Undergraduate Research and Artistry Day

April 20, 2011
Holmes Student Center
Duke Ellington Ballroom
NIU’s Commitment to Undergraduate Research

A cornerstone of NIU’s mission is the creation of new knowledge. As stated in the Presidential Task Force on Curricular Innovations Final Report, we will “establish the skill of inquiry as the value added aspect of an NIU degree by increasing the engagement of undergraduates in research activities on campus.” Daily, NIU students work alongside renowned scholars and scientists on research projects in the pursuit of discovery and academic excellence. In addition, we are happy to welcome students from area community colleges, McHenry County College and Joliet Junior College, to showcase their research activities.

We encourage all students to engage in cutting edge research through faculty-mentored activities, students bring to life their classroom learning. Students who have the opportunity to engage in research activities benefit from enhanced critical thinking skills, a deeper understanding of their academic area, the connection of their research focus to the broader field, and stronger relationships with faculty mentors and others working on a research project.

Through Undergraduate Special Opportunities in Artistry and Research (USOAR), Huskie Research Rookies Program, Undergraduate Travel Fund, Undergraduate Research and Artistry Day offered through the Office of Student Engagement, and other research apprenticeship opportunities offered in each college (URAP, EURA and UARAP), students are able to participate in research and all stages of their academic careers. Check out the undergraduate research website: www.niu.edu/ugresearch for more information on these programs and how you can get involved.
Welcome to Undergraduate Research & Artistry Day. I hope you enjoy learning about the research and academic achievements of our talented undergraduates. I think you will be just as impressed as I am.

At the start of this academic year, I launched the university’s new Vision 2020 Initiative. It is designed to set NIU on a course to becoming the most student-centered public research university in the Midwest. When we unveiled the initiative, I held up this very program, which was inaugurated last spring, as a shining example of the type of engaged learning we strive for at NIU.

We continue to expand hands-on learning opportunities because we know these experiences nurture deep comprehension and critical-thinking skills. Our students can participate in faculty-mentored research projects alongside some of the top researchers and scientists in the country and the world.

Today you’ll see the fruits of their labor. For example, students are investigating a new approach to cancer treatment, examining perceptions of bullying behavior and exploring whether educational video games can improve cognition in stroke and brain-injury survivors. They are using cutting-edge technology, conducting potentially life-saving studies and contributing to scholarly research in their respective fields.

These types of research experiences bring to life the pages of textbooks and make the educational experience relevant to real-world challenges.

It’s important today that we celebrate the hard work and dedication of our students, who represent the next generation of scientists, engineers, inventors and discoverers. We hope this event serves as a catalyst to encourage their continued pursuit of new knowledge. We also hope to encourage more students to take advantage of the many opportunities to work with and learn from our talented faculty members.

John G. Peters
President, Northern Illinois University
Dear Colleagues and Friends of the NIU Community:

I am pleased to welcome you to the second annual Undergraduate Research and Artistry Day! Undergraduate research is a cornerstone of Northern Illinois University. The students you see today have spent countless hours in pursuit of their research. They represent the very essence of our institution as they share their work with you and the NIU community.

This event showcases more than 110 research projects from 26 academic departments representing every undergraduate college. More than 170 students are sharing their findings and highlighting their learning. Judges have the formidable task of selecting the top projects for both the Science, Technology, Engineering, and Math section and the Social Science, Humanities and Arts section.

Please join us for the awards ceremony at 2:30 p.m. to recognize our talented students. Awards will be presented for the first-, second-, and third-place projects, as well as for honorable mention. Additionally, a People’s Choice” Award will be given to the audience’s favorite project. One research adviser also will be honored with the Faculty Mentor of the Year Award.

We are tremendously proud of our students’ accomplishments and invite you to get to know them at this event. Thank you for your support of undergraduate research at NIU.

Raymond W. Alden III
Executive Vice President and Provost, Northern Illinois University
Schedule of Events

Viewing of Projects 9:00AM-2:00PM
(Presenters will rotate throughout the event)

Judging Session 1 9:00AM-10:15AM

Judging Session 2 10:15AM-11:30AM

Judging Session 3 11:30AM-12:45PM

Judging Session 4 12:45PM-1:30PM

Open Session 1:30PM-2:00PM
(All presenters are encouraged to attend)

Awards Ceremony 2:00PM-2:30PM

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RESEARCH CATEGORIES
The Following Two Research Categories Will Be Judged

STEM: Science, Technology, Engineering, Math

SSHA: Social Science, Health, Humanities, Arts

AWARDS
The Following Awards Will Be Given To The Winning Project In Each Category

• First - $200
• Second - $150
• Third - $100
• Honorable Mention - $50
• People’s Choice - $50

The audience will have the opportunity to select their favorite poster in each category
Judging

Almagambetova, Nailya - SSHA
Department of Nursing & Health Studies

Behr, Eric - STEM
Department of Mathematical Sciences

Boughton, Debra - SSHA
Department of Intercollegiate Athletics

Buford, Andrea - SSHA
Office of Sponsored Projects

Carnahan, Jon - STEM
Department of Chemistry

Castle, Nancy - SSHA
Department of Communicative Disorders

Chakraborty, Dhiman - STEM
Department of Physics

Chen, Jie - SSHA
Department of Nursing & Health Studies

Damodaran, Purush - STEM
Department of Industrial & Systems Engineering

Demir, Veysel - STEM
Department of Electrical Engineering

Durik, Amanda - SSHA
Department of Psychology

Gasser, Ken - STEM
Department of Biological Sciences

Henry, Beverly - STEM
Department of Family, Consumer & Nutrition Sciences

Horn, James - STEM
Department of Chemistry & Biochemistry

Kempton, Daniel - SSHA
Department of Political Science & The University Honors Program

