



UNIVERSITY *of* ST. THOMAS

UNDERGRADUATE RESEARCH AND COLLABORATIVE
SCHOLARSHIP (URCS) PROGRAM:
COLLABORATIVE INQUIRY

Inquiry at UST:
A Poster Session with the Results of
Faculty/Student Collaboration
at the University of St. Thomas

Abstracts

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Introduction

The abstracts published here summarize some of the sustained research and creative inquiry carried out in recent months across many disciplines by undergraduate students at the University of St. Thomas. In all cases, the student researchers have worked in close collaboration with faculty mentors who have contributed their time and talent to help our students dig more deeply into topics of the students' choosing and design.

Funded by the University of St. Thomas through its Undergraduate Research and Collaborative Scholarship (URCS) Program, this poster session allows our dedicated scholars an opportunity to share their work with larger audiences and receive the critical scrutiny of their peers, professors, and the general public.

We hope that you enjoy this event and invite you to engage our scholars in ways that will both challenge them and encourage them to continue their journey of the mind.



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May 2010

As president of the University of St. Thomas, I am both pleased and proud to introduce the fifteenth annual poster session devoted to faculty/student collaborative projects, sponsored by the Undergraduate Research and Collaborative Scholarship (URCS) Program.

I believe that one of the most effective ways for students to learn is through collaborative inquiry: students and faculty working together on research that can have real-world consequences. In fact, this was one of the major themes of my 2008 Academic Convocation address to our faculty. Active learning of this kind is completely in keeping with our mission as a Catholic university grounded in the liberal arts tradition. We strive to provide a high degree of personal attention in a challenging campus environment that is engaged with the complexities of our urban community and the world beyond.

Collaborative inquiry gives our students the opportunity to experience first-hand how their professors approach research questions in a given discipline. It also gives our faculty a better opportunity to understand how our students think, and helps them develop new ways of looking at research problems. Collaborative inquiry enables our students and faculty to experience their disciplines in action, deepening students' academic experience while simultaneously increasing career competency.

I heartily endorse this effort, and I hope this presentation of work accomplished to date will illustrate the importance of collaborative inquiry at St. Thomas.

Sincerely,

A handwritten signature in cursive script that reads "Dennis Dease".

Reverend Dennis Dease
President

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Paul Armstrong

GAME THEORETIC RESPONSES TO THE 2008-2009 FINANCIAL CRISIS

Faculty Mentor: Dr. Craig Marcott

We use Ray Fair's US model to simulate the effects of fiscal policy responses to the current financial crisis in a strategic setting. The Fair model forecasts are used to obtain ten potential payoffs for two- or three-player games involving the government, business and household sectors. A graphical user interface (GUI) created in Mathematica is used to select players, payoffs and conduct dynamic "what if" analyses using Mathematica's interactive manipulation capabilities. The end user chooses the payoffs for households (wealth, disposable income, and consumption), firms (corporate profit, plant and equipment, final sales of firms) and public sector (inflation, unemployment, budget deficit, and a "misery index", a weighted average of inflation and unemployment). In a public sector versus business sector game, the four by three payoff matrix corresponds to public strategies maintaining current policies, increasing transfer payments, reducing the corporate profit tax, or combining both of these policy changes. The business sector strategies are to increase, decrease or maintain constant expenditure on plant and equipment.

The Mathematica package, Nash.m, by Dickhaut and Kaplan is used to solve for all pure and mixed strategy Nash equilibria of the game. When viewed as a dynamic game, the user can alter the order of play among the players and observe how this affects the equilibrium selection. The GUI lets the user explore the effects of the selection of payoffs or policy objectives on the outcome of the game. Slider bars allow the user to simulate the effects of changing parameters in the consumption equations of the Fair model. This capability is used to illustrate situations in which increased household efforts to save can have the unintended consequence of moving the Nash equilibrium to a combination of strategies that may make the parties worse off than they would have been in the absence of counter-cyclical policy.

William Besser

AN INVESTIGATION OF DESIGN ACROSS TWO DISCIPLINES

Faculty Mentor: Dr. AnnMarie Thomas

A call has been made by governing bodies and industry in recent years to put a greater emphasis on design education in the undergraduate mechanical engineering curriculum. Even though this call has been made it has not been adequately answered by mechanical engineering education. There is a need for new methods of administering design education to be investigated in order to further develop mechanical engineering education as a whole. The goal of this article is to illustrate how, and why, teaching methodologies and styles from the discipline of industrial design could be utilized by mechanical engineering educators in order to further develop the undergraduate education on the topic of design. The results of this project were, a more thorough understanding of the current mechanical engineering and industrial design curricula gained from professors currently in these two disciplines, and ideas of how mechanical engineering education could benefit from the utilization of industrial design methodologies. Research concluded that mechanical engineering education could benefit from a better understanding of industrial design and could also benefit through borrowing teaching methods utilized by industrial designers on the topics of sketching, creativity, divergent thinking, and problem defining/finding.

Matt Bigaouette, Stephanie Collette and Jeremy McNeil

TARGETED INTERNET SEARCH ENGINE

Faculty Mentor: Dr. Patrick L. Jarvis

The system implements an Internet search engine that employs three components: a crawler, an indexer, and a query handler. The system reflects an object-oriented model that allows generalized, text-based inquiries to resolve into URL links. Results are ranked using inter and intra page links that often produce more accurate results than commercial systems. Object implementation used stacks, queues, binary search trees, AVL trees, and linked lists.

Jennifer Dada-Samuel

SLEEP PATTERNS AND MOOD IN RECENT TROPIC MIGRANTS TO MINNESOTA AND MINNESOTA NATIVES

Faculty Mentor: Dr. Roxanne Prichard

Purpose: The 24 hr light/dark cycle sets the pattern for behavioral and biological activities for terrestrial animals; this pattern is known as circadian rhythm. Exposure to sunlight varies between latitudes and seasons, as low latitudes experience less variation in day/night length than high latitudes. In high latitudes, day length is greater than night length during summer and night length exceeds day length during fall and winter. Hence sleep patterns and mood may be affected in regions of high latitude especially during fall and winter. Our goal is to (1) assess whether students show seasonality, (2) determine whether students with high seasonality scores show problematic mood and sleep behaviors, (3) determine whether latitude is a significant predictor of seasonality and sleep problems.

Methods: After obtaining IRB approval, an anonymous online survey was used to collect data on sleep, mood, and seasonality among students at the University of St. Thomas, MN (UST). Questionnaires used to assess sleep included the Epworth Sleepiness Scale (ESS) and the Pittsburgh Sleep Quality Index (PSQI). Questionnaires used to assess mood comprised of the Beck Depression Inventory (BDI), the Subjective Units of Distress Scale (SUDS), and the Profile of Mood States (POMS). To assess seasonality, questionnaires used included the first and third sections of the Seasonal Pattern and Assessment questionnaire (SPAQ), and the Morningness Eveningness Questionnaire (MEQ). Basic health and attitude questions were also included in the survey. Finally students were asked to list all places of residence from birth till present in order to determine the areas of latitude.

Results: On average, most UST students reported having a total sleep time of 7-8 hours a day during summer and less than 7 hours during winter and fall ($t=5.27$, $df=179$, $p<0.01$). UST students with high seasonality scores slept less ($M=6.48$ hours) than those with low or medium scores ($M=7$ hours). High seasonality students experienced more stress during winter ($F_{2, 125}=11.67$, $p<0.01$) than they did in fall ($F_{2, 125}=5.08$, $p<0.01$) than low and medium seasonality groups.

