing seniors with meaningful social interaction, and will provide a means by which ESL learners can easily access conversation with lifelong native English speaker to perfect their language ability.

36.

THE EARLY NOTES APP

Elijah Sian Hernandez '19

Faculty Sponsor: Madalene Spezialetti

Early Notes is a childhood education application focused on engaging families in beginning their child's education before school. Musical exposure at a young age has proven to expand early childhood brain development. Early brain development is a crucial factor in academic success, especially in an education system made for certain children to fail. Due to this, my senior project will be to make a free early childhood development Android application that will foster essential life skills through the wonders of music. Early Notes will allow toddlers to participate and complete a sequence of original and imaginative lessons that will demonstrate the basic foundations of music theory. The expectation for this application is that it will support and promote the fun and creativity education has to offer while giving communities an equal chance at receiving a beneficial start to their education.

37.

CHAT-WITH-A-BOT

Jin Pyo Jeon '19

Faculty Sponsor: Chris Armen

Since the early days of artificial intelligence, developing a bot that can hold a human-like communication have been and still remains to be one of the frontiers of artificial intelligence. However, due to the difficulty of generating and understanding human voice, the medium for the communication have primarily been restricted to a text-based communication. Recent advances in speech-to-text transcription (and vice versa) now allows for real-time voice communication between a chatbot and a human. This project aims to explores that possibility by developing a

chatbot that can communicate through the medium of voice. Utilizing technologies and techniques such as natural language processing, pattern matching and text-to-speech generation, this project allows the users to call a phone number to speak to a chatbot.

38.

PLECTR - ON DEMAND TUTORING

Andrew Lewis '19

Faculty Sponsor: Takunari Miyazaki

Tutoring aids are made available to college students on campus through services like domain-specific tutoring rooms or teaching assistants in labs and classes. This system is limited and has much room for improvement with regards to the scheduling and availability of tutors beyond such environments. As it stands, tutors are either bound physically to certain locations in order to be found by students or are only available during class periods. Within these limitations, I find that there is the potential for tutors to have a wider reach of students and likewise for students to have better access to tutors. As an Android application, Plectr aims to be the platform that enables these potentials by creating a real-time network of tutors. Plectr grants students access to this campus tutoring network and allows for on-demand tutoring sessions, live availability and scheduling. Within the Plectr network, text data is attained from student's reviews on tutors and is used to rank tutors according to domain specific categories extracted from these reviews. Natural language processing is implemented in order to achieve these features, as well as mobile GPS location services and geo-querying. To complete this project, I implemented word tokenization and classification using the Python spacy NLP module. Sentiment is extracted by a monkeyLearn sentiment classification API, and localization functionality was built using the Google maps API and Firebase geo-fire. Plectr combined these features and technologies to establish a trusted platform for connecting students and tutors on campus in much more efficient system.

39.

BIOKIT: AN APPLICATION FOR ANALYZING GENE EXPRESSION DATA

Christopher LoBianco '19

Faculty Sponsor: Christopher Armen

The emerging field of bioinformatics combines DNA, RNA, and protein data sets from molecular biology with processing and analytical tools from computer science and statistics. These tools are widely available, but many biology faculty and students lack the computer science domain knowledge to fully utilize these databases, algorithms, and statistical techniques. This project, BioKit, overcomes this obstacle by packaging key tools for gene expression data analysis inside an easy to navigate interface. A Java based desktop application, this project utilizes R code modules sourced from BioConductor, an open source repository of bioinformatics tools and algorithms. These modules allow a user to upload a file and (i) normalize, (ii) statistically cluster, and (iii) visualize the results of gene expression experiments. By encapsulating the technical implementation of these modules inside a clean user interface, this application allows Trinity College faculty and students to more efficiently analyze and process experimental data while giving them access to tools they previously had poor technical familiarity with.

40.

E-VENTORY: ONLINE INVENTORY SYSTEM FOR TECHNOLOGY IN PUBLIC SCHOOLS

Selina Ortiz '19

Faculty Sponsor: Madalene Spezialetti

E-ventory is a web-based inventory system that is designed to store a virtual inventory of laptops for a public-school. Using an online database, the inventory will hold detailed entries containing descriptive information of the school's laptops. E-ventory's system is made up of two components, a website and a mobile companion Android application. The website interface will be used to view, edit, and maintain the inventory and its barcode scanner application scans barcode tags on the laptops to identify misplaced laptops. The aim of this system is to ease the burden of maintaining an inventory of electronic devices for administrations in public schools who are already doing other tasks. This system is to serve as a free, efficient service that is specifically tailored to the necessities and functions of a public-school.

41.

QUANTITATIVE FINANCE PLATFORM

Samuel I. Oyebefun '19

Faculty Sponsor: Chris Armen

Most records and observations nowadays are captured electronically by devices connected to the internet. This, in principle, allows investors to access a broad range of market relevant data in real time. Given the amount of data that is available, a skilled quantitative investor can nowadays in theory have near real time macro or company specific data not available from traditional data sources. Analysis of large datasets is often done with the use of statistical libraries to design quantitative strategies. QFP provides an analysis solution that allows users to research, develop and analyze trading strategies by providing users with immediate access to a ready-built research and testing environment. QFP will allow investors to develop better strategies for individual companies and entire industries faster and more efficiently than their competition, therefore increasing returns.

42.

MENU SYSTEM USING DOMAIN DRIVEN DESIGN THEORY

Yifan Peng '19

Faculty Sponsor: Ewa Syta

This project is about a menu system with an app and a related website which are mainly designed for restaurants and wait staff.

The menu app is designed to provide a specific sorting function on the meals of the menu, including food type and caloric value. The app can be used to view the menu and make orders to improve customer experience and provide more information on menu items. It will have a search bar at the top for finding specific meals that meet the requirements. It will also have a list of meals below the search bar for the user to view each meal. The user can tap on each meal to take a look at the description of that meal. This app is only available on Android platform. It is mainly designed using Android Studio.

The website is designed to complement the menu app and will provide some extra features. The restaurant can upload the menu to the website and add detailed information to each meal of the menu. Since both the app and the website are using the same database, every change on the website will be reflected on the app. The website will collect information, so it will provide extra features. It will have a side bar for the user to choose to view the menu and the order history. Based on the order history, it can help the user to count out profit within certain time range. It can also export those data out for the restaurant to support its own managing system.

43.

COMPRESSION USING MASSIVELY PARALLEL PROCESSORS

James Rodiger '19

Faculty Sponsor: Takunari Miyazaki

Compression is ordinarily done by one or two threads running on an average CPU containing two to four cores. This is time consuming as only a small amount of data can be processed at a single time, by running this same operation on a GPU which consists of many thousands of cores running in parallel, the amount of data which can be processed at once is far greater and therefore the time needed to compress large files can be reduced. The DEFLATE compression algorithm is used in the popular tools Gzip and png. By porting the DEFLATE algorithm to OpenCL and licensing it as open source this version of DEFLATE could be used to speed up Gzip when compressing certain large files. Many industries could benefit from this especially ones which involve large data storage where quick storage and retrieval of data is necessary.

44.

'ROBIN FOOD' - AN APP THAT CONNECTS FOOD DONORS TO VOLUNTEERS

Simran Sheth '19

Faculty Sponsor: Ewa Syta

23% of India's population (~270 million people) is below the poverty line of \$1.25 a day. On the other hand, due to the lack of storage facilities, tropical temperatures and religious restrictions, restaurants, social gatherings and households throw away extra food instead of storing it overnight. This Senior Project impacts the community we live in and helps people who cannot afford that help. The *Robin Food* android app connects restaurants, households, parties or family gatherings to volunteers (either individual or part of NGOs). This app is based on an honor system, where users share the same ideology of helping those who need food the most. Both donors and volunteers sign food safety disclaimers to ensure secure donation and transportation of food. Donors offer tasks consisting of contact information, details about the food they are donating – quantity, storage requirements and their location details. Volunteers see a list of all available donations and the distance from their current location. They have the ability to choose the one they want. Once a donation task is chosen, the volunteer is given more information about the donor, such as contact details and then is led to a map which shows directions from the current location to the donors location. Finding people who are in need of the food is not hard, most areas have homeless people living on the sidewalks. This benefits the needy as they now can get access to food without needing to own a smartphone that has an active internet connection. This project can also be extended to directly helping orphanages, assisted living homes, and homeless shelters. This application encourages donors to help the people who need the help and donate food instead of throwing it away.

45.

TRINITY COLLEGE CAMPUS NAVIGATION APPLICATION

Tess Starr '19

Faculty Sponsor: Ewa Syta

The Trinity College Campus Navigation Application is a mobile tool for people to gain information about campus. Despite its small size, Trinity's campus can be hard to navigate, and it is challenging to find out detailed information about locations on campus. The goal of this application is to give people on this campus, including students, faculty, and staff, as much information as possible about campus to aid them in their day to day life. On top of that, this application provides anyone visiting with information about campus prior to their visitation. It includes information regarding all locations on campus, along with faculty members and their office location. It includes a search tool which enables users to quickly and easily find the location or faculty member they're looking for. Walking directions can be shown in order to guide a user to any location on campus. This application has the potential to be a valuable resource for both people here at Trinity and interested incoming students to explore campus from afar.

46.

P.A.T. – THE PORTABLE ARTISTIC TUTOR

Clear Tavarez '19

Faculty Sponsor: Madelene Spezialetti

This iOS application is an educational interactive tutorial geared towards budding artists with little-to-no background in visual arts. It will lend a helping hand as a useful artistic resource. Through it, users can learn basic color theory and human anatomy through a series of levels. These levels prompt them to grasp and understand the concept before advancing. Even when the students have gone through all the levels, they will be able to go back and replay levels as well as reread the instructions originally given to them. The final objective of this app is to allow its users to have a foundational background in visual arts as well as begin creating art and becoming artists themselves. After using the app, users should feel some sort of independence in their ability to create art and will hopefully pursue further education in the visual arts. They should also know the primary, secondary, and tertiary colors as well as about color tone, hue, and shade. Furthermore, they will have some knowledge on color compliments and how to draw a human figure.

47.