Kuo, Li-Jen - SSHA
Department of Educational Psychology

Little, Dara - SSHA
Office of Sponsored Projects

MacDonald, Doris - SSHA
Department of English

Matuszewich, Leslie - SSHA
Department of Psychology

Mirman, Cliff - STEM
Department of Technology

Pickett, Michelle - SSHA
Academic Advising Center

Pohlman, Nicholas - STEM
Department of Mechanical Engineering

Reynolds, Jeff - STEM
College of Liberal Arts & Sciences

Rodgers, Diane - SSHA
Department of Sociology

Smith, M. Cecil - SSHA
College of Education

Spears, Christian - SSHA
Department of Intercollegiate Athletics

Spires, Michael - STEM
Office of Sponsored Projects

Stone, David - SSHA
Office of Sponsored Projects

Streb, Matt - SSHA
Department of Political Science

Sunderlin, Lee - STEM
Department of Chemistry

Towell, Beth - STEM
College of Business

Wallace, Doug - SSHA
Psychology

Wallace, Patricia - SSHA
Psychology

Willems, Philippe - SSHA
Department of Foreign Language & Literature

Xiao, Zhili - STEM
Physics

Yore, Adam - SSHA
Department of Finance

Yusko, Rita - STEM
Technology Transfer Office

Zinger, Don - STEM
Department of Electrical Engineering
Abstracts

Text

Please Note: Contents of the Abstracts were printed as submitted by the project participants
At Northern Illinois University, students register for classes using the school wide MyNIU system. Many students find it difficult to choose from the numerous options of courses in order to take the proper combination of classes to fit into a tight schedule. Using Microsoft Excel, this study designed a user interface and system using macros to assist students in scheduling classes. The goal of this project is to demonstrate that this system makes the scheduling process easier, faster, and better. This will be done by having Northern Illinois University students complete a mock schedule using the system. Volunteer students will meet in a computer lab to test the user interface and functioning of the scheduling system. A survey will be given before and after the experiment, and the students will be asked to compare their experience using the scheduling system to their experience scheduling classes using MyNIU alone. The study’s hypothesis is that the scheduling system will give the students a faster, easier, and better opportunity to take the best combination of classes required, on time and without trouble caused by conflicting courses. Testing this hypothesis will involve learning and executing the methods of research and collection and analysis of data, and studying the manner in which young adults interact with new advances in technological programs. Additionally, the construction of the system itself will necessitate learning systems analysis, design, and development techniques and the details of the Visual Basic for Applications (VBA) programming language to create macros in Microsoft Excel.
Within the services domain, Rosenbaum shows that some consumers actively seek out and patronize commercial service establishments, so-called third places, to fulfill not only their consumption needs, but also their needs for companionship and emotional support. By drawing on Attention Restoration Theory (ART), researchers have shown that some third places contain therapeutic, restorative stimuli, which positively influence their customers’ quality of life by mimicking natural stimuli. ART posits that natural stimuli, such as parks, beaches, and recreational areas, positively influence human health by helping people remedy negative symptoms associated with mental fatigue, including stress and depression. Rosenbaum shows that commercial servicescapes possess environmental stimuli that have restorative potential, which benefits some patrons’ health. However, it remains unclear whether not-for-profit health institutions, such as cancer resource centers, can also fashion restorative servicescapes that help their patrons assuage symptoms associated with fatigue. The National Cancer Institute reports that fatigue is the most common side effect of cancer treatment with chemotherapy, radiation therapy, or selected biologic response modifiers. Cancer treatment-related fatigue is reported in 14% to 96% of people undergoing cancer treatment. Not only is fatigue per se a pathogenic symptom associated with cancer treatment, but also, fatigue is seen as a presenting symptom in cancers that produce problems such as anemia, endocrine changes, and respiratory obstruction. This research empirically tests a model (below) that links together the servicescape paradigm with ART. That is, this work focuses on how Geneva-based LivingWell Cancer Resource Center’s restorative servicescape helps its members remedy four effects associated with mental fatigue—namely, general fatigue, cognitive functioning, energy level, and productivity. In doing so, this article shows that homelike cancer centers can offer their members an inexpensive means to obtain life enhancing benefits that are not available from medical treatment.
The accounting firm Arthur Andersen was founded by its namesake in 1913 with a mission to “be an ethical company and have emphasis on business integrity.” As time passed, the priorities of the firm strayed from its core mission, with material values emphasized over business integrity. In the early 2000s, large frauds at U.S. global companies, such as Enron and WorldCom, became public. After that, all the companies involved in the fraud struggled: Enron went out of business, and WorldCom and Arthur Andersen suffered severely damaged reputations. The downfall of these companies wrought significant damage to the U.S. economy, leading to unemployment and tremendous losses in market value. Reacting to these failures and resolving to prevent reoccurrences, in 2002 the U.S. Congress passed an act called the Sarbanes and Oxley Act. Under this act, companies must have stronger financial reporting controls and take more responsibility over company governance. In implementing those controls and responsibilities, companies should be more ethical and emphasizing integrity throughout business processes. Since its implementation, the Sarbanes-Oxley Act has endeavored to shape a stronger and more ethical business environment.
This presentation highlights the future of technological innovations in quick service restaurants (QSR). To achieve this objective, we employed the customer journey mapping technique. Customer journey mapping is a technique that diagrams the steps that customers experience while engaging with a firm. We began this project by visually depicting customer touchpoints; these include, (1) prior to entering a QSR; (2) the enter-order-consume experience, and (3) the post-visit experience. We matched each touchpoint with a technology recommendation using survey methodology. In terms of technologies, we address these questions: Do QSR customers desire to receive promotions via their portable devices, email, in-store kiosks, in-store touch screen dining tables or video displays, and drive-thru displays? To what extent do customers respond to these initiatives: To complete a survey by scanning a barcode on a receipt. To recharge electronic devices by being in a QSR. To create a customized menu on a portable device. A lighting scheme that informs customers of clean and open tables. A “waiter-less” delivery system. To order at a drive-thru in a native language. The ability to pay for an order or collect order preferences via a loyalty program, a QSR credit card, thumbprint, retina scan, or facial recognition. To filter a menu based upon nutritional requirements, allergies, vegetarian, kosher, calories, or price. To monitor preferences via license plate recognition. To place and to pay for order via a virtual assistant. To order and to prepay for orders via portable devices, and to use a “fast-lane” at a drive-thru.
James Alford

