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# TWENTY-SIXTH ANNUAL SCIENCE RESEARCH SYMPOSIUM

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## Presentations

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Ferris Athletic Center  
May 2, 2013  
1:00 – 3:00pm

# TWENTY-SIXTH ANNUAL SYMPOSIUM OF TRINITY COLLEGE UNDERGRADUATE RESEARCH

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# **BIOLOGY**

## **1.**

### **NEUROGENESIS IN THE FOREBRAIN OF ELECTRIC FISH**

Hamdi Abdi '16

Faculty Sponsor: Kent Dunlap

Electric fish are prime candidates for studying the effects of social stimuli on neurogenesis because their electrocommunication signals are influenced by brain regions that have abundant neurogenesis. Although much is known about socially-induced neurogenesis in the midbrain, little is known about the forebrain. This region is homologous to the mammalian hippocampus, which is an important site of neurogenesis in mammals. Fish were injected with BrdU labeling and either isolated or placed in pairs to gauge the effect of the social stimuli. In this experiment, we will be performing immunohistochemistry for BrdU this summer, which will enable to see if the forebrain, like the midbrain, of socially induced neurogenesis. It is currently known that social stimuli cause neurogenesis and behavioral change, but it is unknown whether neurogenesis is also a cause of the social change.

## **2.**

### **GREEN SPACE WITHIN HOME RANGES OF RED-TAILED HAWKS IN AN URBAN ENVIRONMENT**

Sarah M. Black '16

Faculty Sponsor: Joan Morrison

In recent years there has been an increase in urban Red-Tailed Hawk populations. Little research has been done on these hawk populations. We investigated associations between the size of a hawk's home range and the total amount and patch sizes of green space within the home range. Eleven hawks in Hartford were tagged with radio transmitters then released. The size and context of each hawk's home range were determined using the telemetry locations and data were mapped using ArcMap Version 9.3. We overlaid the hawk home ranges on a map layer showing green space in the city of Hartford. The green space was identified using aerial photos of the Hartford area and was digitized in ArcMap. Results of correlation analysis showed a weak negative association between home range size and percent green space within the home range. As the percentage of green space in the home range decreased, the size of the home range increased. Approximately 67% of the green space patches were less than 0.5 hectares. Most of the resources that the hawks need are located within green spaces in the city—food, nesting sites, shelter, so with more green space available, the hawks do not have to travel as far to get resources they need. Maintaining green space in urban areas such as Hartford, and particularly large areas of green space, will help to ensure the continued success of urban Red-tailed Hawk populations.

### 3.

#### **CROWD SOURCING: COLLEGE STUDENT CITIZEN SCIENTISTS ANALYZE WILDLIFE MONITORING CAMERA IMAGES VIA AN ON-LINE DATABASE**

Daniel Carlozzi '13

Faculty Sponsor: Scott Smedley

Composting is an increasingly popular means of disposing household kitchen waste. It is thus important to understand how it affects the ecology of scavenging wildlife. Our study uses remote wildlife monitoring cameras to record what animals visit compost piles or varying composition. These include near-video cameras that are useful for recording behavioral data, but which produce datasets that are much too large (> 500,000 images to date) to be reviewed solely by members of our lab.. As a solution, we have turned to citizen science to get a large pool of contributors to help analyze these images. We conducted a pilot study, which found that citizen scientists are able to categorize images accurately (94%), when compared to benchmarks categorizations produced by members of our lab. To increase the rate of image categorization, we have recently turned to Trinity College students in two courses. This has dramatically increased the number of categorized images. The total number of categorizations is approaching 70,000, and the number of images that have been independently categorized by five people and that are agreed upon (i.e., reached an agreement threshold of  $\geq 80\%$ ) is approaching 11,500. We were able to maintain the interest of users through Facebook site (highlighting our citizen science results and popular press coverage of relevant ecological research) and other incentives, including the formation of teams of users that compete in a game to accurately categorize the greatest number of images.

### 4.

#### **A Q TO A NEW QLUSTER: PHANTOM TALES OF MYCOBACTERIOPHAGE EVANESCE**

James D. Cescon '16, Ricky M. Churchill '16, Mike Cuoco '16, Kate Giddens '16, Frankie Jenney '16, Meghan Keleher '16, Albert Kiladjian '16, Tori Larson '16, Shelby Labe '16, Katherine McArthur '16, Galen V. Polise '16

Faculty Sponsor: Hebe Guardiola-Diaz

Mycobacteriophage are viruses that infect bacteria belonging to the *Mycobacterium* genus. *M. smegmatis* is the common bacterium used in Phage Hunt because it is non-pathogenic and fast growing. It is in the same genus as *Mycobacterium tuberculosis*, which causes an infectious, and often lethal disease known as tuberculosis (Hausler, 2006). The Phage Hunt experiments can help us learn about *M. tuberculosis* and information discovered could aid in better understanding, treating, or even curing, tuberculosis. Students at Trinity college isolated mycobacteriophage species and purified their respective genomic DNA. The Evanesce mycobacteriophage was chosen for sequencing and analysis. What separated Evanesce from the other phages in our program were its TEM micrographs. When attempting to photograph this phage with the Transmission Electron Microscope, the tail of Evanesce seemed to disappear into thin air as the micrograph was taken. Because of this it was very difficult to obtain a defined photo of the phage. The mysterious disappearing of this tail is how Evanesce obtained its name. Until this year, Giles was a singleton, the only member of the Q cluster.

With the discovery of phages Evanesce, HH92, and OBUpride, the Q cluster contains four mycobacteriophages. Evanesce is a Q cluster bacteriophage that has a total of 53,746 base pairs and is comprised of 81 genes. Evanesce has no translational frameshifts or tRNA as other phages do. The GC content is 67.4% which is similar to the comparable phage, Giles.

## 5.

### **THE FUNCTION OF TYROSINE RECOMBINASE IN MYCOBACTERIOPHAGE EVANESCE**

Albert Kiladjian '16, Michael S. Cuoco '16

Faculty Sponsor: Hebe Guardiola-Diaz

Temperate bacteriophage species utilize site-specific recombination proteins called integrases to enter lysogeny in their respective host bacterium. Integrases have the ability to recognize and recombine at a bacterial genome site (*attB*) and a phage genome site (*attP*). There are two distinct families of integrases: tyrosine recombinases and serine recombinases. It appears that Evanesce, a novel bacteriophage isolated by a Trinity College scholar, was found to hold a gene for a tyrosine recombinase, a likely characteristic of Cluster Q members. It is theorized that integrases originated through mutations in retained DNA with no function, eventually resulting in a fully-functioning gene. Due to their many natural advantages these novel genes become highly conserved. Integrases permit phage to lie dormant in a bacterial host's genome in the form of prophage DNA; less than preferable conditions for survival are avoided. Interestingly, Evanesce's integrase-coding gene lies in the left-arm of its genome among genes that code for structural proteins. This peculiar positioning parallels that of Giles; from the obscure positioning, inferences regarding Evanesce's intriguing plaque morphology will be made.

## 6.

### **DUAL FUNCTIONS IN GENES INVOLVING RECOMBINATION DIRECTIONALITY FACTORS AND DNA REPLICATION OF MYCOBACTERIOPHAGES**

Shelby Labe '16, Meghan Keleher '16, Kate Giddens '16

Faculty Sponsor: Hebe Guardiola-Diaz

The mycobacteriophage BxB1, has one gene with two functions: recombination directionality factor (RDF) and phage DNA replication. When a gene's function is an RDF, it controls the directionality of integrase-mediated site-specific recombination reactions. These genes are required to direct the reaction towards excision and to prevent reintegration of the prophage genome when entering a lytic cycle. RDF genes are small and some even overlap adjacent integrase genes, so it is easy for them to escape annotation during analysis of the nucleotide sequence. When a gene has the function of replication, it is required for lytic growth. In an A cluster phage, Bxb1, gene 47 has a known function of both replication and RDF. In a Q cluster phage, Giles, gene 30 is a known RDF, but is not required for replication. In the experiment, Bxb1 was mapped with two Q cluster phages, which showed no alignment with gene 47. When Bxb1 was mapped with L5, a Cluster A phage, there was a similarity between gene 47 in BxB1 and gene 54 in L5. When Bxb1 was compared with another Cluster A phage, Whabigail7, it was found that gene 57 of Whabigail7 was similar to gene 47 of Bxb1. This means that it is possible that the gene with two known functions could be present in all Cluster A phages.

7.

### **TRANSLATIONAL FRAMESHIFTS IN EVANESCE**

Tori Larson '16

Faculty Sponsor: Hebe Guardiola-Diaz

In several phages, there appears a phenomenon which is called a translational frameshift. Translational frameshifting is an alternative process of protein translation where the reading frame shifts by one or two nucleotides and results in the production of proteins required for tail assembly. This phenomenon plays a key role in the exploration of the phage Evanesce and its Q cluster for Evanesce has a phenomenon of its own and translational frameshifting is a possible explanation for it. When EM pictures of the Evanesce phage were attempted, the phage's tail would disappear just before the EM picture could be taken. A possible reason for this disappearance could be that this phage does not contain a translational frameshift. The absence of the translational frameshift may possibly explain the disappearance because frameshifting aids in the production of tail assembly, so without this process the tail might not be assembled correctly and would therefore lead to its disappearance. This lack of a translational frameshift was found to be true when the Phamerator map and the coding potential of Evanesce did not show any signs of a shift. Also, when Evanesce was compared to its fellow Q cluster members, they too were found to not contain translational frameshifts. Through these investigations, the mystery of the disappearing tail of Evanesce moves closer to being explained with the help of the phenomenon of translational frameshifts.

8.

### **ILLEGITIMATE RECOMBINATION AND MOSAICISM IN MYCOBACTERIOPHAGE EVANESCE**

Galen Polise '16, Frankie Jenney '16, Katherine McArthur '16, JD Cescon '16

Faculty Sponsor: Hebe Guardiola-Diaz

Although the genotypic and phenotypic characteristics of organisms vary greatly across the many species of the world, their genetic information is united by a single common theme: mosaicism. We call genomes <sup>3</sup>mosaic<sup>2</sup> because they are collections of DNA segments which have been derived from contemporary and ancestral individuals. There are presently two hypotheses concerning how mosaicism came to be: homologous recombination, and illegitimate exchange. In the illegitimate exchange model, the viral DNA of the bacteriophage undergoes recombination events with the bacterial DNA of the host. Most of the resulting genomic information is impotent, due to the fact that this genomic <sup>3</sup>trash<sup>2</sup> produced is often too large for packaging in capsids or lacks necessary genes. Natural selection is the refining agent that selects for the recombinant types that maintain biological feasibility. The recombination sites which surface most often in the biologically-compatible offspring tend to be the joints between genes the boundaries that have limited impact on genome viability. An instance of illegitimate recombination is shown in the mycobacteriophage Evanesce at the right end of the genome with its bacterial host *M. smegmatis*. This important discovery provides conclusive evidence of the illegitimate recombination between bacteriophage and their bacterial hosts contributing to a unique and highly mosaic genome.

## **9.**

### **A SERRATE MINIGENE GENERATES CELL AUTONOMOUS INHIBITION OF NOTCH**

Tayoot Chengsupanimit '13

Faculty Sponsor: Robert J. Fleming

The Notch cell signaling pathway is a highly conserved juxtacrine pathway present in most metazoans and is composed of the Notch receptor and two ligands, Serrate and Delta. Previous research has shown that different Epidermal Growth Factor-like repeat domains (ELRs) along the Serrate ligand can be assigned to roles in activation and/or inhibition of Notch. A novel mutant of the Serrate ligand, the Serrate “minigene”, has ELRs 7-14 and part of the cysteine-rich region knocked out and shows an exclusively inhibiting effect on Notch. In order to characterize the autonomy of this mutant form of Serrate, a heat shock promoter coupled to a flip recombinase gene was used along with the GAL4/UAS system to create mosaic animals containing clones of cells expressing the Serrate minigene. Larval stage wing margins of mosaic individuals were examined after heat shock to determine the extent of Notch inhibition by clones of cells expressing the Serrate minigene. The Serrate minigene appears to act autonomously and its inhibition of Notch is not affected by Fringe, a glycosyltransferase that normally prevents Serrate from activating Notch.

## **10.**

### **ANALYSIS OF TRENDS IN GROUP SIZE OF COMMON WINTER BIRD SPECIES IN CT**

Xiaomeng Deng '16

Faculty Sponsor: Joan Morrison

Non-Trinity Sponsor: Project FeederWatch, The Cornell Lab of Ornithology

Bird behaviors are useful indicators of their environment. In Project FeederWatch, sponsored by the Cornell Lab of Ornithology, participants report their observations of bird species observed at feeders across North America. These data help scientists keep track of winter birds' distribution and abundance. We participated in Project FeederWatch by observing birds at a hopper feeder on Trinity's campus from mid-February to late-April, 2013 and then submitting our data to Project FeederWatch. We also obtained data from Project FeederWatch for north cardinal, house finch, American robin, song sparrow, mourning dove, house sparrow, dark-eyed junco, black-capped chickadee and tufted titmouse. These data represented observations at feeders throughout Connecticut from 1988 to 2011. Linear regression analysis was performed for all species over this time period to determine whether there is a trend (either increase or decrease) in group size of each species at feeders. We found that average group sizes of many bird species at feeders are declining.

## 11.

### **LOOKING FOR EVIDENCE THAT THE PHOTOSYNTHETIC PSBO GENE HAS BEEN HORIZONTALLY TRANSFERRED TO THE GEONOME OF THE SACOGLOSSAN *ELYSIA CRISPATA***

Jake Gallagher '13

Faculty Sponsor: Kathleen Archer

*Elysia crispata* belongs to a group of sea slugs, the sacoglossans, that sequester and maintain photosynthetically functional chloroplasts from the algae that they feed upon. This is of interest because animals do not possess the proper genetic material which is necessary for photosynthesis of a chloroplast. We investigated the possibility that horizontal gene transfer (HGT), the transfer of genetic material from one organism to another, has occurred between these sea slugs and their algal food source. Cesium purified *E. crispata* DNA was used to transform *E. coli* DH5a cells and a genomic library was plated. In progress, the library will be probed for the presence of the psbO gene, an essential gene for photosynthesis, with a light sensitive DIG hybridization technique. If probe detects clones for psbO, they will be sequenced. Sequencing of these clones will hopefully reveal if the adjacent region to the psbO gene is of algal or animal origin. The composition of the adjacent region will indicate whether the psbO gene arrived from HGT or the presence of algal nuclear DNA within the *E. crispata* cell.

## 12.

### **THE EFFECTS OF INCREASING CALCIUM CHLORIDE CONCENTRATIONS ON *CHLORELLA* PRIMARY PRODUCTION**

Margaret Georgevits '13, Heather Loring '15

Faculty Sponsor: Craig Schneider

Salinity is an important abiotic factor in aquatic environments that can affect the chlorophyll a content and therefore the growth rates, of resident algal species. During the winter months in New England, calcium chloride, CaCl<sub>2</sub>, is spread on roads to act as an ice-melting agent. Run off from the roads spreads the CaCl<sub>2</sub> into nearby bodies fresh water and can alter the salinity of these environments. Calcium is known to be a secondary messenger in promoting plant cell growth and has an antagonistic relationship with the growth inhibitor, auxin. This suggests that the addition of Calcium as CaCl<sub>2</sub> will induce growth in *Chlorella* sp. (Chlorophyta).

The effect of increasing CaCl<sub>2</sub> salinities on *Chlorella* chlorophyll a content was tested over the course of seven days in order to gain insight on the effect its addition to roads in the winter has on the environment. The results indicated a significant difference in chlorophyll a content between *Chlorella* grown in 2 ppt and 8 ppt, and between 4 ppt and 8 ppt. These results suggest that salinities of 8 ppt are the most beneficial for *Chlorella* growth. Additionally, deviating away from this specific salinity does not diminish the growth of *Chlorella*, but instead suggests a larger range in which *Chlorella* is capable of growing.

### 13.

#### **EFFECT OF SOCIAL INTERACTIONS ON CHIRPING BEHAVIOR IN ELECTRIC FISH, *APTERONOTUS LEPTORHYNCHUS***

Tasmerisk Haught '15, Heather Loring '15

Faculty Sponsor: Kent Dunlap

*Apteronotus leptorhynchus* is a gymnotiform electric fish, which communicates and navigates its surroundings through continuous electrical discharges from their electric organ (EOD). Brief (15-30ms) modulations of the sinusoidal wave produced, known as chirps, are communication signals generated by a pre-pacemaker nucleus in the midbrain. Chirps are observed during aggression and courtship, forms of social interaction that have shown to induce neurogenesis. From previous experiments, it is known that paired fish exhibit more neurogenesis than isolated and artificially stimulated fish. In this experiment, the behavioral effects of different groups were analyzed to further clarify the relationship between chirping behavior and neurogenesis. We determined chirp rate in three treatment groups: fish housed in isolation, fish housed with one other fish, and fish stimulated by artificial sine waves produced by a function generator, mimicking electrocommunication signals of another fish. Through this experiment, it was shown that the presence of another fish increased chirp rate when compared to both function generator stimulated fish and isolated fish. Fish stimulated artificially produced fewer chirps than paired fish but more chirps than isolated fish. Together with previous studies focusing on social interaction and neurogenesis, our data indicates that fish with moderately elevated chirping levels do not necessarily show enhanced neurogenesis, but fish with the greatest level of neurogenesis show the greatest chirping rates.

### 14.

#### **BLOCKING CELL DIVISION DURING SEGMENTATION IN RED FLOUR BEETLE**

Sara Khalil '15

Faculty Sponsor: Terri A. Williams

Segmentation is a key feature of arthropods and the process by which segments form has been well studied in the model system, the fruit fly *Drosophila*. However, in *Drosophila* segmentation occurs simultaneously. By contrast, most arthropods do not add segments simultaneously. Instead, segments are formed sequentially from the posterior region called the growth zone. The growth zone plays a role in directing the formation of repetitive identical units or segments. Although the growth zone must elongate for additional segments to form, little is known about exactly how elongation occurs. Elongation is generally hypothesized to be controlled by cell division occurring in a growth zone. *Tribolium castaneum*, commonly known as red flour beetle, is a non-drosophilid arthropod that undergoes a process of elongation that differs from that of the generalized *Drosophila* model system. Hydroxyurea (HU) can block DNA replication in the cell cycle. We tested whether HU would block cell division in *Tribolium castaneum*, in order to determine if growth zone elongation depends on cell division. If germ band elongation is observed despite having successfully blocked cell division, then this would indicate that elongation can occur without cell division. Segment formation in other major taxa such as vertebrates and annelids involves the presence of a growth zone. Studies of development of the growth zone in arthropods can help us determine whether there was a single ancestral origin of segmentation.



## 15.

### **FETAL MEMBRANE MORPHOGENESIS OF CORN SNAKE (*PANTHEROPHIS GUTTATUS*) THROUGHOUT DEVELOPMENT**

Weston Klimas '13

Faculty Sponsor: Daniel Blackburn

In my research I am using light and Transmission Electron Microscopy (TEM) to observe changes in the developing fetal membranes of *Pantherophis guttatus* (Corn Snake). Through development, fetal membranes that line the inside of the eggshell change in order to meet the needs of the growing embryo. Fetal membranes provide a means of respiration via the chorioallantois and water uptake from the environment presumably occurs via the omphalopleure. It is also believed that both membranes function in calcium uptake from the eggshell through an unknown method. My observations in the ventral region of the eggshell have shown the isolated yolk mass becomes decreases in size through replacement by allantois, and the ectodermal cells become reduced. Within the dorsal region, chorioallantois increases in vascularity and the blood vessels have been brought closer to the eggshell due to shrinking of ectodermal cells. In both of the regions, ectodermal cells bordering the eggshell have a large concentration of mitochondria, Golgi apparatuses and endoplasmic reticulum suggesting a high level of metabolic activity. Dark granules have also been observed, but their contents and function are unknown.

## 16.

### **THE EFFECT OF mTOR INHIBITION IN OLIGODENDROCYTES ON CELL PROTEIN AND LIPID COMPOSITION**

Christina McGuire '13, Michael McQuiston '16

Faculty Sponsor: Hebe Guardiola-Diaz

Myelin, a lipid and protein-rich membrane in the nervous system, engulfs the axon of a neuron forming a sheath around it. This sheath is essential for homeostatic neuronal function, and its synthesis is dependent on the various biochemical changes occurring in oligodendrocytes throughout differentiation. In an effort to further understand the PI3K/Akt/mTOR pathway and its involvement in proper oligodendrocyte differentiation, the protein kinase mTOR, a protein complex known to regulate ribosomal production of proteins, was inhibited. Additionally, endoplasmic reticulum (ER) stress was chemically induced, as it has been suggested that ER stress inhibits the mTOR pathway. Western blotting techniques were used to detect the presence of UDP-galactose:ceramide sulfotransferase (UGT8) and cerebroside sulfotransferase (GAL3ST1), proteins involved in the production of ceramides and sulfatides, while lipid extraction methods were used to quantify ceramides and sulfatides present. Malfunctioning antibodies meant that western blotting was not a viable option for quantifying UGT8 and GAL3ST1. Results previously obtained in the lab from lipid detection suggest that mTOR inhibition has a negative effect on lipid levels in oligodendrocytes. Preliminary results from our experiment similarly indicate a decrease in lipid content due to ER stress. This experiment may provide insight into much needed information on the PI3K/Akt/mTOR pathway and how it relates to ER stress. In addition, more can be learned about the biochemical pathways that control the biochemical changes in oligodendrocytes through the maturation process.

17.

**AN EXPERIMENTAL STUDY OF STONE WALL USE BY FOREST ANIMALS IN CONNECTICUT**

Pierre Plath '13, Billy Watts '13

Faculty Sponsor: Scott Smedley

Humans have had a profound effect on the natural world. Beginning in the 17<sup>th</sup> century, stone walls have been a man-made fixture of New England forest landscape. Anecdotally, it has been noted that wildlife frequent stone walls; however, no experiment has been conducted to test this claim. The purpose of this experimental study is to determine whether or not animals have a preference for these particular man-made structures versus other features in the surrounding environment. To determine this, we employed a block design using wildlife-monitoring cameras. Each block was composed of three cameras: one focused on a stone wall (treatment), another on a wall-like wooden structure (substrate control), and a third on an open area of forest floor (blank control). There were two near blocks, designed to detect the presence of smaller animals, as well as two far blocks, designed to detect the presence of larger animals. This on-going experiment is underway at a forested field site in Andover, Connecticut. We here present data from October 10, 2012 through April 6, 2013. We used a chi-square goodness of fit test within each experimental block to determine if the treatment had an effect. All four blocks showed a significant treatment effect with the greatest number of encounters at the stone walls ( $p \leq 0.05$ ). This suggests that animals do show a preference for stone walls in comparison to the substrate and blank. This is consistent with forest wildlife using stone walls as means of transit, foraging sites, cover/nesting sites, and as perches. Our ongoing study will allow us to examine seasonal differences in stone wall use. Expanding the study to different habitats such as open fields would be informative.

18.

**INTERFERRING WITH THE NORMAL GROWTH OF A CRUSTACEAN: EFFECT OF CELL CYCLE INHIBITION ON THE CELL DIVISION AND SEGMENT PATTERNING IN FAIRY SHRIMP**

Niranjana Pokharel '15

Faculty Sponsor: Terri A. Williams

Segmentation is a key feature of arthropods, the phylum with greatest number of species. We know in some detail how segments develop simultaneously in the model system, the fruit fly, *Drosophila*. However, almost all arthropods do not develop their segments simultaneously but use a posterior growth zone to add them sequentially. To understand and establish a model of sequential segmentation, we have been studying the crustacean *Thamnocephalus platyrus*. *Thamnocephalus* add segments sequentially from the posterior region, called the growth zone. Previously we found that, although the size of growth zone decreases as more segments are added, the initial growth zone is insufficient to form all adult segments. To understand expansion of the growth zone, we examined the role of cell proliferation. We tested cell cycle inhibitor, hydroxyurea and visualized cell division using phosphorylated histone-3 antibody. We found that hydroxyurea significantly reduces cell division. To test the role of cell division in growth zone elongation, animals were exposed to hydroxyurea during segmentation. We observed shorter larvae compared to the control group, suggesting that cell

proliferation is important for elongation of animals. We hypothesized that the normal elongation of the animals would be slowed down by inhibitor when larvae are exposed to a pulse of inhibitor followed by normal growth. Contrary to the expected results, larvae quickly recovered from the inhibition, with body length and segment number like that of the control group. Surprisingly, segments formed during inhibition showed patterning abnormalities. We observed irregular segments between regular segments in the anterior and the posterior region. The results suggest that cell division not only expands the field of cells that will eventually form segments but also plays some role in normal segment patterning.

**19.**

### **TISSUE MORPHOLOGY AND FUNCTION IN *NERODIA SIPEDON* AND *MABUYA MABUYA***

Matthew Tesone '13

Faculty Sponsor: Daniel Blackburn

Placental tissue function plays an important role in fetal development in squamate reptiles. Viviparity is a continuously evolving trait that has already evolved over 160 times among vertebrates. This study examines morphology of various placental tissues in the Brazilian lizard *Mabuya mabouya* and the water snake *Nerodia sipedon*, and how structural features of these squamates contribute to tissue function. The species vary in such features as interdigitation of fetal and maternal tissue, uterine glands, secretory cells, and vascularization, reflecting how different placentas function in gas exchange and nutrient uptake.