BANTAMBOT

Ha Tran '19

Faculty Sponsor: Chris Armen

The project aims at creating a chatbot named BantamBot, a software program that can chat with prospective students in a simple, understandable, helpful and friendly way on texting platforms to provide them with the most up-to-date answers to general questions about the admission process of Trinity College. BantamBot is expected to have a number of features that can engage prospective students in using the program to learn about the admission process. BantamBot's personality is knowledgeable, dependable, and friendly. It will be pre-trained to handle many

questions with different styles in a human-like, short and simple approach. It may ask students clarifying questions or encourage them to ask questions. It can ask and answer questions with emojis. The answers can be messages, forms and documents, links to Trinity websites, or multiple choices on which students can click to proceed. The questions that BantamBot can answer are restricted to the admission domain, i.e, application forms and materials, application fee, deadlines, essays and standardized tests, and so on. BantamBot is going to make the Trinity admission process more simple and fun for both students and Trinity counselors.

48.

INCREASE PRODUCTIVITY RATE WITH THE POMODORO TECHNIQUE

Binh Vo '19

Faculty Sponsor: Takunari Miyazaki

We live in an age where patterns of procrastination are pervasive in our society. It would not be common to say that we don't get interrupted by notifications while concentrating. As the pace of modern life increases, people start to feel anxious and stressed out. Common procrastination behavior makes people seek out time management solution to increase their productivity rate. One of the most effective methods is the Pomodoro Technique, created by Francesco Cirillo.

The project is aimed to build an app that implements the Pomodoro Technique in a two semesters development cycle. The app will be built on Android with the goal to satisfy users through the stages of planning, visualizing, tracking and recording. Designs and features/components of the app will be implemented in XML and Java in Android Studio. Open Libraries such as MPAndroidChart and JSoup use for graph plotting and parsing website's data. Backend service will be provided by Google Cloud-Based API Firebase to handle user's authentication and app's data.

Plan-t a Pomodoro is an app that builds off the Pomodoro method's philosophy. The objective is to achieve more with less, but also move through tasks quickly and consistently. The reduced complexity lets users focus solely on their efforts in their activities.

49.

TRISTY MOBILE APP

Genxing Zhan '19

Faculty Sponsor: Ewa Syta

Striving to be a residential college that currently houses over 90 percent of matriculated students in college-owned and -operated housing, Trinity requires all these students to be enrolled in meal plans. However, most of the students are disappointed with the dining services on campus. Though the school is starting to pay close attention to students' feelings, for now, they don't have an efficient way to collect all the feedback. There's no such platform for the voices of students to be heard and for the school to know how to fit the students' needs. My solution is to create an Android mobile app called Tristy which publishes ratings and reviews of all dishes on Trinity campus. It's portable and user-friendly. Authorized Trinity users can view everyday menus on the app. Users will be able to rate, write reviews and post pictures under each dish. For the authorized Chartwells staff members, the Tristy app will generate a report of top 3 most popular dishes and top 3 least popular dishes. They can analyze and study the data based on the report and furthermore, improve the dining services.

ENGINEERING

50.

WEARABLE TELECOMMUNICATION SENSOR EMBEDDED GLOVE

Alison Adamski '19, Yesenia Garcia Balbuena '19, Stacy Lam '19

Faculty Sponsor: Lin Cheng

Wearable technology is quickly becoming the next big consumer interest, with important applications to benefit everyday life. Such devices aim to combine user convenience and advanced technology to offer new and innovative solutions to complex and unique challenges. The inspiration for this project came from the idea of having ease of hand movements instead of pressing buttons on a remote control. Immediate applications exist, like a sign language sensor-embedded glove that is able to translate hand motions into text and voice. Using similar logic and intention, this project consists of a tactile glove that records hand movements with sensors, and translates that motion into commands for a secondary device. In the scope of this yearlong project, the secondary device is a robotic car. This can be of use to combat ready soldiers on the field who depend on rapid decision-making and benefit from “hands-free” applications. This wearable technology will eliminate the risk of soldiers being disarmed in order to operate a secondary device, such as a drone or unmanned vehicle. The system places a focus on communication - that is, the ability to communicate with the device at different ranges.

In order to achieve the design and execution of a smart, wearable, and portable telecommunication sensor-embedded glove, five flex sensors, an Inertial Measurement Unit (IMU), two Radio Frequency (RF) chips, two Arduinos (one Uno, one Mega 2560), a piezoelectric sensor, and a robotic car assembled by the team were needed. After analysis of ideal parts and design of the glove and band were completed, the system was assembled and optimized to record hand movements with the glove via the flex sensors and the IMU, with a locking mechanism initiated by the piezoelectric sensor to limit false recordings. It sends the data from the glove to the robotic car via the RF chips, and processes the data into car movement commands to have the car respond according to the set commands. This system is designed to be an action/reaction device that requires expertise in both hardware and software systems to implement.

There are three general main accomplishments of the project: the glove can detect and classify real-time hand movements from the user, it analyzes the hand movements based on the developed software algorithms, and it is able to communicate a resulting action to a secondary device which processes the data accordingly.

Following completion of the assembly and software design, the system responds as intended, in real time. With four main commands and four IMU directionals, each unique movement corresponds to a direction (forward, right, left, backwards, backwards right, backwards left) that the car moves in. With clear line of sight, the response time is in real time, with minor delays within a cluttered environment. The system still functions outside, with an increased loss of data packets received, resulting in a slight lag time. Maximum range is about 50 meters (165 feet), indoors, with clear line of sight. The system fulfills the intended design and range of communication was improved with antenna and software.

Although there has been existing work done on sensor embedded gloves, this project offers a unique application that includes a telecommunication component which requires signal transmission from one device to another. With the success of data communication and processing determined in the structure of the designed software, the application of this system may be extended to control other secondary devices in the future, rendering the possibilities endless.

51.

INVESTIGATING THE VEHICLE-TO-VEHICLE WIRELESS PROPAGATION CHANNEL

Marios Bourtzonis '22

Faculty Sponsor: Lin Cheng

Wireless propagation channels are a largely untapped field of engineering that can innovate and improve modern-day society. Especially when it comes to vehicle-to-vehicle propagation channels, there is still a lot of research to be done to accurately model and predict the behavior and characteristics of these channels. Because on-field data collection is rigorous and requires extensive time, equipment, resources, and is very costly, accurate simulated data is valuable to understand real-world environments. Simulated environments can imitate real-world scenarios in urban, suburban, and rural areas. Using parameters provided by the simulated environment, we can use different models to predict the physical characteristics of communication channels, such as changes in power and frequency received. More specifically, we explored the power delay profile using different scenarios and parameters, such as in the case of urban, suburban, and rural areas. Comparing these results to real-world measurements will assist in validating the models and deeming them effective to describe the physical nature of wireless propagation channels, opening the doors to a variety of potential applications to scientists. The power delay profile plots the power received on a multi-path channel as a function of time delay. Physical models were implemented on the simulation environment to calculate the delay profiles given a communication pair. These profiles will be compared to real-world collected data to evaluate the accuracy of the model. If the model can be verified, it will allow scientists to continue making breakthroughs and improving their understanding of wireless propagation channels, which can assist with traffic control, road accident prevention, and various other on-road applications that will benefit society.

52.

TELELOCOMOTION: MAKING ROBOTS WALK

Digesh Chitrakar '22, Isabella Yung '22

Faculty Sponsor: Kevin Huang

Robotic proxies have the potential to replace human first responders in emergency situations, and thus save lives. While robot technology has allowed for robust and repeatable manipulation (autonomous or teleoperated) even in dynamic environments, locomotion still presents many issues. In particular, autonomous walking is ill-suited for unpredictable, dynamically changing terrain with heavy topological variations not uncommon to emergency scenarios. Falling robots present high mission costs, as damage may occur, time will be lost, and the critical tasks may potentially be left unfulfilled rendering the mission failed. This work explores a novel architecture for robot locomotion to reduce the likelihood of mission failure: telelocomotion or human-controlled robot walking. By incorporating haptic feedback, an intelligent user interface will combine the high-level understanding and adaptability of human operators with the benefits

of machines. The proposed work will then validate performance gains through user studies comparing the developed interface with standard ones, such as keyboard, mouse and game controller, to control a simulated locomotion task while systematically varying task parameters.

53.

RECONFIGURABLE ROCK CLIMBING WALL

Zane Chitty '19

Faculty Sponsors: Joseph Palladino, Clayton Byers

The goal of this project was to design and fabricate a free-standing climbing wall with reconfigurable geometry that can be easily broken down and stored. This wall should also be able to incorporate training tools used by climbers to improve their skills. Although full climbing wall was deemed too large and unsafe for a single person group to build, a 4'x4'x2.5' model was constructed, this model has two attachable modules that create a vertical wall as well as a 15 degree angled wall. COMSOL Finite Element Analysis was used to show that the structure was safe even after applying a factor of safety.

54.

BATTERY CHARGING BICYCLE ATTACHMENT

Devon deFilippi '19, Ukuch Ligol '19, Paul Swetz '19

Faculty Sponsor: J. Harry Blaise

Working adults are turning to bicycles as an environmentally friendly and convenient way to travel as gas prices and population density in cities increase. Portable electronics such as cell phones and wireless headphones have skyrocketed in popularity over the past decade. The introduction of powerful cameras, powerful processors, HD screens, and HD speakers on a portable scale has caused people to become increasingly dependent on smartphones in particular. Battery technology has failed to improve at the same impressive rate. Since bicycle riders are not immune to the issue of dead electronics, the purpose of this project is to use a bicycle to create an affordable method of charging portable electronics all the while preserving a comfortable riding experience for the cyclist. The user will have the choice of safely charging Universal Serial Bus (USB) devices or a 9.6 volt nickel metal hydride (NiMH) battery so the user can continue to charge their devices away from the bicycle.

55.

DESIGN OF A FLYWHEEL-CONTROLLED INVERTED PENDULUM

Lucas Duros '19, Gordon Hyduke '19, Jack McInnis '19

Faculty Sponsor: Kevin Huang

An inverted pendulum is an unstable, nonlinear mechanical system which consists of a rigid pendulum with a center of mass located above its axis of rotation. This equilibrium is unstable, and any nonzero disturbance will cause it to fall due to gravity. The common control solution to the inverted pendulum problem consists of stabilization by translational motion of its base, as observed in ballbot and Segway-like devices. In contrast, this project explored an inverted pendulum control solution by means of attaching and actuating an inertial flywheel mounted to the rigid pendulum body. An input control torque applied to the flywheel by a brushed DC motor

served to counteract any destabilizing torque. In order to employ linear control tools, a third-order linear state-space approximation of the system was calculated about the equilibrium. System identification unveiled physical motor parameters that prescribed a terminal motor voltage to generate the torque control input. With this setup, a modern linear control strategy, namely linear quadratic regulation (LQR), was employed to achieve stabilization of the nonlinear system. The LQR framework regulates the system to the zero state using state-feedback while simultaneously optimizing cost functions associated with system state parameters and control input. Simulated results using MATLAB/Simulink were compared to the results of the physical system.