*A Time Line of the Black experience post the 1860’s*

Authors: James Alford
Faculty Mentor: Regina Curry & Laverne Gyant
Department: Counseling, Adult and Higher Education
Research Category: Social Science, Humanities and Arts
Judging Time: 10:15-11:30AM

This research is an analysis of the Black Experience within the United States beginning with the post 1860’s era. Given the de-humanizing treatment, experience and harsh reality suffered under the institution of slavery; it is important, to document the significance of Black accomplishments, contributions and struggle. This research provides a chronological detailed account of events depicting the past, present and persistent experiences to date. As the data will show over 600,000 of the 4 million blacks were free. However, free blacks being free did not have the same rights as their white counterparts. The constant struggle continued through the Jim Crow Era and the Civil Rights Movement Era. As, Blacks finally made strives for equality with Bus Boycott, the March on Washington and the Poor Peoples March. This paper charts Black History from 1860 to the present. This research is going to be used as a reference to help inspire future generations and help understand Dr. Maulana Karenga’s philosophy of Black Experience and Black Initiative. The Paper looks in depth at The Civil War, Reconstruction Era, The Compromise of 1877, Harlem Renaissance, Brown V. Board of Education, and the 2008 Presidential Election.
6 Anahi Gasse

Assessing Effective Recruitment Initiatives Aimed at Latinos Accessing Higher Levels of Education

Authors: Anahi Gasse & Emily Prieto
Faculty Mentor: Emily Prieto
Department: Latino Resource Center
Research Category: Social Science, Humanities and Arts
Judging Time: 12:45-1:30PM

One of the many objectives of the Latino Resource Center is to learn about the levels of awareness and accessibility of Latino students attaining higher levels of education. An approach taken to accumulate data on this subject has been by hosting school site visits at Northern Illinois University to several target high schools and community colleges that are predominantly Latino. These visits include campus tours along with student, staff and faculty presentations regarding admissions, campus life, financial aid and the CHANCE program. After each visit, the Latino Resource Center along with the Office of Undergraduate Admissions records and assesses reactions and responses from students to better understand and subsequently address their needs and interests. With the data that is collected, the Latino Resource Center is better able to tailor outreach programs, recruitment, and retention initiatives for Northern Illinois University.
The objective of the study was to determine the effects of KinesioTape® on balance and muscular power production. Sixteen participants were recruited through the KNPE department. Participants were excluded if they had injuries or instability in the lower extremities, or if they answered “yes” to any questions on the PAR-Q©. The independent variables were KinesioTaping® application to the quadriceps and lower leg. The dependent variables were vertical jump height and Star Excursion Balance Test (SEBT) performance. Each subject participated in an introduction, intervention, and control session. During the intervention session, the subjects performed a warm-up on a stationary bike, followed by the SEBT. A mean was calculated from three attempts. The subjects then performed the vertical jump, using a Vertec system. The mean was also calculated from three jumps. KinesioTape® was then applied to the dominant lower leg. The SEBT was repeated in the same manner as before. The tape was then removed, and applied to both quadriceps femoris muscles. The subjects performed the vertical jump post-test. During the control session, the subjects performed the same actions, replacing tape application with 4 minutes of rest. The mean reach and average jump height during the control and intervention sessions increased from the pre-test to the post-test. However, there was no significant difference with the tape. In conclusion, we found no practical differences for SEBT and vertical jump performance with KinesioTape®. Further research is warranted to examine the effects of KinesioTape® application on other populations, such as athletes with injuries or instabilities.
The lack of physical activity has dire health-related consequences, namely diabetes, cardiovascular disease, and obesity. Type-2 diabetes is expected to affect 300 million people worldwide in the next two decades (Allender, Cowburn, & Foster, 2006). Lack of physical activity is an especially relevant issue for the Latino and African American communities. There are multiple factors which contribute to the lack of physical activity among these communities, specifically, 1) the lack of parks and recreational centers in the neighborhoods, 2) limited street lighting and bike paths, 3) inadequate availability of physical education classes in schools, and 4) public safety issues such as high violence and crime rates. Numerous programs and initiatives have been developed to address the lack of physical activity among the African American and Latino communities. However, these programs have yet to be evaluated for their effectiveness. This paper provides an overview of the current literature on extant programs and initiatives and proposes to evaluate one such program in the Chicago land area.
I researched the steelpan, also called the steel drum, in its home land of Trinidad and Tobago. Although I study the steelpan here at Northern Illinois University, studying the instrument in the country that invented it gave me a completely different perspective on the significance of this young instrument. Being invented around the 1930’s makes this among the youngest acoustical instruments in use today. The steelpan is still an evolving instrument but already has a very colorful past. Being immersed in the culture of Trinidad and Tobago for six weeks gave me a deeper respect for this instrument and its home land.

