



**Second Annual
Science Undergraduate Research
Symposium**

Thursday, December 1, 2005
Beaman Student Life Center
Belmont University

KEYNOTE ADDRESS

Beaman Student Life Center Meeting Room A/B
3:00 PM

**“Attention Deficits, Hyperactivity, and Impulsive Behavior: The
First Complete Mouse Model of ADHD”**

Dr. Michael McDonald
Vanderbilt Pharmacology Department

RECEPTION & STUDENT POSTER SESSION

Beaman Student Life Center Meeting Room Lobby
4:00 – 5:00 PM

STUDENT PAPER PRESENTATIONS

Beaman Student Life Center Meeting Rooms A & B
(Simultaneous sessions)
5:00 – 7:00 PM

POSTERS

Beaman Student Life Center Meeting Room Lobby and Atrium West Lobby
4:30-5:00 PM

Biology

“Relationship between serotonin and glutamate signal transduction for chemotaxis in *C. elegans*”

Jimmy Berthaud
Lori L McGrew, PhD

This project utilized the nematode *C. elegans* as a model system for studying neurobiology. Nematodes are easily maintained and manipulated. Their genome has been sequenced and a number of characterized mutations are available upon request from the Caenorhabditis Genetics Center (CGC). *C. elegans* have 302 neurons, representing about 30% of the total number of 959 somatic cells. *C. elegans* use many of the same neurotransmitters that vertebrates utilize including acetylcholine, GABA, dopamine, glutamine and serotonin. All these factors make the nematode an attractive model system for undergraduate research in neuroscience. This project specifically used *C. elegans* to assess the role of serotonin in modulating glutamatergic response detection/avoidance of a chemoattractant (iso-amyl alcohol) and a chemorepellant (1-octanol). Worms with defective serotonin or defective glutamate signaling were used to assess the effect of exogenous serotonin on detection of attractants or noxious substances. The application of exogenous serotonin did restore wildtype chemotaxis in the glutamate deficient worms, consistent with the idea that serotonin activates glutamate which stimulates chemotaxis.

“Selective Serotonin Reuptake Inhibitors (SSRIs) restore chemotaxis in ethanol-treated nematodes.”

Tuyen Bui
Lori L McGrew, PhD

This project utilized the nematode *C. elegans* as a model system for studying neurobiology. Nematodes are easily maintained and manipulated. Their genome has been sequenced and a number of characterized mutations are available upon request from the Caenorhabditis Genetics Center (CGC). *C. elegans* have 302 neurons, representing about 30% of the total number of 959 somatic cells. *C. elegans* use many of the same neurotransmitters that vertebrates utilize including acetylcholine, GABA, dopamine, glutamine and serotonin. In this project, *C. elegans* were used to assess the effects of ethanol on serotonin-dependent behaviors. Our hypothesis was that ethanol inhibits chemoattraction and that this behavior is dependent on serotonin. Chemotaxis experiments demonstrated a reduced response in ethanol-treated worms. The worms were then treated with a serotonin re-uptake inhibitor (Prozac) to determine whether this would restore wildtype behavior in the ethanol-treated worms, and in fact, it did.

“Epizootic Hemorrhagic Disease in White-Tailed Deer in Williamson County, Tennessee”

Katy E. Reed
Faculty Advisor: Steven Murphree, Ph.D.

Epizootic Hemorrhagic Disease (EHD) is caused by biting midges in the genus *Culicoides*. (EHD is an acute, infectious, often fatal viral disease of wild ruminants, particularly white-tailed deer (*Odocoileus virginianus*). It is spread from deer to deer by biting midges and humans cannot contract the disease by handling or consuming the meat of an infected deer. It is hypothesized that white-tailed deer in Williamson

County Tennessee have recently been infected by EHD. In this study, hunter's check points in Williamson County will be monitored for deer possibly infected with EHD. The data being gathered will include: the region of first spotting of deer, the sex of deer, the degree of hoof sloughing, mouth ulcerations, and swollenness around the neck and face. By identifying the infected deer and the region from which they were taken at on a topographical map, future studies can be conducted such as collecting *Culicoides* biting midges from these *sites* and identifying the vectors related to EHD infections.

“*Borrelia lonestari* Infection Rates in Cheatham County, Tennessee Lonestar Ticks (*Amblyomma americanum*)”

Bridget M. Shariat

Faculty Advisor: Steven Murphree, Ph.D.

In the northeast United States, Lyme Disease is most commonly transmitted through *Ixodes scapularis* on their reproductive host, white-tailed deer. The American South annually receives reported cases of Lyme Disease, but the majority of patients test negative for the disease-causing bacterium *Borrelia burgdorferi*. The collection and testing of lonestar ticks (*Amblyomma americanum*) for *B. lonestari*, a closely related species, can aid the understanding of Lyme Disease transmission in the south. Since *B. burgdorferi* and *B. lonestari* infect hosts such as white-tailed deer (*Odocoileus virginianus*), it is thought that the lonestar tick can receive *Borrelia* when it attaches to an already infected host. The purpose of this study is to understand Lyme Disease in middle Tennessee by specifically testing lonestar ticks for the presence of *B. lonestari*.