56.

INFUSION THERAPY DEVICE

Hanna Engstrom '19, Shannon Phillips '19

Faculty Sponsor: Clayton Byers, NASA CT Space Grant, Tendo Technologies, and Travelers

Infusion therapy is the administration of medication through either a needle or a catheter. Currently, infusion therapy is performed in hospital settings or clinics and must be constantly monitored by a nurse or doctor. A flow rate is set on a pump and if there are any kinks or leakage in the system, an alarm will sound in the pump. The pump alarms are known to be unreliable and require constant monitoring. A novel infusion therapy system is proposed that allows medications to be delivered more efficiently and at optimal comfort for the patient. It uses an all-new Elastic Filament Velocimetry (EFV) sensor to detect the flow rate and ensure accurate performance. The EFV sensor is an electrically conductive nanoscale ribbon suspended between silicon supports which deflects in the fluid flow. The system also integrates a differential pressure sensor close to the injection site to ensure optimal comfort of the patient. Since EFV technology is a new invention, initial characterization of the fluid drag of the nanoribbon was determined in order to optimally design the new device. The extremely small geometry of the nanoribbon coupled with infusion therapy flow rates ranging from 1 to 400ml/hour result in viscously dominated flow, where it was determined it would be experiencing Reynolds numbers below 1. These flow conditions were simulated in ANSYS to determine the drag over the ribbon. Next, with the now known coefficient of drag equation of the nanoribbon, a device was designed and a plot of voltage output for each flow velocity was created. These results informed the final design of the device, which was built and performed as predicted.

57.

OBJECT DETECTION FROM CAMERA TRAP IMAGES USING EIGENBACKGROUNDS

Justin Kim '19

Faculty Sponsor: Lin Cheng

In this paper, Eigenbackground method of object detection is summarized. Finding a way to model and subtract a common background from a sequence of images or video is becoming increasingly popular and important, because it is the first step in computer vision and object identification of non-static objects. The data set that this paper is based on is from Trinity College's //tbos/Projects/Smedley database, formerly a biology/ecology project concerned with compiling biodiversity data. The images from this data set were obtained through camera traps, which is a motion triggered stationary camera source. The methods outlined in this paper are generalized, and they can be applied to any sequence of images from other stationary image data sources such as traffic cameras and security cameras.

58.

ENERGETICS AND DECAY OF ISOTROPIC TURBULENCE FROM AN OSCILLATING GRID

Ike Njoroge '22, Kieran Neath '22, Ahmed Eldmerdash '20

Faculty Sponsor: Clayton Byers, National Aeronautics and Space Administration (NASA)

Subjecting stagnant liquids to the movement of an oscillating grid produces nearly isotropic, homogeneous turbulence. When isolated from outside motion, energetics and decay of said isotropic turbulence can be investigated by resolving velocity components of particles constituting the system. Modelling these particular decays provides a step forward in solving De Karman and Howarth's differential equation.

$$\frac{\partial F}{\partial t} = \frac{1}{r^4} \frac{\partial}{\partial r} \left[r^4 \left(K + 2\nu \frac{\partial F}{\partial r} \right) \right]$$

(de Karman & Howarth, 1938)

In this equation, F is a correlation of the velocity at two points in the flow field and K is a correlation of the square of velocity at one point with the velocity at another. Using this mathematical expression enables turbulence in a decaying isotropic field to be statistically described. One can consider the term on the left as the rate of change of kinetic energy in the fluid (which always decreases), while the last term on the right represents the dissipation of energy due to viscous fluid forces.

This research is conducted using oscillating grids to create homogeneous isotropic turbulence within water in a stationary tempered glass tank. Grids are fabricated using metal and are driven by a reciprocating motor able to vary torque and frequency. The velocity of the fluid is estimated by populating the flow with small particles that travel with the motion of the fluid. The velocities of particles are analyzed using two dimensional particle image velocimetry in which a high speed camera records movement of silver particles placed within the water on which laser light will be reflected. This process is carried out during turbulence decay - which takes place when the grid stops oscillating and the kinetic energy of the fluid decreases due to viscous dissipation. Results of this research will be used to form a deeper understanding of how turbulence decays and create more accurate mathematical models for it. Changing characteristics of particular grid sizing, including fractal elements in grid design and adding a second opposing grid will be variables that will be including in development of this research. Modelling and being able to describe the nature of turbulent flows can be applied to aerospace industry advancements and validations of computer simulations.

59.

ON-STREET AND OFF-STREET PARKING AVAILABILITY PREDICTION USING PARKING AVAILABILITY DATA IN A LARGE URBAN AREA

Muhammad Hassan Rashid '22

Faculty Sponsor: Lin Cheng

Parking guidance and information (PGI) systems are used for cars and infrastructure to reliably communicate with each other. However, there is great uncertainty in terms of parking availability. We study and model the parking trends for a large urban area using historical data that is collected every fifteen minutes, and take into account temporal correlations of parking availability. We analyze the parking availability data characteristics, which reveal that parking trends are seasonal, and that there are temporal correlations between parking availabilities for

each parking location. These characteristics will be used in a multivariate autoregressive model that is used to accurately predict parking availability. The data used is collected from the areas of San Francisco, provided by the San Francisco Municipal Transportation Agency.

60.

RECONFIGURABLE MOBILE PLATFORMS

Emilio Viteri '19, Joseph Orosco '19, Andrew Agard '19

Faculty Sponsor: Taikang Ning

Unmanned ground vehicles (UGVs) are used by warehouses to move millions of packages every day. The *warehouse problem* has largely been solved by mapping out warehouses and using UGVs of standardized sizes to fit under standardized carts. This makes it easy for these autonomous robots to operate at scale as more and more robots are added to the warehouse floor. One limitation to this design is that the robots are limited to carrying only objects that fit on the standardized carts. Another limitation is, the robots do not communicate amongst each other or collaborate with one another. Our project focuses on building scale models of UGVs that can operate individually but also have the capacity to lock together to create UGVs of varying dimensions with increased surface area and load bearing ability.

ENVIRONMENTAL SCIENCE

61.

TOTAL MERCURY ACCUMULATION AND DISTRIBUTION IN HARTFORD COUNTY URBAN PONDS, FOCUSING ON BEACHLAND POND IN WEST HARTFORD, CT

Shane McLaughlin '19

Faculty Sponsor: Amber L. Pitt

Ponds are ecologically important as centers for biodiversity, and those within urbanized watersheds typically have altered hydrology, morphology, and water chemistry. The accumulation of heavy metals, such as mercury (Hg), in subaqueous pond sediments has the potential to harm pond ecosystems, but the behavior of Hg in urban ponds is poorly understood. I investigated Hg accumulation in the sediments of seven urban ponds in Hartford County, based on approximately ten sediment samples per pond. Elizabeth Park Pond in West Hartford was found to have the largest mean sediment Hg concentration of the study ponds. I also investigated higher resolution spatial variability of Hg accumulation within the sediment of Beachland Park Pond, in West Hartford, Connecticut, USA. This was done by directly analyzing for Hg the fine (<63 μm) fractions of 70 sediment samples, which were collected at 14 distinct sites around the pond's perimeter, in groups of 5 individual samples. Mean Hg concentration exceeded the Threshold Effect Concentration (TEC) at four sample sites, and the Probable Effect Concentration (PEC) at a site on the northeastern shore of the pond. An analysis of variance (ANOVA) and post hoc Tukey test revealed that mean Hg concentration at this site differed significantly from all other sites. The relative lack of variability among most sample sites was to be expected due to ubiquitous atmospheric deposition of Hg, and additional Hg sources must be considered for the four sites which all exceed at least the TEC. It is possible that flooding events cause water and contaminants to flow out of the nearby Trout Brook and into Beachland Park Pond. It is more likely that the accumulation of Hg in the northeastern pond shore is a result of prevailing regional wind patterns altering the deposition pattern, but more research must be done to investigate temporal variation in Hg concentration.

62.

ESTIMATING SNOW LEOPARD (*PANTHERA UNCIA*) ABUNDANCE IN NORTHERN AREAS OF PAKISTAN

Kaelie Murray-Simmons '20, Alexandra Lao '19, Jane Provost '19

Faculty Sponsors: Amber L. Pitt, Joseph Tavano

Snow leopards (*Panthera uncia*) are challenging to monitor because of their wide home ranges and unpredictable nature. Noninvasive techniques such as camera trapping and scat DNA analysis are used to gain an understanding about their habitat. We evaluated photography from capture-mark-recapture (CMR) techniques for estimating snow leopard population abundance and density within Skoyo, Karabathang, Basingo, and Hushe, Pakistan. Camera traps were placed along trails and valleys within 5km of the villages. Between 2016-2018, we obtained a total of over 100 snow leopard photographs at varying body orientations. The scat DNA analysis identified seven individuals and R-Studio was used to determine the influence of elevation and prey species on snow leopards.

63.

DISCOVERING THE CAUSES OF INCREASED PYRRHOTITE DETERIORATION IN CONCRETE

Jordan Stephan '22

Faculty Sponsor: Jonathan Gourley

Homeowners in northeastern Connecticut are facing problems of cracking in concrete found in their basements due to the mineral pyrrhotite, an iron sulfide that starts to break down to form larger sulfate minerals. We identify pyrrhotite by using a magnetic susceptibility test combined with a total sulfur analysis (CNS). To understand under what conditions pyrrhotite breaks down, one of the factors of deterioration could be submersion in water. By leaving samples submersed in water for periods of one to four weeks, the effects of water on pyrrhotite concentration were examined. After submersion, the samples were dried and tested for sulfur concentration using the CNS analyzer. T-tests of the results showed that submersion alone did not have a significant impact on the rate of deterioration of pyrrhotite. When samples of a control from each week and the submersed concrete were compared, the sulfur concentrations for the submersed samples were similar. Although this test did not show that water alone was a cause of increased deterioration of pyrrhotite, it allowed other options to be considered as other factors that could lead to deterioration. This could include pH of water, exposure to oxygen, and even the temperature and humidity of the surroundings of the concrete. Understanding how deterioration occurs could help find threshold levels of pyrrhotite before damage occurs.