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A relationship exists between speaking rate and a listener’s perception of personality. A large group of listeners were asked to rate speech samples of speakers talking at different speaking rates. Results will explore the relationship between speaking rate and personality characteristics. Discussion will focus on implications for speech therapy requiring speaking rate modification.
Maximizing Generalization in Severe Aphasia: Script Reading versus Scenario Training

Authors: Valerie Berg
Faculty Mentor: Jamie Mayer
Department: Allied Health & Communicative Disorders
Research Category: Social Science, Humanities and Arts
Judging Time: 9:00-10:15AM

The purpose of this study was to compare two treatment protocols, script reading (Holland, 2010) versus a novel intervention protocol, scenario training, for an individual with severe aphasia. A single-subject, multiple-baseline-across behaviors, alternating treatment design was used to determine which treatment protocol would engender the most improvement in functional expressive language. Typically, the most difficult aspect of aphasia treatment protocols – especially for those with severe aphasia - is generalization of treatment gains outside of the therapy room. Therefore, we designed scenario training to increase contextual relevance and hence generalization by rehearsing linguistic, motoric, cognitive aspects of particular situations. We trained sequentially the language for three functional tasks using both script and scenario protocols, with the protocols alternated across weekly treatment sessions. Although our initial hypothesis was that the richer context of scenario training would promote increased generalization compared to script reading, we found that both treatment protocols yielded similar degrees of improvement. Qualitative analysis of our data yielded an order effect in that script training appeared most beneficial when it preceded scenario training, but not vice versa. Continued exploration of our treatment protocol is warranted to evaluate optimal dosage and task content. Similar to previous treatment studies for severe aphasia, our protocols yielded improved expressive language in treated tasks for our participant but failed to trigger generalization to additional, untreated contexts. This study reinforces the need for functional, meaningful treatment protocols to best serve individuals with severe aphasia.
The title of my research project is “Nintendo BrainAge 2: Improving Cognition in Stroke Survivors.” The focus of this study is to determine whether consistently playing an educational videogame can improve the memory, cognition and executive function of people who have had a stroke or brain injury resulting in mild to moderate cognitive impairments. Recent research in neural plasticity of brain function has provided evidence that after injury, the brain can compensate for damaged areas through plastic changes. After intense and extensive practice of functional activities, the neural patterns of the brain are reorganized and strengthened, leading to more efficient neural networks that are beneficial for cognitive function (Kelly et. al 2006). Observational studies performed by Butcher (2008) showed consensus that consistent cognitive practice from Brain-Age 2 helped deter the onset of dementia. What has not been investigated is whether such cognitive stimulation, known to be helpful in preventing or delaying the onset of dementia in those with normal cognition or mild cognitive impairment, can actually help to increase or restore certain cognitive processes in those with cognitive problems secondary to stroke or brain injury. Therefore, the purpose of this study is to determine if consistently playing an educational video game can improve memory, cognition and executive function in people who have had a stroke or strokes. Our hypothesis is that after 6 weeks of consistently playing the video game, stroke survivors’ cognition and memory will improve to a measurable degree. My project is part of a larger study being conducted by Dr. Jamie Mayer.
In order to eat a sufficient amount of food for a healthy diet, a person has to be able to swallow correctly. Inability to swallow correctly requires additional effort and stress resulting in an undesirable eating experience. Many times, people find it effortful to swallow due to factors such as weakening of the lips, tongue, jaw, and impaired coordination within the oral cavity. Other major factors that increase perceived effort are taste, texture, amount, consistency, and the time it takes to chew the foods consumed. All of these factors, when trying to be performed regularly, can cause stress and more physical effort than one is used to. The perceived effort that a person may present can be rated on a pre-established ratio scale called the Borg CR-10 (Borg, 1982). This scale will be studied in depth to find its ecological validity along with its correlation to perceived quality of life.
The Future of Probiotic treatment of Clostridium difficile

Authors: Heather Domanski
Faculty Mentor: Robert Bellas
Department: Joliet Junior College
Research Category: Science, Technology, Engineering, Math
Judging Time: 12:45-1:30PM