## **CHEMISTRY**

**20.**

### **SYNTHESIS OF $\gamma$ -CARBOXYGLUTAMIC ACID**

Lauren Aber '13

Faculty Sponsor: Richard Prigodich

The focus of this project is to find a new method of synthesizing a modified amino acid,  $\gamma$ -carboxyglutamic acid. There are three published methods. We are trying to develop a more efficient synthesis. The first step of this synthesis is to produce 2-allyl-di-tertbutyl-malonate. In this first reaction different bases and solvents were used along with varying molar equivalences of reagents and bases. The goal of this investigation was to optimize the formation of the desired product without producing the double addition side product. The reaction that produced the most product used one equivalent of sodium hydride in THF to react with di-tertbutyl-malonate. Allyl bromide was added after a specified amount of time. The reaction is monitored by GC-MS and  $^1\text{H}$  NMR. The second step was to oxidize the 2-allyl-di-tertbutyl-malonate to an aldehyde with a catalytic amount of ruthenium (III) chloride and two equivalents of sodium periodate to produce 2-methylenecarbaldehyde-di-tertbutyl-malonate. The presence of the aldehyde was confirmed using proton  $^1\text{H}$  NMR. The third step is to react the aldehyde in benzene with aminodiphenylmethane and sodium sulfate. This reaction conditions are currently being optimized and  $^1\text{H}$  NMR and GC-MS are being used to monitor this reaction. The final step is a

Strecker-type reaction facilitated by a Jacobsen-type chiral catalyst. This reaction is currently being studied.

21.

### EXPLORATORY BIOASSAY STUDY OF *SENNA ALATA*, AND *NEUROLAENA LOBATA* WITH *E. COLI* AND *S. AUREUS* CULTURES

Ashish Adhikari '13

Faculty Sponsors: Timothy Curran, Lisa Ann-Foster, Michael O'Donnell, Scott Smedley, Kent Dunlap, Milla Riggio, Trinity-in-Trinidad Program.

Non-Trinity Sponsor: Cristo Adones (*specimen collection*)

*Senna alata* and *Neurolaena lobata* are plants from Trinidad widely used in many homeopathic remedies to combat constipation/irritation, and infections. The presence of sennosides in the leaves and pods of *S. alata* has been validated. However there is also evidence to support the presence of numerous secondary metabolites that are known to have antibacterial antifungal, antimycobacterial and anticancer properties. An exploratory bioassay was conducted on CH<sub>3</sub>OH, H<sub>2</sub>O, CH<sub>2</sub>Cl<sub>2</sub>, and diethyl ether extracts of the plant using *E. coli*, and *S. aureus* strains grown on nutrient agar and blood agar plates respectively. The punch hole method was used to test for antibacterial activity. *Please note: The results are pending at the time of abstract submission. They will be present for the presentation.*

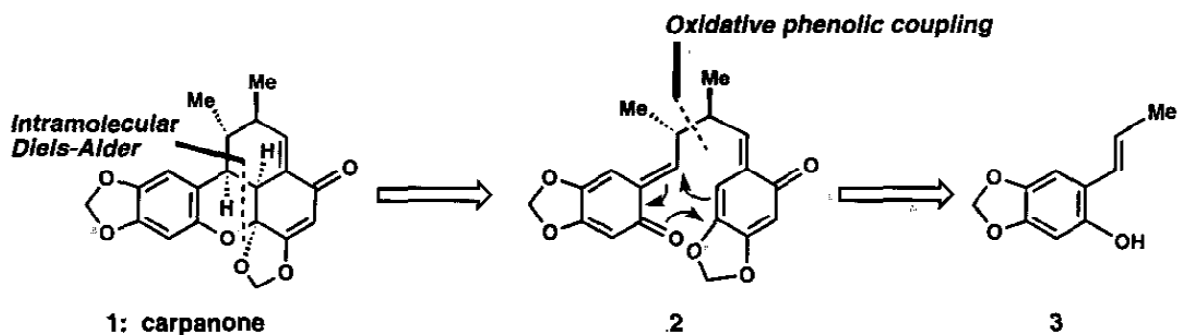
22.

### CARPANONE

Shawna Berk '13

Faculty Sponsor: Cheyenne Brindle

The structure of carpanone was revealed in 1969 by Australian scientists and made synthetically by Chapman et al only two years later. The synthesis was accomplished in only two steps generating five contiguous stereocenters and two new rings. Chapman recognized that a late stage symmetry-breaking step would allow the synthesis to be simplified to the union of two identical much less complex starting materials. This key insight led to the completion of the complex target, carpanone, in only two steps and in 46% yield overall yield.



23.

### PREPARING PEPTIDE DERIVATIVES OF 2-ETHYNYLANILINE

Shawna Berk '13

Faculty Sponsor: Timothy Curran

Peptide derivatives of 2-carboxy-2'-aminodiphenylacetylene can act as beta-sheet models. These derivatives can be prepared using a Sonogashira reaction between an acylated form of 2-ethynylaniline and an acylated form of 2-iodobenzoic acid. One difficulty in the synthesis is acylation of the ethynylaniline. Accordingly the reaction of 2-ethynylaniline with various activated forms of Boc-Val-OH was investigated. The best yields of Boc-Val-ethynylaniline were obtained when the symmetrical anhydride (Boc-Val-O)<sub>2</sub> was used. To add additional amino acids, the Boc group was carefully removed under acidic, non-aqueous conditions. The resulting amine salt was then reacted with Fmoc-Ala-OSu to yield Fmoc-Ala-Val-ethynylaniline. Current work is focused on reacting Fmoc-Val-Ala-ethynylaniline with peptide derivatives of 2-iodobenzoic acid in a Sonogashira coupling to yield the diphenylacetylene beta-sheet model. In the presentation details about this work will be given.

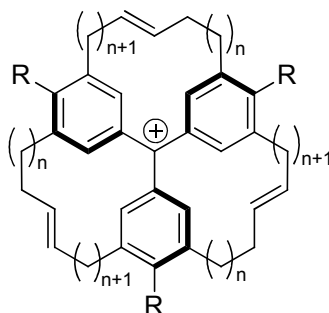
## 24.

### DESIGN AND SYNTHESIS OF CHIRAL TETHERED C3-SYMMETRIC TRIARYLMETHYL CATIONS FOR USE AS CATALYTIC ELECTROPHILE ACTIVATORS

Mark Chesson '13

Faculty Sponsor: Cheyenne Brindle

In-depth research and design of effective catalytic electrophile activators has been explored extensively using both Brønsted and Lewis acid activators, including the use of chiral, C2-symmetric activators to great effect. Less studied is the related C3-symmetric catalyst. Triarylmethyl cations have been explored primarily in the area of physical organic chemistry, but the synthesis and resolution of an enantiomerically pure triaryl methyl cation for use as a chiral catalyst has not yet been explored. One issue that must be addressed before these cations can be utilizing for enantioselective catalysis is low barrier to racemization. One way in which the racemization process can be prevented is by tethering the aryl groups together covalently. Current efforts are directed at the synthesis of these tethered cation precursors.



## 25.

### OVERMAN'S TOTAL SYNTHESIS OF STRYCHNINE

Mark Chesson '13

Faculty Sponsor: Cheyenne Brindle

Strychnine is a highly toxic substance used primarily as rat poison. Discovered in 1818 by Pelletier and Caventou, the first total synthesis of strychnine was completed in 1954 for Woodward. Several additional research groups would go on to publish their own total syntheses of strychnine: examined here is the synthesis accomplished by Overman. Presented are the steps

of Overman's total synthesis of strychnine, a mechanistic examination of the synthesis' key steps, and an NMR analysis of an important intermediate.

**26.**

### **SOLVENTS FOR PREPARATION OF TUNGSTEN BIS-ALKYNE COMPLEXES**

Lauren Davidson, '16

Faculty Sponsor: Timothy Curran

Tungsten bis-alkyne complexes involve attaching two alkynylpeptides to a tungsten center. In order to create a metallacyclicpeptide two alkynes in the same molecule are attached to the tungsten center. These reactions were previously conducted in refluxing methanol. However, methanol may not be the best solvent for these reactions, because the bis-alkyne complexes may be reacting with the methanol, thereby causing the synthesis to yield small amounts of product, or to fail. This research seeks to answer the question of whether tungsten bis-alkyne complexes can be better prepared in a solvent other than methanol. To probe this question, the reaction to form the tungsten bis-alkyne complexes will be performed in various refluxing solvents, and then the product will be analyzed for purity. The work completed so far is as follows. First, the alkyne component was made and analyzed by thin layer chromatography, mass spectrometry and NMR spectroscopy. Then, separately, the initial tungsten complex,  $W(CO)_3(dmtc)_2$ , was made. With heat, the two components were reacted in different solvents. In order to analyze the products for purity, thin layer chromatography, flash chromatography, and NMR spectroscopy were utilized. Toluene proved to be viable solvent for the preparation of tungsten-bisalkyne complexes, because the complex was successfully synthesized in toluene.

**27.**

### **PROBING RIGIDITY IN CYCLIC TUNGSTEN BIS-ALKYNE COMPLEXES**

Woojung (OJ) Ji '15

Faculty Sponsor: Timothy Curran

In previous work by Lawrence a dialkynylamide was prepared by acylation of 1,1'-ferrocenedicarboxylic acid with propargylamine. This dialkynylamide was then coordinated to tungsten to form a cyclic bis-alkyne complex. Unlike other cyclic bis-alkyne complexes which have been found to be conformationally flexible, the complex prepared by Lawrence was rigid and only adopted one solution conformation. To define the reasons why this complex is rigid, a new ferrocene dialkynylamide was synthesized by reacting 1,1'-ferrocenedicarboxylic acid with 4-butyn-1-amine using the EDC coupling reagent. The cyclic tungsten bis-alkyne complex was then synthesized by reacting the ferrocene dialkynylamide with  $[W(dmtc)_2(CO)_3]$ . The final product was analyzed by  $^1H$  NMR. The cyclic ferrocene dialkynylamide tungsten bis-alkyne complex was shown to be flexible due to the appearance of multiple peaks for the alkyne hydrogens in  $^1H$  NMR spectrum. Details about this work will be presented.

**28.**

### **RETROSYNTHETIC ANALYSIS AND STRATEGY OF DEVELOPING ISOCOMENE**

Pathik Khatri '13

Faculty Sponsor: Cheyenne Brindle

Isocomene is a naturally occurring sesquiterpene. It was first isolated from the rayless golden rod *Isocoma wrightii*. The structure of isocomene was determined in 1977 and the first total synthesis was described by first described by M.C. Pirrung in 1979. The key steps are a photocatalyzed intramolecular [2 + 2] cycloaddition reaction followed by a rearrangement reaction which forms three contiguous chiral centers, the mechanism of which are well known. Isocomene has a three ring system with four separate stereogenic centers which are of interest. Since 1979, modern total syntheses' have been developed for isocomene.

## 29.

### **SYNTHESIS AND STRUCTURE DETERMINATION OF THE MIXED CRYSTAL HYDRIDE $\text{Eu}_{2-x}\text{Yb}_x\text{RuH}_6$**

Pathik Khatri '13

Faculty Sponsor: Ralph O. Moyer Jr.

Samples of various compositions of the mixed crystal metal hydride,  $(\text{Eu}_{2-x})\text{Yb}_x\text{RuH}_6$  ( $0 \leq x \leq 2$ ), were synthesized from stoichiometric mixtures of  $\text{EuH}_2$ ,  $\text{YbH}_2$ , and Ru powders heated in a hydrogen atmosphere at  $800^\circ\text{C}$ . Powder X-ray diffraction results of the single phase products were indexed on the basis of being a face-centered cubic cell. The unit cell lengths increases linearly with decreasing "x" between the limits  $7.239 \text{ \AA}$  and  $7.558 \text{ \AA}$ .  $\text{EuYbRuH}_6$  was the one composition unable to be synthesized. Infrared analyses of metal-hydrogen bonds of the mixed crystals were inconclusive.

## 30.

### **NMR ANALYSIS OF CAPSAICIN IN SOLVENTS WITH VARIOUS POLARITY**

Richard Kim '13

Faculty Sponsor: Richard Prigodich

Capsaicin is a molecule with both hydrophobic and hydrophilic areas within the molecule with the potential for conformation changes within the structure under various polar conditions. Through a series of proton NMR experiments, the structure of capsaicin was studied in solvents with various polarities. COSY experiments were done to assign the proton peaks correctly for each of the 15 unique protons of capsaicin for each solvent. Finally, series of ROESY NMR experiments were done to analyze the proton to proton spacial interactions to study any potential conformation changes of capsaicin in the solvents.

## 31.

### **RETROSYNTHETIC ANALYSIS OF PENICILLIN V**

David Mallick '14

Faculty Sponsor: Cheyenne Brindle

Since its discovery in the early 1920s, penicillin has become one of the most recognized groups of antibiotics used in the medical field. All penicillins are  $\beta$ -lactam antibiotics, a structural feature that is responsible for penicillin's biological activity. The  $\beta$ -lactam ring was the subject of much controversy and later, headaches, as this structural feature was initially disputed and later was found to be particularly difficult to install, due to the same ring strain and instability in acidic and basic mediums that led some scientists to doubt its existence. No non-biological

synthesis of penicillin existed until 1957 when Professor J. Sheehan produced a successful total synthesis of penicillin V (Figure 1). Although Sheehan's synthesis of penicillin V resulted in a low yield of product, it gave researchers a solution to the challenging problem of  $\beta$ -lactam ring formation. Key steps of this synthesis will be presented, focusing on Sheehan's most groundbreaking contributions.

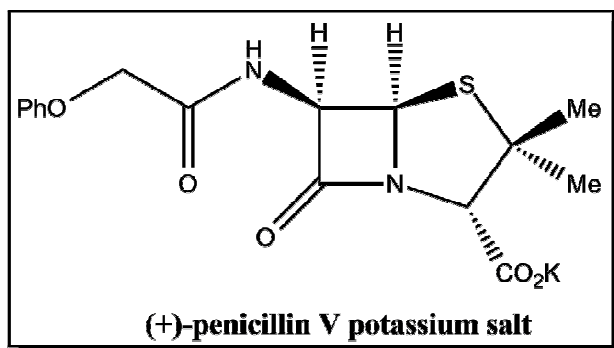


Figure 1: Structure of (+)-Penicillin V Potassium Salt

32.

### CUBANE SYNTHESIS

Mac McCarthy '14

Faculty Sponsor: Cheyenne Brindle

This is an overview of Philip Eaton's 1964 synthesis of cubane,  $C_8H_8$ , the first of its kind. The poster will provide an examination of the most important reactions in the synthesis.

33.

### THE SYNTHESIS OF RAPAMYCIN

Christina McGuire '13

Faculty Sponsor: Cheyenne Brindle

Rapamycin (Figure 1) is a complex macrocyclic ring, originally synthesized within the bacterium *Streptomyces hygroscopicus*. Discovered in the late 20<sup>th</sup> century, it has been found to possess immunosuppressive qualities and is currently in use with organ transplant patients. The chemical synthesis of rapamycin presented a big challenge to organic chemists, but in 1993 Nicolaou et al. succeeded in producing this compound. Because the molecule itself is so large and complex, it is no surprise that its synthetic route requires the use of complex reactions and reagents. Here I will discuss the synthetic route taken by Nicol Stille coupling, the Nozaki-Takai-Hiyama-Kishi, and the Esc due to their interesting chemistry and application in the synthesis of rapamycin.

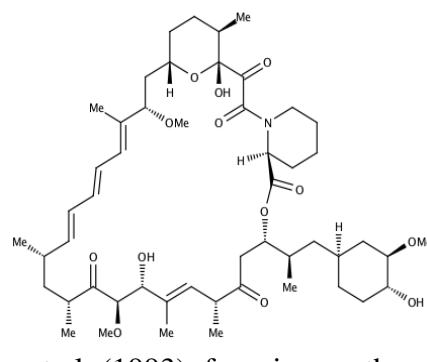


Figure 1: The structure of rapamycin



**34.**

**ANALYSIS OF AMPHETAMINE ANALOGUES USING HEADSPACE SOLID-PHASE MICROEXTRACTION AND IN-MATRIX DERIVATIZATION**

Adamo Miceli '13, David M. Correll '13

Faculty Sponsor: Janet F. Morrison

The current study explores the development of an analytical method based on headspace solid-phase microextraction (HS-SPME) and gas chromatography-mass spectrometry (GC-MS) for the rapid laboratory confirmation of amphetamine, methamphetamine, MBDB, MDEA, PMA, PMMA, MDMA and MDA in oral fluid. In-matrix derivatization with ethylchloroformate was explored. Results of method optimization experiments designed to maximize SPME recoveries of analytes from oral fluid will be presented. Parameters investigated included incubation temperature and time, extraction temperature and time, sample pH, and salting out effects. An internal standard calibration method was developed using matrix-matched calibrators and denatured internal standards. Validation data including limit of detection, limit of quantification, intra- and inter-day calibration reproducibility, and accuracy and precision of quantification for spiked saliva samples will be presented.

**35.**

**CONSTRAINING PEPTIDE STRUCTURE USING TUNGSTEN BIS-ALKYNE COMPLEXES**

Taylor Murtaugh '14

Faculty Sponsor: Timothy Curran

The Curran lab is investigating whether cyclic tungsten bis-alkyne complexes can be used to constrain peptides to particular secondary structures. For this to work, the cyclic tungsten bis-alkyne complex should be limited to one conformation. Unfortunately, many of the cyclic tungsten bis-alkynylpeptide complexes prepared to date are remarkably flexible. However, a recent cyclic tungsten bis-alkyne complex only adopts one solution conformation. A dialkynylamide, prepared by acylation of 1,1'-ferrocenedicarboxylic acid with propargylamine, was coordinated to tungsten to form a cyclic bis-alkyne complex; this complex only adopts one solution conformation. To probe why this complex is rigid, the corresponding dialkynyl diester was prepared and coordinated to tungsten. This dialkynyl diester was synthesized by reacting 1,1'-ferrocene dicarboxylic acid with propargyl alcohol and the coupling reagent, EDC. The ferrocene diester was then reacted with the tungsten complex,  $[W(dmtc)_2(CO)_3]$ , in order to yield the ferrocene diester tungsten bis-alkyne complex. The ferrocene diester tungsten bis-alkyne complex was determined to be rigid based upon the presence of two distinct peaks in the alkyne region in its  $^1H$ NMR spectrum. The implications of this finding with regards to constraining peptide conformations are being considered. Further details will be presented on the poster.

36.

### SYNTHESIS AND APPLICATIONS OF NOVEL C<sub>3</sub>-SYMMETRIC TRIARYL NAPHTHYL CATIONS

David W Pierce '13

Faculty Sponsor: Cheyenne Brindle

One of the main goals of organic chemistry is to develop reactions that improve efficiency and selectivity. In-depth research and design of effective catalytic electrophile activators has been explored extensively using both Brønsted and Lewis acid activators, including the use of chiral, C<sub>2</sub>-symmetric activators to great effect. A C<sub>3</sub>-symmetric triarylmethyl naphthyl cation with a propeller shape would act as a Lewis acid that brings the chiral information into closer covalent proximity to the electrophilic. The synthesis and resolution of an enantiomerically pure triaryl naphthyl cation for use as a chiral catalyst has not yet been explored. One issue that must be addressed before these cations can be utilizing for enantioselective catalysis is a low barrier to racemization. One way in which the racemization process can be prevented is through the use of sterically-hindered groups near the central atom. In particular, the synthesis of a *o*-methyl naphthylmethyl alcohol, which can serve as a precursor to the desired cation, will be described (Figure 1).

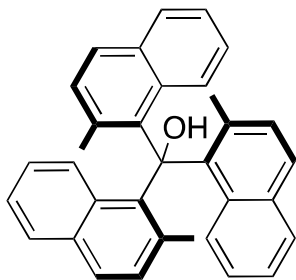


Figure 1: C<sub>3</sub>-Symmetric *o*-Methyl Trinaphthylmethyl Alcohol

37.

### TOTAL SYNTHESIS OF ESTRONE

Michael Rueger '13

Faculty Sponsor: Cheyenne Brindle

Estrone is the least abundant of the natural estrogenic hormones found in human females. Although naturally occurring, estrone is classified by the Occupational Safety and Health Administration as a carcinogen in females and can have various negative side effects in both male and female bodies. The synthesis of estrone by Vollhardt *et al.* is currently the most efficient synthesis of estrone other than its natural biosynthesis. Vollhardt *et al.*'s synthesis utilizes 2-methylcyclopentenone and 1,5-hexadiyne as the starting molecules, which are run in parallel reactions before an enolate alkylation is used to combine the iodide and enolate intermediates into a single molecule. This intermediate then undergoes a cobalt-catalyzed cyclotrimerization, creating benzocyclobutene and estratrienone intermediates. The benzocyclobutene intermediate can be converted into estratrienone via an intramolecular Diels-Alder reaction, which allows for greater product yield as estratrienone is converted to estrone via exposure to trifluoroacetic acid. While the synthesis of estrone is useful, it is the cobalt-catalyzed cyclotrimerization step that has the most potential for future use in helping to synthesize other natural products.

**38.**

**PREPARING BETA-SHEET MODELS WITH DIAMIDE DERIVATIVES OF FERROCENEDICARBOXYLIC ACID**

Edgar Soto '15

Faculty Sponsor: Timothy Curran

The reaction of an organo-metallic reagent, ferrocene di-carboxylic acid, with activated forms of alanine t-butyl ester was investigated. This reaction was undertaken to determine whether a viable beta-pleated sheet model of amino acids could be made in hopes of reacting it with tungsten alkynylpeptide compounds. Current work is focused on isolating the conformational ferrocene diamide via flash chromatography and the analysis of the compounds via <sup>1</sup>H NMR. Once this is done work will proceed in the formation of a bis alkyne conformational complex by reacting the ferrocene diamide with a tungsten complex to yield a beta-sheet model. In the presentation details about this work will be given.

**39.**

**TOTAL SYNTHESIS OF (-)-MENTHOL**

Simon Wei '14

Faculty Sponsor: Cheyenne Brindle

The natural product (-)-menthol is a well-known compound which can be found in many foods and daily products. The retrosynthetic analysis and the Takasago process of synthesizing menthol were both analyzed, with telomerization, asymmetric isomerization and carbonyl ene reaction identified as three key steps. The mechanisms of the key reactions are also included. In order to show the particular stereochemistry (-)-menthol, every hydrogen in the molecule was assigned with <sup>1</sup>H NMR spectroscopy, and a very rare long range coupling between two equatorial hydrogen was revealed.

**40.**

**MASS SPECTROMETRIC CHARACTERIZATION AND SPME/GC-MS DETECTION OF SYNTHETIC PIPERAZINES**

Alexandre Zhang '14

Faculty Sponsor: Janet F. Morrison

Piperazines are a class of synthetic drugs which are often marketed as a legal alternative to 3,4-methylenedioxymethamphetamine (MDMA or 'Ecstasy'). At low doses the piperazines have very similar stimulant effects to MDMA, while hallucinogenic effects may be experienced at higher doses. For this reason 1-benzylpiperazine (BZP) has already been classified as a Schedule I controlled substance under the Federal Controlled Substances Act. Despite their prevalence, there is a lack of analytical data for the piperazines, which has made detection and identification of these compounds difficult.

The goal of this research project is to characterize the mass spectrometric fragmentation of BZP and 1-(3-trifluoromethylphenyl)-piperazine (TFMPP) using liquid injection gas chromatography-

mass spectrometry (GC-MS), and to develop an analytical method based on headspace solid-phase microextraction (HS-SPME) and GC-MS for the detection and quantification of these piperazines in oral fluid.

GC-MS fragmentation data for underivatized, ethylchloroformate-derivatized and trichloroethylchloroformate-derivatized BZP and TFMPP will be presented. Preliminary results demonstrate rapid and efficient piperazine recoveries by HS-SPME, with in-matrix derivatization offering improvements in both chromatographic performance and MS selectivity.

## **COMPUTER SCIENCE**

### **41.**

#### **THE GENERATION AND ANALYSIS OF RATEMYPROFESSOR.COM DATA**

Alexandre Zhang '14

Faculty Sponsor: Saira Kazmi

RateMyProfessor.com has long been used by students to pick their professors before they even pick their classes. Therefore, the data on this site can greatly influence a student's education. The goal of this research project was to generate and analyze the RateMyProfessors.com data for all of the Trinity College professors. The data was manually obtained and preprocessed using the R 2.15.2 environment for Windows 7. The data was then analyzed using the rpart and apriori algorithms. Using the rpart algorithm, ten 10-fold cross validation runs were performed and the results indicated a moderate true positive rate, ranging from 0.10 to 0.67, and a relatively low false positive rate, ranging from 0.08 to 0.30. The apriori algorithm provided a set of 87 rules with support and confidence values of at least 0.50 and 0.095 respectively. These rules showed some expected and unexpected results, such as the initial interest of the student strongly correlated with the helpfulness of the professor and that professors who received more than five ratings were mostly in the non-sciences.