“The Bacterial Preference of *C. elegans*”

Reca Barwin

Nick Ragsdale

It is known that *C. elegans* is a soil dwelling nematode and that the food source are the bacteria in the soil. However, the strain of soil bacteria that they prefer is not well known. Thus, to add to the general knowledge of *C. elegans* a chemotaxis protocol was utilized to test the preference of *C. elegans* to several characterized bacterial strains. The knowledge gained by this experiment will improve the husbandry of *C. elegans*. Additionally, the results could be utilized in the development of additional experiments focused on metabolism and cellular respiration.

“Reducing the Cost of *C. elegans* Husbandry”

Kelly Deweese

Nick Ragsdale

C. elegans, a nematode in which adult specimens are approximately 1 millimeter long, has become a model organism for scientific studies as it grows well in laboratory settings and is relatively easy to culture and maintain. In a laboratory, the worms must be grown on a nematode growth medium that will supply them with essential nutrients and also support growth and reproduction. Currently, the growth medium can be purchased or produced in the laboratory. The objective of this exercise was to develop a nematode growth medium that could be made relatively easily in our laboratory and support *C. elegans* functions while also providing a more cost efficient way to maintain our worms. The new M1 media is more convenient for students, is more cost efficient for the department, and sufficiently supports the necessary functions of *C. elegans*.

“Utilization of *C. elegans* for the Measurement of Cellular Respiration”

Ashley Dozier
Nick Ragsdale

Cellular respiration is commonly explored in both lecture and laboratory exercises of the biology courses offered to majors. Students confuse much of the lecture material due to the abstract nature of the molecular interactions. Lecturers attempt to alleviate the confusion through laboratory exercise reinforcement. Currently, many of these laboratory exercises require the utilization of test organisms that either do not help solidify the cellular respiration concepts and/or that require the use of expensive equipment. The purpose of this study was to determine the effectiveness of *Caenorhabditis elegans* as a model organism for the study of cellular respiration. Vernier™ software and transducers were utilized to measure the consumption of dissolved oxygen. Results indicate that *C. elegans* cellular respiration can be measured with inexpensive materials. Furthermore, the rate of cellular respiration can be altered with simple manipulations. *C. elegans* is an easy and inexpensive organism to demonstrate cellular respiration.

“Role of the Dopaminergic System in Response to Acute Ethanol Exposure”

Ricky Patel
Nick Ragsdale

The dopaminergic system has an indicated role in the human responses to rewards as well as in response to certain drugs. Scientists have utilized the round worm *C. elegans* to better understand the role of the dopaminergic system. The human response to ethanol involves the dopaminergic signaling pathway. McIntire *et.al.* and others have shown that the chemotaxis ability of *C. elegans* requires the dopamine system. The current experiment tested the role of the dopamine receptors dop-1, -2, and -3 in the response to ethanol as it pertains to chemotaxis. The current work suggests that the dop-2 receptor may be required for response to acute ethanol exposure. Future experiments will elaborate on the role of dop-2 as well as elaborate on the neurological pathway. These studies will provide insight on the effects of ethanol on human musculoskeletal capabilities.

“Dopaminergic Role in *C. elegans* Response to a Chemorepellent”

Meg Voss
Nick Ragsdale

C. elegans is a common soil nematode that must constantly use its sensory ability to navigate an extremely hostile environment. This round worm must be able to detect attractants (usually to food) and avoid repellents (usually to toxic substance, organisms, or environments). The current study investigates the role of the dopaminergic system in response to known chemorepellents. Specifically, do the dopamine receptors- Dop-1, 2, and 3- play a role in response to a repellent? Both wild types and dopamine knockout worms were subjected to the known repellent benzaldehyde and the response determined by calculating a chemotaxis index. Results show that the Dop-2 receptor may be important in chemotaxis away from a repellent.

“The Role of Dopamine Receptors in Response to Multiple Ethanol Exposures ”

Lindsay Honea
Nick Ragsdale

Caenorhabditis elegans are used for this experiment due to their simplicity in anatomy and behavior, their quick propagation, and their well-understood genetic background. Dopamine neurons are believed to be involved in drug addiction, motivation, and reward. There has already been indication that ethanol plays a role in reducing *C. elegans* locomotion rate. This work investigates whether the dopaminergic system plays a role in ethanol reducing *C. elegans* chemotaxis. Wild-type worms in addition to mutant worms dop-1, dop-2, and dop-3 were used for this experiment. The worms underwent a series of ethanol exposure

for four days. On the fifth day, a chemotaxis assay was performed to examine the role of dopamine receptors in ethanol-reducing chemotaxis.