Conclusion: Students in regions of high latitudes show seasonality. Students with high seasonality experience more mood and sleep problems in winter than those with low and medium seasonality. We were unable to compare sleep, mood, and seasonality by latitude as only 2% of participants were born and raised in latitude 0-30°N. For future studies, an Actigraph and Sleep Diary study will be used to compare sleep, mood, and seasonality by latitude.

Angela Duffy

PARENTING AND SOCIAL NETWORKS

Faculty Mentor: Dr. Mary A. Chalkley

It was once believed that how the family chose to rear a child had little or no effect on the child's development. However research has indicated that parental actions, both passive (neglectful) and active (punishment), and the

resources provided within (food, shelter, clothing) and outside (art, sports, religious activities and neighborhoods) the home affect children. Children need the consistent and reliable care of their parents and other adults, but to provide that care parents need the support of employers, schools and society as a whole (Bronfenbrenner, 1988). This work examined the availability of social networks when raising children. Analyzing how and why parents choose childrearing advice as well as the availability of benefits in the work environment will allow for insight into factors which are likely to affect parenting. The results provide a scant hint that participants rely on benefits offered from employers, as well as seek advice from family, friends and other sources such as media and professional sources. In order to give our children the optimal environment to be raised, we must provide family-friendly resources to support families. Creating family-friendly government policies concerning the amount of employee benefits in today's work force would allow for a greater amount of support for employees with families. Improving the availability of professional resources and advice when raising children would allow first time parents the opportunity to consult with and receive valuable information from professional sources. Raising a child requires the cooperation of the parents, other immediate family members, friends, communities, and professionals.

Angela Duffy and Katie Broadwell

DOODLING: CAN IT HELP THINKING?

Faculty Mentor: Dr. Greg Robinson-Riegler

The present study investigated how doodling is related to memory and daydreaming. A recent study by Andrade (2009) that found that participants who performed a simple doodling task (shape shading) while listening to a phone message recalled significantly more pieces of information from the message (29% more) relative to participants who did not doodle. Andrade proposed that a simple doodling task actually aids focused attention (and prevents mind wandering) during a potentially boring task. This increase in focus leads to an improvement in memory. The present study expanded on Andrade (2009) by making it more applicable to the classroom setting. Instead of listening to phone messages, participants viewed a videotaped classroom lecture in either a control condition or a doodling condition like that used by (Andrade, 2009). The present study also explored how individuals might be affected by doodling. Different individuals have varying memory capacities, attention spans and tendencies to daydream. These diverse tendencies might dictate different (beneficial or detrimental) effects of doodling. The present study addressed these factors by asking participants questions related to the amount of daydreaming they experienced while in the stimulated classroom environment during the study. Given students' tendencies to daydream and doodle while sitting through their classes, gaining insight into the results of these processes would be of considerable value.

Brian Dwyer and Shane Smith

REFORMING TEXT USING RANDOM SYNONYM SUBSTITUTION

Faculty Mentor: Dr. Patrick L. Jarvis

The system implements an object-oriented model of a text analyzer that employs a trie-based thesaurus to modify sentences by identifying synonyms in the text and making random substitutions that create an alternative rendering of the text.

Evan Eid, Sara Seidl, Pat Zawadzki, Ryan Lill, Dustin Potter, Adam Johannsen and John Yang

SOY PROCESSING PLANT EFFLUENT EXHIBITS ESTROGENIC ACTIVITY IN VITRO AND FEMINIZES MALE FISH

Faculty Mentor: Dr. Dalma Martinovic-Weigelt

Industrial effluents can contain a variety of estrogenic chemicals, which have potential to disrupt fish reproduction and development. This study focused on the use of an in vitro bioassay with estrogen-dependent human breast cancer cells stably transfected with luciferase reporter gene construct under control of triplet estrogen response elements (T47D-Kbluc cells) to detect and quantify total estrogenicity of a soy processing plant waste effluent. The results of the in vitro T47D-Kbluc assay were compared with the induction of estrogenic gene transcription in male fathead minnows (*Pimephales promelas*) following in vivo exposure to the same effluent. A grab sample of effluent for the paired in vitro and in vivo studies was collected in November 2010. The sample was concentrated and fractionated with varying concentrations of methanol (25-100%) using solid phase extraction C18 columns. Estrogenicity of the effluent fractions 75-100% as determined in the T47D-Kbluc assay was ca 100 17⁻ estradiol equivalents (ng/L). Male fathead minnows exposed to the most estrogenic fraction of the effluent (75% methanol) for 48h showed a significant increase in expression of hepatic vitellogenin relative to controls. The in vitro and in vivo results both support the conclusion that the effluent released by the soy processing plant contains significant estrogenic activity.

Laura Farley

FOLLOW THE LEADER: THE BENEFITS OF ADAPTING EUROPEAN UNION STRATEGY TO DEVELOP U.S. CLIMATE CHANGE POLICY

Faculty Mentor: Dr. Rick Kunkel

Over the past decade the realities of climate change have become increasingly apparent, as water and surface temperatures are continuing to rise. Global warming can largely be attributed to the anthropomorphic impact and the resulting increase in green house gas (GHG) emissions. Thus far, international negotiations to address the issue have been driven by the United Nations Framework Convention on Climate Change and the Kyoto Protocol of 1997. Over 150 countries have ratified this commitment to make tangible efforts to minimize GHGs and reduce the human impact on the global climate. The U.S. has not ratified this agreement, and it is not likely that the US will join the Kyoto Protocol by its 2012 expiration date. By analyzing the United States' place within past international negotiations it seems that national legislation to combat climate change will need to precede international agreement. The United States federal government should take action to create a realistic climate change strategy that is effective, practical, and desirable. Immediate action is crucial; the United States must initiate a mandatory national program that creates binding goals, facilitates state action, and encourages state participation in regional programs. I argue that this will be best accomplished with a federal program leveraging action by the states. This program would be modeled after the European Union's Climate Change Program. The EU has recognized that the member nations are more effective as a whole, rather than separate parts, in their efforts to address climate change. Just as the EU has recognized the benefits of a comprehensive strategy, the US should create a program that promotes flexibility, accountability, and increased opportunities for state initiatives. A federal program would benefit from adapting the European Union's successful, comprehensive plan to address climate change and ultimately minimize our country's impact on global warming.

Cory Gagne

CONVINCING WOMEN TO CHOOSE TO BECOME ONE LESS: A RHETORICAL ANALYSIS AND EVALUATION OF MERCK & CO.'S CAMPAIGN TO MARKET THE GARDASIL VACCINE TO YOUNG AMERICAN WOMEN

Faculty Mentor: Dr. Debra Petersen

Merck & Co. has been very successful in marketing Gardasil, the first FDA approved vaccination for prevention of four strains of the humanpapillomavirus (HPV) that can cause cervical cancer and genital warts to U.S. medical professionals, young women, and the parents of daughters. Since gaining FDA approval in 2006, it is estimated that 25 percent of school-age girls and 15 percent of females 18-26 have been immunized (Pettypiece, 2008). Controversy has accompanied Merck's success, including charges that it has created a false sense of urgency for the immunization due to overstated concerns regarding cervical cancer. My research focuses on the marketing campaign directed to young women via television, print and internet ads. I focused on the audience of female college students, ages 18-26. My methodology included a rhetorical analysis of the Gardasil ads in which I discovered that Merck extensively uses themes of empowerment and femininity for this target audience. I also conducted interviews with local public and private college health officials to determine if Gardasil vaccinations were available in their college health centers, and if so, how this information disseminated to undergraduate female students. I learned that Gardasil is available at all but one of the campuses I contacted, and that Merck has provided their health centers with information packets to make it easy for them to promote the vaccine. My interviews with undergraduate female students indicate that despite the fact that the Gardasil vaccination is readily available on these campuses, there are significant factors that keep them from being vaccinated, including: the relatively high cost of the three-shot vaccine (over \$300); the way in which the three shots must be scheduled; health risks of the vaccination; and uncertainty and skepticism regarding the need to get vaccinated prior to sexual activity.