Clostridium difficile, commonly known as C-diff, is the leading cause of infectious diarrhea in hospitals worldwide. Deaths from C. difficile exceed the total of all other hospital acquired intestinal infections combined. The primary factor in a C. difficile infection is the use of antibiotics to treat a disease. The antibiotic destroys the normal intestinal micro-flora and opens the door for C. difficile to emerge from its protective endospore. Most C. difficile residing in the human colon is not toxic; however, rates of 15-25% contain toxins and become life-threatening if not treated promptly. This infection is treated with about a 90% “cure” rate utilizing current antibiotic treatments, and yet only half of patients experience a complete eradication of the endospores with 20-30% of patients experiencing a recurrence of C. difficile. The current treatment for C. difficile is not proactive; it relies upon a prompt and accurate diagnosis to be treated successfully, yet illness may be preventable. The improvement of the resident intestinal micro-flora, damaged by a course of antibiotics, can be attained through the ingestion of live micro-organisms known as probiotics. Probiotics are beginning to see use as an adjunct to standard antibiotic treatment of C. difficile; however use of probiotics in conjunction with any antibiotic treatment would be a pre-emptive measure to ensure the viability of the intestinal flora and its vital function.
This research project focused on the relationship between early vocabulary and speech sound development in six children between eighteen and twenty-two months of age. Expressive vocabulary was measured by the MacArthur Communication Development Index (MCDI) and Type-Token Ratio (TTR) was extracted from a mother-child play based conversational speech sample. Syllable Structure Level (SSL) was used to summarize early speech sound combinations. Although all children performed within the expected range for the standardized MCDI measure, there was variability between children on the informal measures. The one child who exhibited asynchrony across measures, was diagnosed with speech-language impairment at five years of age.
Can an “educational” video game improve cognition in stroke/brain injury survivors?

Authors: Stacey Behnke
Faculty Mentor: Jamie Mayer
Department: Allied Health & Communicative Disorders
Research Category: Social Science, Humanities and Arts
Judging Time: 9:00-10:15AM

Current healthcare policies limit the time rehabilitation is available for stroke/brain injury survivors (AAPM&R, 2009). The recovery timeline from such insults extends beyond the rehabilitation provision window, making independently administered cognitive stimulation essential for recovery. Bhogal (2003) proves that it is possible for stroke/brain injury survivors to progress for years after a stroke but, there needs to be a structured/repetitive program to follow. Unfortunately, little data exist as to the efficacy of such programs. This smaller study supplemented a larger study which was meant to explore the possibilities of using an “educational” video game to improve cognition of stroke/brain injury survivors. The Nintendo Brain Age 2 game was used because of its benefits of (1) available for public use, (2) doesn’t require training, (3) self-motivating which is important for completing the program (Cherney et al., 2008), and (4) automatically tracks performance/reaction time for collecting data. Participants in the large study included stroke/brain injury survivors with mild cognitive-linguistic deficits and age/education-matched healthy participants for the smaller study. Control subjects are crucial for exploring the validity of this game for a rehabilitation program. All subjects were assessed for memory, attention, reaction time, executive function, and subjective perception of cognition using three different tests. Participants then played the game for 6 weeks, 30-60 min/day. Participants repeated the same baseline testing at the conclusion of the 6 weeks. Analysis of the data included comparing pre- and post-test scores. Qualitative questionnaires were created to augment the quantitative data from the standardized tests.
Swallowing abilities are in many ways central to our well being. Not only is the ability to eat essential for our physical health, but in addition, many of us see meal time as a pleasurable experience and use it for social gathering; all of which are factors that contribute to our perceived quality of life. In patients with dysphagia (swallowing difficulty), quality of life may therefore be detrimentally affected. This study assesses the relation between quality of life and swallowing effort both in patients with dysphagia and healthy adults between the ages of 40 and 80. The participants in this study were asked to swallow a number of substances including thin liquid (water), nectar consistency apple juice, honey consistency cranberry juice, apple sauce, pudding, mixed canned fruit, and graham crackers. Following each swallow, participants rated their perceived effort using an adapted BORG-CR 10 exertion scale. After all consistencies were consumed, participants then filled out self report measures of quality of life including the SF-12 and SWAL-QOL. This study aims to understand the relation between quality of life and swallowing effort; this understanding is ultimately essential for health professionals to accurately judge sources of impairment in their patients.
The current study addressed the following questions: When mothers teach infants representational gestures, how often do they simultaneously present words with the gestures? What are the characteristics of words mothers pair with representational gestures? These questions are important because there are many popular programs (e.g., Baby Signs®), that advocate teaching representational gestures to infants as a way to improve language. Research has demonstrated that exposure to representational gestures may help facilitate acquisition of first words (e.g., Goodwyn, Acredolo, & Brown, 2000). However, no study has examined what mothers say as they teach representational gestures. To examine how mothers use words when they teach representational gestures, the current study employed an existing data set collected from 19 mother-infant dyads at 13 months as they looked at a book depicting 4 representational gestures. Mothers were first shown how to make the representational gestures and then instructed to teach infants the gestures while looking at the book. Mothers’ representational gestures were identified along with any utterances they produced simultaneously. The current study coded the number of times target words (i.e., words that matched the gestures) were presented, the number of times target words were presented in isolation, and the number of target words in utterance final position. Analyses found that 100% of mothers’ gestures were accompanied by words, 66% of the utterances included a target word (t(18)=4.6, p<.001), 70% of the gestural episodes included multiple target words presentations (p=.001), and 87% of the gestural episodes included target words in utterance final position (p<.001).
Playground Equipment and Grant Proposals