“Relationship Between Calcineurin Expression and Cocaine-Seeking Behavior”

Neeti Sasi

Danny G. Winder, Vanderbilt University

Cocaine addiction creates profound changes in behavior and brain morphology. Previous research indicates that the dorsal striatum of the brain is a major target for cocaine and contributes to habit-learning. Calcineurin (PP2-B) is a calcium-dependent protein phosphatase also expressed in the dorsal striatum and works to negatively regulate long-term potentiation, learning, and memory storage. The current study investigates the relationship between calcineurin expression within the dorsal striatum and cocaine-seeking behavior in transgenic mice utilizing Conditioned Placed Preference (CPP), Western blotting, and fluorescence microscopy. Additionally, CPP was used to determine if sex differences in transgenic mice account for behavioral differences in cocaine addiction.

“A Survey of the Presence of Nine-Banded Armadillos (*Dasyops novemcinctus*) in Middle Tennessee: Focus on Davidson County”

Lee Griggs

Faculty Advisor: Darlene Panvini, Ph.D.

Beginning in the summer of 2005, I documented and recorded the presence of the nine-banded armadillo, *Dasyops novemcinctus*, within middle Tennessee, focusing specifically on Davidson County. Communicating with observers by phone and email, I was able to record information regarding armadillo sightings within counties of region II as listed by the Tennessee Wildlife Resources Agency. The survey took place between the months of July through December of 2005, resulting in approximately 300 sightings of which 200 were within middle TN. These sightings took place on various urban and rural roads, highways, interstates and also in habitats such as state parks and private properties. From the recorded data, a visual representation of armadillo progression into middle Tennessee can be seen, and their further expansion hypothesized.

“Allelopathy in the Exotic Bush Honeysuckle, *Lonicera maackii*”

Amanda Stinnett

Faculty Advisor: Darlene Panvini, Ph.D.

The exotic bush honeysuckle, *Lonicera maackii*, was introduced into the United States from Asia as an ornamental shrub and has invaded natural and urban areas over much of the eastern United States. Several ecological and biological characteristics contribute to *L. maackii*'s competitive success, including earlier seasonal leaf production and seed germination. Another possibility for its successful invasiveness is that the shrub might produce chemicals that ward off germinating native species thereby preventing their growth. Two experiments were performed to detect the presence of allelopathy in the exotic *L. maackii* shrub. The first study used processed leaves and roots of *L. maackii* mixed with different concentrations of water. Ryegrass and lettuce seeds were grown in the different concentrations of each processed medium. In the second experiment, soil was collected at varying distances from *L. maackii* in the field. Ryegrass and lettuce seeds were sown in the soil samples and germination rates determined. Results indicated that in higher concentrations of leaf and root extracts, ryegrass and lettuce seeds did not germinate as frequently as those grown in lower concentrations of honeysuckle leaf or root extract. Similarly, ryegrass and lettuce seeds had depressed germination when grown in soil collected nearest to bush honeysuckle. These experiments suggest that allelopathy may be a mechanism that *L. maackii* uses to compete with native species. Future studies are needed to detect the presence of any chemicals that may be produced in the roots and leaves that inhibit native seed germination.

“Protecting a Rare Medicinal Plant: Goldenseal”

Jenny Pollard

Faculty Advisor: Dr. Panvini

With the environment becoming more diverse with exotic plants it is important to protect the native ones. Along with exotics there are other factors that play into threatening the natives. Over-collecting, change in the environment, deforestation, and basic characteristics of the plant affect its survival. Goldenseal is a particular native species that is becoming threatened by many of these factors. As a medicinal plant it is used as an all-purpose medicine and adds value to our society. Goldenseal has many characteristics that are helpful and some that are detrimental to its reproducing. It is a slow-growing herb that is found mostly in woodlands with a large cover canopy. It is also found on slight slopes near water or trails. All of these characteristics are found at Warner Parks, where goldenseal is located in four sites. When observing each site they were very similar. All were on a slight slope, small patches, and two types of stems. The stem that has two leaves grows a flower and produces fruit. I also observed that an exotic plant, *Vinca*, has a negative impact on the goldenseal population. Since goldenseal has a large impact on the medicinal side it is important to figure out the reason why it is rare. To find such information a population viability analysis would be researched. One condition to consider is the impact of exotics that keep it from growing and how long before goldenseal is completely gone. Another condition is why it only grows in patches and does not spread to multiply.

“Stomatal density in the exotic shrub *Lonicera maackii* and the native shrub *Symphoricarpos orbiculatus* in different environmental conditions”

Bethany Thomas

Faculty Advisor: Darlene Panvini, Ph.D.

Stomatal density can affect the photosynthetic rates of plants since the number of stomata impacts gas exchange across the leaf-air interface. Differences in stomatal density have been noted among plants growing in different habitats. This study looks at differences in stomatal density, stomatal index, and stomatal length and width between the exotic shrub *Lonicera maackii* and the native shrub *Symphoricarpos orbiculatus*, both in the family Caprifoliaceae, grown in similar habitats. Microscopic analyses of stomatal peels were used to determine abaxial stomatal characters. Samples were analyzed from plants found in three different environmental conditions: low light, intermediate light, and high light. The results are discussed in terms of the impact of stomatal frequency and size on rates of photosynthesis and the invasiveness of exotic plants as compared to native species.