Meghan Grathen

LEG JOINT FLEXIBILITY AND VELOCITY OF KICKED SOCCER BALL IN COLLEGE AGE MALES

Faculty Mentor: Dr. Bridget Duoos

The use of stretching prior to athletic performance to reduce injury and enhance athletic performance has been controversial. A review of the literature concluded that it cannot be recommended to continue or discontinue stretching as there is not sufficient evidence (Gilchrist, Stroup, and Thacker, 2004). Also, it was suggested that there is a greater ability to increase foot speed when the swinging leg covers more distance (Young, Clothier, Otago, Bruce, and Liddell, 2004). Thus, the purpose of this research was to examine the importance of stretching and the effects it may have in college age males (age: 20.89 ± 1.45 years; height: 72.56 ± 3.47 inches; weight: 214.42 ± 40.55 pounds). The hypothesis for this research was that stretching will increase leg joint flexibility and leg joint flexibility will not affect the velocity of a kicked soccer ball. Research was conducted using nine right leg dominant college age males. The following leg joint range of motions were measured using a Saunders Digital Inclinometer both with and with out implementing a stretching program on two different days: ankle plantar flexion ($31.11 \pm 7.20^\circ$ and $25.33 \pm 10.61^\circ$), ankle dorsiflexion with knee bent ($37.33 \pm 11.30^\circ$ and $37.67 \pm 7.14^\circ$) and straight ($40.67 \pm 10.20^\circ$ and $42.11 \pm 9.774^\circ$), knee flexion ($118.56 \pm 7.80^\circ$ and $122.44 \pm 6.89^\circ$), hip flexion ($124.44 \pm 12.00^\circ$ and $126.44 \pm 11.58^\circ$), hip extension ($23.11 \pm 11.35^\circ$ and $25.44 \pm 16.79^\circ$), and hip abduction ($52.78 \pm 10.86^\circ$ and $64.89 \pm 9.97^\circ$). Subjects performed six instep soccer kicks and the velocity of the ball was measured using a Bushnell Radar Gun (40.22 ± 7.34 mph and 41.39 ± 6.20 mph). Correlation coefficients calculated for leg joint flexibility and velocity revealed a weak negative correlation for knee flexion on Day 1 (-0.516) and a strong negative correlation for ankle dorsiflexion with knee bent

on Day 2 (-0.791). A Pearson Product Moment T-Test performed for stretching and no stretching resulted in a significant p-value for hip abduction (0.026).

Will Grimmius

IDENTIFYING FACTORS RELATED TO SIX-YEAR GRADUATION RATES AT DIFFERENT TYPES OF POSTSECONDARY INSTITUTIONS

Faculty Mentor: Dr. Michael Cogan

Six-year graduation rates have been reported to the National Center for Education Statistics since 1993 and are one of the variables used to define the success of higher education institutions. For students entering any national four-year institution in the 2001 cohort approximately 54 percent graduated from the same institution within six years.

Six-year graduation rates have been studied for a number of years, however; little is known about how factors that institutions can control influence graduation rates based upon what type of institution it is. With that in mind, the intent of this research project is to compare and contrast six-year graduation rates at Catholic, other private not-for-profit, and public institutions as well as identify factors that may be related to these rates.

There were 64 explanatory variables, as well as 1,351 institutions used in this project. These 64 variables were broken down into four groups, listed below. The data was collected using the National Center for Education Statistics' Data Analysis System.

Demographics: (E.G. Percent of women enrolled and Percent persons of color)

Cost of Attendance: (E.G. Tuition and Percent of students receiving federal grant aid)

Admissions Patterns: (E.G. Total applicants and Application yield)

Institutional Measures: (E.G. Student to faculty ratio and Percent of students enrolled full time)

After analyzing the model, results showed three factors affected graduation rates at Catholic institutions, six factors affected graduation rates at other private not-for-profit institutions, and six factors affected graduation rates at public institutions.

Nick Hafften

PROJECTIONS OF THE ANTERIOR OLFACTORY CORTICAL REGIONS TO THE PREFRONTAL CORTEX IN RODENTS

Faculty Mentor: Dr. Kurt Illig

The olfactory cortex is associated with processing olfaction, or the sense of smell. Input from the olfactory cortex is received by the prefrontal cortex (PFC), the region of the brain linked to executing decisions and behavior. Although the olfactory cortex is in a position to affect several functions of the brain, little is known of its interactions with other areas. The present project sought to evaluate the circuitry between the olfactory cortex (specifically the anterior olfactory nucleus; AON) and the PFC. Small amounts of neural tracer were injected into the AON of rats to determine the topography of interconnections between the various subregions of the AON and the PFC. Using the computer software NeuroLucida, a reconstruction of a dendritic tree of a neuron in the AON was achieved. Examination of the dendrites revealed an abundance of widely dispersed spines covering the branches, suggesting that the cell receives input from a high number of cells scattered throughout the AON. Also, the dendrites branched through multiple layers of the AON, indicating that the neuron receives connections from the olfactory bulb. From these observations it can be proposed that the AON is involved in processing information from the olfactory bulb. Also, due to the interconnectivity of the cells in the AON, it could be suggested that the AON is involved in identification of olfactory stimuli. Although evidence for the AON's connection to olfaction processing is limited, the results of this study exhibit the complex networking involved in behavioral responses to external stimuli such as olfaction.

Daerek Hart and Chad Wertish

AN INTELLIGENT SUDOKU SOLVER

Faculty Mentor: Dr. Patrick L. Jarvis

Sudoku is a numeric puzzle consisting of nine grids formed into a three by three square. Each grid contains nine sub-grids also arranged in a three by three configuration. The puzzle is solved when each column and row of the square and each of the nine sub-grids contain all of the digits one through nine. The program we created uses an intelligent approach to solving the puzzle. Four characteristic grid sub-problems are identified and used to generate a whole puzzle solution by employing a 2D linked list to hold the puzzle state.

Kristina Hensbue

INFLUENCE OF SHOULDER RANGE OF MOTION ON 50-YARD FREESTYLE TIMES OF DIVISION III FEMALE COLLEGIATE SWIMMERS

Faculty Mentor: Dr. Bridget Duoos

Swimming is one of the oldest, most popular and frequently researched sports in the world. It has been proven that swimmers traditionally have greater glenohumeral joint laxity compared to a normalized group (Bak, Klaus, & Magnusson, 1997). Increased joint range of motion creates significant problems for swimmers often known as swimmers shoulder (Ho, Sherwin, 2010). However, this increased joint range of motion could be beneficial for competitive swimmers. This study examines the influence of shoulder joint range of motion on 50-yard freestyle times of Division III female collegiate swimmers (age: 20.20, ± 1.51 , height: 65.10, ± 2.47 , weight: 142.55, ± 11.31). Determining the role shoulder laxity plays in swim times could influence training techniques and establish whether or not stretching of the shoulders is important for swimmers. It was predicted that swimmers with greater shoulder range of motion would have faster 50-yard freestyle times. A Saunders digital inclinometer was used to measure shoulder range of motion of ten Division III female collegiate swimmers. Internal rotation, external rotation, flexion, and extension were measured on subjects' right and left shoulders. Each subjects average 50-yard freestyle times were obtained from the 2009-2010 University of St. Thomas swim season records. Minitab 15 was used to conduct a Pearson Product Moment correlation between subject's shoulder range of motion measured in degrees and average 50-yard freestyle times. Results determined there were little/no correlation between right and left internal rotation, right and left external rotation, right and left flexion, and right extension and 50-yard freestyle times. A weak negative correlation between left extension and 50-yard freestyle times indicated that as left extension increased, 50-yard freestyles times decreased. Results suggest there is little relationship between should joint range of motion and 50-yard freestyle times of Division III female collegiate swimmers.