Authors: Katie Haft
Faculty Mentor: Nancy Castle
Department: Allied Health & Communicative Disorders
Research Category: Social Science, Humanities and Arts
Judging Time: 9:00-10:15AM

This project identifies the information and approaches needed to seek funds for special projects. Using the need for playground equipment at a Child Development Lab as its focus, and a description of philanthropic approaches as a guide, I will identify the steps and components for developing grants application to seek funding.
In the summer of 2010, we participated in a NIU sponsored field school in Phnom Penh, Cambodia. The USOAR grant provided us with the opportunity to conduct additional research in rural villages and temples. Our research focused on religion, and the different forms it assumes within rural life. Although Buddhism is the predominate religion, it has been influenced by the continual integration of Hinduism and Animism. In addition to these influences, employment and educational opportunities which coincide with the gradual re-adaption of Buddhism into Khmer society has directly impacted the young adult’s role within the temple. Today, Buddhism is in the process of re-growth after its prohibition during the Khmer Rouge regime. Some of the questions we consider were how did the prohibition affect the practice of Buddhism by young adults and how do people incorporate both indigenous and Hindu beliefs yet live in a Buddhist society with no trepidations at the divergences of cultural models that exist within Khmer life? The integration of Hinduism and Animism within Buddhism, and the role of young adults within the temple help us to understand the cultural influence Buddhism has within Cambodia.
In number theory a very famous sequence of numbers is the Fibonacci sequence. It has the form 1, 1, 2, 3, 5, 8 ..., where each subsequent number in the sequence is formed by adding together the two previous numbers. The Fibonacci sequence has many interesting properties and connections with art forms, nature and elsewhere and can be found through the Golden Ratio, otherwise known as Phi, or Φ. Topics include identities of the sequence, which lead to a discussion on the Bilinear Index Reduction Formula, the Golden Ratio and its applications, the logarithmic spiral and the Golden Rectangle. This is a study of applications of the Fibonacci sequence, as well as the recursive formula of the sequence itself. It results in a greater knowledge of the sequence and an understanding of how a mathematical sequence is incorporated in real life, how the numbers appear in nature and it gives the reader an understanding and appreciation of the multiple layers of complexity inherent in a numerical sequence.
Malaria causes between 1 and 2 million deaths each year in the developing world, and most of the deaths occur in children. The emergence and rapid spread of a strain of malaria that is resistant to chloroquine has posed a significant challenge to controlling malaria. There is an urgent need to develop new drugs to treat malaria. Recently, inhibitors of the enzyme methionine aminopeptidase 2 (MetAP2) were reported to have anti-malarial activity in vitro. Human MetAP2 has been a drug target for cancer, and there is a significant amount of data and compounds known to inhibit human MetAP2. We are focusing on modifying the human MetAP2 inhibitors so that they will be effective drug like molecules that target malarial MetAP2. This poster will present the synthesis of triazole MetAP2 inhibitors that will target malarial MetAP2.
The purpose of this project was to raise antibodies against phenylpyruvate. Since low-molecular weight compounds do not elicit an immune response, first, a derivative suitable for conjugation to a protein carrier was produced. For that, the commercially available amino acid p-aminophenylalanine was converted into the corresponding keto acid, p-aminophenylpyruvate, utilizing the enzymatic activity of the enzyme L-amino acid oxidase. NMR spectroscopy was used to follow the enzymatic reaction and to confirm product formation. After a simple purification procedure, p-aminophenylpyruvate was then conjugated with the proteins Bovine Serum Albumin (BSA) and Keyhole Limpet Hemocyanin (KLH), respectively, by diazotization. The KLH-conjugate served as immunogen for the immunization of mice. Serum samples were tested for antibody production by enzyme-linked immunosorbent assay (ELISA) using the BSA-conjugates as solid phase coatings. Both noncompetitive and competitive tests indicated that immunizations were successful and that antibodies to the target molecule phenylpyruvate were produced.
Molecular radical cations of tryptophan were generated by collision-induced dissociation of ternary metal-ligand-tryptophan complexes in the gas phase. The production of these radicals allows us to study the nature of the cation as well as the role they play in protein damage. The yields of radical cations were dependent on both the auxiliary ligand and metal used and also the ratio in which they were complexed. Metals used were copper(II), iron(II), iron(III) and cobalt(II) along with the ligands 2,2’-dipyridine and salen. A radical cation of tryptophan was obtained by the cleavage of the metal-amino acid bond in the [iron(III)(salen)Trp] complex. Experiments with preparation of complexes showed that if the complexes were heated at 60-70 degrees Celsius for approximately 20-30 minutes, the intensity of the complex was higher.
Camelid VHH antibodies are a unique class of antibody which lack a light chain. There is significant interest in developing such antibodies for life science applications due to their high expression yield and ideal biophysical properties. Here, we describe methods used to express and purifying these unique antibodies so that their structural and biophysical properties may be investigated. Initially, VHH is produced through over-expression in E. coli. As most variants express as insoluble inclusion bodies, VHH must be resolubilized and re-folded. The resulting soluble VHH is then purified using His-trap and size exclusion column chromatography. Finally, functionally active VHH is assessed with isothermal titration calorimetry.
Liver X receptors regulate transcriptions of genes involved in controlling cholesterol levels in the body. Riccardin C is a polycyclic natural product isolated from liverworts, which activates liver X receptor α, but not liver X receptor β. Activation of only one subtype can lead to gene selectivity, thus improving therapeutic potential of this protein. However, due to low micromolar potency of Riccardin C, development of more potent analogs is necessary. The overall structure of Riccardin C is highly strained, so in our analogs ring D will be substituted with a flexible ester linker. Efficient synthesis of the three-ring sub-unit was developed prior to my joining the group. My goal this semester is to complete the synthesis of a Riccardin C analog. To achieve this, the ethylene linker between rings B and C was first reduced to a single bond. Then, an ester on ring A was reduced to an alcohol, which was subsequently oxidized to an aldehyde. The aldehyde was purified by a silica gel column chromatography to give 50% yield. The linker was assembled using Horner--Wadsworth--Emmons and Wittig reactions. These reactions were performed on a submillimolar scale. The final macrocycle will be prepared by the reaction between the carboxylic acid on the linker and the phenol on ring C. The analog will then be tested to determine whether it carries the characteristics of the natural compound Riccardin C. Then additional analogs will be synthesized by changing either the ligand ring structure or functional groups on the rings.
Resveratrol, 3,4’,5-trihydroxystilbene, is a phytoalexin (plant-produced antibiotic) which occurs in plants such as grapes, berries and peanuts. In recent years health benefits such as a reduced risk of cardiovascular disease and cancer have been attributed to consumption of resveratrol (Chan, 2002). Resveratrol is now available as an over-the-counter supplement. Recent studies show that many human-associated bacteria are susceptible to resveratrol in vitro (Paulo, 2010); endogenous urinary tract infections (UTIs) are often caused by such bacteria. Resveratrol and its metabolites are excreted in urine (Boocock, 2007). To date, no studies have been conducted to determine if dietary resveratrol and its metabolites may reduce the risk of such UTIs. This study investigates the effect of dietary resveratrol on bacterial growth in human urine. Urine was collected pre and post ingestion of resveratrol supplements. Growth studies with common UTI causing enteric bacteria were conducted on these urine samples and lag phase growth was evaluated.
Synthesis of tumor specific vehicle for use with BNCT