“Telomerase Activation in HPV-Associated and Unassociated Cervical Cancer Cell Lines.”

Deanna C. Gardenhire

Faculty Advisor: Jennifer T. Thomas, Ph.D.

Human papillomavirus (HPV) is linked to invasive cervical cancer in its high-risk form. Although the primary mechanism for tumor progression involves the binding of viral oncoproteins E6 and E7 to cell cycle regulators p53 and Rb, another potential role of HPV in cancer progression is in the upregulation of telomerase. This reverse transcriptase adds base pairs to chromosomal telomeres, allowing for continued DNA replication and cell division that can eventually result in malignancies. The role of telomerase expression in HPV-associated cervical cancers has been previously explored, although the mechanisms for controlling this expression are yet to be fully understood. In this project I am comparing the levels of expression of hTERT, the catalytic subunit of telomerase, in different cell lines to determine if there is a correlation with HPV status and telomerase activation. The cell lines include HPV18-expressing (HeLa) cells, HPV31-expressing (LKP) cells, and HPV negative (C33A) cervical cancer cells.

“Expression of ASIC2 mRNA in Brain Tumors”

Brooke Goodman

Faculty Advisor: Jennifer T. Thomas, Ph.D.

GBMs (glioblastoma multiformes) are responsible for 30% of all brain tumors and are the most common primary brain tumor in adults. Patients have a median survival rate of 12 months with treatment. In both normal astrocytes and cultured GBM cells, there is a group of sodium ion channels known as ASICs (acid-sensing ion channels). In normal astrocytes, protein subunits ASIC1 and ASIC2 are present at the cell membrane, resulting in inactivation of the channel. In GBMs, however, ASIC2 is not present at the membrane and the channel is continuously active. This increased Na⁺ channel activity may contribute to the ability of the GBM cells to invade surrounding brain tissue, a hallmark of the rapid progression of GBMs. The purpose of this study, therefore, was to determine why ASIC2 is not found at the cell membrane in GBMs. We chose to examine the levels of mRNA in normal brain samples and GBM samples to see if the problem is at the transcriptional level. Our findings demonstrate that all of the normal brain samples expressed both ASIC1 and ASIC2 mRNA, indicating proper transcription of the genes for ASIC1 and ASIC2. While all of the GBM samples expressed ASIC1 mRNA, 50% of the GBM samples did not express ASIC2 mRNA. These results indicate a problem with production of ASIC2 at the transcriptional level in some GBMs.

“Analysis of Photosynthetic Protein Ribulose 1,5-bisphosphate carboxylase (Rubisco) in Exotic and Native Plants”

Kristal M. Wicks

Darlene Panvini and Jennifer T. Thomas

Exotic invasive species are a serious threat to biodiversity in Tennessee. Exotic plants out compete native plant species, alter habitats required by animals, and have other direct and indirect effects on native environments. Exotics exhibit characteristics such as rapid growth rates, aggressive root systems, and increased photosynthetic capabilities. We examined photosynthetic capacity in exotic bush honeysuckle (*Lonicera maackii*), exotic winter creeper (*Euonymus fortunei*), native coralberry (*Symphoricarpos orbiculatus*), and native Virginia creeper (*Parthenocissus quinquefolia*). We found that in the early fall, native species showed higher rates of photosynthesis than exotic species but in late fall, native rates decreased significantly, indicating that they were halting their photosynthetic processes; exotic species, however, were able to sustain their rates of photosynthesis. A key component of photosynthesis is the protein ribulose bisphosphate carboxylase or Rubisco, an enzyme which plays an important role in carbon fixation during the photosynthetic process. We will next compare levels of Rubisco protein in exotic species *L. maackii* and *E. fortunei* to native species *S. orbiculatus* and *P. quinquefolia* by western blot analysis. We anticipate that the levels of Rubisco will correlate to the sustained photosynthetic capability of exotic species.

Chemistry

“The Antibacterial Properties of Tannins Extracted From Walnut Hulls”

Megan E Riddle

Faculty Advisor: Kimberlee Faison, Ph.D.

Tannin molecules extracted from medicinal plants have been found to act as bacteriocidal agents as well as enhance the antibacterial properties of commonly used antibacterial agents. However, as microbes develop resistance to these agents, a need for new sources arises. Many potential sources of tannin have remained unexplored. This research focuses on tannins found in Black Walnut hulls. Extraction of tannins from the walnut hulls was accomplished with an extraction solution consisting of acetone, water, and diethyl ether. Ground hulls in extraction solution underwent sonification producing a mixture that was filtered, separated, and characterized with high pressure liquid chromatography and infrared spectroscopy. Isolated tannin will

be used as an antibacterial agent against different species of bacterium to determine bacteriostatic and bacteriocidal properties. Based on previous studies, it is predicted that the tannins will have a bacteriocidal effect on the bacteria, especially the Gram-negative strains.

