



UNIVERSITY of ST. THOMAS

**BUSH FOUNDATION PROGRAM GRANT:
COLLABORATIVE INQUIRY**

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

Abstracts

**Vol. 2
September 18, 2003**

Introduction

The abstracts published in this volume reflect the value we at the University of St. Thomas place on faculty/student collaboration.

Students who have recently done collaborative work with a faculty member present that work in these abstracts and at this poster session for purposes of dissemination and scrutiny by their peers, their professors, and the academic public.

The University of St. Thomas expresses its deep gratitude to the Bush Foundation, who funded this event through a three-year Program Grant. The grant seeks to increase the use of inquiry-based teaching methods, so that students experience the real work of the professions, working on real problems often taken from outside the university, in the ways they will be called upon to employ their disciplines after they leave the university.

A second theme of the Bush Program Grant is to increase faculty/student collaboration. We believe that one of the very best ways to teach is to have professors work with students collaboratively. Students see how work is really accomplished in their chosen professions, and professors have the chance to share their work as it is being created.

We hope this event and this volume gives visibility and credibility to the ideas represented in our Bush grant.



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September 2003

As president of the University of St. Thomas, I am both pleased and proud to introduce the second annual poster session devoted to faculty/student collaboration projects developed as part of our three-year grant from the Bush Foundation, *Focus on Inquiry: Faculty/Student Collaboration at the University of St. Thomas*.

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. This 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,



Reverend Dennis Dease
President

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Nathan A. Aamot

BEST PLACES TO PROTECT OR RESTORE OAK SAVANNA IN MINNESOTA

Faculty Collaborator: Catherine Hansen

This study's purpose was to find lands in Minnesota best suited for oak savanna protection or restoration. In order to answer this question of where, six variables were considered: population density, distance from roads, current land use category, distance from pre-settlement oak savanna habitat, distance from current oak savanna habitat and distance from industrial sites. The originating data of these six variables was analyzed and transformed to obtain raster data sets with 100 x 100 meter square grid cells. The final overlay process whereby the six variable layers would be added together to create the final most suitable lands layer necessitated a transformation of the six variables' numerical values into a simple 1 – 10 categorical system. A ten was assigned to those values in each variable most suited to oak savanna protection or restoration (i.e. close to current oak savanna habitat or far from roads) and a one to the least suitable areas. Finally the variables were weighted according to the likely significance each would play in determining how suitable an area is for oak savanna protection or restoration. Results from the final overlay indicate the largest areas of highly suitable land for oak savanna restoration or protection in Minnesota are in the far northwestern or southeastern parts of the state.

Amanda Bialke

THE SYNTHESIS OF A HOLE-TRANSPORTING AGENT

Faculty Collaborator: Dr. J. Thomas Ippoliti

A new, efficient, high yielding synthetic route to Dibenzob[e][1,4]dioxin-2,3,7,8-tetramine has been developed. This product can be used in various reactions to synthesize new hole-transporting agents to be used in Organic Light Emitting Diodes (OLEDs).

Alex Blissenbach

Carl Lindor

PORSOLT SWIM TEST: MODEL FOR ANIMAL DEPRESSION

Faculty Collaborator: Dr. Dwight Nelson

Behavioral immobility in the Porsolt forced swim test in animals is correlated with human depression. Termed “learned despair”, immobility in animals in the Porsolt swim test denotes a “depressed” state in the animal. Therefore, this system represents a method for the study of human depression via an animal model. Since the development of the Porsolt swim test in 1977, it has been used most effectively as a screen for treatments with anti-depressive properties. In this capacity, it has performed admirably, being able to positively identify anti-depressive effects in a large number of drugs, including drugs that when examined from a purely bio-chemical perspective would not appear to be effective antidepressants. Moreover, the Porsolt swim test is also able to detect the anti-depressant and depressant effects of non-drug treatments, including sleep disruption as well as other temporal alterations.

The purpose of this project is twofold. First, the protocol for the Porsolt Swim Test was researched and then recreated in lab. Secondly, a novel computer program was developed, using the NIH's labview, to

score each tape recorded trial. This was done so as to ensure a high degree of consistency in the scoring of animals as well as expedite the scoring process. Finally, in order to evaluate the effectiveness of the experimental setup, a number of trials were conducted to determine if the designed computer program returned consistent data when scoring the same piece of film as well as whether or not the program was able to clearly distinguish between mobility and immobility.

Jeffery S. Brubaker

SUBURBAN PERCEPTIONS OF THE INNER CITY

Faculty Collaborator: Dr. William J. Kinney

Inner cities across the United States have suffered substantial population declines since widespread suburbanization began in the 1950s and 1960s. As the middle and upper classes moved away from the city center, businesses began to follow them to the suburban fringe. The population shift to the suburbs, still prevalent today despite signs of urban renewal in some cities, is unhealthy for the inner-city economy. Jobs formerly available in the inner city move to the suburbs and become more inaccessible to inner-city residents without cars, who must rely on mass transit systems that offer few routes to suburban areas. Suburban migration creates a spatial separation with the inner city that causes its residents, due to lack of direct contact with the inner city, to form perceptions based almost entirely on media depictions. These perceptions facilitate the definition of the inner city resident as “Other.” Thus, a social rift forms in the metropolitan area. In order to remedy these problems, the metropolitan-area population trends must undergo a reversal. Suburban and non-urban residents must express some desire to move back to inner-city neighborhoods, if they are to be fully revitalized. For this reason, one can ascertain the probability of such an urban renewal emerging in the near future by studying suburban perceptions of the inner city, the topic of this research. To determine what they thought of the inner city, a telephone survey on several aspects of inner-city perceptions was conducted with residents from four Milwaukee suburbs, two inner-ring and two outer-ring. The respondents expressed little interest in moving (back) to the inner city, although they felt that most of its residents were good citizens. Other facets of inner-city perceptions are explored by the research. A comparison is also made to determine differences between inner- and outer-ring suburban perceptions. Additionally, urban and suburban Milwaukee criminal offense statistics are incorporated into discussion about perceptions of danger and fear of crime among suburban residents.

Joseph C. Casey

ENGLISH MAJOR PROJECT

Faculty Collaborator: Dr. Martin L. Warren

The purpose of this project was to propose a revision of the current requirements for the English majors at the University of Saint Thomas. Our Issues in English Studies class undertook the examination of the history of the requirements for the English majors at the University of Saint Thomas and compared the current requirements to those of several comparable colleges and universities in the United States. We read Robert Scholes’ *The Rise and Fall of English*, David H. Richter’s *Falling into Theory: Conflicting Views on Reading Literature*, and N. F. Blake’s *A History of the English Language* and based on those scholars’ opinions as well as our collective experiences, identified what we believed are the essential elements of an English major. Each member of the class then devised proposed new requirements for

the English major at the University of Saint Thomas applying their unique experiences and values. The structure of the English major was developed using Inspiration, software.

English, as a University discipline, should focus on preparing students for teaching. It is the foundation of all other subjects in the preparation of pupils for intellectual development, including critical observation and thinking, values analysis, and development. Because of my belief that English is the cornerstone of all learning, I have made the English Major with an Education Emphasis the primary English major with the goal of providing students with the knowledge necessary to impart to pupils in Secondary Education. The objectives of this English Major with an Education Emphasis are the three disciplines on which communication are based: reading, writing and speaking. Throughout the English Major with an Education emphasis there is a strong focus on the cultural context of language and literature. The other three English Major emphases are Literature, Creative Writing and Technical Writing.

Jeff Caudill

COMPUTATIONAL STUDIES OF THE STRUCTURE AND VIBRATIONAL SPECTRUM OF PYRROMETHENE 546

*Faculty Collaborator: Dr. Joseph Brom**

Infrared spectra of 1,3,5,7,8-pentamethylpyrromethene-difluoroborate complex (P546) were collected and compared to vibrational spectra generated by B3LYP based density functional theory (DFT) calculations. The geometry, frequency and intensity of the vibrational bands of P546 was obtained by DFT with the 6-31G* basis set. The computed IR spectrum of P546 at the DFT level provides general agreement with several observed vibrational modes, with respect to frequency and intensity, allowing reliable vibrational assignments.