64.

INVESTIGATING PYRRHOTITE CONTENT ACROSS CONNECTICUT GEOLOGY

Alexis Zanger '19

Faculty Sponsor: Christoph Geiss

In recent years, basements across northeastern Connecticut have failed prematurely do to internal sulfur attack. This issue is found in foundations that were poured with a pyrrhotite containing aggregate. In this project, I conduct a detailed investigation of pyrrhotite content in the metasedimentary rocks of northeastern Connecticut, specifically the variability of pyrrhotite in

geologic formations thought to contain pyrrhotite. After collecting 44 bedrock samples from outcrops, I analyzed their magnetic properties and sulfur content. I measured magnetic susceptibility between room-temperature and 700°C to determine the Curie-temperatures of the magnetic minerals present. We complimented the magnetic analyses by determining the total sulfur content of each sample through purge-and-trap chromatography. Results show the presence of pyrrhotite in locations not previously identified, prompting further studies.

65.

PRESENCE AND ACTIVITY OF LONG-TAILED BATS (*CHALINOLOBUS TUBERCULATUS*) IN THE HŪNUA RANGES AND ADJACENT PARCELS OF PRIVATE LAND IN AUCKLAND REGION, NEW ZEALAND

Yunzhuo (Doris) Zhang '19

Faculty Sponsor: David Clarke, EcoQuest Program, University of New Hampshire

The two native bat species in New Zealand, lesser short-tailed bats (pekapeka or *Mystacina tuberculata*) and long-tailed bats (*Chalinolobus tuberculatus*), are both considered threatened in the country and understudied regarding their population and distribution, especially in the Hūnua Ranges, the largest native forest in the Auckland area. Little research has been done on the bat population on private land even though local landowners have indicated encounters with bats in their backyard. In this research, eight automatic bat monitors (ABMs) were set up on the conservation land of the Hūnua Ranges, and six were placed on selected areas of the adjacent private land. The ABMs recorded nine days of bat activity on each site. BatSearch 3, software designed by the Department of Conservation, was used to analyze the data. In addition, 32 standardized walking transects were conducted by students to assess long-tailed bats' presence, absence and other visual activity observation in the Hūnua Ranges after sunset. A total of 2128 bat passes, 1447 (61.44%) on the conservation land and 681 (38.56%) on the private land, were recorded at 13 out of 14 sampled sites. Eighty four feeding buzzes were collected, in which the highest feeding activity was collected on a private land. Bats were found to be most active two hours and four hours after sunset in the fall, in contrast to seven hours after sunset in the early summer. This study shows the existence of a potentially important *C. tuberculatus* population in the Hūnua Ranges on both conservation and private land. Thus, pest control, the recovery of native biodiversity in the Hūnua Ranges, and public education on the bat population and the values of biodiversity in people's backyard are crucial to protect the *C. tuberculatus* population in the future. More studies also need to be done on bat hourly activity in summer time.

HEALTH FELLOWS

66.

SURVEY OF PATIENTS USING THE ED AT HARTFORD HOSPITAL FOR EMERGENT DENTAL NEEDS

Roxana Alvarez '20

Faculty Sponsors: Peter Pasciucco, DDS, Hartford Hospital, Alison Draper, Amy Hunter, MPH, PhD

Dental issues account for 0.9-4% of all visits presenting at hospital emergency departments (Bae, Kim, & Choi, 2011; Fleming, Gregg, & Saunders, 1991; Verma & Chambers, 2014). Most of the research on this topic has been conducted at pediatric hospitals and focuses on the

epidemiology of the emergency visits. Research investigating the socioeconomic catalysts for dental visits at EDs is limited. In this study, a 10-question survey was distributed to patients referred to the HH dental clinic from the ED to investigate the effect of socioeconomic factors on ED visits for dental care. Patients were interviewed at the beginning of their dental appointment. A total of seven patients were interviewed from April 1st to April 15th, 2019. 86% of patients answered that they did not always use the ED for their medical or dental needs. The average pain on a scale of 1-10 was 7. Most patients had been in pain for 2 days on the day they were interviewed. 86% of patients did not have a private dentist that they saw regularly, and 86% of patients had government-issued insurance. Though a positive pattern is seen with the occurrence of dental ED visits and the social factors, type of insurance (most patients were government-issued or self-pay) and regularity of receiving dental care (most patients did not have a dentist that they saw regularly), a greater sample size would be needed to determine whether these results are significant.

67.

THERAPIES FOR COGNITIVE DEFICITS ASSOCIATED WITH CHEMOTHERAPY FOR BREAST CANCER: A META-ANALYSIS

Sababa Anber '20

Faculty Sponsors: David Finitisis, PhD, Hartford Hospital, Alison Draper, Amy Hunter, MPH, PhD

Breast cancer is one of the most frequently diagnosed cancers in women, with about 1.7 million new cases added each year. Increase in survival rate of breast cancer patients has generated a rising awareness of the side effects of breast cancer treatment, which majorly includes cognitive dysfunction. Several studies over the years have implemented various rehabilitative therapies to address this cognitive deficit, which includes cognitive behavioral therapy, pharmaceutical treatment, cardiovascular exercise, acupuncture, gentle movement and meditation and mindfulness. The goal of this meta-analysis is to identify all the implemented therapies and perform a meta-analysis to compare the efficacy of these treatments and therefore, identify the most effective rehabilitative therapy. Literature searches were conducted electronically across three databases (PubMed, PsycINFO and CINAHL), with a total of 12 studies included in the present study from a pool of 3062 extracted studies. Among these studies, 7 studies were cognitive behavioral therapy, 2 were cardiovascular exercise therapy studies, 1 acupuncture, 1 meditation/mindfulness and 1 pharmaceutical. The domains most tested and most successfully treated were verbal memory, attention and processing speed. Neuropsychological test results from each included study were imported into a spreadsheet and from that, Cohen's d (d) and weight for effect size (w_i) was calculated. Among the five identified types of rehabilitative therapies, cognitive behavioral therapy is hypothesized to produce the most promising results.

68.

DEMORALIZATION IN MOVEMENT DISORDERS

Julianna Armentano '20

Faculty Sponsors: Duarte Machado '01, MD, Hartford Hospital, Alison Draper, Amy Hunter, MPH, PhD

Demoralization is described as a state mind in which a person feels deprived of spirit and courage, distressed, disheartened, and thrown into a confusion. The clinical hallmark of demoralization is subjective incompetence, “a self-perceived inability to successfully complete tasks and express feelings deemed appropriate in a stressful situation”. Demoralization involves a combination of subjective incompetence and distress and has been observed in various clinical settings, particularly alongside non-psychiatric disorders. The purpose of this research is to understand the prevalence of demoralization and subjective incompetence in patients with all movement disorders and to examine the association of demoralization with anxiety, depression and the quality of life of the patients. Survey tools assessing disability (GDS), resilience (BRS), family functioning (BAFFS), depression (PHQ-9), perceived social support (ISEL-SF), anxiety (GAD-7), demoralization (DPCR-D) (DDS), and stress (IES) will be used to assess the patients' psychological states. Based on the current knowledge of demoralization in Parkinson's disease, we hypothesize that demoralization and subjective incompetence will be prevalent in patients with all movement disorders. The information gained from this research will be beneficial in better understanding how to treat patients with movement disorders who suffer from demoralization in the future. Future studies will have the possibility to improve a patient's quality of life by providing them with more information about demoralization and eventually better treatment options.

69.

EXAMINATION OF PNEUMOCOCCAL VACCINATION STATUS IN RELATION TO DEMOGRAPHIC TRAITS AND EMERGENCY DEPARTMENT VISITS

Ahmad Chughtai '20

Faculty Sponsors: Cunegundo Vergara, MD, Hartford Hospital, Alison Draper, Amy Hunter MPH, PhD

Pneumococcal diseases are infections caused by *Streptococcus pneumoniae* bacteria, which can cause conditions such as pneumonia, bacteremia, and meningitis. Pneumococcal vaccines, including the pneumococcal polysaccharide vaccine (PPSV23) and the pneumococcal conjugate vaccine (PCV13), help to prevent pneumococcal diseases and are recommended for adults over the age of 65. Studies have shown that pneumococcal vaccinations may also be effective in reducing infections in patients with chronic obstructive pulmonary disorder (COPD), a condition seen in many smokers that causes breathing problems and airflow blockage in the lungs. This study focused on investigating the relationship between demographic characteristics and pneumococcal vaccination status, as well as the relationship between vaccination status and emergency department visits. A list of patients included in the study was provided by automated searches of the Epic electronic medical record system and was refined through manual audits to ensure only COPD patients at the Brownstone clinic were included. Data was collected on the demographic traits, vaccination status, and number of emergency department visits of patients in this list using the Epic system. The results of this study indicated that black patients were more likely to receive the PPSV23 or PCV13 vaccines rather than no vaccines compared to Hispanic patients. Results also showed that patients were less likely to receive the PCV13 vaccine rather

than no vaccines as age increased. This information could help to design programs to improve vaccination rates and reduce the prevalence of pneumococcal disease.

70.

IMPROVING INTIMATE PARTNER VIOLENCE SCREENING AMONG FEMALE CAREGIVERS AT CONNECTICUT CHILDREN'S.

Jennifer Durocher '19

Faculty Sponsors: Garry Lapidus, PA-C, MPH, Connecticut Children's Medical Center, Alison Draper, Amy Hunter, MPH, PhD

Intimate partner violence (IPV) is a major public health problem that affects nearly 1/3 women in their lifetime (Breiding, Black, & Ryan, 2008). There are screening tools for IPV, but they are not used enough by healthcare professionals. The goals of using the anonymous tablet-based screening tool for female caregivers in the Emergency Department of Connecticut Children's Hospital include raising awareness to the problem of IPV as well as determining how frequent it is in this setting. Any female caregiver who was over 18 years old and was alone with the patient was eligible to participate in the screen, which consisted of demographic questions, a short educational module, and a six question screen for IPV. Out of the 108 caregivers that came in at this time, 58 were eligible, 48 agreed to participate and completed the survey, and four screened positive for IPV. None of the four requested a social work consult. Since the number of positive screens is so small, no significance can be drawn between any demographic factors and the risk of IPV. The majority of the women screened were between ages 20 and 29, were single, and did not have a bachelor's degree. Further work on this study will continue to increase screening for IPV, and if it is successful, it will provide evidence to establish a screening method that can be integrated into multiple areas of the hospital.