“The Amount of Lycopene in Tomato Products”

Todd Oldham

Faculty advisor: Kimberlee Faison, Ph.D.

Lycopene, which is responsible for the red color of tomatoes, is an important antioxidant. Antioxidants have been proven to neutralize free radicals formed when the body's cells burn oxygen for energy. Lycopene is not found naturally in the body and has to be absorbed from tomato products during digestion. This study compared the concentrations of lycopene in fresh tomatoes, Heinz ketchup, and tomato paste. Lycopene was removed from the tomato products via dehydration and extraction using acetone, petroleum ether, and methylene chloride. Lycopene will also be separated from these products using reversed-phase liquid chromatography. Results will be compared with a standard source of lycopene and to claims made by the commercial producers. Concentrations of lycopene are predicted to be highest in the tomato paste, then the ketchup, and lastly the fresh tomato.

“Ibuprofen in Over the Counter Drugs and Causes for False Positives in Drug Testing”

Joseph Crane

Faculty Advisor: Kimberlee Faison, Ph.D.

Ibuprofen is an over-the-counter medicine (OTC) for the temporary relief of pain. As a popular pain relieving drug, ibuprofen is available in both name brand and generic forms; however, it is not known that the quality and quantity of ibuprofen present in OTC is comparable between name brand and generic forms. In this study, ibuprofen has been isolated using methanol, centrifugation, and column chromatography from four different brands of OTC medicines. The purity of ibuprofen was established using melting point detection and IR spectroscopy to determine the differences between name and generic brands. An additional study will focus on the claims that the ingestion of ibuprofen causes one to fail a drug test for marijuana. The metabolites of ibuprofen, (+)2,4 (2-hydroxy-2-methylpropyl) phenylpropionic acid and (+)2,4 (2-carboxypropyl) phenylpropionic acid, will be compared with the metabolites of marijuana to see if false positives occur. Ibuprofen will then be ingested by the investigator in moderate doses and a drug screening will be performed to determine if the drug really causes false positive tests. This study will ultimately determine how much ibuprofen results in a false positive drug test.

“The Effects of the Bacteriocin, Nisin, Against Gram-positive and Gram-negative Bacteria”

Bert M. Loftus

Faculty Advisor: Kimberlee Faison, Ph.D.

The bacteriocin Nisin has been widely used as a food preservative for the past several years. Nisin is a small 34 amino acid peptide that is produced from the Gram-positive bacteria *Lactococcus lactis*. Nisin inhibits the growth of a wide variety of Gram-positive bacteria. Heat processing kills off the majority of bacteria that are present in the food, but some bacteria can still survive through a mechanism of the formation of endospores. Endospore forming bacteria form spores within their cells that hold the bacterial DNA needed for reproduction. These spores can withstand harsh environments that would normally destroy bacterial cells. When the pH levels lower, temperature lowers, etc, the spore breaks open and the bacteria are able to flourish again. The addition of Nisin to processed foods adds a secondary line of defense against endospore formation and the possibility of food spoilage. This study will focus on isolating a Nisin sample from a nutrient broth culture of *L. lactis*, purifying this product, and testing Nisin for its ability to inhibit the growth of several different Gram-positive and Gram-negative bacteria. The inhibition will be studied using the disc diffusion method on Nutrient Agar plates. Additionally, the concentration effect of Nisin will be investigated. I am predicting that all of the Gram-positive bacteria will have

inhibition zones and I am hoping to find that one of the Gram-negative bacteria under study will be sensitive to the Nisin bacteriocin.

Mathematics

“Assessing a Math Inquiry Class: Do Students Gain an Appreciation for Mathematics?”

Renee Torres, Kacie Kleja, Eninka Kombe
Faculty Advisor: Barbara Ward

The Department of Mathematics and Computer Science teaches Mathematical Inquiry (MTH 1080) as a part of the university's general education curriculum, the Bell Core, first offered to matriculating students in fall 2004. Quantitative reasoning as measured by problem solving and critical thinking is an integral part of the Bell Core learning goals. Mathematical Inquiry is a required math course for all calculus-ready freshmen, including mathematics and computer science majors. The course emphasizes topics that are intriguing to students and are chosen to develop mathematical thinking, abstract thought, and the logic of proof. The common theme is to develop mathematical thought at a rigorous and challenging level. Some topics included in the courses are graph theory, formal logic, proofs, number theory, dynamical systems, game theory, and coding. Different topics may be incorporated if the course is taught by instructors with unique research interests yet the common theme prevails.