Stephanie Churchill and Nicole Duxbury

RESOURCE LIMITATION AND PATTERNS OF SEX ALLOCATION IN PRAIRIE LARKSPURS DELPHINIUM VIRESCENS

Faculty Collaborator: Simon K. Emms

Like the majority of Angiosperms, Prairie Larkspurs *Delphinium virescens* are insect-pollinated hermaphrodites. Thus, in order to maximize their reproductive success they must optimally divide their resources between three types of floral structure: stamens, through which they achieve male success; pistils through which they achieve female success; and attractive structures such as petals, nectar, and scents, through which they attract pollinators to deposit and remove pollen. Moreover, the optimal division of resources among these structures may change through the blooming season as the opportunities for male and female success change. Previous research in our lab, at three field sites in 2000 and 2001, found that larkspurs always decreased their allocation to female structures in late blooming flowers, but that changes in male allocation were more variable. The decrease in female allocation appeared to be due to the fact that ovules were less likely to mature into seeds in late blooming flowers. Investment in large numbers of ovules in these flowers would therefore have been maladaptive. However, the reason for the decline in seed maturation rates was not identified. In 2003 we studied the same three populations as in previous years and discovered that male allocation typically increases in late blooming flowers. This is a very unusual pattern, and the reason why it occurs has not

yet been identified. We also carried out an experiment to determine the cause of the declining seed maturation rates. Early blooming flowers were removed from some inflorescences and the seed set in late blooming flowers was compared with that of control inflorescences that were left intact. If resources were limiting seed set, control inflorescences should have produced fewer seeds than experimental inflorescences. If pollen was limiting seed set, the opposite should have been true, because pollinators tend to prefer to visit large inflorescences. Our results clearly showed the former pattern, indicating that resources limit the seed set of late blooming flowers and explaining why female allocation declines through the blooming season in this species.

Nathan Coleman

SYNTHESIS OF A NEW HOLE-TRANSPORTING AGENT APPLICABLE IN ORGANIC LIGHT EMITTING DIODES

Faculty collaborator: Dr. Thomas Ippoliti

The synthesis of compounds with ideal properties to function efficiently in organic light emitting diodes has, over the past ten years, been the subject of much research. In this experiment a hole-transporting agent was the final goal. Considerable progress was made. An IBX•MPO complex was used to oxidize cycloheptanone to 2,6-cycloheptadienone. On a large scale, an insufficient amount of product was obtained. An alternate three-step synthesis by dibrominating, then dehydrohalogenating the cyclic ketal of cycloheptanone was then utilized. This route yielded sufficient quantities of the desired product. In a mixture of 2,6-cycloheptadienone and 4-Bromoaniline, a double Michael addition formed the key intermediate on route to the new hole-transporting agent.

Benjamin Colwell

THE EXTRACTION OF GENOMIC DNA FROM BACTERIOPHAGE T5.

Faculty Collaborator: Dr. Gary A. Mabbott

Progress was made toward accomplishing the goal of developing a universal method of detecting viruses. A procedure for releasing the viral DNA from its protein coat was developed using guanidine HCl to lyse the protein coat, allowing viral DNA to leak out into the surrounding medium. The viral DNA was then digested by two restriction enzymes, EcoR I and Hind III. Both of these enzymes leave sticky ends on the DNA, so synthetic oligonucleotide adapters, complementary to the digested DNA's sticky ends, were ligated to the ends of the DNA fragments. The same adapters were then used as PCR primers, and PCR was then performed on the viral DNA. The PCR products were then analyzed using agarose gel electrophoresis. Removal of the viral DNA from the protein coat, however, failed with our protocol. Procedural modifications as well as alternate methods of DNA extraction will be performed in the future.

Rebekah Cowdrey

TOO CLOSE FOR COMFORT: MAPPING THE ORBITAL MOTION OF NEAR EARTH OBJECTS

Faculty Collaborators: Drs. Paul Ohmann and Marty Johnston

Anyone who's seen Armageddon can tell you how catastrophic an asteroid impact on Earth's surface would be – and how important it is that we monitor the possibilities of such an impact. Tracking asteroids is difficult, though; they're very small, and they move very fast. The best way to keep track of them is to already know where they are – so we turn our attention to predicting where they will be at any given time. Predicting their motion is an extraordinarily complex operation – known to physicists as the “many-body-problem” because of the intricacies of the gravitational equations when three or more ‘bodies’ are concerned. To simplify the mathematics, we generate a computerized model, in which we make assumptions that hold true only for very small amounts of time – which means we need to do many calculations. We successfully tested our model with a well-known system: the Sun, the Earth, and the Moon. We used these three bodies to gauge the accuracy of our model; then we added an asteroid, to see if our model predicted Armageddon!

Ryan Erlenbush

ARISTOTLE'S NICOMACHEAN ETHICS: EUDAIMONIA AND CONTEMPLATION

Faculty Collaborator: Dr. Michael Degnan

Some scholars contend that, in the Nicomachean Ethics, Aristotle fails to decide between two accounts of happiness (eudaimonia)—a comprehensive account and an intellectualist account. These scholars assert that Book X of the Ethics presents the intellectualist account—where happiness consists solely in the activity of contemplation (theoria)—and that Book I and the middle of the Ethics present a comprehensive account—in which the happy life consists in both contemplation and morally virtuous actions. If these scholars are correct, Aristotle is indecisive and the Ethics is a disjointed work.

On the contrary, I propose that Book X and the whole of the Ethics claim that happiness consists in one type of good (moral virtue), and that this good life can be identified particularly with the life in accord with the most complete virtue—understanding (nous). Thus, happiness can be identified with contemplation (the activity of the understanding) more than any other activity. Finally, the contemplative life presented in Book X is more far-reaching than many assume and is not contrary to the earlier Books, but is a specification of them. Contemplation is not, as some have suggested, the whole of happiness, but, it is the single activity which most completely exhibits the qualities of happiness. Still, the life of contemplation must include excellence in all the virtues and, in a special way, excellence in the activity of contemplation.

Rebecca Faber

SYNTHESIS OF A CHIRAL CHROMOGENIC SUBSTRATE SCREENING AGENT FOR LIPASES OF NAPROXEN

Faculty Collaborator: Dr. J. Thomas Ippoliti

In three proposed steps the synthesis of a chiral acid chloride, an isolated photochromic salt, and a chiral chromogenic compound can be obtained. The chiral acid chloride is the acid chloride of the S enantiomer of the drug Naproxen. In using this chiral acid chloride the trapped form of a photochrome attached to the acid chloride will be synthesized and used as a substrate for the screening of enzymes. These enzymes will specifically cleave only the S-enantiomer of the chiral chromogenic substrate. The rate of cleavage of this compound shall be measured in order to determine the most efficient enzyme with which to cleave the chiral chromogenic substrate. In finding an efficient lipase with which to cleave the S-enantiomer of the Naproxen acid chloride a more successful way to produce the commonly used drug Naproxen will have been found.

Michael Gallagher

ARISTOTLE'S UNITY OF VIRTUE, PRUDENCE AND HABITUATION

Faculty Collaborator: Dr Michael Degnan

Aristotle's Unity of Virtue thesis states that in order for one to have any single virtue one must have all the virtues. This thesis hinges upon the connection of prudence to the moral virtues. Since prudence is a necessary condition for each individual virtue, and since all the moral virtues are necessary for one to have prudence, it logically follows that all the virtues must be connected. To further complicate matters Aristotle insists that moral virtue must be habituated. If each particular virtue must be habituated, it seems as though it would be impossible for a person to become virtuous for several reasons. First, if all virtues are connected, then it seems as though they would all have to be habituated simultaneously which is impossible. Second, very few people would have all the circumstances necessary to habituate all the virtues. A poor person, for example, cannot have the virtue of magnanimity.

In response, I argue that habituation perfects rational desires which do not necessarily have to be perfected simultaneously, but instead, can be perfected over time while the person is not yet virtuous. Once perfected it is these desires that affect action in the virtuous person. If the desires are aligned rightly, then the person will necessarily act in a virtuous way given the appropriate circumstances. Consequently, a person is not required to habituate every sub-species of every virtue. Magnanimity is a sub-species of generosity and the poor person can be generous. In this paper I explore these ideas as well as confront a simple counter-argument posed by Peter Geach in his book *The Virtues*.

Kimberly Gauquie

SYNTHESIS OF A NOVEL ISOXAZOLINONE ANTIBACTERIAL AGENT

Faculty Collaborator: Dr. J. Thomas Ippoliti

Antibacterial resistance is a continuing threat as many bacteria are becoming resistant to multiple treatments. Recently, a research group has developed a new class of antibacterial agents, known as

isoxazolinones, for treatment against resistant strains of bacteria. A seven-step synthesis of a novel isoxazolinone that would also be effective against these resistant strains was attempted. Products from the first four steps have been isolated and identified using proton NMR. The final three steps have yet to be completed.