Dan Houle

EXPLORING THE RELATIONSHIP BETWEEN STUDENT CHANGE AND SATISFACTION WITH UST

Faculty Mentor: Dr. Michael Cogan

This study examines student reported change over the course of their college experience and what implications this has on educational outcomes and satisfaction. Using surveys that students take upon entering St. Thomas and comparing them to surveys that they take when they graduate, each individual's change can be measured. This study includes students who took the 2009 College Senior Survey (CSS) and also the CIRP Freshman Survey between 2003

and 2005. 184 students were identified and their survey responses were merged into a single data set along with data from the Student Information System (SIS).

Using a data reduction method known as an Exploratory Factor Analysis (EFA), questions that were asked on both the CIRP surveys and the CSS survey were identified and selected. The EFA assembles questions that were answered similarly into groups known as factors. Four significant factors were identified and determined to be reliable. The groups related to four main topics: involvement, political views, partying, and self-awareness. The questions making up each factor were then aggregated and computed into a single variable for both the CSS and the CIRP. Finally, a variable measuring the change was computed by finding the difference between the aggregate variable for the CSS and CIRP.

Bivariate analysis were run using the variable measuring the change in each of the four factors and individual survey questions, constructs developed by HERI to measure specific areas, and data from the SIS. Noteworthy findings are noted and discussed.

Matthew Humbert

GAS PHASE MICRODIALYSIS AND CHEMILUMINESCENCE DETECTION: A SMALL, FAST, SELECTIVE, AND SENSITIVE TECHNIQUE TO MONITOR AQUEOUS NITRIC OXIDE

Faculty Mentor: Dr. Tony Borgerding

Gas phase microdialysis extraction interfaced with a selective nitric oxide chemiluminescence detector is capable of extracting and detecting nitric oxide produced from MAHMA NONOates and nitrite anion in artificial cerebral spinal fluid as low as 1 μM . The probes used are small (200 μm x 3 mm) and provide rapid (steady states reached in less than 5 seconds) and continuous extraction and measurement. Recent work has demonstrated that the probes can effectively measure nitric oxide in the cell cultures with macrophage cells. These experiments have demonstrated that gas phase microdialysis extraction and chemiluminescence detection can serve as a powerful tool to better understand the nitric oxide dynamics of in vitro studies. The data presented here has recently been submitted for publication in a peer-reviewed journal.

Renee Huset and Amy Schmelling

MINNESOTA PRAIRIE RESTORATION WITH THE NATURE CONSERVANCY

Faculty Mentor: Dr. Paul Lorah

Minnesota once boasted 18 million acres of the world's largest prairie, but agriculture and development has significantly decreased the amount of prairie in the state to under 1 percent of its original acreage. With this in mind, efforts intended to bring back prairie land must seek to both preserve land that is currently native prairie as well as restore lands that have remnants of the prairie grasses that once grew there. Working with data provided by the Nature Conservancy (TNC), this project utilizes Geographic Information System (GIS) tools including zonal statistics, density, and Single Output Map Algebra to target prime locations for prairie restoration projects with considerations for private, unpaved land, proximity to existing preserves and developed land, land quality for prairie restoration projects, and land enrolled in the Conservation Reserve Program (CRP). Using GIS and spatial analysis, this project identifies the top locations for future TNC prairie restoration projects in the state.

Alexandria K. Johnson

INFORMATIONAL SOCIAL SUPPORT: FEMALE MUSICIANS COPE WITH BREAST CANCER

Faculty Mentor: Dr. Jean Giebenhain

More women than ever are surviving breast cancer. Therefore, for this significantly increasing survivor population, the identification of coping strategies that facilitate adjustment to life after breast cancer is an important facet of survivorship. One of the ways breast cancer patients can cope with their illness is through the use of informational social support. Because musicians are a special subgroup of cancer patients who use their bodies in a way akin to athletes, breast cancer treatments threaten their ability to make music and their livelihoods. The unique threats that breast cancer treatments pose to musicians may cause musicians to place extra value on informational social support. This study examined how a particular population of female musicians surviving breast cancer viewed informational support offered to them by fellow musicians, fellow breast cancer survivors, and healthcare providers. Based on the analysis of interview transcripts from thirty-eight female musicians, 1-5 years post breast cancer treatment it was found that fellow breast cancer survivors, especially if the survivors are also musicians, are able to offer highly valuable advice. Facilitating networking between musician-survivors could be an important source of information, which would supplement information given to patients from their healthcare providers.

Kelvin Kosbab

MULTI-THREADED FILE COPYING

Faculty Mentor: Dr. Patrick L. Jarvis

Operating systems typically use sequential processing when copying a directory containing multiple files. The copy of one file finishes before the copy of the next begins. This does not always make the best use of system resources especially when the copy takes place between two different physical devices. An object based model was developed and implemented in Java that uses multiple, independent processes to work in parallel to quickly copy multiple files. The processes are dynamically assigned in such a way that multiple processes can be copying parts of the same file. The file copy is not constrained to either sequential reading or sequential writing thus allowing the processes to “fill in” the contents of the target file based on which process is given a time-slice.

Chantal Lenway

WHAT MIGHT INFLUENCE SERVICE LEARNING PROGRAMS: AN INSIGHT INTO ST. THOMAS STUDENT’S PERCEPTIONS

Faculty Mentor: Dr. Michael Cogan

Knowing what makes a great service learning program is important for a University that has many service learning opportunities. Knowing how to improve a program is not always easy. This study will help by being able to look into what the students are thinking about service learning programs through a survey administered to them before and after their service learning experience. This will help us get a better feel of how the programs are working from a student’s perspective before and after their service learning experience. It will also give us a chance to ask students questions we have for them regarding service learning experiences. This will help the University to know where the service learning program is and if there is anything that we might need to look deeper into. It will also be a way to keep generating information on the service learning programs over time. If surveys are continued to be sent out every

semester it will help to look at long term improvement of the service learning program at the University of St. Thomas.