### **42.**

#### **ANALYSIS OF BEAUTIFUL FEATURES ON "BEAUTIFULPEOPLE.COM"**

Vlad Burca '14, Zach Freedman '14

Faculty Sponsor: Saira Kazmi

The goal of the project was to be able to predict whether a user applying to the social platform BeautifulPeople.com will be accepted into the community, or not, based solely on the descriptive features provided by the applicant, and not the uploaded photo. The subjectivity of this task forced us to implement our own decision tree, based on a set of feature attributes that generated the lowest error rate. Given the difficulties caused by the nature of the data set, we created a model that, given a tree depth of 4 attributes, produces an error rate of 48%, and although a more complex decision tree expectedly produce more accurate predictions, we found a particular tree of depth 1 produced the lowest error rate, yielding an accurate prediction 73% of the time.

**43.**

**WARBOT: ONLINE BATTLE-ARENA**

Rahul Chatterjee '13  
Madalene Spezialetti

WarBot is an Online-Multiplayer-Battle-Arena with support for up to 10 players simultaneously. It allows friends to team up as robots and fight an opponent team and to reap the benefits with an in-game gold system that allows the purchasing of upgrades for your weapons to further bring about the enemy's demise.

The aim of this project will be to emulate an industry standard Multiplayer Flash Game with all the necessary implementations required to make it a viable competitor in a real-world market. The tools used in this project will also be that of industry standard IDEs such as Flash from Adobe's Creative Suite and the popular java IDE Eclipse. The features of the game will include multiplayer support, an achievement system, chat rooms to serve multiple clients, robust gameplay and a certain degree of character progression all of which are expected in today's multimedia

**44.**

**CLUSTERING PATTERNS IN HISTORICAL EARTHQUAKE DATA IN SOUTHERN CALIFORNIA**

Philip Cho '15, Megan Chiu '14  
Faculty Sponsor: Saira Kazmi

In this paper, we employ various clustering algorithms to detect patterns in historical earthquake records in the Los Angeles area over the last 100 years. Since seismic activity occurs as tectonic plates rub against one another, we emphasize geographical continuity in clustering decisions. In particular, we use the latitude and longitude coordinates as inputs to the clustering algorithms. We evaluate the algorithms with 1) internal measures such as average cohesion and 2) external data such as fault line distribution. Each cluster captures not only the frequency of earthquake incidents but also their characteristics such as magnitude and depth. We conclude that a density-based algorithm gives a clustering that best captures the distribution of fault lines.

**45.**

**CROSS PLATFORM DATA COLLECTION TOOL WITH CLOUD BASED DATA VISUALIZATION**

Nyi M. Htet '13  
Faculty Sponsor: Ralph Morelli

This project is a cross platform mobile application that addresses the issues of customizable data collection, and data visualization in one application package. The goal of this project is to provide an easy way to create and share custom data forms in order to perform data collection as an individual or group project, and integrate the data visualization component into the data collection process. With just a smart phone or tablet, and a free Google Cloud storage account, data collection can be performed through customizable forms, and the collected data can be

saved on the device. The collected data is then sent to the cloud, and connected to the cloud based data visualization tools. The visualized data can be shared among the users or downloaded and saved onto the device.

**46.**

### **COMPUTER-TECHNOLOGY HELPER**

Pauline Lake '13

Faculty Sponsor: John Ridgway

The Computer-Technology Helper is a digital repository that allows educators to view, edit, create, upload, and comment on teaching materials related to Computer Science and Technology. More importantly, it provides a social space in which educators can collaborate and share teaching ideas. The application also includes membership management that allows for differentiation in user roles and user access. Since there is a lack of Computer Science and Technology in K-12 schools, having a website like the Computer-Technology Helper is a great way to provide educators with access to Computer Science and Technology teaching resources and provide a support system for non-Computer Science educators. The Computer-Technology helper was created using Ruby on Rails along with HTML and CSS.

**47.**

### **HELP ME NOW: A SENIOR PROJECT**

William Laughlin '13

Faculty Sponsor: Madalene Spezialetti

Help Me Now is a help website where users can post jobs, request help, or even make money by helping others. Will Laughlin began Help Me Now about 9 months ago as his senior project and has since developed it into the website it is now.

**48.**

### **MUSE: REDEFINING INTERNET MUSIC CONSUMPTION**

Willem van Daalen '14

Faculty Sponsor: John Ridgway

The Internet has revolutionized content consumption in the twenty-first century for people around the world. One of the challenges the people now face when attempting to find information is not that the information does not exist, but rather that it is located in too many sources, some more trustworthy than others. Additionally, the process of data discovery and recovery has become increasingly time consuming, often negating the benefits gained from the easy access to data provided by the Internet.

Muse is a web application designed to help resolve this problem in the field of music; it provides a single live-feed of new songs customized to each user's preferences. Specifically, muse works by parsing through a wide variety of user-specified websites and extracting song information which is then presented to the user in their feed. Muse also allows users to specify content filters based on song metadata, allowing users to exercise fine-grain control over the songs that appear in their feed. Lastly, muse uses Jaccardian similarity and memory-based collaborative filtering to provide custom recommendations for each user based on trends in their likes and dislikes.

# **ENGINEERING**

**49.**

## **FORMATION OF CLOGS UNDER ULTRASOUND EXCITATION: A MICROFLUIDIC STUDY**

Erin Barney '15, Pratistha Shakya '15  
Faculty Sponsor: Emilie Dressaire

Acoustic waves and more specifically ultrasound are commonly used in microfluidic devices to focus, separate and mix particles. We study the influence of ultrasound on the formation of clogs of colloidal particles in microchannels. In particular we focus on the role played by the flow properties and the characteristics of the acoustic wave (such as its frequency). We show that the ultrasound excitation delays the formation of clogs and rationalize our results with acoustofluidics theory.

**50.**

## **THE CONSTRUCTION OF ELECTRODES AND THE PERFORMANCE OF STEREOTAXIC SURGERIES TO TEST THE EFFECTS OF STRESS ON RODENT BRAINS**

Alison Callegari '14, Yun Gong '15, Nijel Hill '15, Georgia McAdams '14, Joanna Wycech '14  
Faculty Sponsor: J. Harry Blaise

Neonatal stressors such as isolation are known to have an effect on long-term potentiation in rodents. In the electrophysiology lab at Trinity College the synapse from the perforant path to the dentate gyrus is being studied. In order to conduct this research, three types of electrodes were built and surgically implanted into the rodents' brains. The three types of electrodes used are: noise reducing ground electrodes implanted in the cortical surface, stimulating bipolar electrodes implanted in the perforant path, and monopolar recording electrodes placed in the dentate gyrus. Rodents were anesthetized and placed in a stereotaxic surgical frame in order to surgically implant the electrodes into the respective brain locations. The brain signals were viewed using an oscilloscope. A week after surgery electrophysiological tests are performed and signals are recorded. These methods will be continued to be used in further research.

**51.**

## **AUTONOMOUS QUADROTOR**

Nick Guzman '13, Roarke McCormick '13  
Faculty Sponsor: David Ahlgren  
Non-Trinity Sponsor: Travelers Insurance

The objectives of this senior capstone project were to design, build and operate a small-scale quadrotor. Quadrotors are four-motor aerial vehicles which were first developed in the 1920's.

Widespread use has begun only in the last decade and has achieved popularity in unmanned aerial vehicle (UAV) research. Properly designed quadrotor platforms are capable of 3-D movement which allows for mission profiles unsuitable for other aerial vehicles. A materials selection process determined the frame design and hardware selection. Energy calculations and dynamics were simulated to predict the performance of the quadrotor. Sensor readings from an accelerometer, gyroscope and barometer were input into PID control loops regulating motor thrust to maintain stability of the system during flight. The system was implemented via an Arduino Mega 2560 microprocessor. An autonomous hovering routine was developed to demonstrate the viability of the project.

**52.**

**DEVICE FOR ON-SITE MANUFACTURE OF STERILE WATER FOR INJECTION IN A DISASTER ZONE**

Jeff Hebert '13, Chislon Richardson '13

Faculty Sponsor: J. Harry Blaise

Non-Trinity Sponsor: Joseph McIsaac, MD, MS

This project sought to design and produce a device for the on-site manufacture of sterile water to be subsequently used to produce IV fluid in disaster zone. In order to accomplish this, the water produced must be sterile, non-pyrogenic, and satisfy the United States Pharmacopeia (USP) standard for water for injection (WFI). Furthermore, the device should ideally be low powered, low cost, robust yet portable, and deliver at least 10 liters per hour. Our design incorporated purification methods of carbon filtration, reverse osmosis and ultra-violet treatment to successfully produce WFI. However, due to power and cost constraints our device was unable to produce 10 liters per hour. Further improvements should include a more powerful pump, more robust frame structure and a portable power source.

**53.**

**IGNITION STUDY OF SUPERSONIC FREE STREAM JETS USING SHOCK TUBE**

Barok Imana '16, Christian Firsching '15, Binod Giri '15

Faculty Sponsor: John D. Mertens

A puncture or failure of seals may occur in pipes containing pressurized fuels. Because of the high pressure gradient between the pressurized fuel and the surrounding air, the gas jet may ignite due to the formation of a supersonic pressure wave (shock wave) that travels into (and heats) the air. In order to map the different temperatures and pressures at which a variety of fuels will ignite, a double diaphragm shock tube has been designed and built at Trinity College. The shock tube will be used to simulate the environment in pipes containing pressurized fuels by creating a shock wave in its driven section to pressurize the test gas and create a pressure gradient with the surrounding air. This leads to supersonic free stream jets exiting the shock tube into the immediate surroundings which could possibly lead to its ignition as a result of the shock wave. This phenomenon will be analyzed quantitatively to understand the relationship between the various physical parameters and ignition properties of different fuels. The overarching goal of the study is to form a better understanding of supersonic free stream jets and the analytical methods of studying them.



**54.**

**AERODYNAMIC DRAG FORCE**

Khari-Elijah Jarrett '16

Faculty Sponsor: Joseph Palladino

An aerodynamic drag force is the force that opposes motion when an object is traveling through a fluid. This force can be felt while swimming, driving, and while in a plane which makes aerodynamic studies important to designers and manufacturers of vehicles including boats, automobiles, and airplanes. In an effort to analyze the aerodynamic drag forces on objects of varying shapes, a wind tunnel was implemented as a way to simulate the movement of the object through air. A load cell used with a strain gauge and Wheatstone bridge was connected to the object to manipulate the physical force into a signal that could be interpreted. Using scale models, we are able to represent and analyze the aerodynamic drag force on objects and discover which shapes are more aerodynamic.

**55.**

**ULTRASONIC FLAW DETECTION**

John Lehrkind '13, Shraddha Basnyat '13

Faculty Sponsor: Taikang Ning

Ultrasonic flaw detection provides the means to determine the mechanical properties, microstructure, imaging, and microscopy of various substrates. Ultrasound can penetrate through substrates from metals to flesh and bones and detect up to micro cracks based on its frequency and hence is an interesting domain to explore and has applications along various fields. The niche application for this project is non-destructive (through wall) testing to detect termite tunnels. Ultrasonic flaw detection has not been explored much in the home inspection field. Termite inspections have been limited to primitive methods that are mostly not non-destructive and require high manpower and cost. The overall design included analysis of attenuation, crack size and material properties to determine optimal results and signal analysis. Through our research, detection of termite tunnels within wooden structure is now possible through low cost non-destructive testing.

**56.**

**BIOLOID: HUMANOID ROBOTICS**

John Lehrkind '13, Shraddha Basnyat '13, Binod Giri '15

Faculty Sponsor: David J. Ahlgren

This semester Trinity College Robotics Study Team (TCRST) focused a small group of students to research using humanoid robots to perform functional household tasks. This year, TCRST built and programmed Robotis's Bioloid Premium kit to ascend and descend a staircase. Unlike wheeled robots, humanoid robots must move dynamically, transitioning the weight as they move. We tackled this problem by defining several statically balanced positions in the motion of a step.

Throughout the research, dynamic motions were included in the motion files to perform dynamic balance between each statically balanced position. From our research, we have demonstrated dynamic motion with humanoids both in the vertical and horizontal plane.

**57.**

### **DESIGN AND CONSTRUCTION OF A BIOMIMETIC ROBOTIC MUSCLE SYSTEM**

Andrei Marchidan '13

Faculty Sponsor: Joseph Palladino

A mechanical muscle system prototype was designed and built that describes the human upper arm, and uses a novel design for biomimetic muscles. The system includes two pneumatic artificial muscles controlled using a pressure regulator and four solenoid valves. The muscles are built out of latex rubber tubing enclosed in a strong nylon mesh. To achieve the smooth force generation of human muscles, the artificial muscles are pressurized or depressurized using a valve control system. This provides the necessary contraction and relaxation specific to human muscles. The muscles were assembled on a skeletal support system that mimics the upper arm motion, with beams representing bones and pivots representing joints. The arm design was constrained to one degree of freedom for simplicity, allowing 180° rotation around the shoulder pivot in the coronal plane. The control system of the upper arm contains a rotary encoder that feeds back information about the arm's angular position. Based on the feedback inputs, which are processed by computer, the valves are switched on and off to control the pressurization of the muscles and their contraction state. The robotic muscular system is capable of lifting weights of 15 lbs.

**58.**

### **DRAG REDUCTION IN SUPERHYDROPHOBIC PIPES**

Tarah Sullivan '13

Faculty Sponsor: Emilie Dressaire

Non-Trinity Sponsors: NASA, Oceanit

Superhydrophobic surfaces such as the lotus leaf are known for their water repellency. These surfaces also exhibit other fascinating characteristics such as self-cleaning and drag reducing properties and ice-repellency. In this experiment we focus on the drag reducing property of superhydrophobic surfaces in pipes. The pipes are rendered superhydrophobic by the micro and nano asperities of a coating layer. To determine the drag reduction, we conduct experiments by flowing water through pipes at a controlled flow rate and measuring the pressure difference across the pipe. The pressure difference is used to define the slip length, which quantifies the drag reduction. Results show significant drag reduction due to the superhydrophobicity. More specifically, for the flow rates between 0.1 to 1.6 L/min we measure drag reduction values greater than 14%. Our data indicate that this drag reduction depends on the geometry of the surface features and on the Reynolds number of the fluid flow.

**59.**

**PARALLELIZED SOFTWARE ARCHITECTURE ON Q FOR THE IGVC**

Hokchhay Tann '14, Adam Norton '13, Steve Petkovsek '13, Vlad Burca '13,  
Alex Merchen '14, Ben Williams '15, Jiajia Zhao 15, Abhishek Khanal '15

Faculty Sponsor: David Ahlgren

Q is Trinity Robot Study Team's entry to the Intelligent Ground Vehicle Competition (IGVC) at Oakland University in Rochester, Michigan. There are two main challenges at the IGVC, navigation and autonomous. The navigation challenge requires Q to navigate to 8 GPS waypoints in six minutes while avoiding obstacles such as fence and barrels. The autonomous challenge requires the robot to complete an obstacle course circuit within 5 minutes. In this poster, we present the some mechanical systems and the parallelized software architecture employed on Q to compete in the two challenges.

**60.**

**DESIGN AND IMPLEMENTATION OF A WASTE VEGETABLE OIL (WVO) FUEL SYSTEM WITH TEMPERATURE CONTROLLED HEATING FOR A 1985 MERCEDES**

Han Wu '13

Faculty Sponsors: John D. Mertens, Lin Cheng

Waste vegetable oil (WVO) has been recognized as a clean and cheap fuel for diesel engines. However, WVO can only be used if it is heated to approximately 160 to 180 degree F, due to its high viscosity at lower temperatures. In this project, a fuel system was designed and built for a 1985 Mercedes 300SD diesel car to use either WVO or diesel. It uses both engine coolant and electric heating wires for heating WVO. A temperature-controlled switch is used to control the temperature of WVO entering the engine. The heating components were designed and simulated using Matlab, and tested both in the laboratory and on the car. Temperatures of various spots in this system can be monitored through temperature gauges. This new and unique design eliminates the need to run on diesel during warm-up. The whole system has been tested on the car and functioned as desired.

## **ENVIRONMENTAL SCIENCE**

**61.**

**THE EFFECT OF CLEAR CUTTING ON SUB-ALPINE FOREST SOIL NUTRIENTS AND TRACE METALS WITHIN THE WHITE MOUNTAIN NATIONAL FOREST, NEW HAMPSHIRE**

Justin Beslity '15, Daniel Hong '15

Faculty Sponsor: Jonathan Gourley

Non-Trinity Sponsor: Robert A. Colter (Soil scientist from USDA Forest Service, White Mountain National Forest)

Clear-cutting is the most popular and economically profitable method of logging and has been in use for centuries to provide lumber. However, there are several issues with clear-cutting, which involve increased likelihood of erosions, loss of nutrients due to rapid runoff, disruption of habitats and wildlife, and the cost of aesthetic values. In the summer of 2013, commercial logging at three pre-determined sites will be practiced and with a collaboration of Andy Colter from USDA Forest Service, soil samples from A-horizon will be collected at the three sites before and after the clear-cut to see the effects of clear-cutting on the soil. The purpose of this two-year study is to observe and analyze the effect of clear-cutting on soil nutrients, trace metals, nitrogen cations, toxins, and organic material and determining the sufficient baseline concentrations of the tested compounds in order for the forest to grow back over years. Milestone's DMA-80 Direct Mercury Analyzer and ICP will be used to quantify the effects of clear-cutting and GIS to map out the different sites for a visual aid.

**62.**

### **ASSESSING TRACE METAL CONCENTRATIONS IN THE SEDIMENTS OF THE TROUT BROOK, WEST HARTFORD, CT**

Linnea Gotberg '13

Faculty Sponsor: Jonathan Gourley

The Trout Brook is a tributary of the Park River watershed located in West Hartford, CT. The river has been polluted with trace metals due to runoff, deposition, point sources, and various metal finishing facilities located in the area. The focus of this study was to quantify the concentrations of lead, zinc, cadmium, chromium, and copper in stream and bank sediments at sample sites located on the Trout Brook. A previous study (Semrod and Gourley, 2012) sampled directly at, and downstream of, a sanitary sewer outflow (SSO) and concluded that the SSO was a significant source of metal contamination to the river. Our study focused upstream of the SSO to determine if particular trace metals are discharging from the SSO exclusively or are originating from an upstream source. In addition, we wanted to determine if sediment concentrations had changed with time at the SSO. All of our results were compared to sediment quality guidelines (SQG) and probable effect concentrations (PEC). Copper, lead, and zinc fell within the SQG and only copper and lead exceeded the probable effect concentrations. Preliminary sampling results suggest metal levels are less than previously reported and therefore there may be a significant temporal component to bedload sediment trace metal concentrations.

**63.**

### **ANALYSIS OF GROUND TEMPERATURE DATA ON THE TRINITY COLLEGE CAMPUS**

Lia Howard '15

Faculty Sponsor: Jonathan Gourley

Global temperature has been rising for the past 150 years. These increasing temperatures have begun to affect earth's delicately balanced climate and ecosystems. To determine if these global trends have begun to alter our local environment, I analyzed Trinity College's ground temperature data in this study. Underneath the soccer fields on campus there are six probes that measure ground temperature. Since June 2007 these probes have recorded the temperature, at six different depths, every hour of every day.

Graphs of the average monthly temperature and the maximum and minimum monthly temperature display a slightly increasing linear trend over the past six years. For the average monthly temperature and monthly minimum temperature, these trend lines steepen with the increasing depths of the probes. These results suggest that the changing global climate has had an increasing, warming effect on local ground temperature. Through graphing and analyzing this data I have begun to measure climate change on campus.

**64.**

#### **ACID RAIN AND STORM TRACKING AT TRINITY COLLEGE**

Paula Shea '14 Shuyang Zhu '13

Faculty Sponsor: Jonathan Gourley

Acid rain has been a serious environmental problem in recent history with the increased use of fossil fuels that emit sulfur dioxide and nitrogen oxides. These gases convert to sulfuric acid and nitric acid in the atmosphere. Acid rain destroys trees, breaks down building materials and acidifies lakes and stream to make it inhabitable to organisms. Starting in late December to early March precipitation samples were collected from the Clement weather station and from various locations around campus, but mostly from the LSC quad. The storms' paths were tracked using a radar tracking application from wunderground.com. Each sample was tested with a pH meter and a Digital Titrator to determine it's acid strength. The samples were run through an Ion Chromatography (IC) machine three times to measure their anion concentrations. The anions included in the samples were chloride, nitrate, and sulfate. In our preliminary analysis there is no correlation between temperature and pH values. As a general trend, in January the chloride concentration was around 5-6 ppm. On February 11th the concentration jumped to 12 ppm and then dramatically decreased to less than 2 ppm after that date. The nitrate concentration generally was not very high (up to 4 ppm) but had a significantly high value of more than 14 ppm on January 30. January 30 also had the highest concentration of sulfate at about 5 ppm. We collected the January 28<sup>th</sup> snow sample from various locations around campus and their concentration values varied depending on locations and the dates collected.

**65.**

#### **INVESTIGATING THE EFFECTS OF URBANIZATION ON THE TROUT BROOK SUB-BASIN OF THE PARK RIVER WATERSHED IN GREATER HARTFORD, CONNECTICUT: ANALYSIS OF STREAMFLOW AND SUBMERSIBLE DATA LOGGER CONDUCTIVITY MEASUREMENTS**

Sama Shrestha '14, Renee Swetz '14

Faculty Sponsor: Jonathan Gourley

We investigate the impacts of urbanization on a fluvial system by measuring instantaneous discharge and long-term conductivity, parameters that can be used as criteria to assess 'urban stream syndrome'. The Trout Brook sub-basin, which is a tributary of the south branch of the Park River Watershed in West Hartford, CT flows through suburban to urban neighborhoods. The stream is channelized in downstream reaches, receives significant storm water from a major sanitary sewer overflow (SSO) and lacks any permanent gauging station on the south branch which makes quantifying discharge a challenge.

The stage-discharge method was used to build a baseline rating curve for the Trout Brook. Stage height was established at an easily accessible and repeatable location and discharge was measured four different times during the fall of 2012. We selected a stretch of river that is completely contained within a concrete rectangular channel to simplify the geometry of the cross-sectional area of the stream. Submersible pressure data loggers were employed to estimate real-time stage height at the same site. Using the resulting hydrograph, it was determined that the rating curve represented times of low and medium flows. Several rain events resulted in a flashy hydrograph response suggesting a symptom for urban stream syndrome. We also compared our results with the real time USGS gauging station data from the rurally located Mt. Hope River to contrast the hydrograph response.

Submersible conductivity data loggers were used to assess the contribution of the SSO to the Trout Brook. Baseline conductivity levels at and upstream of the SSO were established, as well as conductivity patterns in both locations during a significant storm event. Using the hydrograph produced from pressure data loggers, diurnal effects in conductivity, independent of stage height variations were also observed. Storm event patterns at the SSO record an initial “super-spike” of conductivity during the first flush of the storm water system followed by dilution during the majority of the storm event. The conductivity recorded upstream of the SSO did not record this initial super spike. The rapid conductivity variations observed in the Trout Brook at the SSO are potentially harmful to aquatic life in the river and likely contributes to urban stream syndrome.

**66.**

## **UNDERSTANDING TRINITY COLLEGE AS A CAUSTIC POINT USING SEISMIC ANALYSIS CODE**

Renee Swetz '12

Faculty Sponsor: Jonathan Gourley

The Trinity College Seismograph (TCCT) records activity from around the world, including some of the strongest quakes in Japan, South America, and Indonesia. While some seismic activity falls within TCCT's Shadow Zone, an area where the contents of the earth's core keeps clear seismic waves from reaching TCCT, much of the most significant seismic activity is within its reach.

Indonesia falls within the shadow zone for TCCT. However, seismic activity from the region still reaches the seismograph, and is recorded with a clarity and magnitude that exceeds the expectations of an epicenter so far from the recording station and within its shadow zone. This seismograph-epicenter relationship is not unique to TCCT and is referred to as a caustic point. The data recorded at a caustic point can offer information on discontinuity at the base of the mantle as well as on the depth of the core mantle boundary.

Seismic Analysis Code (SAC) is software that can be used to manipulate the data recorded by a seismograph. At TCCT, SAC is being used specifically to interpret the data recorded from seismic activity around Indonesia. There is a multitude of information that can be gained from the data SAC is able to produce. Research done previously allows a SAC user to locate very precise and accurate wave arrival times along with other variables such as trace length for use in normalizing data for location, magnitude, etc.

# **HEALTH FELLOWS**

67.