This year the department is conducting an extensive assessment of Mathematical Inquiry. One purpose of the study is to determine if students who have a wide variety of intended majors and are enrolled in Mathematical Inquiry show an increased appreciation for the beauty and utility of mathematics. By using qualitative analysis of a survey and open-ended questions concerned with student's feelings towards mathematics, it can be determined how Mathematical Inquiry affects student's appreciation for mathematics.

“Fuzziness vs. Probability: Quantifying Mathematical Ambiguity”

Nathan Davis
Faculty Advisor: Dr. Stephen Campbell

Although the issue of ambiguity in mathematics is hardly a new concept, how that ambiguity is quantified has changed greatly since Dr. L. A. Zadeh introduced the idea of the fuzzy set in 1965. His work introduced the world to the concept of “fuzziness.” Previously, the only mathematical way to quantify ambiguity had been probability. Ever since, it has become increasingly difficult to determine which types of ambiguity fall under “probability” and which are in the realm of “fuzziness.” This project aims to show the similarities and differences between probability and fuzziness by displaying the basic set theory underlying each. Additionally, through simple examples, this project will demonstrate the types of ambiguity that are quantified by probability and fuzziness, as well as show applications of each.

“Plinko and Probability”

Joe Weisenberger, Parisa Fatheddin, Sara Williams
Faculty Advisor: Dr. Stephen Campbell

Many people do not realize that the television show, The Price is Right, is full of games with mathematical applications. One of the most well-known games, Plinko, is a prime example. When a contestant is invited to play Plinko, they first have the opportunity to win up to five chips. These chips are then dropped one at a time from the top of a rectangular board with a series of alternating pegs. At the bottom of the board are nine different slots with cash prizes ranging from \$0 to \$10,000. Which ever slot the chip lands in is the prize won. The game is advertised as “win up to \$50,000”, but the chance of doing so is slim. The principles of discrete probability as well as combinatorics will be applied to Plinko. Basic rules of probability will be investigated and applied to find the probability of getting each prize amount in Plinko.

Then for each prize, a histogram will be drawn to allow for the comparison between each of the nine available slots a chip might be dropped. Pascal's Triangle and the binomial theorem will also be used to find the probabilities of the chip landing in each prize. Plinko will be further explored with multiplication tree diagrams to show the possible paths that the chip may take.

“Connected Graphs and Their Applications”

Andrea Robertson, Todd Oldham, Lauren Hight
Faculty Advisor: Stephen Campbell, Ph.D.

Graph theory is the study of graphs and the relationships between them. Graph theory first evolved when Euler solved a puzzle many years ago. From that discovery many problems were applied to graph theory. Graph theory can be useful in a number of real world applications. Graph theory is involved with networks, websites, electric systems, etc. Though it is not always known or obvious, graph theory is present in every day life. Graphs consist of a set of points, called vertices, and the lines between them, called edges. Graphs can be described as connected, locally connected, n-connected, or locally n-connected depending on the connectivity and the relationships that exist between the vertices. Locally 2-connected graphs can be constructed using cycles and complete graphs with a minimum amount of edges.

“Application of block design in Statistical Analysis”

Kelly Major and Josh Moffitt
Faculty Advisor: Stephen Campbell Ph.D

Combinatorial mathematics or combinatorics is a branch of mathematics that studies finite collections of objects that satisfy specified criteria. It is concerned with counting the objects in those collections along with deciding when the criteria can be met and then analyzing and constructing objects meeting the criteria. It also involves finding “smallest,” “optimal,” or “largest” objects along with finding algebraic structures that these objects may have. Sir Ronald A. Fisher found a methodology for the design of experiments. In doing so, he illustrated the most important ideas of experimental design: randomization, replication, blocking, and orthogonality. Fisher was the first to consider the statistical theory of blocking or arranging the experimental units in groups (blocks) which are similar to one another. An example of an application of Fisher's design of experiments is greater precision in drug testing by further organizing the blocks, or groups of patients, thus reducing sources of variability which leads to greater precision. This project will show the various applications of Fisher's experimental work as well as our own interpretation of his work as it applies to our lives.

“Wonderful World of Numbers”

Rhonika M Robinson
Faculty Advisor: Stephen R. Campbell, Ph.D.

Figuring, The Joy of Numbers, by Shakuntala Devi explores unconventional methods to solving problems involving basic arithmetic calculations. The areas covered in this book are as follows: multiplication, addition, division, subtraction, highest common factor (HCF), lowest common multiple (LCM), square roots and squares, cube roots and cubes, percentages, discounts and interest, decimals, fractions etc. Mr. Devi's objective is to change the typical dull, morbid view associated with mathematics and transform it into something exciting and wonderful; not tedious but adventurous. He uses special methods, which he terms “shortcuts”, as an alternative to what is taught in the classroom for answering fundamental arithmetical questions. This research delves into the logic behind his “shortcuts” and proves that his “techniques” are mathematically sound and valid. Concentration will be on the following areas: addition, subtraction, multiplication, division and square roots.

“Basic Cryptographic Fluency”

Jeremy Walker and Patrick JM Ward
Faculty Advisor: Stephen Campbell, Ph.D.