71.

ESTABLISHING THE ROLE OF QUASI-DYNAMIC BALANCE IN CONCUSSION RECOVERY

Anna Hackett '20

Faculty Sponsors: Matthew J. Solomito, PhD, Elite Sports Medicine, Connecticut Children's Medical Center, Alison Draper, Amy Hunter, MPH, PhD

Over the last decade, interest in concussions has grown to the point that they are discussed in popular culture. A concussion is classified as a minor traumatic brain injury, which afflicts millions annually in the US. Diagnostic techniques for concussion must be more sensitive to better assess recovery and prevent permanent cell damage that may result from improper care. Dual-task diagnostic tests assessing cognition and balance have been shown to improve diagnostic sensitivity. Static balance is typically used in concussion recovery however there is a growing need to improve the knowledge of what role dynamic balance has in concussion recovery and diagnostics.

The Elite Balance Protocol (EBP) developed at Connecticut Children's Medical Center used a Nintendo Wii Balance Board to test both concussed and non-concussed individuals in both static and dynamic states. Concussed subjects completed the balance assessments weekly until clearance was determined. MatLab was used to measure the three parameters of interest: path

length, time, and velocity of movement per trial. A series of ANOVAs and t-tests were run to assess the data along with a linear regression of age vs. each parameter.

Results show age improves dynamic balance; for every one-year increase in age a 3.2 cm decrease in total path length is expected ($p = 0.007$). The sport of each athlete was grouped based on level of contact and it was found that sport had no significant effect on performance, supporting the generalizability of the EBP. Finally, path length was larger and velocity shorter in non-concussed individuals as compared to concussed individuals, which is postulated to be a result of greater confidence in the ability to control balance.

These results suggest that, while important, more research is essential to determine the role of dynamic balance in concussion diagnosis and recovery.

72.

IMPLEMENTING UNIVERSAL HIV SCREENING IN ADOLESCENTS: A QUALITY IMPROVEMENT PROJECT

Avery Hayes '19

Faculty Sponsors: Caleb Wasser '08, DO, Cathy Wiley, MD, Community Health Center, Connecticut Children's Medical Center, Alison Draper, Amy Hunter, MPH, PhD

It is estimated that greater than half of adolescents infected with HIV are unsuspecting or unaware of infection. Due to this reason, the CDC recommends universal screening for HIV in adolescents. Our main objective is to examine if the implementation of rapid HIV screening improves screening rates in adolescents in primary care patients aged 13- to 18-years old. From February 2019 to February 2020, a plan-do-study-act quality improvement model will be used. A total of approximately 2,842 patients aged 13 to 18 years old will be utilized in this study, 1,342 patients were analyzed in retrospective chart review and a proposed 1,500 patients will be analyzed in prospective chart review. Baseline HIV screening rate from retrospective chart review was 13.59%. In continuation of this quality improvement model, the aim is increase this screening rate to at least 30%. The need for implementation of routine rapid HIV screening in adolescents at CHC is necessary. Screening rates are extremely low. If screening rates significantly increase post intervention, routine, rapid HIV screening can effectively increase HIV screening in adolescents.

73.

AN EVALUTATION OF A FIREARM SAFETY INTERVENTION IN THE PEDIATRIC SURGERY CLINIC

Kristina Kurker '20

Faculty Sponsors: Brendan Campbell '92 MD MPH, Connecticut Children's Medical Center, Alison Draper, Amy Hunter, MPH, PhD

Firearm violence is a public health concern. The purpose of this study is to provide parents evidence-based information on firearm safety, to help make firearm ownership as safe as possible. The hypothesis was that viewing a firearm safety video would be associated with parents saying they will adopt safer firearm storage practices in their homes. The participants were the parents or caregivers of patients at the outpatient pediatric surgery clinic at Connecticut Children's Medical Center between May 2018 through September 2018. Participants were

presented with a questionnaire on a tablet, which also included a safety message on firearm safety practices. The gun safety opinions of gun owners versus non gunowners were analyzed using SPSS 16. 81% of the study participants thought it was appropriate to receive firearm safety information from their physician during a visit. Of the gun owners, who did not already store their guns safely, 50% said they would change their storage behavior. If a majority of parents feel comfortable with their physicians providing information on firearm safety, physicians should potentially incorporate it into their visits. In practice, this safety module could potentially cut unsafe gun storage in homes in half, which would make homes with guns safer. More research needs to be done to confirm whether parents are actually adapting safer storage practices or just saying they will.

74.

STIGMA OF CHRONIC PAIN AMONG ADOLESCENTS AT SCHOOL

Tulsi Sumukadas '20

Faculty Sponsors: Emily Wakefield, PsyD, Connecticut Children's Medical Center, Alison Draper, Amy Hunter, MPH, PhD

There has been little research done on how the stigma surrounding chronic pain, especially in the pediatric population. This qualitative study specifically focuses on how the invisibility of chronic pain influences stigma experienced by adolescents in the school environment. Three focus group interviews were held each with 3-4 adolescents of ages 12-17 years. Participants were asked to share anecdotes of how teachers, school nurses, and other school personnel perceive their chronic pain and how they are treated due to any stigma that exists. Focus group interviews were recorded, transcribed, and coded for themes of stigma and how it is experienced. Results showed that adolescents with chronic pain are affected by stigma in the school environment, and that stigma is reinforced by the invisibility of functional chronic pain and the lack of knowledge of such conditions among school personnel. Adolescents' chronic pain complaints are many times dismissed. Future research should study the effects of such stigma on adolescents' health outcomes, and benefits of educating school personnel on pediatric chronic pain conditions.

75.

IMPACT OF AN ANTIMICROBIAL STEWARDSHIP PROGRAM ON PRESCRIPTION USE OF ANTI-INFECTIVES IN AN ACUTE CARE SETTING

Angela Magardino '19

Faculty Sponsors: Kristine E. Linder, PharmD, BCPS, Booth Wainscoat, DO, Hartford Hospital Department of Infectious Disease, Alison Draper, Amy Hunter, MPH, PhD

This paper describes the implementation of an antimicrobial stewardship (AMS) program capable of real-time infectious disease antibiotic recommendations by addressing the misuse of anti-infective agents. Few studies have prospectively examined the impact of an AMS program in an acute care setting. Beginning March 14, 2019, the Infectious Disease Unit implemented the AMS pilot program in the Bliss 7 East Unit, which is specifically a teaching floor. An electric chart review was done to collect AMS recommendations and data on the patients admitted that were treated with anti-infective agents during their stay. Out of 128 patients admitted between the start date and April 11, 2019, 30 patients were not prescribed anti-infective agents and excluded from the study and 98 patients treated with anti-infective agents and included in the study. Out of the total number of patients included, 18 of those patients were given AMS

recommendations. The purpose of this quality improvement (QI) project is to observe the impact of interventions given by the AMS team, an Infectious Disease Specialist and a Clinical Pharmacist, on patients' length of stay (LOS), number of days on anti-infective agents, and number of days to transition to oral therapy. Due to the narrow timeframe for the project to take place, the primary outcomes are inconclusive as of now, but preliminary data can be reported. The mean age for patients with and without AMS recommendations are 67 ± 18.59 and 64 ± 17.15 , respectively. Patients with ASP interventions were 72% male and 28% female, whereas the patients without AMS interventions were 52% male and 46% female. Lastly, 50% of the patients that got recommendations had infectious disease needs compared to 20% of the people without AMS recommendations being admitted with infectious disease needs. Secondary outcomes of the AMS pilot program showed that compliance with recommendations is low (39%). Additionally, compliance with following an antibiotic timeout is also low overall for patients with and without recommendations; 44% and 56%, respectively. All in all, more work needs to be done to enhance physicians' participation and antibiotic awareness. The ultimate goal of the AMS program is to change the behaviors associated with incorrect prescriptions, therefore limiting the spread of antimicrobial resistance.

76.

DIFFERENCES IN CORTICAL FRONTAL ALPHA ASYMMETRY BETWEEN HEALTHY AND ANXIOUS PATIENTS

Pamela Ulloa-Franco '19

Faculty Sponsors: Gretchen Diefenbach, PhD, Carolyn Davies, PhD, David Tolin, PhD, Institute of Living, Alison Draper, Amy Hunter, MPH, PhD

Anxiety disorders are the most diagnosed mental health disorders, and even then, a significant portion of the population remains undiagnosed. Recently, frontal cortical alpha asymmetry was found to be associated with motivation, emotion, and behavior, which are important factors of anxiety disorders. In order to better understand the relationship between frontal alpha asymmetry and anxiety, alpha power values in anxious and healthy patients were analyzed. The healthy controls ($n=14$) and anxious patients ($n=33$) underwent a four-minute EEG resting state reading to get alpha power values. The frontal alpha asymmetry (FAA) index score was calculated from the resting-state alpha power values of the F3 and F4 electrodes. The results showed that anxious participants had greater right-sided frontal activity, which meant decreased right frontal alpha activity, but there was no significant difference between the FAA index score of anxious participants and healthy controls ($p=.205$). Furthermore, the diagnoses of anxious participants were categorized into groups based on their neurobiology, resulting in three groups— a fear-based group (Social Anxiety, Panic, and Specific Phobia Disorder), GAD group, and OCD group. There was no significant difference found comparing the GAD and OCD group with the healthy controls ($p=.659$; $p=.542$). However, there was a significant difference found between the fear-based group and the healthy controls ($p=.043$). These findings support the notion that decreased right frontal alpha activity is present in participants with a fear-based anxiety disorder and may not be generalizable to all anxiety disorders. This could potentially result in the creation of frontal cortical alpha asymmetry as a diagnostic biomarker for these disorders.

77.

A NEW CASE OF CONGENITAL LAMBERT-EATON-LIKE-MYASTHENIC SYNDROME IN A CHILD

Michael Zarra '19

Faculty Sponsors: Francis DiMario, MD, Pediatric Neurology, Connecticut Children's Medical Center, Alison Draper, Amy Hunter, MPH, PhD

Introduction: Lambert-Eaton syndrome (LES) is rare in children. The disorder has a profound impact on voluntary motor function resulting in a diminished function and quality of life. Congenital forms of Lambert-Eaton-like myasthenia syndrome due to a de novo mutation in the *SYT2* have been reported in two prior families. We report a third individual presenting in infancy.