## **PSYCHOSOCIAL RISK ASSESSMENT IN ACTIVE RADIATION ONCOLOGY PATIENTS AT HARTFORD HOSPITAL**

Carly H. Bernstein '13

Faculty Sponsors: Alison J. Draper, Maryann McGuire

Non-Trinity Sponsor: Ellen Dornelas, PhD, Helen & Harry Gray Cancer Center, Hartford Hospital, Hartford

The trends associated with the quality of life and the emotional state of cancer patients has become increasingly important issues in current medical research. Because there is clear evidence that physical disease, including cancer, may result in emotional distress, it is important to monitor the patient's mental health, along with offering the option of supportive services: nutritionist, chaplain, integrative medicine, and social worker. Therefore, a psychosocial assessment was implemented as a trial tool at the Harry and Helen Gray Cancer Center at Hartford Hospital. The Cancer Center Wellness Assessment aimed to assess emotional distress in active radiation oncology patients, as well as provide a method of communication between patient and the desired services. Results showed that there was a significant relationship between distress and depression severity, with an  $r$  value of .558. There were evident trends demonstrating that the more emotionally distressed a patient was, the more likely they were to ask for help; however, this was not statistically significant when "distress" was defined by depressive symptoms. When "distress" was defined by "worry or anxiety" there was a statistically significant correlation with asking for help. Most interestingly, there were certain groups within the sample size of 50 patients who were more likely to ask for a referral. These groups included females, as compared to males, African-American, as compared to Caucasian, and those who were not married, compared to those who were married. As expected, there was a significant relationship between psychological distress and depression severity. Because emotional distress and depression severity were positively correlated, it can be deduced that this screening method is a valid tool for measuring distress and therefore, the screening could possibly be implemented into everyday life at a hospital to improve the monitoring of patient mental health. This study provided evidence that worry was a stronger predictor of likelihood of asking for a referral as compared to sadness among patients with active cancer. Many patients may not pay attention to their own anxiety and worry, but realize only their sadness. This study highlights that it is just as important to monitor anxiety as it is depression and sadness, because there may be more serious impacts on mental health. Future studies may include a more thorough analysis of each of the different patient populations. It would also be interesting to repeat this analysis with a much larger sample to determine whether trends found in the current study are supported..

**68.**

**RELATIONSHIP BETWEEN RESOLUTION STATUS OF A PARENT AND NARRATIVES INCLUDING AVOIDANCE OF A CHILD WITH A CHRONIC ILLNESS**

Tutti Davis '13

Faculty Sponsors: Alison J. Draper, Maryann McGuire

Non-Trinity Sponsor: Jill Popp, PhD., Department of Research, Connecticut Children's Medical Center

The purpose of the current descriptive study was to understand the significance between parents' narratives expressing their reactions to their child's chronic illnesses and the child's interpretation of family functioning through narrative. The goal of the study was to compare parents who were either able to move psychologically forward with their child's chronic illness (resolved) or not able to move forward (unresolved) to avoidance strategies in their child's narrative. It was hypothesized that children with a chronic illness will display higher avoidance in their narrative when they have a parent who is unresolved with the diagnosis, compared to children who have a parent who is resolved with the illness. Also, children who have high avoidance will have parents reporting low cohesion, low family expression, and high conflict on the Family Environmental Scale. The Reaction to Diagnosis Interview was used to assess parents' resolution status, The McArthur Story Stem Battery was used to collect and scale avoidant strategies in the children's narratives, and The Family Environment Scale was used to measure family functioning from parents' self report. Results showed 41% of parents were unresolved with their child's illness. Overall families displayed high cohesion, high expression, and low conflict on the family functioning scale. Child avoidance compared to parent resolution status showed no significance ( $p=0.996$ ). Although no significance correlation between parents' resolution to their child's illness and the child's narrative of family functioning were found, both parents and children groups still had subjects struggling with coping tactics. Future studies may consider looking into interventions specifically for parents, or specifically for young children to help them both cope with living with a chronic illness in their household.

**69.**

**ANALYSIS OF GENDER-RELATED FACTORS IN ANALGESIC PROTOCOLS TO MANAGE CHILDREN'S POST-OPERATIVE PAIN AFTER UNCOMPLICATED LAPAROSCOPIC APPENDECTOMY: RETROSPECTIVE CHART REVIEW**

Peter Deraska '14, Connor McElligott '14

Faculty Sponsors: Alison J. Draper, Maryann McGuire

Non-Trinity Sponsors: Zhu Wang, Brendan Campbell MD, Medical Director, Director, Pediatric Trauma, Connecticut Children's Medical Center, Renee Manworren PhD, APRN, PCNS-BC, Nurse Scientist, Division of Pain and Palliative Medicine, Connecticut Children's Medical Center

Acute appendicitis is the most common condition requiring emergency abdominal surgery of pediatric patients in the United States. Researchers report that children experience moderate to severe pain during hospitalization after laparoscopic appendectomy. Knowledge of the effectiveness of treatment protocols to manage this pain during the hospital stay is limited. The purpose of this study is to explore how gender affects the effectiveness of post-operative pediatric pain management. It was hypothesized that females will demonstrate a higher efficacy



for opioid-related analgesics and a higher prevalence of opioid-related side effects. This is a retrospective study that looked at the medical records of 56 patients coded for non-complicated laparoscopic appendectomy. Data on length of hospitalization, mean and maximum pain scores, analgesic administration and opioid-related side effects was collected and compared between genders. The results comparing the two genders showed a difference in length of hospitalization, with females staying a significant amount of time longer than males ( $P < 0.0003$ ). The results do not show a significant difference in opioid usage, pain scores reported or side effects. The sample size for this study was limited due to time constraints, which may have led to the insignificance of the data. However, the results do show some trends of pain management factors and the difference in the length of hospitalization suggests that a gender-related factor could exist. The study will be continued this year and a larger sample size will be collected and analyzed.

## **70.**

### **THE EFFECT OF MEDICATIONS ON THE RECOVERY TIMES OF PEDIATRIC AND ADOLESCENT CONCUSSION PATIENTS**

Trevor Doolittle '14, Regina Kostyun, Matthew Solomito

Faculty Sponsors: Alison J. Draper, Maryann McGuire

Non-Trinity Sponsor: Matthew Solomito, MS, Biomedical Engineer, Manager, Orthopaedic and Sports Medicine Research Department, Connecticut Children's Medical Center

The purpose of this study was to determine if taking medications at the time of concussion caused a prolonged recovery time in pediatric and adolescent concussion patients. It was hypothesized that taking medications that have the ability to cross the blood brain barrier at the time of concussion would lead to longer recovery times. The study was performed as a retrospective chart review of patients who were diagnosed with a concussion and were evaluated by the sports medicine department at Connecticut Children's Medical Center between September 2010 and October 2012. The data collected from the patient charts included: age, gender, sport, medications, and recovery time. The data was analyzed using a Kirska-Wallis non-parametric test, as the data set was not normally distributed. We found that the recovery times of patients that were taking medications compared to the recovery times of patients that were not taking medications were not significantly different. Although significance was not found, there were trends in our data that showed that medications might have an effect on the recovery times of patients.

## **71.**

### **THE NEUROBIOLOGY OF INTOLERANCE OF UNCERTAINTY IN GENERALIZED ANXIETY DISORDER**

Julianne L.D. McDonough '14<sup>1</sup>, Laura B. Bragdon, R.A.<sup>2</sup>, and Gretchen J. Diefenbach, Ph.D.<sup>2</sup>

<sup>1</sup>Trinity College: Health Fellows Program, <sup>2</sup>The Institute of Living: Anxiety Disorders Center

Faculty Sponsors: Alison J. Draper, Maryann McGuire

Non-Trinity Sponsors: Institute of Living, Anxiety Disorders Center, David F. Tolin MD, Michal Assaf

Generalized anxiety disorder (GAD) is a chronic and impairing mental disorder characterized by excessive worry, stress, and tension. Latest research indicates that Intolerance of Uncertainty (IU), which is the tendency to exhibit an intense stress reaction in situations that are unclear or

ambiguous, may be an underlying mechanism of GAD. This study aims to explore the neurobiology of IU among patients with GAD. Participants with GAD (n = 8) underwent functional magnetic resonance imaging (fMRI) while completing a Gambling Task (GT) designed to elicit anxiety, uncertainty, and ambiguity. Previous research has shown that this task is associated with activations in the dorsolateral prefrontal cortex (DLPFC), a region thought to be associated with uncertainty and ambiguity. It was hypothesized that activation in the DLPFC would correlate significantly with severity of IU and with anxiety symptom severity among patients with GAD. As predicted, results showed that high levels of activation correlated significantly with measures of IU, worry, and anxiety. Results from the current study lend support to the importance of the DLPFC as an area associated with IU and anxiety symptoms among GAD patients. Results further suggest that this brain activation may be uniquely associated with these GAD symptoms under conditions of uncertainty.

72.

### **PAVING THE ROAD TO PREVENTION: USING TABLET TECHNOLOGY TO PROVIDE ANTICIPATORY GUIDANCE ON TEEN DRIVING SAFETY**

Connor D. McElligott '14

Faculty Sponsors: Alison J. Draper, Maryann McGuire

Non-Trinity Sponsor: Brendan T. Campbell, MD, Medical Director, Director, Pediatric Trauma, Connecticut Children's Medical Center

Motor vehicle crashes are the leading cause of death for American teenagers. The purpose of this study was to educate teens about safe driving practices and evaluate the feasibility of using tablet based technology to provide anticipatory guidance on driving safety, with the longer term objective of assessing whether this approach lowers crash risk for novice teen drivers. A tablet-based teen driving safety application (app) was developed through a grant from the American Academy of Pediatrics and the Allstate Foundation. This app was developed by our Injury Prevention Center Research Team in collaboration with the Connecticut Chapter of the American Academy of Pediatrics. The app provides information about Graduated Driver Licensing in Connecticut using a ten minute presentation, and asks users questions about teen driving safety issues via an interactive format. This activity was offered to patients age 15 to 18 years who presented to the pediatric general surgery clinic at an American College of Surgeons verified pediatric level 1 trauma center while they were waiting to be seen by the attending pediatric surgeon or midlevel surgical provider from August 2012 to March 2013. During the study period there were 101 patients who were identified as being eligible to use the teen driving safety app. Seventy-seven (76%) teens completed the teen driving safety app during their clinic visit. Mean age was  $16.1 \pm 0.9$  years, and half (50.4%) were male. Reason for patient visits to the pediatric surgery clinic were classified as new patient/acute problem (n = 32, 32%), post-operative visit/follow up (n = 69, 68%). Subjects had a broad range of clinical problems, with the most common being pilonidal disease (n = 13, 13%), chest wall deformities (n = 5, 5%), obesity (n = 5, 5%), and ovarian pathology (n = 3, 3%). The insurance status was private insurance (n = 50, 49%), Medicaid (n = 35, 35%) and self-pay (n = 16, 16%). The app was used by teenage patients in each of the six attending pediatric general surgeons' clinics and in the pediatric general surgery midlevel provider's clinic. The use of tablet based technology is a feasible approach to providing anticipatory guidance to teenagers on driving safety in the outpatient setting with minimal adverse impact on patient flow. Future studies should evaluate whether this type of intervention produces safer driving behaviors in teens.

**73.**

**URINE SAMPLE CONTAMINATION ASSOCIATED WITH COLLECTION METHODS USING UNSTERILIZED CONTAINERS**

Charles McLendon '13

Faculty Sponsors: Alison J. Draper, Maryann McGuire

Non-Trinity Sponsor: Jack Ross, MD, Infectious Diseases, Director, HIV Program, Hartford Hospital

Urinary Tract Infections (UTIs) are the third most common infection in human beings and are usually diagnosed using urine samples that are collected using a mid stream clean catch method to avoid contamination. However, contamination of these samples is can be as high as 37% in some hospitals in the US, requiring the urinalysis to be repeated. The mostly undocumented use of unsterilized containers for urine sample collection could be the source of much of this contamination though some studies suggest otherwise. The purpose of this study was to determine if the collection of urine samples in unsterilized containers would result in contamination and, if so, determine if the type of container or the amount of time the urine is in the container has any effect on contamination. This was accomplished by introducing previously determined negative urine to unsterilized but clean urine containers and culturing that urine at 0, 1, 2, and 4 hours after the urine had been placed in these containers. The results showed definitive evidence of contamination at all time intervals and showed a distinct decrease of colony formation by the 4-hour mark. However, the results were not statistically significant due in part to large standard deviations.

**74.**

**LATE PRETERM INFANTS AND HYPOGLYCEMIA, NECESSITY FOR QUALITY IMPROVEMENT AT HARTFORD HOSPITAL**

Chinwe Oparaocha '14

Faculty Sponsors: Alison J. Draper, Maryann McGuire

Non-Trinity Sponsor: Margaret McLaren, MD, Primary Care, Connecticut Children's Medical Center

Glucose is an essential metabolic ingredient for providing cellular energy to perform most every task in the human body. Its range includes but is not limited to powering brain activity and fueling every voluntary and involuntary motor function. The brain, although consisting of just 2% of human body weight and 14-15% in newborns, consumes up to a quarter of the body's synthesized glucose. Neonatal hypoglycemia, a condition that occurs when a newborn's blood sugar level drops to critical levels, is particularly hazardous for the continuing cellular development of newborns. Thus, proper feeding and oversight of the glucose levels of newborns at risk for hypoglycemia is increasingly important. Infants are more at risk for developing hypoglycemia when they are born prematurely. Evidence has shown that there is increasing risk in late preterm births (LPB), a category of preterm infants called late preterm or near-term infants who are born between 34 and 36 and 6/7 weeks gestation. The purpose of this study is to determine to what extent early feeding and glucose screening, as recommended by the American Academy of Pediatrics (AAP) in Hartford Hospital's Well Newborn Nursery, affect the

prevention and management of neonatal hypoglycemia in late preterm babies (LPB). This is a retrospective, quality improvement study looking at all neonates (n=75) born by vaginal delivery at 36 weeks gestation within the 2012 fiscal year. The hypothesis is that there will be a positive correlation between lack of adherence to early feeding and glucose screening protocols and hypoglycemia in late preterm infants at Hartford Hospital. The study focused on compliance with screening and feeding guidelines in the first hour of life, feeding and screening intervals and frequency, and outcomes, including weight loss, length of hospital stay, and hypoglycemia. Out of the total number of infants included in the study, 36% experienced hypoglycemia. The results did not fully support the hypothesis. Timing and frequency of feeding showed no significant relationship to the prevalence of hypoglycemia, while adherence to screening protocols as well showed no significant connection to the occurrence of hypoglycemia. While 65.79% were screened in the first hour, only 27.42% received the minimum eight screens in 24hrs with only 8.06% screened at the specified timing interval of every three hours. Though 34.37% were fed in the first hour of life, 63.33% received at least eight feeds in 24 hours with only 3.34% fed every three hours. The results revealed that on average 68% of the time it did not matter if the newborn was screened properly and 53% of the time it did not matter that the newborn was fed properly. Hartford Hospital has room to improve its practice concerning feeding and screening, although in this study there was no untoward effect demonstrated. This allows Hartford Hospital to reconstruct strategies for early detection and prevention of neonatal hypoglycemia as well as reassess what knowledge of care might be relayed to care-givers who take late preterm infants home.

## 75.

### **AN INVESTIGATION OF THE RELATIONSHIP BETWEEN HISTORIC ANTIBIOTIC USAGE AND BACTERIAL RESISTANCE PATTERNS AT CCMC**

Sean Snyder '13, Emily Thornton '13

Faculty Sponsors: Alison J. Draper, Maryann McGuire

Non-Trinity Sponsor: Nicholas Bennett, MA(Cantab), MBBChir, PhD, Co-Director of Antimicrobial Stewardship, Division of Pediatric Infectious Diseases, Connecticut Children's Medical Center

This retrospective study was conducted through the Antimicrobial Stewardship Program at Connecticut Children's Medical Center. The goal of this study was to analyze the relationship between antibiotic usage and rates of antibiotic resistance in the past five years at CCMC. It was hypothesized that there would be a positive correlation between the use of targeted antimicrobials and the development of bacterial resistance. Linear regression analysis and Log Odds Ratio of resistance was calculated to assess the statistical significance of the trends and the strength of any associations. The entire database analyzed in this study included a total of 26,479 patient admissions, which accounted for a total of 192,271 patient days in CCMC pediatric inpatients between January 2008 and December 2012. Significant correlations were observed in five of the nineteen comparisons conducted in this study. Two of the comparisons were negative correlations: an increase in antimicrobial usage associated with a decrease in bacteria resistance. The other three comparisons were positive correlations: an increase in antimicrobial usage associated with an increase in bacteria resistance. The results of this study supported the hypothesis that antibiotic usage affects the rates of antibiotic resistance. The impact is observed both directly with the bacteria it treats and across antimicrobial classes and generations within a class. The relationship between antimicrobial usage and the emergence of

resistance is complicated and will need further investigation to better understand the findings of this study.

**76.**

### **PARENTAL OPINION ABOUT PEDIATRIC BIOSPECIMEN PERMISSION**

Julia M. Vresilovic '14

Faculty Sponsors: Alison J. Draper, Maryann McGuire

Non-Trinity Sponsor: Francis J. DiMario, Jr., M.D.; Pediatric Neurology, Division Chief Emeritus; Connecticut Children's Medical Center

*Background:* Patients' opinions about the informed consent process for biobank research has had limited review to determine when and how consent should be obtained from donors. The available literature has opinions predominantly from adults about their own biospecimens. This study focused on expanding the current consent opinion from a parental permission point of view. Our aim was to find whether or not one-general consent would be preferred over specific itemized permission decisions, and whether factors such as gender, race, or prior experience with consent would influence participants' opinions about obtaining biobank specimens for research.

*Methods:* A prospective survey was completed by parents of children treated at CT Children's Medical Center. The survey of 18 multiple choice and Likert scale questions was administered between the months of March to May of 2013, compiled and analyzed.

*Results:* A convenience sample of 147 English comprehending parents volunteered to complete the survey. The majority of parents wanted to know who (79%), what (76%), where (73%), and how (74%) the sample was processed and further wanted to know to whom their child's medical history would be provided (84%). While 65% allowed general research on a blood sample, only 43% agreed to it for other tissue research, 35% for genetic-based research and 28% for stem cell research. Only half of those surveyed would allow unrestricted future research. While parent gender did not affect the consenting process both race and prior experience did. The white population compared to non-white was more likely to allow research (82% vs. 45%,  $p < 0.05$ ), but both groups had similar concern for knowing who, what, where, and how the sample was processed. Consent for research in those who had previously given consent for research was 81% compared to 59% to those who had not ( $p < 0.05$ ).

*Conclusion:* While the majority of surveyed parents would allow for blood samples to be taken for research, the large majority of parents would prefer a more detailed consent noting what disease would be studied, who is doing the research, where it will be done, and for how long the sample will be used. The survey showed both a population and experience bias.

**77.**

### **AN EVALUATION OF POTENTIAL RISK FACTORS ASSOCIATED WITH INCREASED INFECTION RATE OF PEDIATRIC HYDROCEPHALUS PATIENTS FOLLOWING VENTRICULOPERITONEAL SHUNT SURGERY**

Kimbra A. Wagner '13

Faculty Sponsors: Alison J. Draper, Maryann McGuire

Non-Trinity Sponsor: Paul M. Kanev MD, Department of Neurosurgery, Connecticut Children's Medical Center

Ventriculoperitoneal (VP) shunts continue to be the most common and fundamental treatment for pediatric hydrocephalus. Despite how regularly VP shunt placement and revision surgeries occur, there are relatively high complication, failure and infection rates associated with them. The average rate of infection following VP shunt surgery in North America is approximately 10% , though averages as low as 1% have been documented. Determining the potential risk factors and successful surgical techniques for VP shunts remains of high importance given the extremely detrimental physical, mental and economic implications. A retrospective analysis was conducted of VP shunting procedures at Connecticut Children’s Medical Center (CCMC) in 30 patients from ages 0-18 years from 2011-2013. Medical records of patients were examined with regards to proposed/suspected risk factors such as: age, gender, VP shunt placement, etiology of hydrocephalus, premature birth, number of previous surgeries, CSF leakage and presence of external ventricular draining. Surgical techniques were also reviewed in detail for discussion of successfulness and suggestions of improvement for future surgeries. Of the 30 patients reviewed, two patients developed an infection following VP shunt surgery at CCMC and one patient developed an infection at a different hospital in the United States, making the rate of infection at CCMC 6.67%. There was found to be a significant association between placement of VP shunt and an increased risk of infection following VP shunt surgery ( $p < 0.0001$ ), suggesting posterior placement is associated with a higher rate of infection. All other risk factors showed no statistical significance associating potential risk factors to an increase or decreased likelihood of developing an infection. The results of this study are limited due to a small population size, skewing rate of infection rate higher and decreasing significant difference in assessing risk factors.

**78.**

### **A NEW APPROACH TO ASTHMA INHALER EDUCATION USING SIMULATION TECHNOLOGY**

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Faculty Sponsor: Alison J. Draper

Asthma exacerbations affect 50% of asthma patients and cost the United States about \$56 billion in medical costs, lost school/work days and early deaths in 2007.<sup>1</sup> National asthma guidelines to improve asthma outcomes rely heavily on the use of inhaled medications, metered dose inhalers (MDI) being the most common device. Unfortunately, many patients are unable to use MDIs correctly, despite verbal, written and one-to-one training. As many as 86% of patients use MDI incorrectly<sup>2</sup> and inhaler technique can deteriorate over time.<sup>3</sup> Common problems include hand – breath coordination, failure to fully inhale or exhale, not tilting the head, and others that can be corrected with training.<sup>3</sup>

Our team of physicians, engineers, creative graphic designers, patients, and entrepreneurs brainstormed the learning process to create interactive components – “Learn to Breathe”, and “Learn to Inhale”. The “Learn to Breathe” tool addresses errors that result from failure to take deep breaths or identify the points of full inhalation, full exhalation and the correct time to actuate MDI. A moving vertical “breath bar” is synchronized with an onscreen instructor’s depth and pace of breathing which identifies these points in breathing cycle using visual and audio

cues. The “Learn to Inhale” tool coordinates the steps involved in taking an inhaler with “Learn to Breathe” and provides interactive coaching for each step of using an MDI.

A simulation approach to inhaler training and asthma education is likely to be a more effective alternative to the conventional methods. We are leveraging the technology to improve patient participation in self-management of asthma. In addition, the platform design can be modified for use in various healthcare settings. We envision providers creating integrated treatment plans by setting up training tools, data inputs (symptoms, peak flow etc.) and asthma action plans customized to individual patients that patient can access on any of their own devices.

## **HEALTH AND HUMAN RIGHTS**

**79.**

### **ENDOCRINE DISRUPTORS**

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Faculty Sponsors: Sarah Raskin, Joan Morrison, Sonia Cardenas

Endocrine disruptors are chemicals that interfere with the body’s endocrine system and produce adverse developmental, reproductive, neurological and immune effects in both humans and wildlife. Chemicals such as Bisphenol A, phthalates, and other compounds can be found in almost every commercial product on the shelf, from flame retardants and food containers to cosmetics and even the ink on ATM receipts. Although the European Union has successfully passed legislation regulating endocrine disrupting chemicals, many other governmental bodies, including those of the United States, Japan and China, have not enacted any laws restricting their presence in consumer products, and in some cases have not even officially recognized endocrine disruptors as dangerous. Contact with these chemicals causes health problems and neurological disorders for the human population. Exposure to endocrine disruptors has been linked to attention and learning disorders in young children, disruptions in growth and early signs of puberty, reproductive problems and increased rates of cancer. Beyond the effects on human development, environmental exposure to endocrine disrupting chemicals has led to marked decreases in wildlife biodiversity. Lack of regulations has led to chemical spills and exposure that puts a variety of organisms in affected areas at risk for neurodevelopmental issues and problems with reproduction. This also increases the risk of human exposure as a result of consuming the contaminated animal products. Limited labeling is one of the biggest human rights violations and contributors to the complete lack of public awareness of endocrine disrupting chemicals. Minority groups are especially vulnerable to exposure to endocrine disrupting chemicals as the limited range of products they can afford often contain the greatest number of endocrine disrupting chemicals. As a solution, the first step is to increase public awareness of the chemicals by passing legislation that will ultimately ban certain chemicals and establish a more extensive testing and approval process for those available on the market.

**80.**

### **DEADLIEST CATCH: MERCURY POISONING THROUGH FISH**

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Faculty Sponsors: Sonia Cardenas, Joan Morrison, Sarah Raskin

Mercury is a neurotoxin, which is a pollutant that has ended up in the ocean in large amounts. This toxin is being introduced into fish populations causing major health problems to the humans and animals that consume these fish. “Resulting in birth defects, loss of IQ and developmental problems...decreased lung function, aggravated asthma, irritation of the airways, coughing or difficulty in breathing (Saylor 2010).” Goulet, Dore, and Mirault found that the mice in the experiment showed decreased performance on a reference-and working-memory task, proving that exposure to methylmercury during pregnancy does, in fact, have a significant effect on cognitive functioning. These effects are seen in humans as well, as Ramirez et. al. (2003) found that “children exposed to methylmercury in utero scored lower on measures of neuro-psychological development, and these deficiencies were persistent when the children were tested at 2 years of age” (Hubbs-Tait, L. 2005). It is not surprising that prenatal exposure to methylmercury would have such detrimental effects on neurological functioning, for the development of the central nervous system is “accelerated during the gestational period” (Hubbs-Tait, L. 2005). The marine life is exposed to these toxins by factories emitting mercury into the atmosphere. There are thousands of factories that hug the coastal line and all have their own resources. This could lead to factories not staying up to code and if the buildings resources are outdated it can release more amounts of mercury into the atmosphere. When more mercury is released into the atmosphere, it gets absorbed into water ecosystems, which allows the mercury to travel through the food chain, and into fish in higher concentrations by biomagnification. A way to counteract this situation is by introducing a microbe (microbes were introduced to the arctic and proven successful) in the water with high amounts of methylmercury. This microbe, through the merA gene has been proven to filter out certain levels of mercury out of the water to the point where the fish in the water are safe for human consumption.