Authors: Chris Potocki & Devangi Patel
Faculty Mentor: Narayan Hosmane
Department: Chemistry and Biochemistry
Research Category: Science, Technology, Engineering, Math
Judging Time: 11:30AM-12:45PM

The preparation of magnetic nanoparticles allows for new applications and pharmaceutical drug use. The use of magnetic nanoparticles for cancer therapy is not a new science, but the application of them as drug delivery agents is the next step in Boron Neutron Capture Therapy (BNCT). The BNCT works as a binary treatment facility that selectively targets cancer cells with boron-based drugs followed by neutron bombardment. Bombarding boron with neutrons essentially releases high energy particles that can kill the cancer cell. The purpose of this project is to design, synthesize and characterize novel drug delivery systems that will precisely target cancer cells. The process will involve functionalization of magnetic nanoparticles via in-organic synthesis starting with silica-coated boron, gadolinium and iron particles. The next step is to successively attach the glucose moiety and two sugar substituent compounds sucralose and saccharin to the functionalized nanoparticles. This process has two major steps; the first step is the synthesis of the compound. The next step involves the purification of the compound and characterization. The anticipated learning outcome is to successfully bind the compounds known as sucralose and saccharin to the silica-coated boron in order to form a tumor specific vehicle that will transport the boron safely to the cancerous cells. In addition the outcome involves the use of these cancer drugs in patients that are adversely affected be high levels of glucose.
Sara Billenstein

Determination of DNA sequences of two stereoselective antibodies

Authors: Sara Billenstein
Faculty Mentor: Heike Hofstetter & Oliver Hofstetter
Department: Chemistry and Biochemistry
Research Category: Science, Technology, Engineering, Math
Judging Time: 10:15-11:30AM

Stereoselective interactions between proteins and low-molecular weight ligands, such as drugs, are still not well understood even though they have been described first more than a century ago. Extensive work has been carried out to understand the stereoselectivity displayed by a number of anti-α-amino acid antibodies (D.I. Ranieri, NIU, 2009). We are now interested in the molecular basis of two stereoselective antibodies raised against α-hydroxy acids, namely 8E10 and 10B2. DNA was isolated from hybridoma cell lines and antibody heavy and light chain DNA was amplified using polymerase chain reaction. DNA was then cloned into plasmids and sequenced.
The methyl erythritol isoprenoid (MEP) pathway is a non-mevalonate pathway that is essential to isoprenoid biosynthesis in many pathogens, such as M. tuberculosis that causes tuberculosis and the malaria-causing P. falciparum. Additionally, this pathway is absent in humans which makes the enzymes within the MEP pathway potential drug targets. Specifically, the fifth enzyme in the MEP pathway, 2C-methyl-D-erythritol 2,4-cyclodiphosphate (IspF), is a highly conserved enzyme which would allow for broad-spectrum activity for any chemotherapeutic agent upon discovery. The oligomeric IspF contains active sites that possess three pockets, one that binds cytosine moieties, one that binds ribose and one that binds to a zinc metal ion. This research concentrates on the synthesis of cytidine derivatives and analogs that could be potential inhibitors of IspF, which are then tested for their binding affinity to the active site of IspF. The ultimate goal of this research is to inhibit this, thus creating efficacious treatments for infectious disease such as tuberculosis and malaria.
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Analysis of antibody interactions by alanine-scanning through a methotrexate-VHH model system.