Cryptography is ciphering and deciphering information to achieve secure communications and storage. There are different types of security, and the type of security needed is dependent on various circumstances. Additionally, most cryptographic system failures (security breaches) are due to improper implementation rather than algorithm weakness. With the increased cryptographic need in business and personal use, the new general user of cryptographic systems needs a basic cryptographic fluency to properly select and implement cryptographic products. This fluency includes basic understanding of the cryptographic method, types of security, and proper implementation. We will attempt to define and explain this basic cryptographic fluency for general users.

Psychology

“Psychometric Evaluation of a New Narcissism Scale”

Laura Bear, Sarah Miles, and Natalie Anderson
Faculty Advisor: Peter Giordano, Ph.D.

The purpose of our research was to re-evaluate a measure of non-pathological narcissism developed by the Spring 2005 Psychometrics class at Belmont University. Participants from the Introductory Psychology course completed four scales: a new narcissism scale, an established narcissism scale, an empathy scale, and an altruism scale. These scales were counterbalanced to prevent order effects. Convergent validity was tested by correlating the new narcissism scale with the previously established narcissism scale. Discriminant validity was tested by correlating the narcissism scale with the empathy and altruism scales. Reliability of the new narcissism scale was evaluated by testing for split-half and inter-item consistency.

“The Effects of Positive and Negative Mood Induction on Creativity”

Tyne A. Whitten and Laura A. Guthrey
Faculty Advisor: Lonnie Yandell, Ph.D.

Creativity is a way of solving problems in a way that is novel, practical, and worthwhile (Matlin, 2005). Mood is a lengthy emotional reaction to a stimulus and may affect creative production. In order to induce mood, one group received a happy mood induction by listening to fifteen minutes of allegros from Mozart's *Eine Kleine Nachtmusik*, *Divertimento* No. 136, Vivaldi's *Concerto in C Major*, and Vivaldi's *Concerto in G Major*. A different group received the sad mood induction by listening to fifteen minutes from Barber's *Adagio for Strings*, Mahler's *Adagio*, and Rachmaninov's adagio from *Piano Concerto No. 2 in C Minor*. Creativity was assessed with four items adapted from Guilford's research (Matlin, 2005). After listening to either the positive or negative inducing music, sixty introductory psychology students were administered the creativity test. It is expected that positive mood induction would have a positive effect on creativity, whereas negative mood induction would have a negative effect on creativity. Research in the areas of mood and creativity may provide a means to more creative production in society.

PAPERS

Beaman Student Life Center Meeting Room A

5:00 – 6:00

Dr. Nick Ragsdale, Moderator

Chemistry

5:00 – 5:15

“Isolation and Identification of Conjugated Linoleic Acid”

James Wright

Faculty Advisor: Kimberlee D. Faison, Ph.D.

Conjugated linoleic acid (CLA), a commonly used dietary supplement, is reported to help facilitate a change in body composition, leading to increased muscle mass and decreased stored body fat. This research demonstrates the effectiveness of isolating CLA from safflower seeds and the effect of the digestion process on CLA as a dietary supplement. CLA was isolated from safflower seeds using diethyl ether. The CLA was then separated by use of silver ion HPLC. The structure was verified by NMR and compared to known standards. A source of commercial dietary supplements was analyzed to determine actual concentration and structure. The sample was digested in simulated digestive conditions and analyzed to determine if alteration of the fatty acid occurs before it is absorbed by the body. CLA, if found to affect body fat percentage, may be active in either adipocytes or myocytes. Determining this interaction will eventually lead to clearer understanding of the pathways involved in the activity of CLA.

MATHEMATICS

5:15 – 5:30

“The Crossing Number $K_{r,s} \times C_n$ Graphs”

Mary M. Scott (Emmy)

Glenn. Acree, Ph.D.

The crossing number is the minimum number of crossings necessary to draw a graph in a 2-dimensional plane. Since many crossing numbers are not known, they are usually written as a range between an upper and a lower bound. In this study, the crossing number of the Cartesian product of complete bipartite graphs and cycles is studied. A sound upper bound was proven via a unique drawing and a lower bound was determined using Euler's formula, $V - E + F = 2$. These results may help in determining the crossing numbers of other Cartesian products.

5:30 – 5:45

“Collection and Analysis of Locomotion Data in *C. Elegans* through Image Recognition”

Sergei Temkin

Faculty Advisor: Glenn Acree, Ph.D.

In February of 2005, a research group from the California Institute of Technology published a paper detailing a method for capturing data describing the locomotion of the *C. Elegans*. (The *C. Elegans* is one of several model systems particularly well-suited for genetic studies, since its genome is completely documented.) The reproduction of the work of this paper with available resources is the task of this project.