Nicole Lucca

LITTLE GIRLS AND BIG BAD WOLVES: A CRITICAL ANALYSIS OF THE GRIMM BROTHERS' "LITTLE RED CAP," GEORGE EGERTON'S "VIRGIN SOUL" AND ANGELA CARTER'S "THE COMPANY OF WOLVES FROM A FEMINIST PERSPECTIVE

Faculty Mentor: Dr. Alexis Easley

This project explores the patriarchal bias inherent within traditional fairy tales and examines the feminist response to the Grimm Brothers' "Little Red Cap" story with a particular focus on literary works by George Egerton and Angela Carter. In traditional fairy tales, female helplessness, beauty, and submission are glamorized whereas women that are self-aware and non-conformist are either ostracized or killed. Feminist fairy tales, written in response to this notion, engage in debate about literary conventions and societal norms and attempt to change the cultural and social paradigms for future generations. In "Virgin Soul," (1894) Egerton imagines what would happen if Little Red Cap went back to her mother after her encounter with "the wolf." This re-telling is a story of regeneration—the "New Woman" has to leave the old woman behind in order to establish a new definition of femininity. In "The Company of the Wolves," (1979) Carter picks up on the radical potential of the second ending of the Grimm Brothers' tale and imagines a heroine who is just as strong, assertive, and manipulative as the wolf. Carter, like Egerton before her, is calling on her readers to question society's expectations of what it means to be a woman.

Thomas J. Matlon

DATA TRANSFORMATIONS IN BIostatISTICS

Faculty Mentor: Dr. Erin M. Curran

Many statistical methods, especially linear parametric methods such as analysis of variance and linear regression, require that data meet the assumptions of normality and homoscedasticity so that the results of statistical analysis are reliable and all meaningful inference to be made. In many fields of study, and especially in the biological sciences, data (such as blood concentrations of hormones and drugs) routinely exhibit non-normality and heteroscedasticity. To improve the fit of the data to the assumptions of the planned statistical analyses, variables in the biological sciences are commonly transformed. In other words, a mathematical function is applied to each observation with the intent of improving the fit of the data to the assumptions of the statistical analysis. This study explored the use of three common monotonic data transformations techniques (square root, logarithmic, and inverse transformations) on the log-normal distribution of Vitellogenin (VTG), an egg yolk precursor protein expressed by females of nearly all egg-laying species which was collected from several hundred fish from multiple wild and caged sites in Illinois. Graphical and statistical results show that data transformation techniques differ in their abilities to improve the fit of the data to the assumptions of the analysis and care must be taken to evaluate the results of any transformation applied.

Madelyn E. Mayry and Aly Wadley

PHENOTYPIC AND GENOTYPIC CHARACTER OF PSEUDOMONAS PUTIDA F1 PUTATIVE MUTANT #3

Faculty Mentor: Dr. Jayna L. Ditty

Bacteria are known to be chemotactic, or have a physical attraction to, specific chemicals in their environment, which are usually chemicals that the organism is able to metabolize. This phenomenon is controlled by protein receptors located on the surface of the cell that recognize either energy changes or certain chemicals that are of particular interest to the cell. Once an energy change or chemical is detected, these receptors generate a series of biochemical reactions that lead an organism to swim towards that chemical. *Pseudomonas putida* F1 is a common bacterium found in the environment that displays chemotactic behavior towards the toxic aromatic hydrocarbon, toluene, which is a common environmental contaminant. Currently, it is not known what receptors are used by *P. putida* F1 to detect toluene in the environment. A mutant strain of *P. putida* F1, possibly lacking two receptors may work together to elicit a response to toluene, was tested for deletion of the receptor genes and also the phenotypic response to toluene. If we are able to identify the specific genes that code for the chemotactic protein receptor, it could lead to a better understanding to how bacteria respond to toxic chemicals in the environment and possibly provide some solutions for the degradation and clean-up of chemical toxins in the environment.

Anna Meyer

ON THE DEVELOPMENTAL ORIGIN OF HEPATIC SINUSOIDAL ENDOTHELIUM: CONFIRMATION OF ANGIOCIRCULATORY VASCULOGENESIS

Faculty Mentor: Dr. Glenn Sherer

Developmental mechanisms reported to account for the origin of hepatic sinusoidal endothelium include (1) in situ differentiation of mesenchymal cells (Sherer, 1991), (2) sprouting from preexisting vessels (Gouysse et al., 2002), (3) transdifferentiation of mesothelial cells (Pérez-Pomares et al., 2004), and (4) recruitment of angioblasts and/or vascular endothelial cells (VECs) from the circulation (Pardanaud & Eichmann, 2006; Zhang et al., 2006). The present study was designed to investigate whether the last of these mechanisms, here termed angiocirculatory vasculogenesis, plays a role in the development of hepatic sinusoidal endothelium. Chick livers were harvested from quail/chick parabioses maintained either in ovo or in shell-less culture and were examined for evidence of quail VECs by immunostaining with QH1 antibody. Numerous positively-stained cells were found to contribute to the sinusoids of parabiotic chick livers. Non-parabiotic chick liver, serving as a negative control, lacked staining. These findings confirm that at least some of the cells that form these capillary-level vascular structures are, as previously reported, acquired from circulating blood.

Regan Meyer

IDENTIFYING OPTIMAL LOCATIONS FOR SITING CONCENTRATED SOLAR POWER PLANTS

Faculty Mentor: Dr. Paul Lorah

Given the current global concern of climate change, many countries, including the United States, are attempting to move from a dependency on fossil fuels to renewable and sustainable energy sources. A possible solution to this energy conundrum is the utilization of solar energy. The continental U.S. receives a sum of solar radiation that far exceeds the amount needed to fulfill their energy consumption needs; however it is harnessing this energy that proves

difficult. Concentrated solar power (CSP) plants are the most effective technology today in terms of harnessing solar power. This project has two main focuses:

Determining an optimal location for siting a CSP plant in the United States, based on the following variables: solar intensity, population density, proximity to power lines, bodies of water, elevation, and protected federal lands.

How much land is necessary to generate enough solar energy to fulfill the needs of the United States?

Andrew Michel

SYNTHESIS OF A FUNCTIONALIZED OXALOLIDINONE

Faculty Mentor: Dr. J. Thomas Ippoliti

Bacteria continue to mutate, multiply, and gain multidrug resilience, therefore new antibiotics need to be explored and synthesized. Oxazolidinones are a class of synthetic antibiotics proven to combat these resilient bacteria. An Oxazolidinone functionalized with a thiadiazole group was successfully synthesized in six steps and tested for antibacterial properties. 2-amino-5-(4-methoxyphenyl)-1,3,4-thiadiazole is reacted with benzyl chloroformate in base to form an amide linkage. This product is then reacted with R(-)-glycidyl butyrate and lithium bis(trimethyl-silyl) amide to produce the oxazolidinone ring with an alcohol side chain. The alcohol is then converted to a sulfonate, creating a good leaving group for the following reaction with sodium azide. This azide intermediate is reduced to the amine. Finally the amine is turned into an amide to create the final product.