Methods: Presentation at 2 weeks of life with profound hypotonia, weakness, and areflexia prompted evaluation. Evaluation included: laboratory tests, genetic analysis and electromyography (EMG). Clinical evaluations were done periodically over 22 months from baseline and during treatment with pyridostigmine using a modified Quantitative Myasthenia Gravis Test (mQMG) and on the Patient Global Impression of Change scale (PGIC).

Results: Neuromuscular and comprehensive metabolic testing, chromosome microarray, and spinal muscular atrophy gene testing were all normal or negative. Electromyography demonstrated reduced compound muscle action potential (CMAP) amplitude (left tibial motor <0.1mV, left ulnar 0.04mV), preserved sensory nerve action potential (SNAP) (normal left peroneal at 2 mV, and normal left sural sensory nerve at 8 mV) and a decrement of 23.4% in CMAP response to low-frequency repetitive nerve stimulation (RNS) at 2 Hz. There was a marked increment in CMAP response to high-frequency RNS at 30 Hz of >100% with normal needle study consistent with LES. Genetic testing revealed a compound heterozygote de novo mutation in the *SYT2* (c.802-3C>G) IVS6-3 variant and a (c.977 C>A) TK32K variant carried by his asymptomatic mother confirming LES.

Conclusion: Tone, strength, and function improved post treatment with pyridostigmine suggesting the maintenance of acetylcholine in the neuromuscular junction (NMJ) is efficacious in enhancing neurotransmission in children with congenital forms of Lambert-Eaton-like myasthenia syndrome due to a de novo *SYT2* mutation.

NEUROSCIENCE

78.

ELECTROENCEPHALOGRAM AS A DIAGNOSTIC TOOL IN ACQUIRED BRAIN INJURY

Michael Zarra '19

Faculty Sponsors: Dan Lloyd, Sarah A. Raskin

The ability of electroencephalogram (EEG) to be used as a diagnostic device for acquired brain injuries (ABI) has been conceptualized previously. Averaged event-related potentials derived from an EEG are suitable as markers of dysfunction however, distinctive properties in the frequency domain have not been established previously. In the present study, we examined pre-existing EEG signal data of healthy, mild ABI (mABI), and severe ABI (sABI) human groups. Through Fourier analysis performed in MATLAB, we found that individuals in our sample

population (n=80) were able to be categorized into their respective group based on common neuronal activity detected at specific electrode locations. The characteristic activity patterns of individuals with ABI were found to be related to the amplitude of their theta waves. This novel way of interpreting EEG with respect to ABI, could significantly inform the diagnostic criteria for ABIs; it may also offer a pragmatic way for non-professionals to quickly detect concussions or similar injuries in competing athletes. Further efforts to sonify such neural activity of interest may elucidate more characteristic trends of ABI.

79.

METHODS OF VIDEO EDITING IN THE STUDY OF SPEECH

Anna Barnes '19, Lauren Barret '19, Francesca De La Cruz '19 Hunter Moore '21,

Rachel Fox '21, Edson Zandamela '20

Faculty Sponsor: Elizabeth Casserly

Our lab looks at how degrading one's senses affects speech. A study was done last year to see that when auditory and somatosensory senses were degraded, speech was affected. However, when auditory and somatosensory senses were degraded and visual feedback was added, speech did not improve. A follow up study was done to see why this was by recording videos of people speaking in front of a mirror and people speaking normally to see if one was harder to understand. An acoustic study showed that speech was harder to understand when it was produced in front of a mirror, but it's unclear whether people may have been altering their production to take advantage of *visual* clarity instead. For the past two semesters we have been editing videos of the speech to test this, and have run into many unexpected difficulties in the video editing process. This poster will explore the methods of video editing and the many challenges in editing videos of speech.

80.

UNDERSTANDING SPOKEN WORDS: CAN ORAJEL AFFECT SPEECH INTELLIGIBILITY?

Lauren Barrett '19, Anna Barnes '19, Hunter Moore '21, Edson Zandamela '20,

Rachel Fox '21, and Franchesca De La Cruz '19

Faculty Sponsor: Elizabeth Casserly

The objective of this study was to understand the effects of sensory feedback changes on the physical production of speech. Preliminary experiments exhibited that degrading somatosensory information while degrading auditory feedback alters speech, resulting in reduced speech intelligibility. The question was whether or not the effects of degraded somatosensory information persisted when degraded auditory feedback was eliminated. We predicted that if degraded somatosensory information alone was enough to disrupt speech, intelligibility would decrease. Part 1 consisted of recording participants while they recited words before and after Orajel numbing took place. Part 2 consisted of an auditory speech discrimination task in which participants determined whether the word recorded under the Orajel condition or baseline condition was easier to understand. The results showed no significant difference between speech intelligibility for the Orajel measure and the baseline measure. It can be concluded that auditory feedback is sufficient for one to maintain speech intelligibility despite the somatosensory degradation.

81.

PSYCHOMETRIC PROPERTIES OF THE MONTREAL COGNITIVE ASSESSMENT ACROSS PEDIATRIC SETTINGS

Lori Berger MA '19

Faculty Sponsors: Sarah A. Raskin, Kevin Young PhD ABPP

The Montreal Cognitive Assessment (MoCA) is a brief cognitive screening test designed to measure the cognitive decline of individuals suffering from mild cognitive impairment (MCI) due to disorders such as: Alzheimer's disease, Parkinson's disease, and schizophrenia, but has shown its utility in testing cognition in many other areas of medicine. The MoCA is still relatively untested in adolescents. In this study, its utility as a differential diagnostic tool between psychiatric and organic disorders that cause delirium such as autoimmune encephalopathy (AE) was of primary interest. The aim of this research was to determine the sensitivity of the MoCA in pediatric individuals in general, and its utility as a differential diagnostic tool between organic and psychiatric disorders in this age group. The MoCA was administered to three cohorts (adolescent psychiatric inpatient, adolescent emergency department (ED) hospital control, and adolescent autoimmune encephalopathy). Predictive variables were separated by age, ethnicity, and group. Results indicated that the MoCA may not be appropriate for use in individuals under the age of 10. Ethnicity emerged as a predictor for performance on the MoCA further demonstrating the need for cohort specific normative data. The results also showed that patients with AE performed significantly worse on the MoCA than either ED controls or the inpatient psychiatric cohort ($p < 0.001$) indicating it might be useful as a differential diagnostic tool between psychiatric and organic disorders that cause delirium.

82.

NEUROLOGICAL DISCREPANCIES BETWEEN BIPOLAR DISORDER, SCHIZOPHRENIA, AND SCHIZOAFFECTIVE DISORDER

Nat Bush '19

Faculty Sponsors: Dan Lloyd, Shashwath Meda (Institute of Living)

As neurological research advances, so does the understanding of how disorders and diseases develop and how they can be treated. The debate of how mental disorders develop has been ongoing and complicated, as there is still no clear understanding of their cause. In this study, fMRI scans of individuals with bipolar disorder (BPD), schizophrenia (SZP), and schizoaffective disorder (SAD), and a control group were collected in six cities in the United States and were preprocessed to screen out scans that do not succeed in the standardization process. The subjects were included in three analyses: one that compares the subjects based on DSM diagnosis, one that compares them based on biotype, and one that compares the subjects based on their use of various types of medication to determine whether the brain connectivity differences were due to the disorder itself or to medication usage. The results indicate that there is no significant difference between the biotypes. SAD exhibits some significant difference, but this appears to be caused by medication usage. BPD and SZP are neurologically distinct in their brain functional connectivity. Further studies may consider analyzing other covariates to determine other possible explanations for the connectivity differences between disorders and biotypes.

83.

MEASURING EFFECTS OF ACCULTURATION ON DIFFERENT FORMS OF MEMORY IN SPANISH SPEAKERS

Laura Cadavid '19

Faculty Sponsor: Sarah A. Raskin

Studies show that minorities are more likely to be misdiagnosed as neuropsychologically impaired than non-Hispanic whites due to artificially depressed neuropsychological test scores (Arentoft et al., 2012). One aspect to consider as a possible factor is acculturation (Arentoft et al., 2012). Acculturation is the process of psychological and behavioral changes that occur due to prolonged contact with another culture (Zea et al., 2003). Previous studies have found acculturation into U.S (dominant) culture is correlated with better neuropsychological performance on a variety of neuropsychological realms, such as information processing (Razani et al., 2007) and working memory (Coffey et al., 2005). Latinxs are a growing population in the U.S, increasing by 1,131,766 between 2015 and 2016 (U.S. Census Bureau, 2017). Therefore, it is important to recognize any effects that acculturation may have on Latinx individuals as findings can help assess, treat and diagnose this rapidly expanding population. The present study look at the effects of acculturation on different types of memory in Spanish speakers.

84.

MANIPULATION OF CONSCIOUS AWARENESS USING CONTINUOUS FLASH SUPPRESSION AND VIRTUAL REALITY

Patricia Gaitan '19

Faculty Sponsor: Michael Grubb

Consciousness is one of the biggest mysteries that researchers in the field of neuroscience aim to explore. Continuous flash suppression is a method used to manipulate conscious awareness in the lab, and it calls for presenting each eye with different stimuli: a dynamic, color-filled noise patch to one eye, and a still image to the other. The dynamic noise patch becomes the only perceived stimulus, which allows for the still image to be suppressed from conscious awareness for a long period of time. For my senior thesis, I hoped to empirically validate a method that implements continuous flash suppression using virtual reality since customary methods require inconvenient hardware (e.g., four-mirror stereoscopes and split screen computers). Data across three experiments showed that the mask was able to significantly reduce task accuracy when determining the orientation of different kinds of stimuli in with suppression and without suppression conditions. Upon further investigation, in 2 of the 3 experiments, the accuracy within the suppressed condition was not significantly different than 0.5, chance accuracy in a two-alternative forced-choice task. It allowed us to assume that the mask was successful in rendering the images invisible.

85.