Kathleen A. Graf

ZINC-BINDING AND FUR (FERRIC UPTAKE REGULATORY) PROTEIN AFFINITY FOR THE SUPEROXIDE DISMUTASE GENE IN ESCHERICHIA COLI

Faculty Collaborator: Dr. Kathy Olson

The superoxide radical mutates the DNA of Escherichia coli (E. Coli) cells. The ferric uptake regulatory (Fur) protein plays a regulatory role in the transcription of the Mn-containing superoxide dismutase (MnSOD) gene (sodA). It is thought to activate sodA, causing transcription of MnSOD. Fur exists in different forms dependent on the metals bound to it. In vivo, Fur exists either as the 1 zinc form (Zn1Fur) or the zinc-iron form (Zn-Fe²⁺Fur). In vitro, the 2 zinc form (Zn2Fur) is thought to act in a way similar to that in which Zn-Fe²⁺Fur acts. Protein shift assays using gel electrophoresis were used to determine the relative affinities of Zn1Fur and Zn2Fur. Zn2Fur has shown a higher affinity for the sodA promotor than Zn1Fur .

Jodi Grandy

ETHICS OF VISUAL JOURNALISM AS IT RELATES TO NEWSPAPER DESIGN

Faculty Collaborator: Kris Bunton, Ph.D.

As newspapers use bolder graphic elements to attract readers' attention, visual journalists have become integral to newsrooms. However, their concerns are not represented in journalism ethics. News designers must consider principles governing other journalists (telling the truth, minimizing harm, respecting audiences), as well as issues specific to newspaper design. For instance, cropping a photo or deciding what type font and size to make a headline are decisions based on design principles and news judgment, but not necessarily on ethical principles. No specific ethical guidelines exist for visual journalists, so this study pursued two strategies to learn what ethical issues are important to visual journalists. First, I conducted a content analysis of the leading text and trade books on the subject of news design to consider which, if any, ethical issues are discussed in the books used to train prospective visual journalists. Second, I surveyed newspaper designers nationwide to learn what, if any, ethical issues they regularly face and whether they believe a designer's code of ethics would be helpful.

The content analysis showed relatively little attention to ethical issues for visual journalists. Fifteen of the 22 (68 percent) news design books analyzed did not mention the word "ethics" in their tables of contents or indexes. Most of the books did, however, cover issues that raised ethical questions. The most frequently covered issue was photographs and their manipulation, which was mentioned in 20 of the 22 books (91 percent).

Thirty percent of the 160 visual journalists completing the survey said they confronted ethical issues weekly or regularly. Respondents listed accuracy, photographic manipulation, invasion of privacy, misleading readers, and using visual elements to sell newspapers as the ethical issues of most concern.

Sixty-one percent of respondents supported the development of a specific code of ethics for visual journalists.

Justin A. Gross, Anna M. DePompolo, Bob L. Azar

WHERE, OH WHERE, HAVE MY LITTLE TURTLES GONE? A POPULATION AND MOVEMENT STUDY ON PAINTED TURTLES (CHRYSEMYS PICTA) IN AN URBAN LAKE

Faculty Collaborator: Steyermark, A.C.

The determination of a population size and home range of *Chrysemys picta* is useful information for county officials in order to provide the best environmental habitat in urban settings. We conducted a mark-recapture study using basking traps we constructed and placed in various locations around Lake Judy, Shoreview, Minnesota. Upon each capture, we determined sex, carapace length, plastron length, and girth. CAPTURE, a population estimate model, was used to estimate the painted turtle population size. Latitude and longitude were taken for each trap location. Turtles with five or more recapture records were used to track movement around the lake using GIS (Geographic Information Systems). We estimated a population of 193 individuals for Lake Judy, and we concluded, based on individual recapture sites, that the lake as a whole, was not equally utilized. Based on observations and data analysis, we have speculated that this population estimate for the lake is artificially low, and that a large island in the lake provided a structural resource for *C. picta*.

Corey Guenther

THE EFFECTS OF EXTRINSIC REWARD ON INTRINSIC MOTIVATION

Faculty Collaborator: Dr. John Tauer

The use of rewards and incentive programs has become commonplace across a variety of domains in our society with the understanding that they increase motivation to engage in a specific task. However, researchers have consistently failed to reach a consensus regarding the effectiveness of such rewards. Some have found that rewards have detrimental effects on intrinsic motivation (Deci, 1971; Lepper, Greene, & Nisbett, 1973), whereas others have found just the opposite—rewards may actually increase motivation (Cameron & Pierce, 1994; Eisenberger & Cameron, 1996).

The purpose of our study was to investigate the effect of different types of rewards in different contexts on intrinsic motivation. We conducted a field-study in a naturalistic athletic context, a setting rarely employed within the field of motivation. 360 participants in an instructional basketball camp volunteered for the study. They were randomly assigned to one of nine conditions that combined one of three contexts (individual, cooperative, competitive) and one of three rewards (no reward, expected reward, unexpected reward) to take part in a free throw shooting activity. Participants were then given a performance goal that they may or may not have met. This design allowed us to simultaneously examine the unique and interactive effects of rewards, cooperation, competition, and success/failure on motivation. Intrinsic motivation was then assessed using a self-report measure of task enjoyment.

Preliminary results indicate a trend that unexpected rewards may have the potential to positively influence task enjoyment. Expected rewards and the absence of reward appear to have no effect on

task enjoyment. Furthermore, participants who met their goal enjoyed the task more than those who did not meet their goal. These results suggest that rewards need not be detrimental, and may even have the potential to positively impact motivation if administered carefully. In future research, we hope to examine mediating variables that help explain why rewards can have powerful effects on motivation.

Nicole Gurgel

A STUDY OF HOMELESS SINGLE MOTHERS AND THEIR FAMILIES

Faculty Collaborator: Dr. Brenda Powell

Site: The Family Place is a day shelter for families without permanent housing. It was established in November of 2001 when it became evident that the existing day shelters were not safe, enriching environments for children or their parents. Its clientele is largely comprised of families, but single persons are admitted when space is available. Because The Family Place is a day shelter, the clients do not sleep there, but at various churches in the area that volunteer their space on a monthly rotation.

Job Description: As the assistant coordinator of children's activities I help develop and implement daily activities that entertain, engage, and enrich the minds of the children whose families are staying with us. Our program stresses parental involvement, so working with the children also involves contact with their parents. Through conversations with both parents and children I have been given access to a wealth of narratives, all vastly different, but all leading to the same result: homelessness.

Overall Focus: The face of homelessness cannot be properly or accurately represented by a single gender or racial group, but within its many facets lie recurring patterns. The pattern I will research is that of the single mother. According to my records, almost 60% of our families were parented by single women. Although homelessness is a difficult and frightening experience for all parents, regardless of their sex or marital status, single mothers are made more vulnerable by their sex. Their physical weaknesses give rise to emotional and psychological struggles that produce the immeasurable fear and pain found in the faces of homeless mothers. In her book *Don't Call Us Out of Name*, Lisa Dodson interviews hundreds of women and girls living in poverty in the United States. She comments that these women "are 'an easy hit.' They get stunned from all sides, and from inside too. Poverty, loneliness, and shame can destroy...common sense and caution about men, her devotion to her children, her decent friendships...her belief in herself" (117). It is these women, "stunned from all sides" who are raising their children, our next generation.

Sara Hammerschmidt

STUDY OF ADHD ACCOMODATIONS IN A POST-SECONDARY ENVIRONMENT

Faculty Collaborator: Lauren Braswell, Ph.D.

Staff Collaborator: Kim Schumann

In recent years, greater attention has been paid to the learning needs of post-secondary students with Attention Deficit Hyperactivity Disorder. Accommodations, such as alternative testing locations or use of books-on-tape, have been implemented, yet there is a lack of empirical data on both the usefulness and comfort level of use of these methods from the student's perspective. The current study addressed these

issues with UST students meeting criteria for Enhancement Program services based on a prior diagnosis of Attention Deficit Hyperactivity Disorder.

Nineteen of the 45 potential respondents completed this survey, yielding a response rate of 42%. Respondents reported attempting to implement accommodations in 49% of their UST courses. 78% of these attempts were described as positive. In 22% of their attempts, students experienced some type of difficulty, such as faculty reluctance to arrange alternative testing locations or permit extra time for tests. In a few situations, respondents experienced negative peer reactions which discouraged them from implementing accommodations.

Of accommodations available at UST, alternative testing location and note-taking services were the most commonly used. Two rarely used methods—alternative exam format and access to syllabus prior to the course—received the highest ratings for helpfulness. Accommodations that were relatively more discrete, such as alternative exam format and books-on-tape received highest ratings for comfort with use.

Students reported high levels of satisfaction with Enhancement Program Services at UST, but did offer specific suggestions for program refinement. From some qualitative comments, it was clear that not all identified students were aware of accommodations available to them.