Katie A. Miller

PROGRESS TOWARD A BETTER CONCEPTION OF THE EFFECTS OF NUTRITION ON THE BIOCHEMICAL PROPERTIES OF ANTS THAT INFLUENCE IMPORTANT LIFE HISTORY TRAITS

Faculty Mentors: Dr. Thomas C. Marsh and Dr. Adam D. Kay

Homeostasis of macronutrients is vital to the success of many organisms including social insects such as ants. Insects, in general, respond physiologically to different macronutrient ratios but most of the studies in this area have focused on nitrogen and phosphorus as limiting macronutrients. This study investigates the effects of varying the ratio of nitrogen to carbon in the form of defined protein:carbohydrate diets provided to laboratory colonies of the Argentine ant, *Linepithema humile*. When carbon is a limiting macronutrient, colonies experience an increased mortality rate among workers, workers have lower lipid content and the colony has decreased viability. To gain a better understanding of the underlying biochemical cause of the increased mortality rate, the levels of total nitrogen and the nitrogenous waste product, uric acid, will be measured among different life stages. It is hypothesized that the consumption of the excess nitrogen puts an increasing burden on the limiting pool of carbon due to increased uric acid production. We will also investigate the affects of variation in the availability of important nutrients has on other important biochemical properties of these argentine ants such as cuticular hydrocarbon profiles. Stoichiometry macronutrients homeostasis

Linda Nininahazwe

DEVELOPMENT AND REDESIGN OF A HUMAN-POWERED BLACKSMITH FURNACE AIR SUPPLY FOR DEVELOPING COUNTRIES THROUGH THE USE OF APPROPRIATE TECHNOLOGY

Faculty Mentor: Dr John Wentz

The emphasis of this research was to find a way that rural blacksmithing in developing countries like Burundi (East Africa) can be advanced through the use of appropriate technology. Currently, the technology used to heat metals at the village level is archaic due to a lack of availability of basic facilities and electricity. The standard designs being used require a long time and a lot of energy to heat metals. The goal of the project was to redesign air supply for a blacksmith furnace to increase heat and speed up the heating of the metals. A literature review of work that has been done in developing appropriate technologies and metalworking was conducted and several possible designs were investigated, including different types of fans and bellows. The main potential designs were different kinds of hand-crank blowers, the box bellows, the single chamber bellows and the double chamber bellows. The chosen design, based on a manufacturing analysis of the possible designs, was a double chamber bellows. Volumetric flow calculations were used to size the bellows to be an appropriate size for its task. A virtual prototype was created using Computer Aided Design (CAD) and a working prototype is in the process of being built.

Lucas K. Olson

HYDROCARBON BIODEGRADATION AT THE MIXING INTERFACE BETWEEN CONTAMINATED GROUNDWATER AND WETLAND SEDIMENTS UNDER NITRATE REDUCING AND METHANOGENIC CONDITIONS

Faculty/Staff Mentors: Dr. Jennifer T. McGuire, Erik W. Smith and Isabelle M. Cozzarelli,, U.S. Geological Survey, National Center, Reston, VA

In subsurface systems, biodegradation is often controlled by the metabolic activities of microorganisms. Previous studies have shown that the interface zones between environments, of differing redox states, are zones of increased microbial activity and thus great potential for controlling the extent and rate of biodegradation. This study seeks to understand the controls on rates of hydrocarbon biodegradation at a mixing interface between hydrocarbon-contaminated groundwater and a shallow wetland, in Bemidji, MN. Also investigated was nitrate, an imperative nutrient to metabolic activity in wetland systems. This study explored hydrocarbon degradation under nitrate-reducing and methanogenic conditions using innovative in-situ microcosms (ISMs) to measure reaction rates over 8 weeks. The ISM samplers were designed to provide the means to measure changes in the chemistry of water that has been in direct contact with a known in-situ microbial population, and to investigate linked microbiological and geochemical controls on degradation rates. Samplers contained an inner chamber filled with native wetland sediments which were augmented with two different test solutions to investigate biodegradation under nitrate reducing conditions (NISMs) and methanogenic conditions (MISMs). Native contaminated groundwater from the aquifer was extracted and augmented with a tracer (Br-) and BTEX compounds; test solutions added to NISMs also contained nitrate. After a 24 hour equilibration period, nitrate loss was observed in NISM1 and NISM2 at rates of 0.19 and 0.11 mg/L per hour respectively. During the same time period, BTEX loss was also observed in NISM1 and NISM2. The MISMs produced up to 3 mg/L methane and greater than 20 mg/L acetate. No methane or acetate was produced in the NISMs, indicating microbial reactions in the NISMs were dominated by nitrate reduction. Rate data from the MISMs shows that biodegradation of BTEX compounds was roughly 10 times slower than rates shown associated with nitrate reduction.

Dennis Ouk, Jason Moore and Nathan Winiarczyk

AN OBJECT ORIENTED SYSTEM FOR PERFORMING POLYNOMIAL ARITHMETIC

Faculty Mentor: Dr. Patrick L. Jarvis

A polynomial is a mathematical expression containing zero or more terms. Each term contains three parts: a numeric coefficient, a variable represented by a character, and a non-negative integer exponent. Terms in the polynomial are separated by addition or subtraction operators. For example, in the polynomial

$$4x^3 - 2x^2 + 9x + 2$$

There are 4 terms: $4x^3$, $2x^2$, $9x^1$, and $2x^0$. The system supports single variable polynomials using linked lists to store non-zero terms. Addition, subtraction, multiplication, and division are implemented.

Patrick Persons

EXAMINING THE EFFECTS OF LABOR MOBILITY IN THE EUROPEAN UNION

Faculty Mentor: Dr. Matthew Kim

In this project, I examine the effects of immigration control in the context of the European Union expansion of 2004. Using a constant elasticity of substitution (CES) production function, I simulate the effects of zero barriers to immigration using a model developed by Hamilton and Whalley (1984). I then use a generalized method of moments (GMM) function to fit the model to actual data observed in the European Union using elasticity of substitution between labor and capital as my primary parameter. The model relies on population and gross domestic product (GDP) statistics to estimate the current wage rates for individuals in the regions, and uses a fixed-point method to equate their wages by simulating the movement of people. Once this is done, I examine a situation where there are zero barriers to immigration, and in doing so, I can see how gross domestic product rates, as well as growth rates, are affected by such a large shock to the labor market. My results indicate that regions may not be able to equate wages, even with open borders, due to implicit and explicit costs associated with immigrating. This suggests that the benefits that have been previously estimated may not be as large as others have thought.

Kathryn Pogin

EPISTEMIC INJUSTICE: THE RELATIONSHIP OF TRADITIONAL WESTERN ANALYTIC AND FEMINIST EPISTEMOLOGIES TO SOCIAL JUSTICE

Faculty Mentor: Dr. Stephen Laumakis

Traditional Western analytic epistemology, or philosophy of knowledge, is generally framed in a “S knows that P” schema, where S is a knower (who’s particular identity is irrelevant) and P is some proposition that S knows. According to this account, subjective factors and interests that individuate knowers from one another are not considered significant to knowledge forming processes.

Recently, however, various feminist epistemologies have been put forward critiquing mainstream epistemology as being exclusionary. In fact, feminist epistemologies, particularly standpoint theory, have been better able to account for the ways in which social identity and one’s place in a given power structure interact with one’s knowledge forming processes. According to this account, failure to recognize the limitations of subjectively located knowers damages our ability to assign appropriate credibility to those whose experiences differ from our own, even if that credibility is otherwise deserved.

While epistemic prejudice serves to sustain social injustice by maintaining social power structures through the exclusion of marginalized knowers from the intellectual realm, recognizing that knowers are subjectively situated,

and, that certain groups tend to have a privileged perspective on some issues, can counter this prejudice and the social injustice that follows from it.

Wesley Rolnick

CREATING A JAVA MUD SERVER AND CLIENT

Faculty Mentor: Dr. Patrick L. Jarvis

The goal of this project was to create a java MUD server. A mud is a multi-user dimension that acts as a text based massively multiplayer online role playing game. The project consisted of developing a star topology that handles client connection to the server. The server then relays to the player what he/she sees and takes in player input. Players are also able to interact with each other through the server. In the development of this project data storage, TCP/IP protocols, and I/O streams were explored.