## **81.**

### **WEST NILE VIRUS: CAMPAIGN FOR THE MINIMIZATION OF US CASES**

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Faculty Sponsors: Sonia Cardenas, Sarah Raskin, Joan Morrison

West Nile Virus (WNV) is a growing epidemic in the United States. Though the condition used to be isolated in regions in Africa, Europe, and India, WNV spread to the United States in the late nineties. WNV has become prominent in areas that have experienced extreme heat, drought, and pollution. WNV, a virus that is spread by mosquitoes, is characterized by symptoms that include fever, headaches, and swollen lymph glands. Infection with WNV, however, can be asymptomatic (no symptoms), or can lead to WN fever or severe WN disease (i.e. encephalitis, meningitis, etc). Severe WNV affects the nervous system and can be fatal. We aim to advocate for projects and research to minimize the impact of WNV in the US. In general, the lack of information and education among the American population leads to an increased number of WNV cases. WNV proves most prevalent among people less educated about WNV, which includes immigrants and those in lower socioeconomic classes. Our approach to minimize cases includes creating pamphlets consisting of information about WNV, preventative measures, and health statistics to educate the general population. Since climate is an important aspect of spreading the virus our program will establish community-based projects to prevent the spread of WNV. Preferred mosquito breeding grounds consist of warm polluted water usually from a storm. So campaigns will be run to clean up stagnant pools of water and install mosquito traps in



high breeding areas. Since there is no medical treatment available for the illness, it is important to advocate for more funding and research to develop a vaccine for WNV.

**82.**

### **ENVIRONMENTAL FRIENDLY SOLUTIONS TO WEST NILE VIRUS**

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Faculty Sponsors: Joan Morrison, Sarah Raskin, Sonia Cardenas

West Nile Virus (WNV) is a flavivirus that infects birds and mammals. Mosquitos act as the primary vector for transmission with certain species posing greater threats to either bird or mammal population. WNV has a profound impact on birds. Studies show that, in 2002-2003, when WNV was at its highest level, American crow population dropped 45%. Bluebird populations dropped anywhere between 23% to 52% depending on the region. High levels of the virus result from mild winters, wet springs and hot summers. Urban outbreaks of WNV that infect humans are facilitated by poorly maintained water sources, where mosquitos breed. The virus itself is asymptomatic for approximately 80% of the infected human population, but around 20% of those infected will suffer flu like symptoms, and 1% are subject to serious neurological infections such as facial palsy, dysphagia and motor seizures. The elderly population and those with weak immune systems are statistically more susceptible to the more deadly effects of West Nile Virus. Pesticides used to kill mosquitos are controversial because government official occasionally spray pesticides without informing residents. One study showed a correlation between an increase in asthma patients and pesticide spraying. Most people simply use bug spray in an effort to protect themselves against the disease. However, these sprays are harmful to both the humans who use them and the environment. The solution to this is to educate the public on the negative effects of chemical repellents and spraying. Natural solutions, such as burning Citronella plants, which have an oil to repel mosquitos, can be just as effective as chemical repellents. Also, natural oils such as coconut, lavender and fish oil, apparently have good effects in preventing WNV. Finally, mosquito traps can play a role in preventing the spread of mosquitos in suburban or urban areas.

**83.**

### **MULTI-DIMENSIONAL PROTECTIVE APPROACH TO LEAD POISONING**

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Faculty Sponsors: Sonia Cardenas, Sarah Raskin, Joan Morrison

Although lead is a naturally occurring metal, long-term exposure can cause serious health problems, particularly in the development of young children. Unborn babies and small children run the greatest risk for health problems because they're more susceptible to absorbing and retaining lead. Lead is dangerous because once absorbed into the blood stream it is easily distributed throughout the body. Furthermore, lead based paints are more commonly found in homes of people with lower socioeconomic status, who lack the resources to get tested or to remove the lead from their houses effectively. Lead is deposited into the environment, particularly soil, contaminating air quality in populated areas. Fortunately, moving forward, lead poisoning can be easily eliminated. Through the following steps: home evaluations, mandates on the amount of lead allowed in bullets, paints, etc., an increased awareness of sources of potential

lead poisoning, educating the public on health department resources and what treatments are available if one is diagnosed with lead poisoning. A significant source of lead contamination in the environment is lead bullets left in abandoned game. Lead accumulates in the food chain through biomagnification furthering its effects on not only on hunters prey but other species and the environment. Phytoremediation is a biological remediation utilizing natural processes to eliminate contaminants to soil and underground water, but is mainly used as a secondary effort to public awareness and education. Local governments should hold meetings within all districts so that low-income families have equal access to education on lead poisoning, its risks and prevention. More subsidies could be set aside for helping poorer families in housing renovation, and to ensure that they are able to get the treatment they need. Annual health checks on young children, and house checks on houses built before the 1950s should also be mandated. In the realm of biodiversity, lead threatens the environment. We seek to identify a source of lead poisoning and take preventative measures before we see impact on wildlife. Solution includes: policy changes, environment remediation efforts, such as phylore mediation. The presence of lead in the brain can cause serious impairments including neural death, effects on neurotransmitter storage and release, damage to mitochondria, and harmful effects on glia cells. These brain dysfunctions, particularly in children, lead to cognitive and behavioral problems.

**84.**

#### **ENDOCRINE DISRUPTING CHEMICALS IN PESTICIDES**

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Faculty Sponsors: Sonia Cardenas, Joan Morrison, Sarah Raskin

Endocrine disrupting chemicals (EDCs) are compounds that modify the hormones of humans and animals. Due to their subtle nature and economic application, EDCs' have been unregulated for years. However, recent studies have exposed the long-term implications of EDC exposure. Multiple generations of humans and organisms have been analyzed through comprehensive studies, and their levels of EDC exposure are directly related to the drastic hormonal changes, they have suffered. The lack of EDCs' awareness in our population threatens the health and human rights of our society, and the greater ecology of our planet.

Pesticides commonly contain EDCs'. This investigation will trace the way humans and animals exposed to pesticide through dietary or environmental factors, are affected in the way that the EDC's travel through the food chain. Due to the shorter lifespan and faster reproductive rate of many organisms, the adverse effects of EDCs' first became a major concern, as species in a variety of ecosystem began to show signs of toxic exposure. The effects of EDC's on humans and non-human species development, from conception to adulthood and the nuero-modular dynamics in humans, will detail the health concerns raised by these chemicals.

The health effects that people face from exposure to pesticide EDC's are a violation to the rights of health and information. Children and fetal rights are also violated particularly seeing the effects of EDCs' on human development. There is inadequate regulation of endocrine disruptors affecting humans.

By working with legislators and the community, activists can push for transparency laws, to make consumers aware of what they are ingesting. Pesticides and food imports containing pesticides must be reviewed and appropriately labeled; EDC's should be prevented from entering

the food chain. Extended research must be funded by the government to increase precaution against involuntary and avoidable exposure to EDCs' through pesticides.

**85.**

**PESTICIDE EXPOSURE IN MIGRANT FARM WORKERS: SOLUTIONS TO THE DANGEROUS CHEMICALS**

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Faculty Sponsors: Joan Morrison, Sarah Raskin, Sonia Cardenas

Migrant farm workers are exposed, often unknowingly, to dangerous pesticides during their harvesting activities. Over exposure of pesticides is known to cause neurological, social, and environmental impairments in migrant farm workers. Neurologically, exposure has led to cognitive and physical impairments including memory and motor deficits, as well as asthma, cancer, and learning disabilities. Similar neurological effects have been seen among the children of migrant farm workers. Pesticide exposure has led to damage of other plants, animals, and water sources. The pesticides kill the predators of the pests, which is counter-productive to their cause. By using Integrated Pest Management (IPM), we can find natural and safe solutions that will preserve the biodiversity of the area and keep the workers safe. Additionally, evidence suggests pesticide training (which is proven to be highly ineffective) is reserved for legal migrant workers, who are seen as more valuable than undocumented farm workers. As a result, undocumented farm workers are being denied training for pesticide handling based on their immigration status and are susceptible to overall high rate of injuries, while having no access to appropriate health care. To reduce exposure to and effects from pesticides for migrant workers, free clinics sponsored by donors or by the state should be established at work sites that migrant workers visit. These could provide valuable information to the migrant workers about pesticides they are using and potentially adverse effects they might have on the human body. Clinics and warning labels should be presented in several languages to ensure maximum perforation among the diverse populace of workers. On-site medical personnel would be able to diagnose illnesses and provide workers with basic medical attention that they otherwise would not have access to. These clinics, in conjunction with the solutions posed earlier, would help workers who otherwise wouldn't be able to seek medical attention, greatly reducing the number of pesticide related illnesses.

**86.**

**THE DANGERS OF LEAD POISONING, SPECIFICALLY IN HARTFORD, CT**

Jackie Sanders '14, Nick Pettinelli '15, Ainslya Charlton '16, Jay Kolina '15, Carl Barreto '14, Ian Baker '15

Faculty Sponsors: Sarah Raskin, Sonia Cardenas, Joan Morrison

Currently, lead paint is the most common cause of lead poisoning in children. Many older homes still contain original lead paint under layers of newer, safer paint. When a window is opened or a wall cracks, the lead paint goes into the air or falls onto the ground. The main way lead enters the environment is through paint chips and building waste, spent ammunition, and industrial products such as lead-acid batteries. Once lead is in the soil it can take an extremely long time to be dispersed, sometimes more than a thousand years. Lead exposure in high amounts is harmful to humans, animals (birds are particularly susceptible), and plants, and can disrupt both the

populations and functions of ecosystems. Lead poisoning occurs most often in low-income families, and this socioeconomic class is prevalent in Hartford, CT. The government provides a suggested pamphlet for homeowners that outlines the consequences of lead poisoning. Because there is a very low percentage of Hartford homes that are actually inhabited by the owner, many of the families renting homes don't have the financial means to ask their landlord to investigate lead paint issues. Lead poisoning affects the prefrontal cortex, Wernicke's area, and ACC in the brain that are all responsible for various roles, including executive functions, mood regulation, and decision making. Early exposure to lead poisoning can lead to antisocial behavior, violent behavior, and a lower IQ. Another source of lead poisoning comes from elevated levels in soil. Research shows a large correlation between lead levels, time spent outside, and lead poisoning in children. If lead poisoning is caught early enough, then treatment is possible, but the main solution is to make sure all lead is removed from the home. Our group wants the government to conduct testing on potentially contaminated areas around the home, soil and painted surfaces. Second, we want the government to require landlords to remove identified contaminated materials from the homes of their tenants. Our group also proposes that any instances of children testing positive for lead poisoning should involve a soil test around their home. Phytoremediation is one of the most efficient and cost-effective ways to remove lead and other contaminants from soil.

**87.**

### **PESTICIDES AND MIGRANT FARMWORKERS: AN INTERDISCIPLINARY APPROACH**

Kody Sun '15, Lizzie Becker '16, Chloe Shiras '15, Katherine Rorer '15, Haofan Xu '16, Jacob Jordan '16

Faculty Sponsors: Joan Morrison, Sarah Raskin, Sonia Cardenas

In Connecticut, many migrants seek seasonal work in tobacco fields. These migrants tend to be low-income, undocumented workers, which leaves them vulnerable to abuse. These migrants, with few ties to the community, often know little about the rights they are guaranteed—basic access to healthcare and minimum wage—and therefore rarely seek help. Due to lackadaisical employer regulations, they suffer from exposure to harmful chemicals. These pesticides may alter their neurological chemistry, thereby creating profound health problems. Constant exposure decreases cognitive abilities in coordination and thinking—even permanent brain damage can result. Pesticides also negatively affect biological diversity by damaging surrounding species and environments. Our approach not only showcases concern for the migrant farmworkers, but also emphasizes, at times, the necessity of deviating from an anthropocentric perspective. Since many of the workers are undocumented, they often wait until their symptoms become severe enough to merit immediate medical attention. Then, they are confronted with unaffordable emergency room fees; the workers mount debt and are deterred from seeking help in the future. We developed multiple steps to improve the living, working and health conditions of the migrant workers, as well as reducing damages to biodiversity. First, permanently established medical centers such as the state funded programs in Washing State should be established, which provide basic healthcare to undocumented workers. Second, workers ought to use protective equipment: masks, goggles, and exposure suits. Regular inspections should be conducted to ensure that protective attire is being used and enforced by employers. Lastly, as a long-term solution, there ought to be an overall reduction in the usage of synthetic pesticides. Biopesticides and natural predators are eco-friendly and less harmful. Collaboration among these measures will reduce the

negative effects of pesticide exposure and promote better healthcare benefits, providing safer conditions for both the farmworkers and other ecosystems.

**88.**

### **EFFECTS OF MERCURY IN FISHERIES**

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Faculty Sponsors: Joan Morrison, Sarah Raskin, Sonia Cardenas

In the 1950's, serious and widespread cases of mercury poisoning took place in Minamata Bay, Japan when people suffered deformities from consuming the fish sued the fishing company Chisco. The ensuing controversy of who should bear the responsibility for the tragedy brought the issue of mercury levels in fish into the political realm. Mercury is introduced into the environment naturally through the Earth's crust and from industrial factories. Mercury finds its way into the bodies of organisms through their diet and, through bioaccumulation, larger organisms, like fish, attain unsafe levels of mercury. Prolonged exposure to high levels of mercury has an array of neuropsychological and neurobehavioral effects including irritability, depression, insomnia and decreases in visual/verbal memory, motor speed and vasomotor coordination. Pregnant women and children are especially sensitive to the effects of mercury. Through our research we have developed a multipronged approach to reduce mercury levels in humans. The first step is increasing regulations fish containing mercury, at all levels, consumers, fishers, and sellers. Laws will be created to promote more awareness, and require fisheries to measure factual mercury levels. The next approach includes the bacteria, *Pseudomonas aeruginosa* CH07, that have been experimented with to help naturally degrade mercury before it can be eaten/absorbed by other organisms. These bacteria must be regulated so that they will help reduce mercury levels in the fish. For those who already have been affected by high levels of mercury in their diet, chelation therapy can be used by injecting EDTA to remove undesired metals from the body. Regulations must be tightened on both the fishing industry and local and federal health departments to label high-risk fish at their place of sale and to educate and warn the consumer.

## **MATHEMATICS**

**89.**

### **RATIONALITY OF CALCULUS OPTIMIZATION PROBLEMS**

Gregory Convertito '16

Faculty Sponsor: David Cruz-Uribe

Beginning with the generalization of a basic optimization problem from Calculus I, we attempted to find all possible rational solutions assuming integer initial conditions. The original problem reduced to finding solutions to solving a Pythagorean-like equation  $a^2 + 3b^2 = c^2$ . We solved this by generalizing already known methods of finding Pythagorean triples.

**90.**

### **TAXICAB GEOMETRY**

George Thekkedath '16

Faculty Sponsor: Gregory Kelsey

Taxicab geometry is a form of geometry in which one would measure distance by taking the sum of the absolute values of the coordinates. In doing so, you can only go vertically and horizontally, which changes many things such as: distance, shapes, and the center of a figure. In this project, we explore the major differences between the taxicab metric and the Euclidean metric. For example, a circle in Euclidean geometry is commonly seen as a round plane figure that consists of points on the curve that is equidistant from the center. But if you can only go vertically and horizontally, then how would the circle look in taxicab geometry? Moreover, another constraint that will be explored is introducing a subway system to taxicab geometry—this is known as mass-transit distance.. Since using the subway would no longer present the taxicab constraint of only traveling vertically and horizontally, we will explore how that changes our understanding of the taxicab metric. All of these ideas can then be applied to a realistic setting to help solve real-world problems.

## **NEUROSCIENCE**

**91.**

### **DETERMINATION OF CATECHOLAMINE CONTENT CHANGES IN MOUSE BRAIN FOLLOWING CHRONIC KETOGENIC DIET**

Ryan Adams '13

Faculty Sponsor: William H. Church

Although the exact mechanism by which the ketogenic diet mitigates epilepsy and alleviates autistic symptoms remains unknown, recent studies have implicated catecholamines in modulating seizure susceptibility and autistic behaviors. This work investigated the effects of the ketogenic diet on catecholamine concentrations in the brains of mice. Tissue homogenates of the motor cortex, somatosensory cortex, nucleus accumbens, anterior caudate, posterior caudate and substantia nigra regions were analyzed using high pressure liquid chromatography to quantitate norepinephrine, dopamine, 3, 4-dihydroxyphenylacetic acid (DOPAC), 5-hydroxyindoleacetic acid (5HIAA), homovanillic acid (HVA) and serotonin (5-HT). No significant differences in endogenous catecholamine concentrations were detected in the tissue homogenates. While the results of this experiment do not correlate with previous research pertaining to changes in the global CNS catecholamine levels, it is the first to examine catecholamine concentrations in localized brain regions for mice on a chronic KD.

**92.**

### **INVESTIGATING THE RELATIONSHIP BETWEEN BEHAVIORAL AND ELECTROPHYSIOLOGICAL ASPECTS OF PM IN INDIVIDUALS WITH TRAUMATIC BRAIN INJURY AND HEALTHY INDIVIDUALS**

Erin Aisenberg '16, Tessa Bloomquist '16

Faculty Sponsor: Sarah Raskin

Prospective memory is the ability to remember to complete a specific task at a future time. In an effort to study how prospective memory is affected by a traumatic brain injury, two tests were performed. The first test used was the behavioral test, the Memory for Intentions Screening Test

(MIST). This test combines items that require both action and verbal responses as well as both time and event-based cues. Throughout the test subjects were simultaneously completing a word search puzzle. Subjects were asked to remember to complete the specified tasks after periods of 2 minutes, 15 minutes, and finally 24 hours. A point value was assessed based on both the correctness of the response as well as the timing. In addition, a second electrophysiological test was also performed to assess prospective memory. An electroencephalogram (EEG) was used to monitor the brain activity while the subject completed a computerized test of prospective memory. Subjects were shown word pairs and asked to categorize them as same or different. In addition, interspersed with these, they saw strings of the letters “C” and “V” in either grey or magenta. Once they saw one of these strings, from then on they were asked to hit the corresponding letter when they saw any word in that color instead of categorizing the word pair. With the results from these two tests we hope to find a correlation between the results of the two tests and improve our understanding of the ways prospective memory is affected by traumatic brain injury and what the underlying brain mechanisms are.

### **93.**

#### **THE EFFECTS OF A 3:1 KETOGENIC DIET ON THE BTBR MOUSE MODEL OF AUSTISM**

Joshua Altschuler '13

Faculty Sponsors: Susan Masino, David Ruskin

Autism spectrum disorders (ASD) range in their presentation, but are defined by repetitive behaviors, inability to communicate or pick up on social cues, and difficulties with social interaction. Our lab has shown that a ketogenic diet (KD), which is high in fat and low in carbohydrates, can improve these hallmark impairments in the BTBR mouse model of autism. This specific form of KD, which was 7:1 fats to carbohydrates and proteins, improved repetitive and antisocial behaviors, as well as social communication in this mouse model. In the current study, we evaluate the effectiveness of a less strict, more balanced and clinically relevant form of the KD (3:1 ratio) on the BTBR mouse model. We will specifically study the effects of the 3:1 diet on the BTBR mouse's communication, social interaction, and repetitive behaviors, while also measuring blood chemistry to evaluate the diet's metabolic effects. We fed male BTBR mice a balanced 3:1 KD and a control diet (CD). After three weeks, mice underwent a series of behavioral tests. Sociability was examined using the three-chamber test, repetitive behavior was quantified as time spent grooming, and social communication was evaluated using the social transmission of food preference test (STFP). Tail blood was extracted to quantify levels of glucose and ketone bodies. There was no statistically significant difference in behavior between mice on a CD and a KD. Additionally, there was no difference in blood glucose. However, blood ketone bodies were increased in mice on a KD versus those on a CD. These metabolic results contrast with previous work, in which a 7:1 KD improved behaviors, increased ketone bodies, and decreased glucose levels as compared to a CD. Future directions of this research involve understanding key factors underlying the different behavioral results to the two different KD formulations.

**94.**

**THE USE OF ELECTRODES AND THE STEROTAXIC SURGERIES TO ANALYZE THE EFFECTS OF STRESS ON THE PERFORANT PATH AND DENTATE GYRUS IN RODENTS**

Nicholas Bellas '16, Julia Duggan '16, Jenna Park '16

Faculty Sponsor: J. Harry Blaise

The Electrophysiology Lab at Trinity College is currently studying the effects of postnatal stress on the long term potentiation in the perforant path in the hippocampus of adult rats. Adult rats, between the ages of 70 to 120 days, are put under anesthesia and secured in a stereotaxic surgical frame. Three types of electrodes are implanted into the brain to evoke field potentials that are viewed with the oscilloscope. First, two ground electrodes are placed on the surface of the brain and used to reduce noise. Next, a bipolar electrode is implanted in the perforant path of the brain and used to stimulate the area. Bipolar stimulus allows the signal to be more localized so as to produce less damage to the surrounding tissue. Lastly, a monopolar recording electrode is implanted in the dentate gyrus. After a week of recovery, electrophysiological tests are performed to record signals from the brain.

**95.**

**PROSPECTIVE MEMORY AND NATURAL ACTIONS TASKS IN INDIVIDUALS WITH TRAUMATIC BRAIN INJURY**

Alexis Benedetto '15

Faculty Sponsor: Sarah Raskin

Prospective memory is defined as the ability to remember to do something in the future and is a vital aspect of every day life (Brandimonte *et al.* 1996). This study examines the differences in prospective memory in individuals with traumatic brain injury (TBI) compared to individuals without. Studies have shown that individuals with traumatic brain injury have more difficulty completing tasks involving prospective memory and everyday or natural actions (Shum, Valentine, Cutmore, 1999). The Memory for Intentions Screening Test (MIST) was used as a measure of prospective memory ability while the Naturalistic Actions Test (NAT), was used to evaluate an individual's ability to perform every day, natural actions. The MIST and NAT were used in conjunction to determine the relationship between prospective memory abilities and the ability to complete natural actions in individuals with TBI. The TBI group had more difficulty than the healthy group on the MIST test; significant differences between the two groups were observed in the MIST test involving 2-minute time delay, time cue, verbal response and action response based tasks. Individuals with TBI did not experience difficulty during the NAT test; therefore, the NAT is not sensitive to the effects of brain injury. Overall, it was determined that individuals with traumatic brain injury had more difficulty performing prospective memory tasks. In addition, prospective memory abilities were not related specifically to natural actions tasks.



96.

**ANALYSIS OF SYNTHETIC CATHINONES (“BATH SALTS”) IN ORAL FLUID USING SPME/GC-MS AND IN-MATRIX DERIVATIZATION**

David M. Correll ‘13

Faculty Sponsor: Janet F. Morrison

The recent emergence and widespread abuse of new classes of compounds on the designer drug market as “legal” alternatives to scheduled drugs such as Ecstasy has prompted interest in the development of analytical methods for their detection and characterization. Synthetic cathinones, which are structurally similar to amphetamines, are commonly advertised as a “legal highs” or “herbal highs,” and are marketed under names such as “bath salts” and “plant food.” To avoid drug abuse legislation, a “not for human consumption” warning is typically printed on the label. Their ready availability on the Internet and in “head” shops, convenience stores, and even gas stations has spurred the popularity and abuse of these drugs for their euphoric/stimulant effects. The dramatic increase since 2009 in U.S. drug seizures involving cathinones, coupled with a significant rise in calls to poison control centers, emergency room visits, and even deaths due to synthetic cathinone intoxication, have prompted 37 states to ban these substances. In October 2011 the U.S. Drug Enforcement Agency exercised its emergency scheduling authority to temporarily designate three synthetic cathinones as Schedule I substances under the Controlled Substances Act.

The current study explores the development of an analytical method based on headspace solid-phase microextraction (HS-SPME) and gas chromatography-mass spectrometry (GC-MS) for the rapid laboratory confirmation of synthetic cathinones in oral fluid. Target analytes included butylone, diethylpropion, flephedrone, mephedrone, methedrone, methylenedioxypropylone (MDPV), methylone, and naphyrone. Results of method optimization experiments designed to maximize SPME recoveries of cathinones from saliva will be presented. Parameters investigated include incubation temperature and time, extraction temperature and time, desorption time, sample pH, salting out effects, and reagents for in-matrix derivatization. An internal standard calibration method was developed using matrix-matched calibrators and deuterated analogs of the target drugs as internal standards.

97.