Study results must be interpreted with caution due to the low response rate. Future research should address improving the response rate through online survey delivery and exploring of the reasons students do not even attempt to implement potentially helpful accommodations in certain courses,

Joey J. Hendrickson

PHOTOPHYSICAL PROPERTIES OF NILE BLUE A PERCHLORATE DOPED SOL-GEL MATRICES

Faculty Collaborator: Dr. Joseph M. Brom

The sol-gel process refers to a low temperature method that can be used to produce glasses with better homogeneity than the high temperature conventional processes. The sol-gel process produces inorganic matrices through the formation of a colloidal suspension (sol) and the gellation of the sol to form a wet gel, which, after spontaneous drying, forms a dry gel known as a xerogel.

Sol-gel materials provide excellent optical hosts for a variety of applications. The gels are transparent from near-UV to the near-IR regions of the spectrum, and therefore provide an excellent material suitable for studying the spectroscopic properties of doped organic dyes within their inorganic matrices. In this experiment Nile Blue A Perchlorate (NBA), an organic dye from the oxazine class of dyes, was doped into sol-gels and its photophysical properties were studied through the use of laser induced emission spectroscopy and absorption spectroscopy.

The appearance of two distinct peaks in the emission spectra of the xerogels represents the presence of more than one species of dye within the gel.

The two species can be accounted for by either the emission of NBA and its conjugate base (NBB) or the ability of NBA to react with itself to form aggregates.

The shifting of the xerogel's emission spectra relative to where the excitation occurs can be explained by a phenomenon known as self-absorption, in which the gel is capable of reabsorbing emitted photons that leads to a corresponding shift in the emission spectra.

Christina Holm

LESSONS FROM THE HEART

Faculty Collaborator: Dr. Tim Scully

As a student in COMM 370: Advanced Video Production I had the opportunity to be assistant producer of a video documentary for Children's HeartLink, a nonprofit organization which, for over thirty years, has sent volunteer medical teams from the U.S. to train medical teams in developing countries to perform heart surgery on children. Five other students, Brad Jacobson and I accompanied Prof Tim Scully and the Children's HeartLink team to Nairobi, Kenya on February 21 to document a one-week mission. I was fortunate enough to get to experience the Kenyan way of life, an open-heart surgery and home visits that included a trip to a native Maasai village. Our team interviewed the locals from Kenya, the U.S. and Kenyan medical teams, both current and former patients and Children's HeartLink staff.

Prior to the trip, we learned how to shoot images and sound for effective productions. We learned about Children's HeartLink and its mission and objectives as well. After the trip we assisted in writing and editing a documentary program that would serve as an educational and promotional tool for Children's HeartLink.

The final class product was a 23:00 documentary, "Lessons from the Heart." It was presented to the UST community on May 19, 2003. Excerpts were presented at the Children's HeartLink Gala on May 10, 2003.

This experience not only was amazing from an educational standpoint but also from a personal growth standpoint. This real-life experience was a great addition to my resume and reminded of how much I have to be thankful for.

Mark Holmquist

"THE THAT" AND COMING TO RECOGNIZE IT

Faculty Collaborator: Dr. Michael Degnan

In Aristotle: the desire to understand Jonathan Lear writes, "The point of the Nicomachean Ethics is not to persuade us to be good or to show us how to behave well in the various circumstances in life: it is to give people who are already leading a happy, virtuous life insight into the nature of their own souls."¹ I had never considered the possibility that studying the Ethics was useless for the person who was not already virtuous.

In this paper I seek the foundations of Aristotle's theory of moral development. First, I investigate Aristotle's discussion about "the that" in Book I. I. Vasiliou argues that if a person can recognize that an individual action belongs to a particular ethical kind, then one possesses "the that." On the other hand, M.F. Burnyeat argues that a person cannot come to know "the that" unless one is properly habituated and taught. Only under those conditions can one discover "the that" for oneself. I turn to consideration

of the content of what one must be taught in order to know “the that”. On Burnyeat’s view one can know “the that” without knowing the why, for there are two types of teaching. The first does not require knowing why the acts are right, while the second does. H.R. Curzer denies that Aristotle distinguishes between two types of teaching, for Aristotle does not endorse a type of ethics teaching exempt from proper habits. I argue that Curzer overlooks a text where Aristotle endorses the two kinds of teaching view I conclude that given a loose definition of teaching Aristotle believes that it is possible to recognize “the that” via habituation or habituation and teaching. Hence Burnyeat and Curzer are each partly correct.

¹ Lear, p.157

Kimberly Jasch

MONITORING THE DESORPTION OF ANALYTES FROM NONPOLAR SPME FIBERS USING HIGH SPEED GAS CHROMATOGRAPHY

Faculty Collaborator: Dr. Anthony Borgerding

High speed gas chromatography has been used to separate VOCs such as benzene, toluene, ethylbenzene, and o-xylene in 5.4 seconds. Quick injection pulses have made this process very fast. These fast pulses allowing for fast separation have also made it possible to monitor VOCs. Use of a solid-phase microextractor allows for adsorption of these nonpolar analytes, and the desorption of them can be monitored with the HSGC. Fibers of carboxen and PDMS were studied with varying injector port temperatures and flow rates through the valve.

Melissa Jones

CRYOFOCUSING AND DETECTION OF SELENIUM COMPOUND AND OTHER VOCs IN SELENIUM ENRICHED BROCCOLI

Faculty Collaborator: Dr. Anthony Borgerding

With continued interest in the effects of selenium on intestinal cancer, selenium enriched broccoli has come under the spot light of cancer research. However, the actual cause of the reduction of cancer from selenium-enriched broccoli is unknown. One aspect of broccoli not extensively explored is the volatile organic carbons (VOCs). Using a liquid nitrogen cryofocusing technique, the broccoli was examined for any volatile selenium compounds. Selenium enriched-broccoli and ethyl benzene/dimethyl disulfide solutions were concentrated in a U-tube submerged in liquid nitrogen. An 1 liter sample bag was filled with 50, 100, 200 or 400 mL of helium. The helium bag was attached to a vial containing the solution of 1 part per million (ppm) of both ethyl benzene and dimethyl disulfide and the headspace of the vial was pulled through the cryotrap using a vacuum. U-tube was removed from the liquid nitrogen and placed in a warm water bath (50°C). A solid phase microextractor (SPME) fiber was exposed within the U-tube and then injected into a Gas Chromatograph-Mass Spectrometer (GC-MS). Chromatograms were observed and a plot of the various amounts of helium was created showing that 100 mL of helium is the most successful amount of air to be pulled through without breakthrough of the cryotrap. The sample of broccoli was observed in a similar way, using 100 mL of helium in the 1 L bag. Upon GC-MS analysis, the selenium compound of dimethyl selenide was discovered.

Robert Neil Kennedy

PATTERN RECOGNITION ARTIFICIAL NEURAL NETWORK

Faculty Collaborator: Dr. Sun Chung

An Artificial Neural Network is something that is designed to simulate the kind of activity that happens in the human brain. Like the brain, an Artificial Neural Network has neurons that communicate with each other to produce an output or decision.

Our goal was to build an artificial neural network that would be trained to recognize patterns when distorted or partial patterns are given. We built a Hopfield network using the Java programming language. Theoretically, a Hopfield network reliably remembers $0.138N$ images, where N is the number of neurons in the network.

For general patterns, we verified that our network matched the $0.138N$ bound. For special cases, however, we observed interesting results. For example, for the problem of recognizing the digits 0 through 9, we found that the shapes of the digits needed to be very distinct from each other for the network to remember all ten digits. When we increased the size of the network to allow for more complex shapes, we noted a slowdown in the execution time. Our analysis showed that the execution time increased quadratically for the size of the network. Refinement of the network for this special case is left for future work.

This project was supported by the Spring 2003 Undergraduate Collaborative Inquiry Grant funded by the UST matching funds to the Bush Grant.

Kayla Kent

UTILIZATION OF PHOTCHROMIC MOLECULES FOR DETECTING CHEMICAL WARFARE AGENTS

Faculty Collaborator: Dr. J.T. Ippoliti

The response of a novel indicator, specifically a visual color change, to diethylchlorophosphate (DCP, a compound with similar reactivity to nerve agents) has been observed. The novel indicator reacts with diethylchlorophosphate and water to give the open chain form of the indicator, which is a different color visually than the unreacted closed form of the indicator. The limit of detection and the kinetics of the color change were measured and a rate constant was determined.