DEVELOPMENT OF AN INTRAHIPPOCAMPAL KINDLING MODEL OF EPILEPSY

Carter Jones '19

Faculty Sponsors: J. Harry Blaise, David Ruskin, Susan Masino

Epilepsy is a neurological condition that effects about 1% of the global population. This debilitating condition is associated with overexcitability and ineffective inhibition of neuronal pathways in the brain that can cause serious and diverse symptoms, most prominently seizures. While some antiepileptic drug (AED) regimes have been proven to be effective in treating this

condition, there are many cases where the drugs do not do enough. The ketogenic diet (KD) has been used for decades as an effective anticonvulsant. Its powerful and natural processes result in some patients becoming seizure-free. Sometimes, these patients remain free of seizures even after returning to a normal diet. Kindling is a modern technique of training the brain to be more susceptible to synchronicity and therefore seizures overtime through the electrical or chemical stimulation of specific brain areas. The objective of this project is to assess if a KD can prolong the development of major seizures in an electrically kindled rat model. Male Sprague-Dawley rats between 280 and 300 grams were used in this study. A stereotaxic surgery was performed to implant electrodes into the hippocampus and cortical regions. These brain regions were electrically stimulated daily according to an electrophysiological timeline. Although only one animal was successfully taken through the procedure, the results indicate a proof of concept and provide a foundation towards integration of more animals in the future of the study.

86.

INVESTIGATING THE EXISTENCE OF A PLASTICITY SYNDROME IN *HELISOMA* SNAILS AND A POTENTIAL LINK TO NEURAL COMPLEXITY

Peyton Orloff '22

Faculty Sponsors: Charles Swart, Benjamin Toscano

Behavioral plasticity allows individuals to modify their behavior in a changing environment. Plasticity has been studied extensively in recent years, but there is little known about whether individuals vary in their degree of plasticity or whether this plasticity is consistent between behaviors. We hypothesize that this plasticity is consistent across measures of behavior, resulting in a plasticity syndrome. We also hope to identify neural complexity as a predictor of individual plasticity. To test these hypotheses, *Helisoma* snails will be taken from a local stream. These snails will go through a series of four assays to determine both a baseline for two axes of personality (boldness and exploration) and a measure of plasticity for each. These assays will be repeated three times for each snail to test for repeatability. If individual snails exhibit variation in their degrees of plasticity, and these degrees are correlated across two independent measures of behavior, the hypothesis that they exhibit a plasticity syndrome will be supported. If a plasticity syndrome is found, we will better understand animals' motivations and the effect of individual differences on behavior and survival in the presence of predation. We also hope to find a connection to neural complexity in the form of neural counts and estimates of diameter. If neural complexity is found to be correlated with behavioral plasticity, that will suggest a potential cause for these individual differences in personality, and a way to determine the personality of an animal based solely on brain anatomy.

87.

NEUROPSYCHOLOGICAL FUNCTIONING IN SURVIVORS OF DOMESTIC VIOLENCE

Chloe Ouchida '21, Olivia DeJoie '18, Anna Lee '20

Faculty Sponsor: Sarah A. Raskin

Domestic violence (DV) often includes blows to the head and strangulation. As a result, traumatic brain injury (TBI) can be a result of DV. Individuals who have experienced TBI may present with a variety of symptoms such as impaired memory, attention, difficulty sleeping, and emotional instability. This study was designed to answer four questions: 1) what percent of DV survivors screen positively for TBI? 2) do healthy participants perform better than DV survivors on cognitive measures? 3) do measures of depression, anxiety, and quality of life differ between

the two groups? 4) is post-traumatic stress disorder (PTSD) experienced at a higher rate in DV survivors than healthy participants?

A battery of cognitive, mood, quality of life, and PTSD measures was administered to 81 participants (44 DV survivors and 37 healthy non-DV participants). Women with DV were a mean age of 37.60 years (sd 13.27) of age with 14.44 (sd 1.70) years of education and the non-DV adults were 31.06 years of age (sd 12.54) with 16.00 years (sd 2.36) of education. Assessments were divided into six categories: verbal fluency, memory, mood/life quality, attention, executive function, and PTSD and consisted of standard neuropsychological measures. Participants were administered the HELPS to determine history of brain injury.

Fifty-seven percent of DV survivors screened positively for TBI, and commonly reported symptoms including fatigue and headaches. Scores on measures of depression, chronic stress, and environmental quality of life were significantly higher in DV survivors than non-DV participants. Verbal fluency, delayed recall, and environmental quality of life were significantly lower in DV survivors than non-DV participants.

This study highlights the risks of TBI from DV, as well as the cognitive and mood differences between DV survivors and age-matched participants.

88.

COGNITIVE REHABILITATION OF PROSPECTIVE MEMORY DEFICITS AFTER ACQUIRED BRAIN INJURY: COGNITIVE, BEHAVIORAL, AND PHYSIOLOGICAL MEASURES

Meaghan Race MA'19, Gianna Barbadillo '21, Olivia White '20
Faculty Sponsor: Sarah A. Raskin, Michael Stevens, Ph.D.

Acquired brain injury (ABI) affects approximately 3.5 million Americans. Prospective memory (PM) deficits are important predictors of functioning in daily life for individuals with ABI. Previous studies have shown that cognitive rehabilitation therapy (CRT) via PM training has a high rate of success in improving quality of life, independence and productivity for ABI survivors. There is limited information on utilizing imaging techniques in relation to changes in cognition and behavior following rehabilitation; however, previous studies suggest that imaging provides evidence that CRT could be related to changes to underlying brain plasticity. The aim of this study was to evaluate what brain areas were activated during PM task stimuli in ABI individuals compared to healthy adults (HA) and measure the efficacy of a six-week tailored CRT design. Furthermore, a fMRI post-scan was used to determine if there were changes in the activation of cortical regions associated with the PM task following CRT compared to pre-therapy. 54 participants were enrolled in the study (35 individuals with ABI and 19 HA) and given a neuropsychological battery and fMRI at baseline. Participants with ABI were randomized into two groups and received either six weeks of CRT individualized based on their baseline performance or brain education as control condition. Following treatment, the ABI participants received the same neuropsychological battery and a follow-up fMRI. Individuals with ABI performed significantly worse than HA on all sub-scores of the Memory for Intention Screening Test (MIST), indicating significant impairment in PM function. There was no significant changes on the MIST in either the CRT group or the active control group following treatment. The results of this study suggest strong statistical evidence for sub-region activation in

frontal, cingulate, parietal, premotor, and temporal cortexes at baseline levels in ABI participants; however, there is no evidence of cortical changes post-therapy.

89.

PSYCHOMETRIC PROPERTIES OF THE MEMORY FOR INTENTIONS SCREENING TEST (MIST)-SHORT FORM

Meaghan Race MA '19, Kathryn Marsden '21, Olivia White '20, Dorothy Anika '22
Faculty Sponsor: Sarah A. Raskin

Prospective memory (PM) is the ability to form and complete intentions after a delay period (Einstein & McDaniel, 1990). The Memory for Intention Screening Test (MIST) is used as a clinical measure of PM. The MIST is comprised of both time and event-based tasks. The MIST takes approximately 30 minutes to administer, however in clinical practice this was found to be lengthy. PM involves encoding an intention, storing the intention while performing other tasks, initiating the intention after a period has passed, and executing the intention. The goal of this study was to modify the length of the original MIST, so that it would take less time to complete. Certain tasks were removed from the original MIST, to create the short MIST. These revisions allow the MIST-S to be administered in 18 minutes as opposed to 30 minutes. MIST-S also uses background screening questionnaires as the ongoing task, thereby allowing for that time to be used as part of the evaluation. These tasks are no less engaging and appear to work sufficiently. The correlation between scores from the two independent rates was high ICC= .90, $p \leq .001$, indicating good inter-rater reliability. Given the high validity of original MIST, and that the items from the MIST-S are identical, it is assumed that items are valid. The correlation between the MIST-S and the CAPM was not significant, but this is also true of the full MIST. Not surprisingly, age did show significant effects with lower scores seen in older age group. Overall, the MIST-S performs the same objective as the original MIST with an improved ease of administration. It has demonstrated good reliability and validity, suggesting that the MIST-S may be a good brief alternative to the MIST embedded in neuropsychological batteries. Further research is needed to determine sensitivity to other disorders

90.

THE ROLE OF EMPATHY, CLINICAL TRAITS, AND EYE GAZE IN CONTAGIOUS YAWNING AND ITCHING

Rachel Scheub '20, Taylor Sorenson '17, Anna Kate Luddy '20, Megan Durkin '20,
Sierra Little-Gill '22
Faculty Sponsor: Molly Helt

Previous literature has demonstrated a correlation between contagious yawning and empathy, demonstrating that greater empathy tends to be correlated with higher rates of contagious behaviors, whereas those with Autism Spectrum Disorder (ASD) tend to show decreased rates of these behaviors (Helt et al., 2010). Contagious itching has no association with empathy, is increased in those with ASD (Helt *et al.*, in preparation). Participants in the current study were shown stimuli of faces yawning and itching and their contagious responses were videotaped and coded. They were also administered tests to determine whether they had high levels of either psychopathic traits or ASD traits. It was found that eye contact to target, empathy, and low levels of either type of clinical traits were positive predictors of yawning. In those with high levels of ASD traits, low rates of contagious yawning were mediated by eye contact, and rates of contagious itching were elevated. In

those with high levels of psychopathic traits, low rates of contagious yawning were not mediated by eye contact, and rates of contagious itching were also low. The authors speculate that decreased susceptibility to contagious yawning in those with ASD and psychopathic traits is caused by distinct mechanisms, and that in the case of individuals with ASD, it is secondary to diminished eye gaze. The authors have begun a follow up on these preliminary findings to investigate whether arousal levels play a role in contagious yawning, itching, laughter, and fear. To measure this, participants' skin conductance is measured while watching videos of these behaviors. We hypothesize that individuals with ASD may show increased arousal to these stimuli (and thus defensively turn away their attention).

91.