A java program was created to analyze images of *C. Elegans* and output the data pertaining to the movement of the nematodes. After a video image is recorded from the microscope through a digital camera, it is broken into individual bitmap images which a java program takes as input. After cleaning the

images with the use of an implementation of the Canny Edge Detection Algorithm, the boundary of the nematode is identified. An artificial 'spine' of points is located on each image, which enables various data to be collected to be used to describe the locomotion of the nematode. The movement of the C. Elegans' 'spine' can also be graphically viewed using the java program's functions.

The result of this project is the opportunity to gather locomotion data corresponding to each of the genetic manipulations performed on the C. Elegans by students and faculty in the biology department.

PSYCHOLOGY

5:45 – 6:00

“Autonomic Nervous System Response to Images from the Mass Media”

Zea E.K. Miller, Amanda C. Simpson, Natalie Y. Durr

Faculty Advisor: Lonnie Yandell, Ph.D.

Watching the news can be a remarkably enlightening experience; stock market numbers, political coupes, and human disasters are things that we watch from the comfort of our couches and go on with our day. What impact does all of this exposure to suffering have on the ability of our body to respond with emotion? Do our bodies simply not respond to what we're seeing, because we've seen it a thousand times in the last 24-hour news cycle? This study examines differences in physiological response to novel horrific images and responses to scenes of human tragedy that have been shown repeatedly in the news. Heart rate and Galvanic Skin Response measurements were taken from 16 Introduction to Psychology students as they viewed a randomized series of sixty images, 20 neutral images from the International Affective Picture System (IAPS), 20 novel horrific images from IAPS, and 20 from online news sources. It is expected that horrific images that had been featured frequently in the news would elicit similar physiological responses to completely neutral images, and bear little resemblance to novel horrific images that had not been previously viewed. By understanding physiological responses to images, the mass media can better target the images they use for the audiences' response.

Beaman Student Life Center Meeting Room B

5:00 – 6:15

Dr. Mike Sullivan, Moderator

PSYCHOLOGY

5:00 – 5:15

“Culture and Chivalry: Regions of the US and Chivalrous Actions”

Sarah Lashley

Faculty Advisor: Michael P. Sullivan

New technology has allowed people to travel more widely and form relationships with people country wide. Regional differences result in different views on dating. Through this study, the views of chivalry throughout the US are explored. Southern men view chivalry as more important than men in other regions would. Southern women would expect men to view chivalry as more important than women from other regions. Belmont University students from Northern, Southern, and Western regions of the United States completed a survey. The results are discussed in terms of the regional differences in attitudes related to dating for both men and women.

5:15 – 5:30

“The Effect of Different Distractions on Test Taking Performance”

James K Goodlad (Gunner)

Faculty Advisor: Michael P. Sullivan

College students often complain about distractions in while taking tests. This study was testing to find what distraction had the most adverse effect on test scores. Participants were exposed to either 1 of 4 conditions: visual, audio, olfactory, or no distraction while completing while completing anagram and math tasks. An analysis of variance was used to measure the differences in mean scores of the 4 groups to determine if one is more distracting than another. The implications of these findings to study habits test and testing procedures will be discussed.

5:30 – 5:45

“The Effect of Everyday Stress on Eating”

Chegameh Korvandi-Geledar (Chey)

Faculty Advisor: Michael P. Sullivan

In a college setting there are many stressors, leaving the student looking for an outlet. Not having enough time to deal with stress in a healthy way students turn to eating. It was hypothesized that people under stressful conditions would eat more than people in non-stressful conditions participants were given the opportunity to eat while completing word problems. Some participants faced with a more difficult problem than others, to evoke greater levels of stress. We will find out if people are using food as a coping mechanism for stress. When people realize their unhealthy habit they can come up with a healthier way of dealing with it.

5:45 – 6:00

“The Impact of Music Videos on Attitudes toward Women”

Irena Tepavcevic

Faculty Advisor: Michael P. Sullivan

Past studies have shown that media, particularly pornography, has a strong impact on people’s attitudes toward women. The current study focused on music videos, a prevalent form of media widely viewed by adolescents. It was hypothesized that music videos with sexual images of women would have a negative effect on people’s attitudes toward women. Belmont University students viewed one of two sets of videos: one with sexual images of women or one without non-sexual images of women. After watching the set of 3 videos, participants completed a set of surveys about attitudes toward women, rape, and harassment. Findings are discussed in terms of the study context and larger societal impact of music videos.

6:00 – 6:15

“Seeing is Believing: The Power of the News”

Erica J. McFarland

Faculty Advisor: Michael P. Sullivan

Many experiments have been conducted that study mass media and its effects on the viewer. Among these studies, it has been shown that News programs may take advantage of tragedies and use them to develop related stories presented to the audience. The current study was conducted to examine if a dramatic presentation of information in a news story can motivate individuals to try to become involved. Participants in the study were presented one of two stories relating information about current humanitarian issues in Niger. After watching the new story, individuals completed questionnaires related to their feelings toward these issues and their desire to become involved with it. The results of this study will give insight into the tactics used to pull in and persuade millions of news viewers on a daily basis.

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