Abraham Langseth

CHANGES IN PHOTIC RESPONSIVENESS OF THE MOUSE CIRCADIAN PACEMAKER FOLLOWING LIGHT-DARK ENTRAINMENT

Faculty Collaborator: Dr. Dwight Nelson

In mammals, circadian rhythms of behavior and physiology are synchronized by environmental light-dark (LD) cycles. While circadian clock resetting is often measured in constant darkness, responsiveness of the mouse photic entrainment pathway is reduced transiently by saturating light

pulses. We have quantified changes in responsiveness of the photic entrainment pathway over cycles 1-14 in constant darkness following LD entrainment. Mice were maintained in LD12:12 (140 ?W, fluorescent light) and transferred to constant darkness. Running wheel activity was monitored by a data acquisition system (Stanford Software). Saturating light pulses (15min, 500lux; 330mW) were delivered to each mouse at circadian time 16 on cycles 1-14 of DD (9-12/group). Phase delays measured during cycle 1 of DD were significantly smaller than delays induced during subsequent circadian cycles. Analyses of activity onsets after light pulses (to guard against onset masking in LD) revealed rhythms were significantly altered by light during cycle 1 but delays were small. We also measured responsiveness after 25.5hLD (12.75h:12.75h). Following this “delaying” LD cycle, delays measured on cycle 1 were also significantly smaller than shifts measured during cycles 2-14. Large delays induced on cycles 10-14 were significantly greater than delays measured after LD24h. These data demonstrate in mice that phase delays associated with entraining LD cycles reduce the capacity for light-induced phase delays during initial circadian cycles in DD. Aftereffects of 25.5LD also include an increased responsiveness of the photic entrainment pathway by 5-7 cycles in DD that persists for at least 14 cycles. These findings provide a link between experiments that measure light induced clock resetting after long durations in constant conditions and the synchronization of circadian clocks during continuous LD cycles experienced by most mammals, including humans.

Kalin Laurent

THE MATHEMATICAL MODELING OF A CHAOTIC SYSTEM

Faculty Collaborator: Dr. Martin Johnston

A main focus of our research was to create a chaotic system. However, after this system was functioning, our second concern was to create a mathematical model that could be used to predict regions of chaotic behavior. More specifically, the model would use the equations of motion, which were solved numerically, and the initial conditions in order to determine these chaotic regions. Once the proper initial conditions were found, we could then make a direct comparison between what the model predicted and what actually occurred. Or we could perform the converse; we could find a region of chaos experimentally and see if the model actually predicts chaotic behavior under the given conditions.

Travis Laurent

CREATING AND MODELING A CHAOTIC PENDULUM

Faculty Collaborator: Marty Johnston

The goal of our research was to create and model a chaotic pendulum. This system consisted of a pendulum, which was driven by a DC motor. This motor acting with magnets caused a torque to be delivered to the pendulum. A hybrid stepping motor was then used to move the DC motor sinusoidally. The angular position of the pendulum was then sent to LabView via an optical encoder. Finally, in order to try and model the motion of the pendulum, we developed an equation of motion by examining torques. However, this equation contained several coefficients that had to be experimentally determined. This presentation shows the determination of our system's coefficients.

Ryan A. Lloyd

THE METHOD OF LATENT SEMANTIC ANALYSIS AND PROPOSED ADVANCEMENTS

Faculty Collaborator: Dr. Chehrzad Shakiban

The goals of this project include improving the system of Latent Semantic Analysis (or LSA) and finding new applications for the algorithm. The project consists of two parts. The first component features advancements in the form of new equations and changes to the overall algorithm. A number of unproven theories about LSA also arose during research. The second part centers around using LSA to separate unwanted e-mails from relevant, personal electronic messages. The two components are closely tied together; most of the advancements helped in the development of the e-mail scanning application. Research uncovered a wide range of other uses for LSA, from diagnosing illnesses to helping computers see their world. My work brought LSA away from the strict analysis of text.

Michelle Marquardt

Tierney Winberg

DIFFERING APPROACHES TO PROBLEM SOLVING: FLEXIBLE CHILDREN VS. FIXED ADULTS

Faculty Collaborator: Dr. Mary Anne Chalkley, Ph.D.

Cognitive developmentalists tend to agree that children differ from adults in their approaches to problems. This study is part of an ongoing series examining how children's problem solving differs from adults' and when those differences may lead to superior performance by children. In an earlier diary study, children were slightly more likely than adults to solve a challenging puzzle. The current investigation has participants work on this puzzle in a laboratory setting while videotaping their actions without their knowledge. Based upon the earlier work, we hypothesized that adults would approach the puzzle consciously, building a base and working systematically toward the goal. We thought that children would rely more on implicit learning and explore the pieces in various patterns until they could "see" the solution. Analyses are based on data from 68 subjects (28 children, aged 10-12; 40 adults; balanced for sex). Dependent measures included number of moves (placing or removing a piece in contact with another), percentage of time with bases of 2-3, 4-5, or 6-9 pieces, percentage of time with multiple bases, and percentage of time violating boundaries. MANOVA results indicate no differences or interactions due to gender; there is, however, a main effect for age ($p < .05$). Analyses revealed that no single dependent variable was responsible for the main effect, but that the main effect was only observed when all variables are analyzed in conjunction. These data are consistent with the hypothesized patterns of greater exploration on the part of children and greater systematic behavior on the part of adults. Implications of these findings for understanding developmental changes in problem solving will be discussed.

Jonathan Maurer

MONITORING POLAR COMPOUNDS USING MEMBRANE EXTRACTION AND HIGH-SPEED GAS CHROMATOGRAPHY

Faculty Collaborator: Dr. Anthony J. Borgerding

Volatile organic compounds (VOCs) are found throughout our environment and have a variety of sources. Because of their possible health risk, monitoring VOCs is an important task. Most monitoring techniques focus only on detecting nonpolar compounds, but polar analytes such as methanol, ethanol, and acetaldehyde also pose an important health risk and must be monitored as well. Using high-speed gas chromatography (HSGC), the analysis of these polar compounds was explored using silicon tube membranes, Nafion tubing, and custom-made Nafion-coated solid phase microextraction (SPME) fibers. Silicon membranes are mainly nonpolar and were used to establish detection techniques used for other methods. Nafion, a polar substance, was used in tube form when both submerged in a solution and placed in the headspace of a closed environment to attempt to monitor polar compounds. The system was more sensitive when submerged in solution, but not enough to enable effective monitoring in a natural system. Finally, custom-made SPME fibers were prepared and studied, showing a much better ability to monitor polar analytes than commercial fibers. When submerged in solution, however, these fibers swelled and the coating was stripped off, making detection impossible. More work is necessary for the development of a consistent, effective method for monitoring polar analytes, but this study lays a groundwork for future development.

Alexander Miamen and Hesam Feghabati

WHAT CAUSES AMONG-INDIVIDUAL VARIATION IN METABOLIC RATE?

Faculty Collaborator: Anthony Steyermark

Organisms are thought to have a limited amount of energy to allocate to processes such as resting metabolism, activity, growth and reproduction. Variation between individuals in energy allocation to different portions of the energy budget may lead to fitness differences. Resting metabolism is the minimum amount of energy an organism requires to maintain basic cellular functions. This study examines specific mechanisms of variation between different individuals in resting metabolism, in leopard frogs (*Rana pipiens*). We measured resting oxygen consumption of frogs at 23 (C), from which we calculated resting metabolic rate (RMR). We then sacrificed the animals, removed the energetically expensive organs (heart, liver, kidney, small intestine, and gastrocnemius muscle), and dried them to constant mass. We also measured plasma T₄ thyroxine concentration using ELISA, and mitochondria number in liver using flow cytometry. Finally using analysis of variance and regression analysis, we examined the relationships between RMR and organs' masses, hormone expression, and mitochondrial density.

Catherine A. Micek

DESIGNING AND DEVELOPING A WEBSITE FOR HUYGENS' GCMS

Faculty Collaborator: Dr. Paul Ohmann

(Special thanks to the Atmospheric Experiment Branch at NASA Goddard Space Flight Center)

The Cassini-Huygens mission is an international scientific collaboration, involving over five thousand people from seventeen different countries. The mission is comprised of two parts: Cassini, the spacecraft that will study the planet Saturn, and Huygens, the probe that will study Saturn's moon, Titan. Aboard both Cassini and Huygens are several different scientific instruments that will study Saturn and Titan when the two arrive in July 2004. In particular, aboard the Huygens probe is a gas chromatograph mass spectrometer (GCMS), developed by the Atmospheric Experiment Branch at Goddard Space Flight Center to study Titan's atmospheric composition. The goal of this summer project was to design an interesting, informative, and easy-to-use website about Huygens' GCMS instrument.

The task of designing a high-quality website is more daunting than it may first appear. There are multiple considerations that go into developing a good website, such as choosing tools to use (e.g. resources to consult for the website content, computer software to design the site, type of page format or "template" to use, etc.), deciding what content to include, and choosing the pedagogical approach to take (how to present the reader with the information - whether it be pictures, animations, or text). All these factors were taken into consideration before and during the construction of Huygens' GCMS website, and although this process time consuming, it was well worth the effort. The end result is a web page that is well organized, easy to use, attractive, and interesting.