**PROSPECTIVE MEMORY IN SCHIZOPHRENIA: RELATIONSHIP TO MEDICATION ADHERENCE, NEUROCOGNITION AND SYMPTOMS IN INDIVIDUALS WITH SCHIZOPHRENIA**

David Correll ‘13, Marta Zamroziewicz ‘13, Alexandra Rogers ‘09

Faculty Sponsors: Sarah Raskin

Non-Trinity Sponsor: Dr. Matthew Kurtz, Institute of Living, Jacqueline Maye

Medication management is a serious concern for individuals with schizophrenia. One possible reason for poor adherence to medication is poor ability to remember future intentions. It has been demonstrated in several studies that individuals with schizophrenia do have impairments in prospective memory. However, there have been no studies, to our knowledge, examining the

relationship of prospective memory to medication adherence. In this study individuals with schizophrenia and healthy adults were administered a standardized measure of prospective memory, a standardized measure of medication adherence and a computerized virtual measure of medication adherence. Individuals with schizophrenia demonstrated impairments specifically in prospective memory. Performance on the test of prospective memory was correlated with the standardized measure of medication adherence. This suggests that prospective memory should be assessed before assuming that individuals with schizophrenia will be independent in medication management. It also suggests that prospective memory intervention may be important in this population.

**98.**

### **RECONSTRUCTION OF MUSICAL STIMULI FROM BRAIN ACTIVATION PATTERNS IN FMRI**

Ela Cross '13

Faculty Sponsor: Dan Lloyd

The brain's responses and activation patterns to sensory stimuli, like sound, can be measured with fMRI. Based upon the brain components that are activated while a person listens to music, it is possible to determine the sound that causes a certain brain activation pattern. Brain reading uses only the brain activity to reconstruct a stimulus. Researchers have had success doing this within the visual system through the reconstruction of pictures and movies (Nishimoto et al., 2011), as well as with the auditory and speech processing system to determine the words that a person hears (Pasley et al., 2012). The brain activity of six subjects resting and listening to several musical pieces was measured by fMRI, as well as when the person imagined the musical piece that they had previously listened to during a period of silence. Comparisons of the voxel activation pattern of brain states under different listening conditions revealed that music is a cognitively engaging stimulus, activating many regions, in the temporal, frontal, and parietal lobes in both hemispheres, with variability among subjects. In the second part of the experiment, the music that the subjects heard was reconstructed by a Bayesian method of comparing their brain states throughout the different listening paradigms. The moment in the original music that elicited the brain state that best matched another brain state within the same subject was inserted into the reconstructed music for that time point. Thus, the music that was heard was reconstructed individually for each subject based upon his or her brain activation. The accuracy of the music reconstructions were compared to the original music based upon different properties of music, including pitch, loudness, musical instrument, key, and key mode, and found to be highly significant for all measures except key mode. Therefore, the musical reconstructions were significantly accurate across several measures.

**99.**

### **THE EFFECTS OF ALCOHOL USE ON COGNITION IN COLLEGE STUDENTS**

Sharmy Dhaliwal '16

Faculty Sponsor: Sarah Raskin

Cognition is the mental process of gaining knowledge and understanding it through thought, experience, and the senses. This study examines the effects of alcohol use on cognition in college students by comparing their cognitive results from the beginning of their college experience to the near end of their college experience. The participants filled out numerous questionnaires

regarding demographics, any injuries, and their alcohol use. Following the questionnaire, they did a series of computerized measures which tested their retrospective memories, or memory involving the past, and response inhibition. Cognitive test results from students who do not drink, those who drink but do not binge, and those who binge drink were compared. Depending on the results, methods for treating alcohol use or decreasing alcohol use on college campuses could be properly developed because the developers would know who the targeted would be and why those groups are most affected.

#### **100.**

### **IDENTIFYING CHANGES IN UV-ACTIVE MOLECULES IN BRAIN TISSUE OF MICE FED A KETOGENIC DIET**

Anne Do '16

Faculty Sponsor: William H. Church

As part of an ongoing study evaluating the change in concentration of catecholamines in various brain regions of mice fed a three-week chronic ketogenic diet, chromatograms generated using UV absorbance at 280nm were examined to identify other brain compounds that are also altered by chronic ketosis. The chromatograms were evaluated for peaks that were either present in only the ketogenic diet mice, in only the control diet mice, or in both. Preliminary data suggests there are four peaks of interest that are present in both diet groups, two to four peaks of interest that are present in only the ketogenic diet group, and two peaks of interest that are present in only the control diet group. This data is not yet conclusive due to variations in retention times among chromatograms, which makes it difficult to tell if two peaks are the same or a different chemical. According to this data, it is possible that other chemicals besides the catecholamines and their metabolites are altered in the brains of mice fed a chronic ketogenic diet.

#### **101.**

### **THE EFFECT OF A KETOGENIC DIET ON BLOOD CHEMISTRY AND FORMALIN-INDUCED NOCICEPTION IN MICE**

Jessica Fortin '14

Faculty Sponsors: Susan Masino, David Ruskin

The ketogenic diet (KD) is a high fat, low carbohydrate diet that adjusts the body's metabolism to use ketone bodies instead of glucose for fuel and reduces overall central excitability (Ruskin *et al.*, 2013). Previous studies have investigated the effect of the KD on pain behaviors- for example, a strict KD has been shown to reduce thermal nociception, peripheral inflammation, and body weight in rats (Ruskin *et al.*, 2009). Injected formalin is another pain stimulus that induces acute (phase I) then inflammatory (phase II) pain. Previous studies on formalin-induced nociception in mice found strict KD-induced hyperalgesia in phase II- however, hindpaw weights were not determined in the study which brings to question formalin dosing equivalency (Fortin, 2012). This study investigated the effect of a moderate KD in wild-type mice on formalin-induced nociception and whether ketone and glucose levels directly influence KD-related hypoalgesia. We also analyzed body and hindpaw weight to ensure that any possible weight changes due to the KD did not affect formalin dosing equivalency due to altered paw volume. Mice (n=17) were fed either a control diet or a moderate KD (3:1

[fat:carbohydrates+protein]) for three weeks. The hindpaw was injected with a moderate 3% 10 $\mu$ L dose of formalin and the amount of licking/biting and lifting of the injected hindpaw was recorded. Glucose and b-hydroxybutyrate data were obtained from tail blood two days prior to formalin injection. Body and hindpaw weights were determined after testing. Body and hindpaw weights were not significantly different based on diet, which indicates formalin dosing equivalency in moderate KD-fed mice. Ketone levels were significantly higher and there was no change in glucose levels in KD-fed mice. Although we hypothesized that moderate KD-fed mice would exhibit decreased nociception in both phase I and II, the data indicate that KD fed mice exhibited time-dependent hypo- and hyperalgesia, which also suggests that ketosis alone is not sufficient for hypoalgesia. An alternative explanation for the behavioral effects is variation due to diet in the time course of the formalin-induced pain response. These nociception results are consistent with the previous nociception study in strict KD-fed mice where the diet induced unexpected hyperalgesia in phase II.

## 102.

### **THE EFFECTS OF SEX AND SYNAGIS REGIMEN ADHERENCE ON RESPIRATORY SYNCYTIAL VIRUS SEVERITY AND HOSPITALIZATIONS IN PREMATURE INFANTS**

Jessica Fortin '14, Catherine Wiley, MD<sup>1</sup>, Trudy Lerer, MS<sup>1</sup>, Marietta Vazquez, MD<sup>2</sup>

Faculty Sponsors: Alison J. Draper, Maryann McGuire

<sup>1</sup>Connecticut Children's Medical Center, <sup>2</sup>Yale New-Haven Hospital

Non-Trinity Sponsors: Catherine Wiley, MD, Director, Primary Care Center, Connecticut Children's Medical Center, Trudy Lerer, MS<sup>1</sup>, Marietta Vazquez, MD<sup>2</sup>

Respiratory Syncytial Virus (RSV) is the leading cause of re-hospitalization in premature infants. Given intramuscularly every 30 days for five months, Synagis has been shown to reduce RSV-related admissions by up to 55% in premature infants. Although males have more severe bronchopulmonary dysplasia illness than females, the influence of male sex on RSV admission rates and severity is unclear. We investigated the effects of deviation from recommended Synagis dosing guidelines and sex on RSV hospitalizations and severity of illness. Cases and controls were identified through existing logs of all infants eligible for Synagis at Connecticut Children's Primary Care Center between 2001 and 2011. A case was defined as a preterm infant  $\leq 35$  weeks gestational age (GA) hospitalized for laboratory-confirmed RSV infection during their personal period of Synagis eligibility (based on Red Book guidelines). Matched controls consisted of babies who were not hospitalized due to RSV infection. Controls (3:1) were matched to each patient by GA ( $\pm 2$  weeks) and season ( $\pm 2$  months). A severity score based on clinical criteria (range 0-6) was assigned to each patient. Fischer's exact tests and t-tests were performed where appropriate, with significance set at  $p < .05$ . Twenty-one hospitalizations for RSV (66% female, 62% adherent) were identified from among 369 eligible patients. We found no differences between hospitalization rate and severity due to RSV infection relating to Synagis dosing adherence and sex. In this small sample size, male sex and deviations from recommended Synagis regimens were not associated with RSV admission rates or severity.

## 103.

### **PITCH ACCURACY CORRELATIONS IN FMRI RECONSTRUCTED MUSIC**

Shelby Friel '13

Faculty Sponsor: Dan Lloyd

One important musical component is pitch. Pitch is that attribute of sound, which can be ordered on a scale from low to high and corresponds to the frequency of the sound wave (Bizley & Walker, 2010). The purpose of this research is to reconstruct four different pieces of music from fMRI brain scan data using MATLAB and SPM8 programming. Participants listened to four pieces of music while undergoing an fMRI scan. These were Bach, “Fugue # 2” from the *Well-tempered Clavier*; Mozart, “Instrumental version of the duet of Pamina and Papageno”, from *The Magic Flute*; Philip Glass, “Dance VIII” from *Dance Pieces*; Duke Ellington, “Take the ‘A’ Train”. The reconstructed music was created by analyzing correlations between global brain images at every time point in the scan. The music at each two-second interval in the fMRI scan data was then replaced with its two-second match according to the correlated brain image. From the reconstructed fMRI data for each subject, pitch accuracy correlations were then measured between each pair of pieces in order to determine if perfect pitch matches were made. The results showed that exact pitch matches were significant compared to randomized trials, which indicates that brain reading with respect to music is possible.

**104.**

**REGIONALLY DISTINCT CELL CYCLING BEHAVIOR UNDERLIES FOLIATION PATTERNING OF THE MOUSE CEREBELLUM: INSIGHT FROM THE *ENGRAILED* MUTANT CEREBELLUM**

Jackie L. Gottshall ‘13

Faculty Sponsors: Susan Masino, Charles C. Swart

Non-Trinity Sponsors: Emilie Legué, Ph.D. & Alexandra Joyner, Ph.D., *Developmental Biology Program, Sloan-Kettering Institute, New York, NY*

The layered cortex of the cerebellum (Cb) is divided into complex folds (folia) along the anterior-posterior axis, allowing numerous neural circuits to fit within a compact space. Although Cb morphology and circuit allocation are highly conserved across mammals, the processes that regulate foliation are poorly understood. Data from our previous analyses has provided evidence that asynchrony in production of granule cells (GC) between folial zones contributes to normal Cb foliation patterning. To identify the mechanisms of this asynchrony, we used a mouse Cb foliation mutant (lacking three of the four *engrailed* (*En*) alleles) to analyze the cycling behavior of granule cell precursors (GCPs). In litter-matched postnatal (P) day 6 control and *En* mutant mouse, GCP proliferation and differentiation was assessed using a pulse of BrdU at either 30 minutes or 24 hours prior to sacrifice, respectively. In the control Cb we found a marked decrease in GCP proliferation of the nodular zone. Furthermore, the central zone of the control Cb exhibited a highly significant reduction in GCP differentiation relative to the anterior and posterior zones. This reduction corresponds to a relative delay in foliation of the central zone of the normally patterned Cb. These regional differences in GCP proliferation and differentiation were attenuated in the *En* mutant, corresponding to an altered foliation pattern. Together, these results suggest that at P6, differences in timing of GC production are the result of prolonged proliferation and delayed differentiation of GCPs of the central zone. Analysis of additional time points will provide a more complete picture of GCP behavior during development, affording invaluable insight into the mechanisms of foliation patterning.

**105.**

**CASE STUDY: A DIAGNOSIS OF PARKINSON'S DISEASE**

Varun Konanki '15, Julia Sager '15, Taylor Higgins '15, Amanda Feldman '16  
Faculty Sponsor: Sarah Raskin

The patient is a 48 year-old female CEO of a Fortune 500 company. She presented muscle rigidity and sleep problems. In order to diagnose the patient, we ran a psychiatric evaluation focusing on stress, a family history of degenerative diseases, a liver function test, a MRI, a drug screen, a PET scan, a high field MRI, and a clinical evaluation for Parkinson's disease. The results of the MRI's and PET scan showed striatal dopamine dysfunction and hypointensity spots in the substantia nigra region. The drug screen also showed that the patient had been using 2.0 mg of alprazolam daily for the past ten years. The clinical evaluation showed muscle rigidity, a tremor in the patient's right hand, and slowed movements. The results lead us to diagnose the patient with the early stages of Parkinson's disease. The proposed treatment was Atamet, a combination of carbidopa and levodopa. This treatment was chosen in order to stimulate as much dopamine production as possible, because dopamine deficiencies are the cause of Parkinson's Disease.

**106.**

**THE EFFECT OF A NUTRITIONALLY BALANCED KETOGENIC DIET ON THERMAL NOCICEPTION IN RATS**

Michelle Murphy '14

Faculty Sponsors: Susan Masino, David Ruskin

The ketogenic diet (KD) is a low carbohydrate, high fat diet that causes a change in metabolism: minimizing glucose metabolism and promoting blood ketones as an energy source. The KD has been proven to be an effective treatment of epilepsy and recently, the KD has been found to have an analgesic effect on thermal nociception in juvenile and adult rats. This analgesic effect was observed using a severe version of the KD in a 6.6:1 ratio of fat: (carbohydrates + proteins) as well as in a milder 3:1 ratio. A more nutritionally balanced version of the diet in a 3.2:1 ratio is also available. In order to determine if this version of the KD also produced an analgesic effect, rats were fed on a KD in a 3.2:1 ratio or on a control diet (CD) and were tested for thermal pain sensitivity using a hotplate. Weights of the rats fed the KD compared to rats fed the CD did not differ. Blood testing revealed that rats on the KD had sustained increase in blood ketone levels, but that blood glucose levels were only reduced up to day 3 on the diet and returned to levels observed in rats on the CD by day 26. No significant difference was observed between the pain sensitivities of rats fed the KD compared to rats fed the CD. Therefore elevation of blood ketone levels alone is not sufficient enough to induce the analgesic effect of the KD. The absence of an analgesic effect for this more nutritionally balanced KD in a 3.2:1 ratio may be related to the remarkably short duration of decreased blood glucose. Further research is warranted to determine the relationship between metabolic outcomes of the KD and the analgesic effect of the KD.

**107.**

**EVALUATING THE EFFECT OF A NOVEL REFERRAL TRIAGE PROCESS**

Michelle Murphy '14

Faculty Sponsors: Alison J. Draper, Maryann McGuire

Non-Trinity Sponsors: Erin Cornell MPH, Research Associate, Department of Research, Connecticut Children's Medical Center, Karen Rubin MD, Department of Endocrinology, Connecticut Children's Medical Center

In pediatric medicine, patients are primarily referred to a specialist from a primary care physician (PCP) in order to seek secondary care for conditions or symptoms beyond the scope of the PCP. Unnecessary and/or inappropriate referrals made by the PCP can result in limited access to specialists and a decrease in the overall quality of care. Referral guidelines are a strategy for improving the appropriateness of referrals by facilitating communication between the specialist and PCP, standardizing existing criteria for referral, and providing general information about specific conditions. Due in part to an increase in the prevalence of childhood obesity, the Endocrinology Department at CCMC has experienced an increase in referrals and subsequently, prolonged wait times for patients. In order to address this challenge, a triage process was implemented: PCP referrals for obesity were first reviewed to determine if referral criteria were met before an appointment was scheduled. Through this system referral guidelines were sent out to PCPs in response to referrals deemed unnecessary or inappropriate. An assessment of the triage process was conducted through a retrospective chart review of referred patients to the Endo. Dept. at CCMC before (PRE) and after (POST) the implementation of the triage process. The referral volume, the timeliness of scheduled appointment, the severity of clinical profile, and appropriateness of referral were compared. All data were recorded in hard copy form, transferred into Excel, and coded into SPSS for data analysis. After the implementation of the triage process: obesity referral volume to Endocrinology decreased by 47%, the clinical profile of referred patients trended towards increased severity indicated by BMI z-score and presence of co-morbidities, and more referred patients met criteria for referral. Overall, these results indicate that the triage process had a beneficial impact in improving the appropriateness of referrals to a pediatric Endocrinology department. Further research is warranted to determine the full extent to which the novel referral triage process was effective in increasing the appropriateness of referred patients.

**108.**

**THE INVESTIGATION OF GLIAL-DERIVED FACTORS AFFECTING NEUROBLASTOMA CELL DEATH**

Alexandra Nicaise '13

Faculty Sponsors: William H. Church

Non-Trinity Sponsor: Dr. Stephen Crocker; UConn Health Center

Originally astrocytes were believed to have just played a supportive role in the brain, now it has been discovered that they play imperative roles, from the reuptake of neurotransmitters to signal propagation by releasing factors into the extracellular space. SH-SY5Y and IMR-32 cells are

both common neuroblastoma cell lines, which model cancerous brain cells when left undifferentiated. In recent studies TIMPs (tissue inhibitors of metalloproteinases) have been implicated in neurodegenerative diseases, but their role in tumor growth is unknown. A double-blind cell culture experiment was conducted using astrocytes from both wild type and TIMP-1 knockout mice. Undifferentiated and differentiated SH-SY5Y cells, as well as undifferentiated IMR-32 cells, were treated with the glial media for 24 hours and cell viability was evaluating using the live cell/dead cell assay. Wild type glial conditioned media killed undifferentiated cells to a greater extent compared to the knock out media. Further experimentation indicated that a 50% increase of TIMP-1 concentration in the wild type glial media significantly increased cell viability in undifferentiated cells. Lastly, when the wild type glial media was denatured the apoptotic reaction ceased in undifferentiated cells, suggesting the action of an apoptotic protein. These results suggest that TIMP-1 may be modulating the activity of an apoptosis-inducing factor, which only affects neuroblastoma cells, and is released by astrocytes.

**109.**

**SERTRALINE (ZOLOFT): HISTORY, SYNTHESIS, AND MECHANISM OF ACTION**

Alexandra Nicaise '13

Faculty Sponsor: Cheyenne Brindle

In the past five years an estimated one in ten U. S. adults have reported depression, and 60%-80% of cases can be treated with a combination of medication and psychotherapy. Sertraline hydrochloride, known as Zoloft or Lustral, is an antidepressant of the selective serotonin reuptake inhibitor (SSRI) class, which was introduced to the market by Pfizer in 1991. Not only does this sertraline treat major depressive disorder, it has also been found successful in treating obsessive-compulsive, panic, and social anxiety disorders. An efficient enantioselective synthesis developed by Chen et al. in 1999 will be elucidated within this poster, which utilizes an intramolecular stereoselective anionic addition. Three key steps within this synthesis will be broken down and explained using arrow-pushing mechanisms. This synthesis has provided pharmaceutical generation of sertraline with high stereospecificity.

**110.**

**RECONSTRUCTION OF MUSIC THROUGH A COMPARISON OF BRAIN IMAGING PATTERNS OF ACTIVATION TO VARYING INSTRUMENTS**

Anfal Yesmien Nyhan '14

Faculty Sponsor: Dan Lloyd

Music is a complex stimulus that utilizes the brain in its entirety. Different aspects of music, however, activate different sites in the brain. So, this project aims to see if we can determine what instruments a subject is hearing based on brain scans alone. In order to accomplish this we examined the brain globally to compare patterns of activation to varying instruments at different time points while subjects listened to four different pieces of music. Brain images were collected as the music was heard, with each piece being repeated twice. Music was then reconstructed via these brain images. In a single run of music each brain image was compared to all images, looking for matches that found similar activations for similar instruments for one subject. These matches then allowed us to reconstruct the musical pieces. The intervals of music that matched the images were then replaced with their matches in the original piece of music. In this manner an altered piece of music was generated. In comparing the accuracy between the original piece of



music and the reconstructed piece of music, with both the original set of data and a randomly generated set of data, correlations were found to be significant.

**111.**

**THE EFFECT OF STIMULANT MEDICATION ON EEG RECORDINGS OF COLLEGE STUDENTS WITH ADHD**

Renuka Shukla '13

Faculty Sponsors: Dan Lloyd, Sarah Raskin

Abstract: Researchers have found that quantification of EEGs consistently show significant differences between non-ADHD and ADHD individuals (Thome et al., 2009; Amer et al., 2010). The theta/beta ratios measured at the Cz electrode have been particularly telling in ADHD and non-ADHD subject differentiation (Monastra et al., 2001). Although most studies have focused on differences in such lower frequency bands, more recent investigations have implicated higher gamma frequency bands in ADHD (Vanhatalo et al., 2005). Interestingly, there have been inconsistent findings on the effect of ADHD medications on the EEG recordings of young ADHD patients (Lubar et al., 1995). In this study the effect of ADHD medication on the EEG measurements of college-aged students with ADHD was investigated. No significant differences were found in the absolute power of any lower frequency bands, but significant differences were found in the gamma band. Although some significant differences in this band between subject groups confirmed previous studies on the affect of dopamine agonists on gamma frequencies, some results were inconsistent with previous findings. It is likely that limitations such as high impedance and residual medication in the medication-free condition influenced results, and future studies will need to provide a longer medication-free period before EEG recording.

**112.**

**INVESTIGATION OF THE EFFECT OF SIX-HOUR PGE<sub>2</sub> TREATMENT ON APOPTOSIS LEVELS IN SH-SY5Y CELLS WITH AND WITHOUT ROTENONE EXPOSURE**

Emily Thornton '13

Faculty Sponsor: William H. Church

The degeneration of dopaminergic neurons in the substantia nigra is a primary characteristic of Parkinson's Disease. The neurotoxin rotenone can induce apoptosis in cells analogous to dopaminergic neurons (SH-SY5Y cells) and lead to Parkinsonian neurodegenerative effects. Previous research has suggested that Prostaglandin E<sub>2</sub> (PGE<sub>2</sub>) has the potential to protect against apoptosis in dopaminergic neurons. Literature has also implied a possible neurotoxic effect of prostaglandins. This study investigated the effects of a six-hour prostaglandin (PGE<sub>2</sub>) treatment on apoptosis levels in SH-SY5Y with and without subsequent twenty-four hour rotenone exposure. In experiments with no rotenone exposure, cells were treated with varying concentrations of PGE<sub>2</sub> for six hours and then treated with a low serum feeding media for twenty-four hours. In a subsequent experiment the SH-SY5Y cells were pre-treated with six hours of PGE<sub>2</sub> prior to twenty-four hour rotenone treatment. Results of experiments with no rotenone exposure demonstrated that there was no statistical difference between apoptosis levels in the PGE<sub>2</sub> treated cells and the control. The data following rotenone treatment indicated that cells treated with rotenone had significantly higher apoptosis levels than those in the control; it

was also shown that the cells treated with PGE<sub>2</sub> prior to rotenone exposure had significantly lower levels of cell death than the cells that received no prior PGE<sub>2</sub> treatment. These results imply that PGE<sub>2</sub> alone does not induce toxicity, or apoptosis, in SH-SY5Y cells. The results of this study suggest that PGE<sub>2</sub> may have potential as a treatment against the cell death of dopaminergic cells in the substantia nigra of Parkinson's Disease patients.

### **113.**

#### **OPTIMIZATION OF PROTEIN ASSAY TO FIND BRAIN PROTEIN CONCENTRATION IN MICE ON NORMAL AND KETOGENIC DIET**

Livia Wyss '16

Faculty Sponsor: William H. Church

To examine the changes in brain content of neurotransmitters in mice on a normal diet and mice on a three-week ketogenic diet the amount of brain tissue must be quantitated to standardize the HPLC data. Protein content of tissue punches from five different brain regions were determined spectrophotometrically using the Modified Lowry Protein Assay. Initial results proved highly variable due to excessively low (and at times negative) absorbance values for a majority of the samples. An optimization study was conducted on the reaction protocol and the results are reported here. The optimized experiment indicated that increasing the sample volume and lowering the amount of Modified Lowry Protein Assay Reagent and Folin-Ciocalteu added for derivatization of the protein created positive absorbance and thus positive concentrations for all brain protein samples. The new protein assay protocol allowed the HPLC data to be quantified, reducing the deviation of the data significantly (see Ryan Adams' poster). This new protein protocol provides higher and more accurate readings for future analysis of single brain punch tissue samples.