EFFECT OF INFLAMMATION INDUCED BY COMPLETE FREUND'S ADJUVANT (CFA) ON COMPULSIVE BURYING BEHAVIOR IN C57BI/6 MICE

Allison J. Wells '22, Suzanne N. Carpe '22

Faculty Sponsor: David N. Ruskin, Susan Masino

Mice are valuable model organisms for medical researchers as their genome shares many similarities with the human genome. For this reason, health conditions that affect humans, such as chronic pain and inflammation, can be studied through experimentation in C57BI/6 mice. However, to evaluate pain states in these animals, it becomes essential to establish a mechanism to assess ongoing pain. It has been hypothesized that pain and inflammation affect normal behaviors in mice such as their desire to bury compulsively, but to what extent this happens is still unknown. To analyze this, two groups of mice fed a control diet were evaluated using Complete Freund's Adjuvant (CFA), heat-killed tuberculosis bacteria that induces an inflammatory response in the body. One group of mice was injected with 20 μ l of CFA into a hind paw while the other group was unaltered. A series of burying tests were performed before injection and after injection and repeated every 2-3 days for about a week after injection. It was found that for several days after injection, mice exhibited a reduced desire to bury, yet over time, burying increased to match the level at which control mice buried. Individual mice were found to vary with respect to burying extent, a variable that should be taken into consideration for prospective research. Although statistically insignificant, both groups seemed to display an increase in burying over time, an important variable that should be further researched. Future studies will be geared towards analyzing these findings and evaluating a possible treatment option for chronic pain: the ketogenic diet. Previous research in rats has suggested that the ketogenic diet plays a role in reducing chronic pain and inflammation, but its effect on chronic pain in mice has yet to be determined.

92.

DATA VISUALIZATION ANIMATION DEPICTING THE GROWTH OF SOCIAL MEDIA PLATFORMS OVER TIME

Zach Yung '22

Faculty Sponsor: Dan Lloyd

Social media plays a big role in society, especially with the younger generations. After the success of Facebook, there have been many other social media platforms that have sprung up, with a few quickly growing to prominence. Despite Facebook always seemingly referred as outdated compared to newer platforms like Snapchat and Instagram, there are many users who

still use Facebook in conjunction with the newer platforms. In this study conducted by Zach Yung '22 and with the help of his faculty mentor, Professor Dan Lloyd, the popularity and use of the following social media platforms: Facebook, Twitter, Instagram, Snapchat, and Vine in the form of the number of active monthly users was determined through online research. Using MATLAB and QuickTime, a data visualization animation was created to depict each platform's growth over the past 10 years as well as projected growth for the next 5 years. The animation suggests that despite being older and the negative air around it, Facebook still outstrips the other platforms in terms of monthly users and is projected to continue to do so. However, it is also interesting to note that Instagram, a newer platform has surpassed Twitter, an older platform. This suggests that Facebook is far from dying and that even though new social media platforms may appear, new users will continue to join both concurrently. In addition, it shows the effectiveness of data visualization animation in depicting data, especially over time or in groups. A possible area of future research is to examine the retention rate of each platform (that is to say, how many users do the platforms lose each year?).

PSYCHOLOGY

93.

MEANING-IMBUED ONSETS YIELD INCREASED EFFICIENCY IN PERFORMANCE-CONTINGENT REWARD TASK, BUT ONLY LATER IN TIME

Devin Butler '19

Faculty Sponsor: Michael Grubb

Involuntary allocation of attention by abrupt onsets yields perceptual benefits at attended locations relative to unattended: improved discriminability and increased speed of information processing. Preliminary work found significantly larger attentional effects earlier in time for meaning-imbued onsets, compared to traditionally-tested neutral onsets. In a two-alternative forced-choice orientation-discrimination task, we compared neutral cues with reward-predictive cues to see if the typical behavioral signature for covert spatial attention could be altered. Literature suggests that when reward is contingent upon performance, people do significantly better in behavioral tasks. We manipulated cue timing, used peripheral cues to manipulate exogenous attention, and used cue color to manipulate bonus monetary compensation. Regardless of spatial attention distribution, reward-predicting cues significantly improved performance relative to neutral cues, but only later in time. Participants were more accurate and responded faster at 133ms when the cue predictive of bonus compensation was present, suggesting an arousal signal attuned to monetary reward.

94.

RELATIONS AMONG CULTURAL METACOGNITION, FUSION TEAMWORK, AND TEAM CREATIVITY

Isabella Chen '19

Faculty Sponsors: David Reuman, Dina Anselmi

Cultural metacognition, a dimension of cultural intelligence, is an individual's cultural awareness and consciousness during social interactions. Fusion teamwork refers to team collaboration that produces creative solutions to challenges because it recognizes and respects team members' differences (Crotty & Brett, 2012). Past research has found that multicultural teams tend to show

higher creativity than monocultural teams, but few studies have examined the cognitive mechanism behind the phenomenon. The current study aims to investigate the correlation between cultural metacognition and creativity level through fusion teamwork. The study investigated differences in cultural metacognition for three populations: international college students, non-international North American college students who have returned from study-abroad, and non-international students who have never studied abroad. Data were collected from Trinity College juniors and seniors. Participants were arranged into groups of three, the group was either a monocultural group or multicultural group. Groups completed both an individual and a group creativity task, along with questionnaires measuring cultural metacognition and perceptions of fusion teamwork. Results provide implications for improving problem solving in multicultural task groups.

95.

FOREIGN LANGUAGE LEARNERS' USE OF METACOGNITIVE STRATEGIES IN READING COMPREHENSION TASKS: EFFECTS OF SPANISH PROFICIENCY AND TASK LANGUAGE

Olivia Curreri '19

Faculty Sponsors: Dina Anselmi, David Reuman

Previous research has been conducted on Foreign Language Learners' classroom performance, and separately on reading comprehension and metacognition. There is a gap in the literature regarding the intersection of these topics. The present study investigated students' use of metacognitive strategies on a reading comprehension task in English and Spanish. The participants included Trinity College undergraduates with varying levels of Spanish proficiency. Participants completed a language test for placement in different categories of Spanish proficiency. They were given one passage with comprehension questions in each language and then reported their use of metacognition. As predicted, students with higher levels of Spanish proficiency performed better on the Spanish reading task. Also, as expected, students of all Spanish proficiency levels showed similar use of metacognition on the English task. Unexpectedly, students who were more proficient in Spanish showed a trend toward performing better on the English reading task. Implications for teaching Spanish as a foreign language will be discussed.

96.

HOW FILMMAKERS HIJACK OUR EYES: THE EFFECT OF AVERAGE SHOT LENGTH (ASL) ON ATTENTIONAL SYNCHRONY

Erin Gannon '19

Faculty Sponsor: Michael Grubb

As editing technology has advanced, filmmakers have become increasingly skilled at manipulating overt attention, such that eye movements are highly synchronized during film viewing. Average shot length (ASL, film length / number of shots) is a quantitative metric in film studies that may help us understand this perceptual phenomenon. Since shorter shots give viewers less time to voluntarily scan images, we predicted that shorter ASLs would yield greater attentional synchrony across viewers. We recorded participants' eye movements as they viewed clips from commercially-produced films with varying ASLs. We found that ASL and attentional synchrony were negatively correlated. These findings were replicated in an independent sample

of participants who viewed a different set of clips from the same films used in Experiment 1. We found that within the same films, clips with shorter ASLs synchronized eye movements to a greater extent than did clips with longer ASLs.

97.

PRESCRIPTION STIMULANT MISUSE IN COLLEGE GRADUATES

Megan McCarthy '19

Faculty Sponsor: Laura Holt

A large body of research has shown that prescription stimulant misuse (PSM) is prevalent among college students, with rates ranging from 12-37% (McNiel et al., 2011; Judson and Langdon, 2009; Emanuel et al., 2013; White et al., 2006). Further, research has shown that attending a fulltime college significantly increases an individual's risk for PSM later in life (Schepis et al., 2018). While these prevalence rates have been reported, no studies have conducted an in-depth examination of predictors of continued PSM following college. Accordingly, using The Theory of Triadic Influence, we examined predictors of PSM from three domains (intrapersonal, sociocultural, and environmental) to explore factors associated with maturing out of PSM. We utilized Amazon's Mechanical Turk to survey 219 adults in the United States (55% male, mean age=32.5) with a college degree and a history of PSM in college. As predicted, participants who scored higher on sensation-seeking were more likely to engage in post-graduate PSM. Contrary to my hypotheses, depression and workplace stress did not predict continued PSM. Misuse of prescription stimulants by close friends and approval of PSM in one's social environment also were not predictors of PSM. Implications of these findings are discussed, in addition to exploratory analyses showing significant differences in how postgraduate users of stimulants obtain and use stimulants in college and differences in their substance use behavior following college.

98.

PARENTING STYLE AND CHILD TEMPERAMENT ARE ASSOCIATED WITH DISTINCT TYPES OF CHILD BEHAVIOR PROBLEMS.

Phuong (Kelly) Nguyen '19

Faculty Sponsor: Molly Helt

Parenting style and child temperament are two prominent predictors of childhood behavioral problems (BP), which include both internalizing (e.g., anxiety, depression) and externalizing symptoms (e.g., rule breaking, hyperactivity) (Lengua, 2003; Pinquart & Kauser, 2018). The current study sought to examine the relative strength of their associations to child BP by obtaining mothers' reports of their parenting style, their child's temperament, and their child's emotional and behavioral problems. Results indicate that "difficult" temperament (high emotionality, low sociability, and low soothability) is significantly and positively correlated with *internalizing* symptoms. Meanwhile, authoritative parenting style (high warmth and high control) is negatively correlated with *externalizing* symptoms. There were no interaction effects. These results signify that children's external behaviors may be more influenced by parenting style, while their internal psychological state may be more influenced by temperament. However, the current sample was small and composed of mostly authoritative parents, so results should be interpreted with caution.

Keywords: parenting style, child behavior problems, difficult temperament.

99.

THE RELATIONSHIP BETWEEN PARENTING STYLES AND CHILD ANXIETY WITH AGE AND GENDER AS MODERATING VARIABLES

Sarah Vimini '19

Faculty Sponsors: Molly Helt, Dr. Jeffery Pella, Dr. Golda Ginsburg, UConn Health Partners

The purpose of this study was to investigate whether particular parenting styles are correlated with childhood anxiety levels. Relationships between child age, gender, and anxiety levels were also examined. Finally, the influence of child age and gender on the relationship between parenting style and child anxiety was investigated. Novel analyses were conducted on data previously collected as part of a larger study, the School-Based Treatment of Anxiety Research Study, by the child/adolescent anxiety and mood program at UConn Health. Two-hundred and sixteen children and adolescents (ages 6-18) and their parents were administered the Egnä Minnen Beträffande Uppfostran questionnaire, which gathers information regarding parenting styles, and the Screen for Child Anxiety Related Emotional Disorders questionnaire, which identifies children's anxiety levels. A moderate correlation between overprotective, rejection, and anxious rearing styles and child anxiety levels was found. In addition, female adolescents had significantly higher anxiety levels than male adolescents, male children, and female children. Surprisingly, neither child age nor gender influenced the relationship between parenting styles and child anxiety levels.