Eric Moeker

COMPARING THE SENSITIVITY OF A PHOTO IONIZATION DETECTOR (PID) TO AN AROMATIC SELECTIVE IONIZATION DETECTOR (ARSLID) USING A WIDE VARIETY OF AROMATIC AND NON-AROMATIC COMPOUNDS

Faculty Collaborator: Dr. Borgerding

Aromatic compounds occur in our environment and in studies have proven to have harmful effects on animals and may be carcinogenic to humans. The ArSLID (Aromatic Selective Laser Ionization Detector) is a relatively new aromatic detector. The detector's sensitivity and selectivity to aromatic compounds was studied and compared to the PID (Photo Ionization Detector). The ArSLID was more selective towards aromatic compounds due to its unique ionization and detection methods. A calibration curve of BTEXI (Benzene, Toluene, Ethylbenzene, O-Xylene, Isopropylbenzene) was conducted on both the PID and the ArSLID. Neither the ArSLID or the PID were able to produce a usable calibration curve, however, the ArSLID's results were more determinant than those of the PID. Also, eight aromatic compounds, benzyl chloride, styrene, 1, 2-dichlorobenzene, bromobenzene, 2-chlorotoluene, pyridine, 2-picoline, N-propylbenzene, were chosen to be tested on both the ArSLID and the PID. The PID results were reproducible but were unable to be compared to those of the ArSLID due to a malfunction in the electrometer. A new electrometer will be obtained and further tests on the ArSLID will be conducted later in the year.

Angela Mueller

THE ETHICAL IMPLICATIONS OF BOOTSTRAPPING IN SMALL BUSINESSES; A PRELIMINARY STUDY

Faculty Collaborator: Dr. Alec Johnson

Small businesses play an important role in the economic health of a nation. Yet small businesses have consistently had trouble obtaining traditional financing from banks or other equity institutions due to the relatively higher risk and smaller return inherent in starting a venture. In effect, this barrier to traditional funds forces small businesses to use unconventional methods to finance their start-up costs. Some of these unconventional methods can be viewed as ethically questionable. The purpose of this study was to explore these methods in a theoretical context to forward the discussion on the ethical implications of unconventional small business financing.

This study focused on the problems that small business owners face and perceive as ethical dilemmas. Qualitative data was obtained by personal interview and discussion. This data was then compared to previous research in the areas of ethics and bootstrapping to recognize similarities, in addition to identifying topics for future research.

This study verified that small business owners do encounter problems that they perceive as ethical, although not generally on a day-to-day basis. The results of this research suggest that owners strive to function ethically, despite financial constraints. The vast majority feels that their behavior is wholly transparent to their employees, customers, and stakeholders. In each business studied, there were generally one or two instances that were prominent in the owner's mind as being ethically questionable. These dilemmas commonly involved employees or suppliers of the firm. Rarely did ethical dilemmas arise regarding the firm's customers. From this preliminary examination, topics for further research were posed. More exploration in this area is needed to fully understand the ethical implications of bootstrapping.

Deirdre L. Munroe

BISHOP HENRY WHIPPLE: INFLUENTIAL INDIAN ADVOCATE

Faculty Collaborator: Dr. Joe Fitzharris

My research project focused on Bishop Henry Benjamin Whipple who was the First Episcopal Bishop of Minnesota, from 1859 to his death in 1901. He was devoted to Indian Reform; he felt that the government was corrupt in its dealings with the Indians, and as a Christian missionary, he felt it was his duty to help the Indians receive fair treatment and have honest deals with the government. In my research I found letters he wrote to Presidents, Commissioners, Secretaries, and anyone who could help him to positively impact the lives of the Indians under his care. He warned the government that deceptive treaties, and the misuse of annuity payments would only cause problems, but he was dismissed as being overactive. After the Dakota Uprising in the fall of 1862 he worked for justice for the Dakota. He often published papers explaining his views on the treatment of the Indians, and these papers were invaluable resources to my research. Through many years of negotiations with the government for land, money and provisions until his death in 1901, Bishop Whipple continued to be an active advocate of Indian rights, and my research worked to prove that his efforts had a positive impact on the lives of the Minnesota Indians. My original research was broader and covered his work

with all the tribes of Indians in Minnesota, but with revision my work became more focused on his impact on the lives of the Dakota Indians before and after the Dakota Uprising. The results of this research are being presented at the Northern Great Plains History Conference in October in Fargo, North Dakota under the direction of Dr. Fitzharris.

Em E. Murphy

THE INTRODUCTION OF G-WIRES TO TETRAHYMENA THERMOPHILA VIA BIOLISTIC TRANSFORMATION.

Faculty Collaborator: Dr. Thomas C. Marsh

G-wires, right-handed quadruple helical DNA structures, have been hypothesized to inhibit the telomerase enzyme, which extends the length of telomeres. G-wires were introduced to *Tetrahymena thermophila* via biolistic transformation. The introduced G-wires were decorated with biotin, a small naturally occurring molecule that selectively binds with streptavidin, and salted onto 0.6 mm gold particles via the ion interactions of the negatively charged DNA phosphate backbone and the positively charged gold particle. Cells were then fixed and stained with DAPI and streptavidin-FITC. Though minimal accuracy was experienced, the procedure provided an effective initial screening of the feasibility of introducing G-wires to *Tetrahymena*.

Aubrey Overson

MODELING ELECTRON TRAJECTORIES IN MAGNETIC AND ELECTRIC FIELDS: USING THE “EULER ENGINE”

Faculty Collaborators: Marty Johnston and Paul Ohman,

Experimental investigations of electron-atom interactions are often difficult. Our work at St. Thomas demonstrates some of the difficulties that can arise. Currently, our system is plagued by systematic error due to the disruptive and down right malicious magnetic fields in the Owens Science Hall. In order to work toward the much-needed remedy for magnetic field “catastrophe”, I developed a model that follows the electron’s tortured path. My programming, done in the Mat lab environment, allowed me to imitate the path of an electron from birth, to collision, to fiery end. My project was coupled with Rebekah Cowdrey’s Asteroid Simulation due to some surprising but relevant similarities. Both projects of used identical methods of computation (Euler’s Method), yet they modeled very different systems. The particle sizes alone (planets vs. electrons) differ on many, many orders of magnitude! The two projects together demonstrate an elegant connection that reinforces a powerful simplicity found in physics.

Molly Pein

EXPLORING PHYSICS WITH WATER ROCKETS

Faculty Collaborator: Marty Johnston

Water rockets are an extremely fun way to study some of the concepts that are key to the discipline of physics. One can create a small, yet powerful rocket by filling a simple two-liter pop bottle one third full of water, pressurizing the bottle with a bicycle pump, and releasing the bottle into the air. The objective of this research is to use large water rockets to launch as much weight as possible, commonly called the maximum payload, into the air. Using the two-liter bottle model, a rocket with three bottles has been created. The three bottles are conjoined with a CPVC plastic base, which can then be placed into a launcher and pressurized to around 100 PSI. By simply pulling a string on the launch pad, the rocket is released and it flies into the air with surprising speed. Using analytical computations the maximum altitude of the rocket and other flight characteristics can be determined. This project is in the very beginning stages of development, however the fun is guaranteed to continue. This summer the computational model, used to determine flight characteristics, was created. Designing a connecting base, machining plastic, and having the machined parts break often, briefly sums up the other work completed this summer. Projects to be completed this fall include: more testing of the three bottle design, aerodynamic adjustment to the three bottle design, calculations to determine theoretical maximum payload, and tests to verify, experimentally, the maximum payload.

Emily M. Perron

MOOD AS A MEDIATOR BETWEEN POSITIVE MEMORIES AND LIFE SATISFACTION

Faculty Collaborator: Dr. Elise L. Amel

Previous research has demonstrated that an individual's mood can potentially be improved by recalling positive memories and life events. The purpose of this study was to develop an activity that promotes the recollection of positive memories in order to improve life satisfaction by improving mood. In completing the activity, the participants were asked to cut out five pictures and/ or words from magazines and link those them to a memory or time in their life by writing a brief description of the memory. While half of the participants were instructed to recall positive memories, the other half were only asked to complete the activity. All participants were asked to complete the Satisfaction with Life Scale and the Positive and Negative Affect Scale (PANAS) before and after the activity. While it was hypothesized that the participants in the positive condition would experience a greater positive increase in mood and life satisfaction, the results indicated that the activity was effective for all participants that completed this activity.