### **114.**

#### **EFFECTS OF DRINKING PATTERNS ON PROSPECTIVE MEMORY PERFORMANCE IN COLLEGE STUDENTS**

Marta Zamroziewicz '13, David Correll '13, Dana Estefan '13, Sarah Isaac '14, Emily Aiken '14, Ammara Malik '15, Sharnjit Dhaliwal '16

Faculty Sponsors: Sarah Raskin, Rivkah Rosen, Howard Tennen, Carol Austad, Carolyn Fallahi, Rebecca Wood, Godfrey Pearlson

Alcohol consumption in college students is of interest due to interactions between alcohol and the developing brain and this is an important age for the development of prospective memory (PM). 372 college students completed the Self-Rating Effects of Alcohol (SREA), Modified Timeline Follow-back (TFLB), Alcohol Effects Questionnaire (AEQ), Mini International Neuropsychiatric Interview (MINI-DSM-IV-TR), four measures of PM, and four measures of retrospective memory (RM). The four measures of PM included a short-delay event-based task, short-delay time-based task, long-delay event-based task, and long-delay time-based task. The four RM measures were administered to ensure encoding of PM tasks. Students were divided into the following categories of alcohol consumption based on self-report measures: non-drinkers, drinkers, social drinkers, binge drinkers, heavy drinkers, and heavy binge drinkers. Diagnoses of alcohol abuse and dependence by the MINI were examined separately as well. No correlations between any category of alcohol use and PM performance were found ( $p > 0.05$ ). No significant differences between any categories of alcohol consumption on short-delay and long-

delay PM tasks were found ( $p > 0.05$ ). Additionally, while high scores on RM tasks suggested successful encoding of PM tasks, no significant differences on RM performance between any categories in alcohol consumption were found ( $p > 0.05$ ). Diagnoses of alcohol abuse or dependence did not significantly influence PM nor RM performance either ( $p > 0.05$ ). Finally, potential confounding factors, including previous head injury, substance use diagnosis, and psychiatric diagnosis, were examined but showed no significant influence on PM or RM performance ( $p > 0.05$ ).

## **115.**

### **COMPARISON OF FMRI RESTING-STATE DATA OF AMERICAN AND CHINESE ADOLESCENTS**

Jared Zimmerman '13

Faculty Sponsor: Dan Lloyd

Investigations into functional brain architecture using resting-state data from functional magnetic resonance imaging (fMRI) are becoming increasingly common. To date, a series of ten resting-state networks (RSNs) have been elucidated from fMRI resting-state data that are consistent in form and function across the set of examined subjects, however generally subject samples have been small and relatively homogenous. Cognitive neuroscience often operates on the assumption that neural substrates for perception and cognition will show relatively small inter-subject variance. A long history of cultural psychology and the emerging field of intercultural neuroscience, however, suggest that there may be significant linguistically and culturally dependent variation in the functional architecture of the brain. To my knowledge, this study is the first cross-cultural examination of RSN form and function. The data used was acquired from American adolescents at the New York University Child Study Center, and Chinese adolescents at Peking University, and has been made publically available through the Neuroinformatics Tools and Resource Clearinghouse ([nitrc.org](http://nitrc.org)). The data show significant differences in RSN time-courses for only the auditory RSN. This suggests there may be a linguistically or culturally related difference in low-level auditory processing and perception between the American and Chinese cohorts. Further research is needed to determine the extent and significance of these differences in the auditory RSN.

## **PHYSICS**

## **116.**

### **MAGNETIC PROPERTIES OF SEDIMENTS**

Jami Cogswell '16

Faculty Sponsor: Christoph Geiss

There has been growing concern about climate change and its effect on the Earth's weather patterns over the past years. By analyzing the magnetic susceptibility of lake sediments, it is possible to determine the past storm history of a region. In our study area, lake sediments have generally lower magnetic susceptibility, while the land surrounding them has higher magnetic susceptibility. When this surrounding material erodes into lakes due to heavy rains from storms, an erosion layer forms in the sediment at the bottom of the lake. By collecting sediment cores from lakes and studying the variations in magnetic susceptibility throughout this sediment core,

one can obtain information on past climatic events, such as powerful storms, that caused erosion into the lakes. In an effort to study the storm history of Upstate New York, six meters of sediment core were removed from Otsego Lake in Otsego County, New York. The cores were split and continuous samples were taken from their centers. Low-field and frequency-dependent Magnetic susceptibility measurements were performed on all samples using a Bartington MS2B sensor. The data showed a spike in magnetic susceptibility at 8-m depth, which could indicate an erosion layer at that time period. Additional research will be conducted to determine the definite cause of this spike in magnetic susceptibility and the implications that it has.

### **117.**

#### **STATISTICAL ANALYSIS OF SOIL TEMPERATURES**

Matthew Cohen '13

Faculty Sponsor: Mark Silverman

This project involves the statistical analysis of soil temperatures at specific depths over the course of 5 years. The goal is to show certain trends in the data pertaining to the correlation of data points over time and draw conclusions about climate, weather, and properties of soil from these correlations. This was done by applying statistical tests such as Fast Fourier Transforms, and Moving Average and plotting these results over time to observe. In addition, manipulation of the Diffusion Equation was used to determine the diffusion coefficient for the soil surrounding the temperature sensors.

### **118.**

#### **CONSTRUCTION OF A COINCIDENCE COUNTING MODULE (CCM)**

Douglas Lisk '16

Faculty Sponsor: David Branning

A CCM is an inexpensive and effective way of conducting quantum optics research. Other methods of coincidence counting are much more expensive and difficult to use. CCMs have the potential to make quantum undergraduate research a much more practical endeavor. The box is primarily comprised of AND/OR gates, TTL inputs, and an FPGA. The box is constructed fairly easily by anyone who is capable of using a soldering iron, and drill, and a belt saw. The components were soldered into place, the smaller ones first such as the resistors, followed by the larger components mentioned earlier. The aluminum housing was prepared by drilling the proper holes into the sides, and cutting to slot for the buttons out of the top. The circuit board was secured inside of the casing and the box construction was complete. The box's coincidence windows were then tested to compare to the previous CCM iterations. This model's coincidence windows were in the range of 11.5 ns, 15.0 ns, and 21.7 ns. These times are a minor improvement from the previous iteration of CCM which is advantageous as it allows for more accurate coincidence readings.

# **PSYCHOLOGY**

**119.**

## **THE RELATIONSHIP BETWEEN DEPRESSION AND THYROID HORMONE IMBALANCES**

Emily Aiken '15, Jamie Ballan '16, Nicole Gilbane '15, Vanessa Oppong-Dwamena '14  
Faculty Sponsor: Sarah Raskin

A 21 year-old male college student presented for the treatment of fatigue and irritability, along with notable weight gain over the past 6 months. The Mini Mental State Evaluation indicated that the patient suffers from major depressive disorder and recreationally uses marijuana and alcohol. Family history proved negative for depression. A thyroid panel revealed high T4 levels and low T3 levels, and the MRI showed no tumors or irregularities. The patient was diagnosed with major depression due to an underlying thyroid condition. He undertook a course of treatment consisting of: Zoloft (initially 25 mg/day) to combat depressive symptoms, and Cytomel (initially 25 mcg/day) as a T3 supplement. Additionally, the patient attended cognitive behavioral therapy sessions, his thyroid levels were monitored, and his medication was adjusted as needed.

**120.**

## **CULTURAL INFLUENCES ON THE LIFE SATISFACTION OF WHITE AMERICANS AND LATINOS**

Jaclyn Arencibia '13  
Faculty Sponsor: Janet Chang

Past research has found that individualistic cultural groups, such as White Americans, tend to value self-esteem and optimism as means of enhancing life satisfaction. In contrast, collectivistic cultural groups, such as Latinos, tend to emphasize fulfilling social roles and obligations and preserving group harmony. However, most studies have focused on individualistic cultural values and constructs as potential predictors of life satisfaction, while overlooking values specific to other cultural groups, including Latinos, which constitutes a significant research gap. Recently, a measure that incorporates two factors of self-esteem, labeled collective private and collective public self-esteem, was created. This scale accounts for self-esteem as both an individual and group-related concept. Accordingly, in the present study, we examined the relationship between collective self-esteem and life satisfaction. In addition, we considered the influence of acculturation on the life satisfaction of Latinos. In keeping with past findings, White American participants had greater overall life satisfaction than Latinos. Contrary to our expectations, the public self-esteem of White Americans was significantly greater than that of Latinos. Private self-esteem served as a significant though modest positive predictor of Latino participants' life satisfaction, a trend that was not found among White Americans. Moreover, acculturation did not seem to influence the life satisfaction of Latino participants. These findings suggest that the life satisfaction of Latinos may not be explained by adherence to heritage or mainstream cultural values, and factors outside of public self-esteem should be investigated. Limitations concerning the sample representation and size, along with future directions for research, will be discussed.

**121.****EMOTIONAL INTENSITY BETWEEN INDIVIDUALISTS AND COLLECTIVISTS**

Jaclyn Arencibia '13, Gabrielle Keene '13, Kaity Mascioli '14, Tyree Smith '14

Faculty Sponsors: Susan Averna, David Reuman, Barbara Chapman

Past research has shown that cultures have a differential influence on the intensity of an emotional experience, such as delay, duration, recall, and strength. Specifically, those with a collectivistic orientation tend to have moderate levels of emotional intensity, whereas those with an individualistic orientation tend to have drastically high or low emotional intensity. Given these differences, we focused on the emotional intensity response across four emotion-inducing recall scenarios (job placement, advice provision, public speaking, and personal loss), using a sample of Trinity College students (N=36). We also asked participants to gauge their emotional experience across a continuous scale of emotions, to expand on the common use of a dichotomous positive and negative affect scale. We expected those with a collectivistic orientation to experience lower emotional intensity across situations and to have lower positive and negative evaluations in response to recall experiences. Our results found that collectivists and individualists did not differ in emotional intensity. However, overall participants were significantly more in line with the horizontal dimension of the V-H INDCOL scale. Additionally, emotions differentiated across scenarios, in accordance with our expectations. This suggests that cultural orientation might not influence the emotional intensity or the emotional label participants attached to past experiences.

**122.****DIVORCE, ATTACHMENT, AND INTIMACY**

Yara Benjamin '13, Catherine Daniel '14, Elizabeth Sednaoui '13, Lyndsey Shepard '14

Faculty Sponsors: Susan Averna, Barbara Chapman

The divorce literature shows conflicting findings on the adjustment of children of divorced parents. The goal of this study was to examine the relationship between parental divorce, attachment, and intimacy among Trinity College students. We hypothesized that students whose parents are divorced or separated would report more negative views of intimacy and be more likely to have an insecure attachment style. Our results showed that divorce or separation had a significant effect on attachment style and a significant trend towards less intimacy in relationships.

**123.****EFFECTS OF PERCEIVED OPPORTUNITY AND EGO DEPLETION ON COLLEGIATE ACADEMIC MISCONDUCT**

Michael Benson '13

Faculty Sponsors: Dina L. Anselmi, Laura Holt

In this thesis I used a four group experimental design to identify salient psychological influences affecting a college student's ethical behavior and honest choices in a cognitive testing situation. The thesis sought to replicate past research which showed that ego depletion (i.e. depleted ability to self-regulate) and differential association (i.e. perceived opportunity to cheat) led students to be dishonest more often. I hypothesized that false reports by undergraduates would increase under these two conditions. Additionally, this experiment explored a novel hypothesis; specifically, when undergraduates are exposed to both ego depletion and differential association simultaneously, the frequency of dishonesty would increase over and above the rate of cheating observed in ego depletion and differential association groups individually. This study found no significant evidence to support this hypothesis; however, of the 60 participants, four were cheaters and three of them were from the differential association group. This study found that the personality trait of conscientiousness was significantly and inversely correlated with cheating. These findings offer a positive starting point for future research, such that examining these effects with a larger sample size might show that differential association has a larger effect than ego depletion.

## **124.**

### **COMPARITIVE EFFECTS OF MINDFULNESS MEDITATION AND TRANSCENDENTAL MEDITATION AMONG COLLEGE STUDENTS: PERCEIVED STRESS, MINDFULNESS, AND SATISFACTION WITH LIFE**

Aneta Buraityte '13

Faculty Sponsor: Randolph M. Lee

Non-Trinity Sponsor: David Lynch Foundation

It has been previously shown that meditation is a promising strategy to deal with negative emotions, stress and anxiety. To date, little is known about the different mechanisms of action involved in various meditation practices and what differential effects they produce in certain populations. This project compared the effects of two meditation techniques and a control group on psychological well-being among 14 college students (10 female, 4 male). We hypothesized that practicing Transcendental Meditation (TM) and Mindfulness Meditation (MM) for four weeks would produce differential effects on stress-management, mindfulness and satisfaction with life, with no changes expected in a waitlist-control condition. Due to the small sample size, only differences in mean scores and basic trends were observed and available for comparison. After 4 weeks, the largest decreases in PSRS scores (-17.28%) were found to be associated with TM, followed by a -13.68% decrease in MM, and a 16.47% increase in the control group. Overall, TM also had the largest decreases on PSS (30%). There were no changes on PSS in the control condition. Meanwhile, in MM the scores increased by 13.11%. Average MAAS increased in MM (10.87%), while decreasing by -0.67% in controls and remaining constant in TM. Mean SWLS scores increased by 6% in TM and by 6.96% in MM, and decreased by -5.62% in controls. Generally, larger changes were observed among students who were dedicated and meditated regularly. It seems that brief TM intervention might be more effective in stress reduction as compared to MM or waitlist-control. However, MM might be comparatively effective on improving mindfulness skills. Compared to the control condition, both TM and MM could equally increase SWLS. Despite various limitations of the study the findings suggest that different meditation techniques might have differential effects and encourage future research.

**125.**

**THE IMPORTANCE AND CHALLENGES OF EARLY HIV DIAGNOSIS**

Julia Callahan '16, Anna Kirk '15, Constance Minot '14, Marissa Stein '15

Faculty Sponsor: Sarah Raskin

HIV (human immunodeficiency virus) has become a worldwide epidemic in the thirty years since it was first discovered to be the cause of AIDS (acquired immunodeficiency virus). HIV is characterized by the inability to fight infection; essentially, it progressively attacks the immune system until it is rendered useless. Often, those diagnosed with HIV/AIDS die from opportunistic infections that in healthy individuals could be treated with a course of antibiotics. The CDC estimates that more than one million Americans may be infected with HIV, and a quarter of them are unaware of it (NIH.gov): this is due to the fact that the symptoms are extremely common to many infections and ailments, including Lyme disease, Epstein-Barr virus, and even the flu. Such is the case with our patient.

Our patient is a 35-year old male who presented with weight loss, fever, and night sweats. To reach a diagnosis, we started with a round of blood work including Vitamin D and B12 levels, THS, PTH, CBC, and Epstein-Barr virus tests. All were within normal limits except for CBC, which led us first to a lumbar puncture, and then, after reviewing CD4 levels, an STD panel including an ELISA test for HIV. The ELISA was positive. We used both a Western blot and Multi-spot Rapid Results HIV-1/HIV-2 test to confirm the diagnosis. Course of treatment will be determined by progression and CD4 levels.

**126.**

**MEDIA'S REPRESENTATION OF ATTRACTION**

Stevie Carey '14, Jessica Donovan '15, Lindsay McDonough '14, Maggie Wiatr '15

Faculty Sponsors: Dina L. Anselmi, Barbara Chapman

Social comparison theory (SCT) states that we seek to compare ourselves to others who we perceive to be similar in aspects such appearance and status. As a result of upward comparisons, men's and women's self and body esteem can be negatively affected by the idealized images that come from the media. In this study, 54 students from Trinity College participated in two sessions, one week apart, where they rated their self-esteem and body image. In the second session, participants were randomly assigned to view either a male or female highly sexualized or neutral commercial. Pre and post ratings were analyzed for both self-esteem and body self-image. No differences were found for self-esteem but several aspects of body self esteem were found for males and females for type of ad suggesting that upward social comparison might have an effect on how different aspects of our body are more important than others.

**127.**

**EFFECTS OF SCHOOLING ON COLLEGE SUCCESS**

Stevie Carey '14, Meghan Smith '13, Eli Cassel '13, Sarah Reiner '13, Kyra Saniewski '15

Faculty Sponsors: Susan Averno, Barbara Chapman



Previous research has shown contradictory evidence on how high school educations manifest themselves in collegiate success. The present study examines how type of schooling (public/private) and level of parental education influence GPA and academic engagement for underclassman college students. Using an online survey, we collected data from 44 students of Trinity College, a small liberal arts school in Connecticut. We found no significant relationship between type of schooling and GPA, or between parental education and GPA. However, there was a strong positive correlation between GPA and academic engagement. These results seem specific to the Trinity College population, and contradict much of the previous research done on this topic.

**128.**

### **EFFECTS OF SPORTS PARTICIPATION ON SELF-ESTEEM AND BODY-ESTEEM IN COLLEGE-AGED FEMALES**

Henry Eff '14, Shantel Hanniford '14, Gracie Phillips '14, Jake Shimmel '14

Faculty Sponsors: Susan Averna, Barbara Chapman

The research has been mixed with regard to the impact of sports involvement on body image and self-esteem in females often due to the differences in how it is defined by each study. The purpose of this study is to look at the impact of sports involvement on self-esteem and body-esteem among college-aged females. The current study was conducted at a division three college and involved two brief surveys, one for self-esteem and one for body-esteem, and defined sports involvement as being a current member of a varsity sports team. The current study found there to be no significant effect of sports involvement on either self-esteem or body-esteem. However, senior students reported significantly higher self-esteem than junior students regardless of sports involvement. Future research should aim to differentiate the impact of different types of sports on self-esteem and body-esteem in college-aged females.

**129.**

### **HOW GOOD IS GOLD? RECOGNITION OF THE GOLDEN RECTANGLE**

Rebecca A. Eydt '13

Faculty Sponsor: William M. Mace

The Golden Proportion is the place where a line is divided in such a way that the ratio of the length of the shorter segment to the longer segment is equal to the ratio of the longer segment to the length of the whole line. It has been claimed by artists, architects, and aestheticians that the Golden Section is the most aesthetically pleasing division of a line, and that the Golden Rectangle is the most aesthetically pleasing of all rectangles. The experimental support for these claims has been modest. Many studies have been on preference for the Golden Rectangle. It is possible to recognize something and not prefer it, so one could still be sensitive to the Golden Proportion without preferring it in comparisons. The aim of the current study was to test how good people are at recognizing a shape (as opposed to preferring a shape). This study reports data on ten observers who participated in four experimental conditions. This study was designed to see if, with little training, people could naturally pick out Golden Rectangles. In the first condition, the observers were shown a series of thirty-three rectangles of different widths. There were eight rectangles smaller than a Golden Rectangle, the smallest being 217 by 144 pixels, and twenty-four rectangles larger than a Golden Rectangle, the largest being 281 by 144 pixels. The Golden Rectangle presented was 233 by 144 pixels. The observers were asked if in each instance the presented rectangle was wider than a Golden Rectangle. In the second condition, to test for

directional symmetry, the rectangles varied vertically and observers were asked if each instance was taller than a Golden Rectangle. As a baseline control, observers were given the same tasks but were asked to judge rectangles according to how they compared to a square. In all conditions, rectangles were presented at a random position on the screen in a random order ten times each. The four conditions were presented in random order for each observer. The results showed that the task of judging the rectangles, and even the squares, was fairly difficult. Some observers performed systematically, whereas others did not, as one would expect. Responding to the square conditions was much more systematic and less variable than the Golden Rectangle condition. The results suggest that the claims to sensitivity to proportions of the Golden Rectangle are clearly overstated when dealing with an arbitrarily selected group of college students.

### **130.**

#### **SEXUAL FLUIDITY AND GENDER IDENTITY OF MALES AND FEMALES**

James Geisler '14, Romaric Seuzaret '15, Julia Bellis '15, Nicole Lukac '15

Faculty Sponsor: Dina L. Anselmi

The topic of sexual fluidity has gained more attention today as researchers recognize that the traditional definitions of concepts such as sexuality, sexual orientation, and sexual identity do not always capture individuals' sexual ideas or behaviors. Diamond (2008) studied a group of women over many years and found that some of them did not classify themselves as either straight, gay or bisexual but rather saw their sexuality as more fluid and subject to a variety of contextual variables. Our study looked at how male and female heterosexuals saw their sexual fluidity in terms of different behaviors they could imagine themselves engaging in with a member of the same sex. We were also interested in whether there was a relationship between levels of masculinity and femininity and sexual fluidity.

Our first hypothesis was that males would be less sexually fluid than females. Although males tested as being less sexually fluid than females, the more intimate each act became resulted in less of a difference shown between males and females. Our second hypothesis was that people would be more sexually fluid in private situations than they would be in social situations. For the low intimacy acts, both males and females were more likely to be sexually fluid in public situations than in private. As the acts became more intimate, both males and females became more sexually fluid in private.

Our third hypothesis was that males who were rated high in masculinity would report less sexual fluidity and females who were rated high in femininity would also report less sexual fluidity. Our results did not support this hypothesis. We found that only in low intimacy situations were females with high femininity scores more fluid. Our final hypothesis was that individuals would be more sexually fluid with friends than with strangers. This was not supported by our results. We found that behavior in private versus social situations did not have an effect on fluidity.

### **131.**

#### **GENDER BIAS IN TEACHER RECOMMENDATIONS FOR AUTISM**

Taylor Godfrey '14, Danielle Rock '15, Louise Balsmeyer '14, Allison Cazalet '14

Donald McDonald '13

Faculty Sponsor: Dina L. Anselmi

The purpose of this study was to see if there was a gender bias in teachers' likelihood of recommending children for special needs testing. Research suggests that boys receive more special needs assistance than girls, by a ratio of 2:1. Gender bias in teacher recommendation is one possible explanation for this finding. Using both quantitative and qualitative measures, we examined degree of gender bias exhibited by teachers in regards to recommending students with special needs. Since autism is a common disorder within the category of special needs, we used symptoms associated with autism to measure teachers' responses. Data was collected through the distribution of questionnaires, which included demographic questions and a series of six character vignettes. The vignettes consisted of three levels of disruption (mild, moderate and severe), for each sex. Following the vignette was a 1-not likely 5-very likely scale that assessed how likely the teacher would be to recommend the child for special needs evaluation. Thirty-nine female elementary school teachers, ranging from pre-school to fifth grade, participated in the study. The findings indicated that teachers appear to not exhibit gender bias in regards to recommendation of students for special needs evaluation in any of the three levels of disruption. Teachers reported that they were not inclined to diagnose any child with a special needs characterization, especially with such limited information provided by the vignettes, and no knowledge of whether the behavior was consistent.

### **132.**

#### **A CLINICAL STUDY OF A PATIENT WITH SCHIZOPHRENIA**

Bettina Gonzalez '16, Kate Edelson '16, Asia Wells '16, Sonjay Singh '15,

Samantha Mewbourne (IDP)

Faculty Sponsor: Sarah Raskin

This case study involves a 25-year-old female patient whose symptoms include paranoid delusions, mood swings, initial insomnia with trouble rousing, and difficulty concentrating. Neural imaging scans of the patient's brain through fMRI shows enlargement of the third ventricle and abnormalities in the orbitofrontal and prefrontal gray matter; CT scans confirms the enlargement of the third and lateral ventricles, as well as shows dilatation of sulcal markings on the cortical surface. A six-month behavioral history indicates paranoia, delusions, issues with focusing, initial insomnia, and avoidant behaviors from previously close family members and friends. Based off of the results of these tests, we diagnose the patient with schizophrenia. The patient in this study is being treated with cognitive-behavioral therapy; group therapy; social skills training; an initial prescription of aripiprazole, a second generation antipsychotic drug; and family support therapy to help her family during this hard time.

### **133.**

#### **SELF-REGULATED LEARNING AND ACADEMIC ACHIEVEMENT IN MIDDLE SCHOOL STUDENTS**

Emily C. Howe '13

Faculty Sponsors: Dina L. Anselmi, David Reuman

Non-Trinity Sponsor: Debra Avery, Hartford Magnet Trinity College Academy

Self-regulated learning is a complex but critical aspect of learning. Self-regulated learning is comprised of motivation, cognition, and metacognition, where metacognition is the

comprehension of and control over one's cognitive processes. Research has shown a clear connection between using self-regulated learning strategies and higher academic performance (Dignath & Büttner, 2008). The current study conducted a self-regulated learning intervention with eighth grade students. It was hypothesized that students who participated in the intervention would become more metacognitively aware and increase their use of metacognitive strategies. Additionally, students who received the intervention were expected to have a general increase in their course grades, particularly grades related to assignments that required self-regulation. Seventy-nine students from four sections of eighth grade social studies classes participated in the study. Two classes were assigned to the intervention group and two to the control group, in which each group received nine sessions over a period of seventeen weeks. Students completed pre- and post-test questionnaires which included self report measures of metacognition and measures of student beliefs and motivation. Additionally, performance measures in the form of grades were collected. Contrary to our first hypothesis, the intervention group did not show an increase in metacognitive awareness according to either measure of metacognition. There was not a significant group main effect or group by time interaction effect for course grades as measured by quarterly marking period grade, but the metacognition group did score significantly higher on a unit test than the control group. Implications of this research and its significance to the psychological and educational community will be discussed.