Samantha Rudesill

LEVEL OF SPORTS AROUSAL NEEDED TO BE AN EFFECTIVE HITTER

Faculty Mentor: Dr. Bridget Duoos

Sports arousal level is measured by the activation within the Autonomic Nervous System (ANS) (American Heart Association). The ANS regulates nerves in the heart, blood vessels and glands. Increased activation within the ANS results in higher levels of sports arousal. The purpose of this study was to determine if level of sports arousal while hitting a softball influences hitting performance. Ten University of St. Thomas softball team players (age=20 yr. \pm 1.15, ht= 169.1cm \pm 7.92, wt=66.16 kg \pm 7.52, experience10.6 yrs. \pm 1.71) volunteered for this study. Initial respiratory rate was measured manually by counting respirations for fifteen seconds then multiplied by four to determine respirations per minute. Heart rate was measured using a Polar FS1 heart rate monitor and skin temperature measurements were taken using a GSR/Temp2x machine. Subjects then hit 20 softballs in a long tee hitting drill in which the ball must travel 50 feet and hit a target on the fly simulating the distance needed to achieve a hit on the playing field. During stage two subjects kept respiratory rate pace with a metronome (www.webmetronome.com) for three minutes to keep their respiratory rate to half their initial respiratory rate. Heart rate, skin temperature and hits were recorded after the three minutes. During stage three the metronome was set to three times the initial breathing rate and measurements repeated after three minutes. Statistical analysis was done using Minitab15. Strong negative correlations were found during the relaxed breathing stage between both respirations and heart rate and hits, indicating as respirations and heart rate went down, hits went up. A strong positive correlation between skin temperature and hits during the rapid breathing stage indicates that as skin temperature lowered, number of hits dropped. Data suggests it is effective for a hitter to possess a low sports arousal.

Mark Schreck, Jonathan Gille and Joseph Tursich

VOICE OVER INTERNET PROTOCOL WITH ENCRYPTION

Faculty Mentor: Dr. Patrick L. Jarvis

A Java based object-oriented system was implemented that uses a network to do real-time voice transmission and reception. A client-server model employed as the paradigm for the communication. Voice traffic security was enabled through message encryption.

Nicholas Schwarz

CLIENT-SERVER MULTI-PLAYER RISK GAME

Faculty Mentor: Dr. Patrick L. Jarvis

An object-oriented model of the Risk board game was designed and implemented in Java. A specialized web server was written to act as a repository for the game rules and to hold the game state across the various client machines. The client uses browser technology for user input and output. HTML, cascading style sheets, Flash, and Javascript interact to display game status and capture moves.

Sara Seidl and Andy Van Alst

THE RELATIONSHIP BETWEEN ELEMENTAL COMPOSITION AND WHOLE COLONY GROWTH IN THE PAVEMENT ANT, TETRAMORIUM CAESPITUM

Faculty Mentor: Adam Kay

Organisms are made of materials; the mixture of materials that organisms are composed of can influence organism performance and reproductive success. Ecological stoichiometry is an approach that focuses on the link between organism composition and species interactions, resource availability, and nutrient cycling. One central idea in ecological stoichiometry, The Growth Rate Hypothesis, states that whole-body concentration of phosphorous in organisms has a major influence on the growth rate of animals. The GRH has been tested in solitary organisms but has not been explored in social groups. In this study, we investigate whether phosphorus content and growth rate are associated in the pavement ant (*Tetramorium caespitum*). We manipulated whole colony growth rate by modifying food availability and rearing temperature. We then tested whether ant colonies with higher growth rates had higher phosphorous content, and whether this higher phosphorus content was associated with changes in the ratio of immature workers to adult workers in the colony. Investigating the ultimate role of phosphorus at the colony level is a novel idea that could make a contribution to the field of eusocial insect behavior.

Amanda Sesker

GENDERED DEGRADATION AND THE EXPERIENCES OF SERVICEWOMEN IN THE U.S. MILITARY

Faculty Mentor: Dr. Britain Scott

The purpose of this study is to contribute to current research regarding the effects that gendered verbal degradation has on women in the American Armed Forces. Women are more likely to experience sexual harassment in the male-oriented work settings and are at risk for psychological health problems. Given the patriarchal nature and history of the American Armed Forces, several studies have been conducted in attempts to measure the subjective levels of sexual harassment service women and men experience. However, there is no measure to determine the possible effects of gendered language used during combat training and during other interactions between enlisted women and officers. Using collective questions and elements from the Post-Traumatic Cognitions Inventory (PTCI), Rosenberg Self-Esteem Scale, Sexual Experiences Questionnaire (SEQ-DoD), Silencing the Self Scale (SSS) and some personally developed questions, I created a Verbal Degradation subscale questionnaire in order to measure the frequency of gender-insulting terms and their perceived effects. I hypothesize the results will conclude that female veterans reporting higher verbal degradation frequencies will also have experienced lower levels of self-worth and well-being while serving. I am hoping that the exploratory nature of this study will serve as the foreground needed to expand

the language in what defines sexual harassment, and contribute to the lack of academic knowledge within this area of study.

Amanda Stemig

ANTIBACTERIAL ACTIVITY OF TETRACYCLINE PHOTOPRODUCTS UNDER VARYING PH AND WATER HARDNESS CONDITIONS

Faculty Mentor: Dr. Kristine H. Wammer

The presence of antibiotics in the environment is of concern due to the potential for selection of resistant bacteria. Tetracycline is one of many antibiotics that have been detected at low concentrations in natural waters. Tetracycline is known to degrade, via photolysis, into products that vary with changes in conditions such as pH and water hardness. To assess potential long-term impacts, it is important to determine if the products of photolysis retain antibacterial activity. In this project, the photodegradation of tetracycline was studied under a range of pH and water hardness conditions. The bacterial growth inhibition of *E. coli* DH5 was monitored by UV-Vis Spectrophotometry at various concentrations of tetracycline before and after exposure to simulated sunlight for each of the water conditions. In all cases thus far, no additional antibacterial activity has been seen that can be attributed to the photoproducts of tetracycline.

Jake Sundberg

ENROFLOXACIN AND THE CHARACTERIZATION OF ITS ACTIVE PHOTOPRODUCT

Faculty Mentor: Dr. Kristine Wammer

Enrofloxacin, a drug from a class of antibiotics known as fluoroquinolones, has been widely used on domestic animals for its activity against a broad spectrum of bacteria. Previous work in our lab has shown that enrofloxacin breaks down by direct photolysis, yielding a variety of photoproducts. Selected photoproducts were isolated using HPLC equipped with a preparative column and were manually collected. Antibacterial activity testing was performed by measuring the growth of *E. coli* DH5a using UV-Vis spectrophotometry. The *E. coli* were grown for six hours and exposed to varying concentrations of enrofloxacin or its photoproducts. Through antibacterial activity testing, one of the photoproducts of enrofloxacin was found to be biologically active. This product was further isolated and found to have a molecular weight of 374.1723 g/mol using mass spectrometry. Current work is based on using NMR to determine the chemical structure of the photoproduct.

Eric Tiffany

A BIOMECHANICAL ANALYSIS OF THE LACROSSE SHOT: LONG-STICK VS. SHORT STICK

Faculty Mentor: Dr. Bridget Duoos

With male high school lacrosse being in its fourth year as a male high school varsity sport in Minnesota, it is relatively new and is becoming increasingly popular throughout the state. In lacrosse, two sticks are used. The short stick is about forty inches long and is used by midfielders and attack. The long stick is about seventy-two inches long and is used by defenseman.