Mitch Peterson

TITLE- VIOLENCE AND SEX ON TELEVISION: THEIR EFFECTS ON MEMORY FOR ADVERTISEMENTS

Faculty Collaborator: Dr. Gregory Robinson-Riegler

The present study sought to investigate the effect of a television program's content on participants' memory for advertisements shown during the course of the program. Previous research in this area has

suggested that violent and sexual program content impair explicit memory for televised advertisements. While it has been suggested that this impairment is due to divided attention, additional research suggests that implicit memory can survive despite divided attention. The present study used implicit and explicit measures to assess memory for television advertisements, with our hypothesis being that implicit memory would be unaffected by program content. Participants viewed a television program with either violent, sexually explicit, or neutral content. Participants were asked to rate the program's content, after which they were given either an implicit or explicit memory measure. The results of the study were not in support of the initial hypothesis that explicit memory would be negatively affected by violent and sexual content. However the results did support the hypothesis that violent and sexual content would not have a negative affect on implicit memory for the televised advertisements.

Bryan Piras

SELF-ASSEMBLY AND STREPTAVIDIN DECORATION OF BIOTINYLATED G-WIRES

Faculty Collaborator: Dr. Thomas C. Marsh

Tet1.5 is a 10-mer oligonucleotide with the sequence GGGGTGGGG. When mixed with the proper buffer solution and when in the presence of Ia and IIa metal cations, Tet1.5 has the ability to self-assemble into polymeric structures called G-wires, which can be used as molecular scaffolds. It is possible to modify Tet1.5 and attach the vitamin biotin. Biotin forms extremely strong noncovalent bonds with streptavidin, a tetrameric protein. Streptavidin-gold complexes bind with biotin attached to Tet1.5, making possible easy detection of the DNA, and also the ability to pass a current over the DNA. The prospect of conducting a current across DNA is a goal of many researchers in the realm of nanoscience. The streptavidin-gold can also be silverized giving it a greater ability to conduct a current. With the ability to conduct, Tet1.5 could be used as a semi-conductor. We were successful in decorating the modified Tet1.5 with streptavidin-fluorescein as a precursor to decoration with streptavidin-gold, but have observed limited Au labeling and are currently optimizing our procedure.

Erin Y. Ranta

CRYSTAL STRUCTURES OF TWO BRIDGE-FLIPPED BENZYLIDENEANILINES: N-(4-NITROBENZYLIDENE)-2-HYDROXYANILINE AND N-(2-HYDROXYBENZYLIDENE)-4-NITROANILINE

Faculty Collaborator: Dr. William H. Ojala

We are interested in the solid-state properties of pairs of organic compounds we have designated bridge-flipped isomers, molecules that differ in the orientation of a multiatom bridge connecting two major portions of the molecule. If the atoms in the bridge are of similar size, pairs of bridge-flipped isomers might assume similar molecular packing arrangements in their respective crystals. In addition, this packing similarity might allow the formation of mixed crystals containing both isomers in a solid solution. This kind of solution would be of interest in the area of materials science because it might allow the properties of these crystals to be "tailored" by using appropriate amounts of the two isomers in the mixed crystal. Bridge-flipped isomers are found among the benzylideneanilines, compounds having the formula $R-N=CH-R'$. Two bridge-flipped isomers can exist when R is different from R'. Here we describe one of these pairs. Crystals of N-(4-nitrobenzylidene)-2-hydroxyaniline (Compound I) suitable for X-ray crystal structure analysis were acquired from the combination of ortho-aminophenol

and para-nitrobenzaldehyde, and a crystal structure was determined. Subsequently the bridge-flipped isomer, N-(2-hydroxybenzylidene)-4-nitroaniline (Compound II), the structure of which had previously been published, was prepared and the two isomers were compared. The isomers were found to have different physical properties such as color, size, crystal shape and melting point. The isomers were also found to have different maximum absorbances in the UV-visible spectrum and, therefore, different extinction coefficients. These physical differences confirm the observation that the isomers have different packing arrangements, Compound I crystallizing in space group P212121 and Compound II crystallizing in space group P21/c. Comparison of the two isomers in their packing arrangements shows that the -N=CH- bridge plays a role in how the molecule packs.

Peter Rieke

EVALUATING RETAIL TRADE AREA MODELS: A GIS METHODOLOGY

Faculty Collaborator: Dr. Robert Werner

It is often useful to know the size and shape of a trade area when locating a new retail business or service. It is useful because demographics can then be calculated for the new location, helping us to understand whether or not the new location will be successful. When customer location data is available, such as address and zip code, the trade area can be calculated quite easily. However, there are several important types of cases where customer location data is unavailable, such as with a competing store or a new store. In these cases, the true trade area is unknown, so it must be modeled. There are several modeling methods available: a circle of some fixed distance (called a buffer), a drive-distance, a drive-time, Thiessen polygons, and a Huff model.

This project used Geographic Information Systems (GIS) software to compare and evaluate the accuracy of those modeling methods. The test business is a successful gift-store chain with four locations in the Minneapolis / St. Paul metro area. A trade area for each location was determined by mapping addresses and zip codes obtained by the company from customers at the point of purchase. These trade areas were considered the “true” trade area. Each of the methods of trade area estimation were then applied and compared to the “true” trade area. The results of each trade area model were intersected with U.S. Census demographic data, yielding a demographic profile for each method. Statistical analysis revealed that the Huff Model generated a trade area most similar to the “truth”, and that the fixed-distance buffer (the most popular model with many businesses) generated a demographic profile that was in some cases highly inaccurate.

Ryan Rowekamp

DATA ACQUISITION AND ANALYSIS FOR A DAMPED, DRIVEN PENDULUM

Faculty Collaborator: M. E. Johnston

To study the motion of a damped, driven pendulum, we needed to acquire the angular position and velocity and analyze the data to determine the type of motion. Using an optical encoder and an integrated circuit, we could count every time the pendulum moved 1/8000 of a revolution and the direction of motion. A counter card saved the position into a buffer at fixed intervals of time. This buffer was read by the computer, which calculated and smoothed the velocity before saving it for later analysis. Finally, we sampled the data at the driving frequency to create a Poincarè section and analyze the nature

of the motion. The Poincarè section revealed whether the motion was chaotic and the number of periods required to repeat a cycle for non-chaotic motion.

Gregg Schieffer

REDESIGNING THE AROMATIC SELECTIVE LASER IONIZATION DETECTOR (ARSLID)

Faculty Collaborator: Dr. Tony Borgerding

The Aromatic Selective Laser Ionization Detector (ArSLID) is completely selective towards detecting aromatic compounds in its current design, but it is limited in terms of analyzing less volatile compounds and in terms of efficiency. The initial detector cell components were fastened together using Torr Seal fastener epoxy that limited the detector temperature to 105°C before epoxy decomposition. The efficiency of the original design was dependent upon the radius of the copper half cylinder. An 8mm radius copper half cylinder needed a high make up gas flow rate of 450mL/minute, which was an order of magnitude higher than commercial detectors. Also with an 8mm radius, there is more chance the molecular ion will lose its charge before detection comparison a shorter radius. Last, a transfer line guided the capillary column to the ArSLID. It frequently broke the capillary column and the transfer line temperature was difficult to control. For improvement, the epoxy was replaced with metal screws and nuts. This allowed for 300°C detector temperature. The new design decreased the copper half cylinder radius to 2mm, allowing a reduced make up gas flow rate of 110mL/minute and gave the molecular ion a shorter distance to travel for detection. By building the detector on top of the gas chromatography oven, the need for the transfer line was eliminated.

John Schwerkoske

QUANTITATIVE ANALYSIS OF SOIL PORE WATER CH₄ CONCENTRATIONS UNDER SIMULATED RICE PADDY CONDITIONS

Faculty Collaborator: Dr. Rebecca Bilek

The second leading anthropogenic source of methane (CH₄) emission into the atmosphere are rice paddy fields. With rice becoming an increasingly critical food source in our world this CH₄ source has been expected to increase in the next 20 years. Previous experimentation in rice paddy agriculture has shown that various rice cultivars have been known to emit differing amounts of the greenhouse gas CH₄ into the atmosphere. However, reasons for these differences remain largely unexplored. In this research, the main precursor compounds to the methanogenic process, organic acids, were quantified and concentrations were compared between cultivars to see how the presence of these compounds affected CH₄ emissions. Through pore water sampling techniques, CH₄ and carbon dioxide (CO₂) concentrations in experimental rice plots were determined throughout the course of the growing season. Thus far, results have shown overall slightly higher CH₄ production 70 days after flooding (daf) vs. the first sampling near the 25 daf mark. Significant differences in CH₄ have not yet been seen between the Mars and Lemont cultivars soil pore water samples with respect to CH₄ or CO₂ concentration. Further experimentation has been planned for the remainder of the growing season to look for the causes of the limited CH₄ observed thus far as well as additional sampling to test for variation in CH₄ concentrations between the Mars and Lemont cultivars later in the season.