#### **134.**

#### **THE MC5: CREATING A NEW ADOLESCENT MEASURE OF METACOGNITION**

Timothy Naratil '13

Faculty Sponsors: Dina L. Anselmi, David Reuman

Non-Trinity Sponsor: Debra Avery, Hartford Public Schools

Metacognition has come into the spotlight thanks to its proven potential to help students with their academic work (Joseph, 2009). A notable theory of exactly how metacognition works is the "Cycle of Self-Directed Learning" (Ambrose et al., 2010). The theory focuses on five different steps, from assessing the task to reflecting on and adjusting one's methods, which can lead to successful academic performance when combined with positive motivational beliefs. In order to quantify the change in metacognition that students experience from learning about theories such as these, measures by Pintrich and De Groot (1990), Schraw and Dennison (1994), and Sperling et al. (2002), among others, have been utilized. While these measures have demonstrated validity, there is still a need for an adolescent measure specifically created for younger students and focused on Ambrose et al.'s (2010) ideas on metacognition. By creating a 32 item measure with questions falling into each of Ambrose et al.'s (2010) five steps, my research attempted to fill this gap. As a means of testing out the effectiveness of the measure and teaching based off of Ambrose et al.'s (2010) model, a metacognition intervention was concurrently run with four classes of eighth grade history students. Along with the new measure, called the MC5 (Metacognition Five), students were also asked to complete a survey with a previously validated measure of metacognition (the Jr. MAI), demographics, and motivational measures. The results showed the MC5 to be a reliable and valid measure. The MC5 had strong correlations to the Jr. MAI and moderate correlations between its subscales. The new measure also showed a factor analysis containing three different factors. While the aim to create a method of measuring five distinct steps of Ambrose et al.'s (2010) model of metacognition was not entirely successful, the MC5 does show multiple different factors being measured whereas the Jr. MAI does not. Being the first attempt at creating a new adolescent metacognition measure, there is plenty of work that

can be done in the future to improve the MC5's ability to measure all five steps in the Cycle of Self-Directed Learning.

**135.**

**THE EFFECTS OF ANIMAL-ASSISTED THERAPY ON AUTISM SPECTRUM DISORDER, CEREBRAL PALSY, AND DEPRESSION**

Alicia MacNabb '13

Faculty Sponsor: Randolph Lee

Various alternative psychological treatments are gaining credibility in the United States. One promising treatment for a wide range of disorders is animal-assisted therapy (AAT). However AAT remains overlooked as a legitimate therapeutic intervention. The primary objective of this study is to conduct a literature review addressing the effectiveness of this therapy for patients with autism spectrum disorder, cerebral palsy, and depression. The psychological databases used to conduct this research include PubMed, ERIC, JSTOR, PsycINFO, and PsycARTICLES. This study found that AAT; specifically pet therapy, therapeutic riding, and hippotherapy, is associated with improvements in patient socialization, therapeutic relationships, goal attainments, and engaged participation. While a causal relationship was not found due to the methodological limitations of current research, significant improvements in symptom severity were found following AAT in a diverse patient population. These findings indicate the therapeutic potential of this treatment and the justification for more extensive research.

**136.**

**DIFFERENCES IN EMPATHY BETWEEN HIGH AND LOW SCHIZOTYPAL COLLEGE STUDENTS**

Spencer McCauley '13

Faculty Sponsors: Sarah Raskin

Non-Trinity Sponsor: Silvia Corbera, PhD, Institute of Living

The current study was undertaken to assess differences in emotion reaction between healthy undergraduate students who reported high or low schizotypal symptoms on the Schizotypal Personality Questionnaire (Raine, 1991). The Emotion Reactivity Scale (Corbera, 2012) was used to assess the empathy of individuals. This scale involves presenting pictures that are either painful (e.g., child crying) or non-painful (e.g., person washing dishes). The participant gave a self-report rating of the amount of pain experienced while viewing the picture and the amount of pain the person in the picture was judged to be experiencing. It was hypothesized that individuals who scored high on a measure of schizotypy would have lower levels of cognitive empathy and higher levels of affective empathy than low schizotypal individuals. It was also hypothesized that females would have higher levels of affective and cognitive empathy. The first hypothesis was not supported since the results showed no differences in cognitive and affective empathy between high schizotypal individuals and low schizotypal individuals. The second hypothesis was supported since females did have higher levels of affective and cognitive empathy than males. These data suggest that in a healthy population, levels of schizotypy may not predict differences in empathy. Future studies that measure empathy in people with more severe forms of schizotypy such as schizotypal personality disorder and schizophrenia may reveal significant findings.

**137.**

**EFFECTS OF JUDICIAL WARNINGS ABOUT CROSS-RACE EYEWITNESS TESTIMONY ON JURORS' JUDGMENTS**

Molly O'Connor '13

Faculty Sponsor: David Reuman

On July 19<sup>th</sup>, 2012, the New Jersey Supreme Court released a decision requiring judges to issue a set of instructions pertaining to problems researchers have found with eyewitness identification. This was a landmark decision because New Jersey is the first state to require judges to issue warnings about eyewitness testimony. The present study examines the effectiveness of the New Jersey judicial warnings, specifically focusing on cross-race bias in eyewitness identification. Participants read a modified version of a trial transcript where the races of both the eyewitness and the defendant were manipulated (black or white), and judicial warnings were either present or absent. Judicial instructions did not change whether or not participants found the defendant guilty, but participants did find the judicial instructions to be clear and informative of problems pertaining to eyewitness identification. Implications of the findings for future research and for judicial proceedings are reviewed.

**138.**

**CULTURAL NORMS REGARDING EMOTIONAL EXPRESSION: INFLUENCES ON THE PROVISION AND RECEIPT OF SOCIAL SUPPORT**

Katie Piotrowski '13

Faculty Sponsor: Janet Chang,

Past studies have revealed that individuals from collectivist cultures are more likely to utilize emotional suppression than those from individualistic cultures, who tend to value the open expression of emotions as a means of coping with stressors. However, no studies to date have empirically examined whether individualistic or collectivist norms regarding emotional expression and suppression affect both the solicitation and provision of social support. Recently, researchers have observed differences between individualistic and collectivist groups in preferences for emotion-focused and problem-focused support, but prior findings have been mixed. The purpose of the present study was to examine whether cultural norms regarding emotional expression and suppression, which are shaped by either individualistic or collectivist values, influence how individuals seek out and provide social support. In this study, we primed participants as either individualistic ( $n = 22$ ) or collectivist ( $n = 23$ ) before they completed measures of emotional regulation, social support solicitation and provision, and demographics. Results of this study revealed that both groups of participants primed as individualistic or collectivist preferred to provide emotion-focused support over problem-focused support, but there was no significant difference in preference for the types of solicited support. There were no significant differences between individualistic and collectivist participants in the extent to which they sought out or provided emotion-focused or problem-focused support. Implications regarding the characteristics of the present sample, as well as future directions for strengthening priming methods, are discussed.

**139.**

**DIAGNOSIS AND TREATMENT OF DUCHENNE MUSCULAR DYSTROPHY**

Tyree Smith '14 Nate Hopkins '14 Nidhish Tulsiani '15 Ashley Ravesloot '15

Faculty Sponsor: Sarah Raskin

Our patient, a five year-old boy, has developed a waddling gait and has trouble standing up from a chair and climbing the stairs. Firstly, running a physical examination on the child we learn that our patient has gluteal muscle weakness, an increased amount of falls, Gower's sign when raising, and deep tendon reflexes. Next we ran a deletion duplication test in which we found that all exons of the dystrophin gene were analyzed using MLPA, followed by a point mutation test, which found a shift in the reading frame of the DMD gene at exon 46. Lastly we ran a muscle biopsy on the patient that showed an absence of dystrophin when stained, which let us know that the young child has a case of Duchenne muscular dystrophy (DMD). For treatment we recommend 0.9 mgm of Deflazacort along with along with regular doses of natural remedies such as Vitamin E, Green Tea Extracts, as well as Amino Acids. We will also prescribe hydrotherapy to help maintain muscle strength and function. Lastly we will provide orthopedic appliances such as braces and wheelchairs to help with daily mobility and self-care abilities.

**140.**

**RELATIONS AMONG PSYCHOLOGICAL AND DEMOGRAPHIC FACTORS IN INDIVIDUALS WITH LOWER LIMB AMPUTATION**

Jasmine Washington '13

Faculty Sponsors: Laura Holt, Randolph Lee

According to Graham et al. (2008) in the United States, there are roughly 1.7 million people living with limb loss. Adams et al. (1999) estimated that one out of every 200 people in the United States alone has had an amputation. The loss of a limb is devastating and requires many life adjustments. Amputation can lead people to a loss of self-esteem, loss of one's independence, and even unemployment. Few studies, however, have explored a) the extent to which depression is associated with other psychological factors such as body image and social support, b) if age at amputation is significantly associated with depression, and c) if depression in female amputees is more/less common than in male amputees. I anticipated that age at amputation would be positively associated with depression in this sample and that females would exhibit lower rates of depression and endorse higher rates of social support compared to males. Lastly, I expected that body image dissatisfaction would be positively correlated with depression and negatively correlated with self-esteem for both male and females.

To conduct this study, I recruited a sample of 35 lower limb amputees (57% male;  $M_{age}=23.56$ ,  $SD=3.67$ ) from three Hanger Prosthetics and Orthotics clinics at various locations in Connecticut. Patients completed a survey that assessed demographics, quality of life following an amputation, body image, and depression. Consistent with my hypothesis, the younger the participant was at the time of amputation, the more likely s/he was to be depressed. Perhaps older adults were less depressed because they have had time to deal with the amputation and find

adequate resources whereas if the amputation occurs when one is younger it could be more challenging to cope. Consistent with previous research, males reported higher rates of depression than females. Contrary to my hypothesis, however, there was no relation between body image and depression. Lastly, depression was positively correlated with social support from friends but not from family, which I had not predicted. Findings from this study may help to inform protocols for medical and mental health personnel who work with lower limb amputees.

**141.**

### **IS THERE A GENDER BIAS IN STUDENT'S UNDERSTANDING OF ADHD AND EATING DISORDERS**

Evadne Coache '15, Jasmine Washington '13, Chelsea Cummings '14, Sarah Watson '15  
Faculty Sponsor: Dina L. Anselmi

In today's society Attention Deficit-Hyperactivity Disorder (ADHD) and eating disorders are being diagnosed in large numbers. According to the Centers for Disease Control and Prevention (CDC) in 2011 parents of children ages 3-17 years old reported approximately 8.4% of children (5.2 million) have been diagnosed with ADHD. Out of all the children between the ages of 3-17 years old 12.0 % are boys with ADHD and 4.7% are girls. It is estimated that 8 million Americans have an eating disorder – seven million women and one million men. Research shows that in 1970 girls started dieting around age 14, whereas by 1990 the average age was around 9-10 year olds. (The Eating Disorders Foundation, 20 April 2013). This dieting trend demonstrates that girls are becoming more self conscious about their body image at an earlier age. Studies show that 50% of girls and 30% of boys aged 8-10 year old are uncomfortable with the size of their bodies. (Silencing Eating Disorders, 20 April 2013).

## **SOCIOLOGY**

**142.**

### **DROPPING THE BALL: ACCESSIBILITY TO RECREATIONAL FACILITIES**

Olivia Berry '14

Faculty Sponsor: Theresa Morris

For my research, I am interested in answering the question whether a person's social class affects their perception of whether recreational facilities for exercise and sport are accessible. My initial hypothesis was that people who own their houses (an indicator of social class) will be less likely to feel that accessing recreational facilities is difficult than people who rent their homes. My hypothesis is based on the theoretical idea that access to public resources is stratified such that people of a lower socio-economic class will have less access than people of a higher socio-economic class. I hypothesize that individuals who rent their homes are more likely to be in a lower class and therefore will be less likely to have access to recreational facilities. In order to test this theory, I used the Harvard School of Public Health/Robert Wood Johnson Foundation Health Priorities 2 – Americans' Views on Public Health. After a series of recoding and statistical interpretations, I found that overall people answered that their perceived accessibility was not an issue regardless of home ownership level. When holding for employment level, full-time employees were the only group in which the findings were statistically significant. Only 27.3% of full-time employees who owned their home found perceived accessibility as a problem in comparison to 38.3% of people who were full-time employees and rented their homes. These



findings are important because social class is a determinant of accessibility to recreational facilities.

**143.**

**SOCIAL CLASSES AS GLASSES: DOES SOCIAL CLASS IMPACT ONE'S PERCEPTION OF THE HOMELESS?**

Laura Figueroa '15

Faculty Sponsor: Theresa Morris

There are stereotypes and assumptions for each social class in terms of their beliefs, values and opinions. For my study I decided to see if different social classes have different attitudes towards the homeless and homelessness in general. Using secondary data from The Roper Center for Public Opinion Research's 2005 study on opinions toward the homeless I looked at the relationship between a respondent's income and whether or not they think that people who are homeless are homeless because they are victims of circumstances or because they are responsible for their situation. I hypothesize that there will be a statistically significant relationship between income and attitude toward the homeless, and I expect that it will be people from lower social classes who have a more positive attitude and people from a higher social class who have a more negative attitude. After researching this topic using The Roper Center's data, I found that there is not a statistically significant relationship between social class and attitude toward the homeless.

**144.**

**THE CORRELATION BETWEEN SOCIOECONOMIC STATUS AND OPINION CONCERNING ABORTION**

Alegro Godley '15

Faculty Sponsor: Theresa Morris

My study concerns the connection between one's opinion on abortion in certain circumstances or ever and the socioeconomic status of one belongs too. Using chi squares when controlling for this with variables such as gender, religion, and race I've found a definite correlation between certain groups such as women, catholics and blacks. The studies I've used have acquired their data through varied means such as one on one research through interviews ,the national polling service and exhaustive sampling. Other studies I used didn't measure people's opinions and instead gave me a wealth of historical studies and facts. The data I'm collecting is quantitative and my hypothesis, that your opinion on abortion is or can be affected by your socioeconomic status or class applies to virtually everyone. All of the united states would be my population. No real ethical considerations entered into my project.

To me the significance of this particular subject matter is that abortion is an important matter of both human rights and women's health that intersects with certain themes of class and race and affects many millions of people worldwide. Understanding why different groups feel different ways about it and how that affects policy gives us new insight into the debate for and against it and what stigmas and considerations come with it.

**145.**

**UNEMPLOYED AND ON THE BOTTLE?**

DJ Goldberg '13

Faculty Sponsor: Theresa Morris

The goal of this research project is to determine which group of people will drink on more days in a given month, those who are unemployed or those who have a job. The initial hypothesis stated that if people are unemployed, they are likely to drink on more days out of the month. Obviously, those who are unemployed have a much greater amount of free time on their hands. For example, college students are considered a segment of the population that is unemployed, and they have plenty of time for drinking related activities. Furthermore, the elderly, or, retirees, have entered a permanent state of relaxation. However, after reviewing the data, it is clear that the initial hypothesis is completely incorrect. The data states that 60% of people unemployed drank zero days in the previous month. The data goes on to prove that those who are employed drink more than those who are unemployed. Reasons for these results include the stress of employment, and a lack of funds for those without jobs. Ultimately, according to the data, drinking is a luxurious habit for those who can afford it.

**146.**

**THE EFFECT OF SOCIAL CLASS ON THE DEVELOPMENT OF EATING DISORDERS**

Corinne Goldstein '15

Faculty Sponsor: Theresa Morris

Today's society associates values such as success, power, control, wealth, and beauty with thinness. Women are encouraged to try and maintain a low weight in order to be associated with all of the previously mentioned values. Some women feel more pressure to remain thin or have more access to resources that help them remain thin. Some women even go to extreme measures to achieve a low body weight and develop eating disorders. The objective of this research is to explore how a woman's social class affects whether or not she will develop an eating disorder. The studying of literature on this topic led to the formation of the hypothesis that upper class women are more likely to develop an eating disorder due to social and cultural influences which idealize thinness. Symbolic Interactionism theory is used to explain why thinness is so desirable in our society. Secondary quantitative data from the data set *National Health and Nutrition Examination Survey (NHANES), 2005-2006* was found and analyzed to determine if a relationship between social class and the development of eating disorders exists. The variables from this data that were analyzed were social class and whether or not the incidence of self-starvation in attempts to lose weight occurred. The findings indicate that a relationship between the two variables could be possible, but the data is not significant. This research ultimately reveals that social class is not one of the main factors contributing to the development of eating disorders. However, eating disorders are affected by other independent variables that require further exploration.

**147.**

**SEXUAL ASSAULTS: KNOWING THE STATISTICS BUT MORE IMPORTANTLY CHANGING THEM**

Katie Hawkins '15

Faculty Sponsor: Theresa Morris

Throughout a women's four-year college career, there is a one in four chance of her being raped or sexually assaulted. This is a statistic that is not widely known or acknowledged, in my opinion anyways. While there is a significant amount of research and literature on sexual assaults, not all of it is easily accessible. I chose to focus on college sexual assault statistics which also made the research at my disposal minimal. However doing so allows my findings to be relatable to myself and my current college peers. A considerable amount of the literature written on college sexual assaults relates to alcohol abuse and intoxication, therefore I used alcohol as my independent variable due to the constraint by the available data. Although alcohol appears to be the dominant related factor in rapes and sexual assaults there are also other variables that tend to be overlooked such as m, misinterpretation, age and gender.

**148.**

**EMERGING ADULTHOOD**

Jarred Jones '16

Faculty Sponsor: Theresa Morris

My data research focuses exclusively on one aspect of Adulthood: marriage. More specifically all of my data is focused on the age at which one was first wed. The purpose of this study is to see how, for a specific group, the age of first marriage has or has not risen. Working inductively I hypothesize that the ages at which one first is wed will increase steadily from 1972 to 2012. This is due to my having scholarly resources that all show a rise in the age of marriage since 1970. This increased marrying age is only one part of a larger social phenomena of what some might call delayed adulthood, but for over a decade has been known as "Emerging Adulthood" (Arnett 2000). Emerging Adulthood is commonly defined as

"Arnett (2007) describes emerging adulthood as taking place between 18 and 25 years of age, and it is characterized by the following: (a) identity exploration, (b) instability, (c) focus on self, (d) feeling in-between, and (e) possibilities. ((Esparza, Colón and Davis 2010)."

Practically, emerging adulthood is characterized by lack of meaningful employment, inability to be completely self-reliant, and prolonged education. Alternatively, those from a lower Socio-economic Status (SES) might view emerging adulthood as a time of a rapid assumption of adult roles and status. The data I have gathered from the bi-annual General Social Survey will be my small contribution to this growing field, as I search for a pattern in my findings.

**149.**

**NEIGHBORHOOD CHARACTERISTICS AND CRIME: A CASE STUDY OF 1980 ATLANTA**

Will Kaplan '13

Faculty Sponsor: Theresa Morris

Crime is something that impacts everybody's daily life, but it impacts different groups of people and different neighborhoods in varying ways. Some neighborhoods find themselves plagued by crime, and yet for those in other areas crime is the exception not the rule. The unfortunate reality remains that those plagued by crime are most often at the bottom of society's totem pole those without the financial means or influence to ensure their needs are met and rights are not infringed. This study operated as a case study of Atlanta in 1980, and using quantitative survey data focused on how a neighborhood's physical characteristics impact crime. I hypothesized that physical characteristics of a neighborhood impact crime, specifically that neighborhoods where a major six-lane street is present will have higher crime rates than neighborhoods that do not. For the most part the data supported this hypothesis. This study is given a voice by the theory of Jane Jacobs (1961), regarding how planning from the top down can be so detrimental to those citizens at the bottom. Time and time again we see how city planning in the interest of the elite can be so detrimental, just look at I-84 segregating Hartford or the housing projects that dot urban landscapes, just to name a few. These are some of the aspects that make this analysis so crucial.

**150.**

**MARIJUANA GATEWAY HYPOTHESIS**

Andrew Meagher '15

Faculty Sponsors: Theresa Morris, Rachael Barlow

Because Marijuana use often precedes the use of other more dangerous substances, it has for many years been characterized as a gateway drug. As marijuana has undoubtedly become more accepted over the past few decades, the question remains if marijuana use causes the use of more serious drugs. This study analyses data from the annual National Survey on Drug Use and Health (NSDUH). The NSDUH primarily measures the prevalence and correlates of drug use in the United States. The survey asked questions concerning the use of illicit drugs among members of United States households. Questions included age of first use as well as lifetime, annual, and past-month usage for the following drug classes: marijuana, cocaine (and crack), hallucinogens, heroin, inhalants, and prescription drugs. After several cross tabulations, the data showed that marijuana was the most commonly and earliest used drug by far. Very few respondents have done an illicit drug, but never done Marijuana. Similarly over half of respondents who have smoked marijuana in their lifetime, have also done another illicit drug. While these and many more findings point to Marijuana being a gateway drug, there are several "third variables" that may be threatening the hypothesis. This study examines and controls for these "third variable" in order to determine if the Marijuana gateway hypothesis is supported. Through examining the

data provided by the National Survey on Drug Use and Health, as well as testing for “third variable” spuriousness, this study attempts to determine if the gateway theory is supported.

**151.**

**IMMIGRATION AND CRIME**

Pornpat Pootinath '14

Faculty Sponsor: Theresa Morris

One of the most controversial topics in contemporary society is the connection between immigration and crime. A common public perception is that immigrants contribute to higher crime rate. Those in favor of strict immigration laws say illegal immigration leads to more crime. But does it? The aim of this study is to determine are foreign-born persons more likely than native-born persons to be convicted of a crime? To investigate this study, I analyzed data set collected the National Opinion Research Center at the University of Chicago consisting of was respondent born in this country, convicted of crime ever, and respondents' sex. Using the chi-squared test and control variable, I accessed the relationship between immigration and crime. My findings show that immigrants are associated with much lower rates of crime than native-born Americans, countering to the public opinion. This research and analysis provide great insight into the relationship between immigration and crime to policymakers, the media, and the general public.

**152.**

**THE ACADEMIC ACHIEVEMENT OF FIRST- AND SECOND-GENERATION UPPERCLASSMEN COLLEGE STUDENTS**

Xonana Scrubb '14

Faculty Sponsor: Theresa Morris

Over the years, there have been numerous comparative studies of the academic achievement (grade point averages) of first- and second-generation college students. Second generation students (students whose parents graduated from college) tend to outperform first-generation students (students whose parents did not graduate from college). Based on the research, the attainment of high academic achievement can be caused by a myriad of factors. However, these studies tend to focus on freshman college students rather than upperclassmen (juniors and seniors). In order to ensure that this performance gap is not being caused by the social/academic acclimation of freshmen to college, this project will test whether or not there is a difference in the academic achievement (G.P.A.'s) of 4,958 first- and second-generation upperclassmen college students. Race will be used as a control variable.

**153.**

**THE IMPACT OF PRESCHOOL ATTENDANCE ON STUDENTS' EDUCATION EXPECTATIONS**

Victoria Smith Ellison '15

Faculty Sponsor: Theresa Morris

This study examines the impact of preschool attendance on education expectations. While there is a great deal of research on the benefits of early childhood education there is not a lot of information on the connection between preschool attendance and higher education. Based on secondary data from the Educational Longitudinal Study (ELS) this study aims to see whether preschool attendance impacts 10th grade students' expectations of pursuing higher education. I hypothesize that students who attended preschool are more likely to expect to complete degrees in higher education (bachelor's, masters, advanced degrees or equivalent ) than students who did not attend preschool. I further examine the the connection between race, preschool attendance, and college expectations.

**Keywords:** education expectations; preschool attendance;10th graders; race.

**154.**

### **TURNING STATES GREEN: AN ANALYSIS OF STATES WITH MEDICAL MARIJUANA LEGALIZATION IN THE UNITED STATES OF AMERICA**

Conor Systrom '13

Faculty Sponsor: Theresa Morris

Prohibitions have often failed in American History, with the prohibition of alcohol being the most significant short-lived example. Now in the latest election with the legalization of marijuana in Colorado and Washington and more states the having legalized medical marijuana, it seems the dawn of the prohibition of marijuana is upon us as well. Although it may be easy to stigmatize this legal shift as a 'drug users paradise' there are clear social, medical, political and economic benefits of the legalization of marijuana or at least medical marijuana.

There are now eighteen states that have legalized marijuana for medicinal purposes. And although science has strongly supported the benefits cannabis can have as a prescription, there still seems to be strong views on both end of the spectrum.

What this study attempts to understand is what distinct these 21 states from the rest of the states which have not legalized medical marijuana or legalized recreational use. I have decided to use personal income averages as the independent variable and the political affiliation of state governors as the control. These are what I deduced to be the most viable variables in whether talks of legalization were held on a legislative scale in different states.

**155.**

### **THE DRONE CONTROVERSY**

Jonathan Wolff '15

Faculty Sponsor: Theresa Morris

Drone warfare is a new and innovative science that focuses on the use of drone aircraft for eliminating foreign threats. Much controversy has arisen as a result of this new technology with regard to human rights violations, leading us to question where the origin of these opposing arguments comes from in the first place. The United States has a history of being divided politically based on geographic region, and to include drone warfare in this political discussion is necessary if political leaders wish to see where their constituents fall on the issue. We seek to solve this problem, and identify any disparity that may exist across regional borders within the United States.