Ten male collegiate lacrosse players (age=21.80 yr. \pm 1.03; ht=182.75 cm \pm 4.65; wt=82.69 \pm 12.75) volunteered to participate in this study. Each participant was videotaped in the sagittal plane with a Canon ZR850 Mini DV video camera. Participants shot ten shots on a goal 44 feet away and were given six feet in which they could move towards the goal before shooting. Five shots were taken with a long-stick and five taken with a short stick; each participant used the same two sticks. Shot speed was measured using a Bushnell Velocity Radar Speed Gun. The third trial of each group of shots was digitized using Kinematics Video (Schleihauf, 2004) to determine the angular velocity of the stick at three phases of the shot: wind-up, shot and follow through.

Data were analyzed using Minitab 15 t-tests. When comparing the average shot speed of the long stick and short stick, the p-value $<.05$; indicating a significant difference between the shot speeds generated by the short stick vs. the long stick. The short stick generated significantly faster shots than the long stick. No significant difference was found between angular velocity of the two sticks in regards to the wind up, shot or follow through. When comparing the angular velocities of both sticks at each phase of the shot, the p-values $>.05$. Data suggests that there is a significant difference between the shot speeds generated by the short stick vs. the long stick, but there is no significant difference in angular velocity of the stick when comparing short stick to long stick.

Lauren Vecere

THE WAY OF SAINT JAMES

Faculty Mentor: Dr. Jane Tar

Over the past semester, I have researched and analyzed various elements of el Camino de Santiago (the Way of Saint James), a pilgrimage route leading to the Cathedral in Santiago de Compostela. According to tradition, the remains of Saint James the Greater were miraculously translated to Galicia and rediscovered in Compostela in the 9th century, a time of reconquest for the Christians. After the rediscovery, Saint James was declared Patron Saint of Spain and became the driving force behind the Christian reconquest of the Iberian Peninsula from the Moors. The motives of pilgrims to undertake the journey to Santiago differ greatly from medieval times to today. Also, the popularity of certain representations of Saint James has evolved since medieval times. Saint James has been depicted as a disciple, martyr, apostle, pilgrim, and moor slayer in both art and literature since medieval times. He has played an international role in the lives of pilgrims everywhere and a national role in the lives of militant Spaniards, encouraging and fostering the reconquest of the land from the Moors. He is depicted in art and literature as a slayer of the moors, while at the same time he is depicted as a pilgrim open to every individual on a personal level. Although these two representations contradict each other today, they were seen as complementary images in medieval times. Both Reconquest and pilgrimage played a role in forming the identity of a Spanish Christian nation. The poster will give a general outline of the pilgrimage to Santiago de Compostela and different aspects of the pilgrimage itself, such as the routes, pilgrim experiences, and motives to undertake the journey. It will also serve to explain the multiple representations of Saint James throughout art and literature and how each corresponds to the formation of the Spanish identity.

Vy Tran

SYMMETRY-BREAKING IN CUMULATIVE MEASURES OF SHAPES OF POLYMER MODELS

Faculty Mentor: Dr. Eric Rawdon

In a thermally agitated environment, randomly generated polygons are used to model the conformations of fluctuating polymer chains. To characterize the shapes of these polygons, we created 3D density plots of the vertex

distributions of families of random 6 edge polygons. The distributions give a measure of the shapes of the polygons, and our symmetry-breaking alignment procedure is not only able to reveal their average bulk shape, but also distinguish between different knot topologies and chirality. We looked at the family of 6 edge polygons, separating them by knot type, and we also looked at 6 edge open chains.

Vy Tran and Eric Brost

OPTICAL TRAPPING AND MANIPULATION OF MICRON SIZED PARTICLES AND BACTERIA

Faculty Mentor: Dr. Adam Green

Optical tweezers have become a widely used tool in biology for the manipulation of micron-sized objects. A trap is created by focusing a laser beam through a microscope, the objective that is also used to view the specimen being trapped. They work on the principle that a beam of light carries momentum and an object that bends the beam will experience recoil in the opposite direction. Using off-the-shelf parts, we have built a multi-array optical tweezers setup in the optics lab and are investigating possible applications for its use. So far we have made micro-motors using calcite crystals and a circularly polarized light and trapped latex microspheres and bacteria. The ability to precisely trap and manipulate small objects opens the door for many possible experiments. We hope to expand our setup by introducing an infrared laser and software controlled beam steering.

Vy Tran, Eric Brost, Jillian Scheilcher and Ann Ziegler

CHARACTERIZATION OF NON-LINEAR PENDULUMS THROUGH FREQUENCY BIFURCATION

Faculty Mentors: Dr. Mary Johnston and Dr. Jeff Jalkio

A sinusoidally-driven pendulum was studied by bifurcating through a range of driving frequencies. At each step, the dynamics were characterized by calculating the system parameters, and by looking at the attractor through Poincare sections. The system was then modified by placing a magnet under the pendulum which opposed a magnet attached to the end of the pendulum. This dipole-dipole interaction split the original single-well potential into a double-well potential. The bifurcation was repeated for the perturbed wells and the characterization parameters were calculated and compared with the unperturbed system. The results from both pendulums were compared with a simulated system bifurcation created using an ODE solver.

Vladimir Vinnik

ADVANCEMENTS TOWARDS THE SYNTHESIS OF A TOPOLOGICALLY DESIGNED NOVEL ANTIBACTERIAL

Faculty Mentor: Dr. J. Thomas Ippoliti

In recent years, the pharmaceutical research community has had to address the problem of growing bacterial resistance to currently available drugs. Novel pharmaceuticals, which are equally effective yet also safe, must be continually developed and synthesized. Molecular Topology (MT) is a technique for predicting, among many other things, the antibacterial properties of theoretical molecules that have yet to be synthesized. With the use of MT pharmaceuticals can be synthesized that differ greatly in structure from known antibiotics and are therefore very effective at combating multi-drug resistant bacteria. The focus of my research is to synthesize a compound that has been predicted to have

an 85% chance of success of being an effective antimicrobial through the use of Forward Engineering™ 4 topological identification. A convergent synthetic route was designed in which the upper and lower halves of the molecule would be synthesized in five and two steps, respectively. The first step of the lower half was an amide formation in which 2,4,6-trichloroaniline was converted to 2-bromo-N-(2,4,6-trichlorophenyl)acetamide using bromoacetyl bromide in 74% yield. The following step, the alkylation of aminocyclopropane to yield 2-(cyclopropylamine)-N-(2,4,6-trichlorophenyl)acetamide, was accomplished in a 94% yield in a microwave reactor. Advancements toward the synthesis of the upper half were made as well. In the first step 4-methylcatechol was acetylated using acetic anhydride in 86% yields. The reaction conditions for the following four steps have been developed and are a modification of researched primary literature as well as novel design. Each reaction intermediate was characterized with ¹H Nuclear Magnetic Resonance (NMR) and the final product, which will be tested for its activity as an antimicrobial, will be confirmed with ¹³C NMR as well as High Performance Liquid Chromatography Mass Spectrometry.

Kelly Ward

ROBERT E. LEE: A DIRTY OLD MAN?

Faculty Mentor: Dr. Joseph Fitzharris

Robert E. Lee has been placed on a pedestal in popular American thought as the perfect antebellum Southern gentleman. Traditional accounts of his life rarely include his marital frustrations and extramarital correspondence. In a letter to a female friend, Confederate General Robert E. Lee described an ideal wife, rather unlike his actual spouse, Mary Lee. Tidy, neat and gregarious, Lee seems to have been unhappy with his messy, pampered and unpleasant wife. Using the correspondence of Robert and Mary Lee I will examine the relationship between the legendary Confederate general and his wife to better understand a rarely researched aspect of Lee's life.

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