Jonathan M. Smieja

SOLID-STATE STRUCTURES OF SUGAR DERIVATIVES

Faculty Collaborator: Dr. William H. Ojala

Sulfa drugs are interesting for both their pharmaceutical value and also for their molecular structure. Our long-range goal is to bond sulfa drugs to monosaccharides and to determine the structures of these derivatives by means of single-crystal X-ray diffraction. We wish to determine whether or not bonding sulfa drugs to sugars will produce derivatives that possess increased blood stream solubility and increased bioavailability compared to the sulfa drugs themselves. X-ray diffraction is an especially powerful technique for determining the molecular structures of the derivatives produced. Thus far, obtaining crystals of these derivatives has proved to be difficult, perhaps due to side reactions involving rearrangement of the monosaccharide. This has led us to prepare model systems for the products we tried to obtain originally. These model systems have been prepared by combining various aromatic amines (which are less complicated structurally than the sulfa drugs, which are also aromatic amines) with monosaccharides. Of the many aromatic amines tried, thus far only meta-nitroaniline has reacted with a monosaccharide to give crystals suitable for single-crystal X-ray analysis. meta-Nitroaniline reacted with

D-mannose to yield viable crystals that could be analyzed by X-ray diffraction. The analysis has shown that this derivative is a glycosylamine, a cyclic molecule similar in configuration to mannose derivatives we have created in previous reactions. This new crystal structure provides insight into how sulfa drugs might be expected to bond to monosaccharides. Because this derivative, being a pure single enantiomer, must necessarily assume a noncentrosymmetric packing arrangement in the crystal, it might also serve as a possible nonlinear optical material. Although testing for nonlinear optical properties has not been done on this molecule as yet, the preparation of new nonlinear optical materials by means of this type of amine-monosaccharide reaction is a new and additional goal of our research.

Jason Smock

A COMPARISON OF THE U.S.S. MONITOR AND C.S.S. H.L. HUNLEY

Faculty Collaborator: Dr. Joe Fitzharris

For this research project, I compared the contributions made by the U.S.S. Monitor and C.S.S. H.L. Hunley and their inventors in technical advances, construction techniques, tactics, and public opinion of naval power during the Civil War. By using the most recognizably successful first-generation Union armored warship and the Confederacy's only successful third-generation submarine, I aimed at discussing how two seemingly unrelated vessels combined to exert the most influence in pushing the modern navy into the age of iron and away from wood and sail. The first research project aimed at an in-depth description of these as a base for a lecture given to a seminar audience.

The revision of this research project was recently made to be a more direct source of information focused solely on the impact of these vessels' existence on the period's perception of naval power and how directions in future designs were made based on those two examples. This revised version and the resulting revised version of the lecture are to be given to a conference audience of members of the historical community in the near future.

Kyle Symoniak

USING GEOGRAPHIC INFORMATION SYSTEMS TO CONSTRUCT AND EVALUATE THE DEMOGRAPHIC PROFILE OF A TWIN CITIES CHURCH

Faculty Collaborator: Dr. Robert Werner

St. Odilia is a Catholic parish located in Shoreview, Minnesota. The church council was interested in the effect of household income on contributions, attendance, and school enrollment (the parish also operates a K-8 school). St. Odilia provides a very interesting case study, because the parish boundaries and immediate surrounding area provide a very unique mix of economic affluence. Working with the Church's planning committee, which provided us with a wealth of data about their parishioners, we were able to construct a demographic profile to assist them in their long-range parish and school planning. The effects of household income on contributions to the church were investigated in detail, as were the effects of income on church membership and school enrollment. Simple visual examination, in-depth GIS analysis, and statistical methods were all used to better understand these issues, including: linear regression, point-in-polygon operations, and spatial autocorrelation. We concluded that income has almost no effect on the percentage of a family's income that is contributed to the church. Our examinations of the effect of income on school and church enrollment were inconclusive; the data used to investigate this correlation was incomplete.

James Thielen and Trevor Richert

GAMMA GAMMA COINCIDENCE AND ITS ANGULAR CORRELATION

Faculty Collaborator: Dr. Martin Johnston

We redesigned the experiment, "Gamma Gamma Coincidence and its Angular Correlation" to yield more accurate and consistent data. This experiment is performed to verify conservation of momentum in electron/positron annihilation. Our goal was not only to verify the conservation of momentum, but to determine an accurate and consistent method that can be used in a classroom setting. We accomplished this by utilizing lab electronics including Nuclear Instrumentation Modules, an oscilloscope, and an optical encoder. We also had to redesign the mechanical aspect of the apparatus. Through the reengineering of the experiment, we achieved accurate and consistent data.

David Turnbloom, Brandi Swenson

DO TODDLER MICE DISOBEY PARENTAL CIRCADIAN RHYTHMS?

Faculty Collaborator: Dr. Dwight Nelson

We are conducting experiments to assess the circadian system of very young mice (0-3 weeks of age) and specifically to determine the influence of parental circadian oscillations upon their offspring. Pregnant mice were kept in a 24-hour LD cycle and monitored using a video image acquisition program developed in our laboratory. The imaging system was used to monitor their activity rhythms of locomotor activity as an assay for the state of their daily activity rhythm. After the birth of the pups, the mother and pups were placed into complete darkness (DD) so that their activity would reflect the endogenous circadian pacemaker in the mice. The mother and pups were allowed to freerun in DD for 3 weeks. After three weeks of free running, the pups were separated from their mothers and the mice

were placed in individual wheeled maintained in DD. The wheel in each cage was connected to a computer data acquisition system to the circadian activity rhythm for each individual mouse. The mice were again allowed to express their endogenous circadian rhythm of locomotor activity for three weeks in DD. Our experiment will monitor the circadian rhythm of locomotor activity of the mother and the pups to determine whether the pups are influenced by their mother's activity rhythm or if their circadian cycles are distinct from their mother's rhythmicity

Mark Ulrick

INVESTIGATION OF METHANE PRECURSORS IN FLOODED RICE MICROCOSMS: METHANE EMISSION AND INHIBITION OF METHANOGENESIS

Faculty Collaborator: Dr. Rebecca Bilek

Methane (CH₄) is produced within the soil of flooded paddy fields by bacteria called methanogens, which use the oxidized exudates sloughed from the roots of rice plants to produce CH₄ through a process called methanogenesis. Previous studies have shown that within varying cultivars of rice, differing amounts of CH₄ are emitted. We hypothesized that the varying emitted concentrations were due to varying amounts of exudates sloughed from the different rice cultivars. To investigate this, a controlled system of microcosms housing two rice cultivars, Mars and Lemont, were created in an attempt to measure in situ CH₄, CO₂ and organic acids in congruence with emitted CH₄ concentrations. Organic acid measurements were dependent on our ability to inhibit the methanogenic process with nitric oxide (NO) since the acids are quickly converted to CH₄ and CO₂ by methanogenesis and oxidation respectively. We found that by the 69th day after flooding (daf) emitted and pore water samples of CH₄ were significantly lower than previous studies due to alternative electron acceptors, Fe³⁺, present within the soil that had higher standard reduction potentials. We also discovered that the gaseous concentration of NO that we had planned to use to inhibit did not result in the necessary 2.5 mM aqueous concentration necessary to fully inhibit methanogenesis.

Angie Westin

DEVELOPMENT OF A FLOW CYTOMETRIC BASED ASSAY TO MEASURE NATURAL KILLER (NK) CELL KILLING OF TUMOR CELLS

Faculty Collaborator: Jill M. Manske

Our lab has been investigating the ability of the neuropeptide Substance P (SP) to enhance the immune response to tumor growth in mice. We have found that SP treatment protects mice from the development of K1735 melanoma tumors. This protection requires the presence of Natural Killer (NK) cells. If mice are depleted of NK cells, SP offers no protection from tumor development. This observation supports a role for NK cells in SP-mediated tumor protection. To determine how SP effects NK activity, we need to develop an assay that can measure the ability of NK cells to kill tumor targets. In this project, we utilized a flow cytometric assay to measure NK cell-mediated cytotoxicity using a cell membrane dye that provides an early marker of cell death.

Jonas Williamson

MOTORS AND ELECTRONICS OF THE CHAOTIC PENDULUM

Faculty Collaborator: Dr. Marty Johnston

To observe chaotic behavior in any system, two conditions must be met. There must be more than three independent variables, and they must be coupled by a non-linear term. A driven, damped pendulum meets these requirements. Our work involves characterization of this pendulum, as well as computer modeling of the system. In order to model the system easily, an eddy current motor is used to produce the driving forces necessary for the experiment. The speed of the eddy current motor is held constant by a feedback loop. After resolving problems with stepper motor torque, the electronics of the experiment appear to be adequate for our needs.

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