Authors: Kevin King
Faculty Mentor: James Horn
Department: Chemistry and Biochemistry
Research Category: Science, Technology, Engineering, Math
Judging Time: 9:00-10:15AM

In order to better understand antibody interactions, we use a methotrexate-VHH model system. Methotrexate is a drug that is used in the treatment of some cancers, arthritis and other various diseases. We use a protein, anti-methotrexate, to study specific amino-group interactions and through alanine scanning, we can determine how important or unimportant various amino acid residues are in the binding interactions. Alanine scanning is the process of changing a specific amino acid residue to an alanine residue to evaluate that specific residue effect in the binding strength, if there is an effect at all. Understanding how and why certain amino acid residues create strong or weak binding is important in the development of future drugs or modifications of current drugs to increase their effectiveness while hopefully reducing side effects by creating higher affinity drug-drug target binding.
In 2007, the researchers of Antarctic Geological Drilling (ANDRILL) obtained a rock core from McMurdo Sound, Antarctica, by mud rotary drilling. In the drilling process, approximately $5.6 \times 10^5$ liters of the synthetic drilling mud used was lost beneath the surface. The major concern in the loss of this material is the contamination of the pristine subsurface environment. In order to fully assess the geochemical impacts of the drilling, samples were taken at varying depths to be analyzed for their composition and biodegradability. The synthetic mud used is organic in nature, which allows for a simple extraction from the non-organics contained within the samples. After extraction, the samples can be analyzed by High Precision Liquid Chromatography (HPLC), where the composition of the mud components can be fully inspected. The purpose of this is twofold: the first is to develop a method by which the samples can be analyzed quickly and efficiently; the second is to gain a better understanding of the content in the samples for the preparation of a degradation study. Three trial runs were performed, each with varying conditions and methods to determine the best procedure. After a procedure was chosen, the ANDRILL samples were extracted and run under HPLC.
Boron Neutron Capture Therapy (BNCT) is one of the promising treatments for cancer. Besides many other factors, the success of BNCT depends significantly on the transportation of drugs and their absorption by the tumor tissues. Among several boron-rich drug carriers, that are being investigated for BNCT, carborane-appended molecules have proven to be highly tumor targeted. In that context, purines are an important class of compounds to form biomolecules with a vital role in cellular metabolism. We have designed and synthesized adenine containing carborane compounds as drug delivery agents for BNCT applications. Characterization of these compounds, including bio-distribution studies, will also be presented.
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Do TASK3 Potassium Channels Contribute to the Growth and Survival of Glioblastoma U-138 Cells?

Authors: David Parlberg
Faculty Mentor: David Lotshaw
Department: Biological Sciences
Research Category: Science, Technology, Engineering, Math
Judging Time: 11:30AM-12:45PM

TASK3 channels are a member of the two pore domain potassium channel subfamily. These channels function primarily in maintaining the resting plasma membrane potential. TASK3 has been reported to be overexpressed in numerous human carcinomas where it is hypothesized to contribute to oncogenesis, the formation of these growths. Glioblastoma multiforme is the most common form of brain tumor diagnosed in the United States annually and several glioblastoma cell lines are reported to express TASK3 mRNA. We set out to test the hypothesis that TASK3 expression enhances cell growth rate and/or inhibits cell death in the glioblastoma cell line U-138, previously reported to express TASK3 mRNA. To test the contributions of TASK3, we inhibited TASK3 expression by transfecting U-138 cells with a dominant negative mutation of TASK3. However, U-138 cell growth rate was unaffected in cells that we stably transfected with the dominant negative mutation when compared to the untransfected cells. Patch clamp recordings which measure the magnitude of TASK3 K+ current suppression by the dominant negative mutation led to the discovery that the untransfected cells did not express functional TASK3 channels in the plasma membrane. Further experiments are underway to determine whether or not the U-138 cell line expresses TASK3 protein. These analyses indicate that functional TASK3 channels, either in an intracellular membrane or the plasma membrane, do not promote U-138 cell growth. Whether TASK3 confers resistance to U-138 cell death remains to be tested.
Recent advances in fetal surgery require advanced knowledge of fetal anatomy. While a number of atlases of embryonic anatomy (0 – 2 mo. of age) exist, to date there is only one known atlas of fetal anatomy that covers mainly late stage (30 weeks) fetuses. In this presentation I will describe the key anatomical features of the thorax in a 22 week old fetus. The fetus used for this study died in utero of complications from twin to twin transfusion syndrome and was spontaneously aborted. Both twins were donated by the parents to Northern Illinois University body donor program in the hopes that studying them might lead to a better understanding of fetal disease. Initially body length and weight was noted and recorded. Examination of the hands and feet showed polydactyly of both feet (6 toes). Following this, the skin in the thorax was removed after which the pectoral muscles and branches of the brachial plexus were examined. The rib cage was then removed revealing the lungs in the two plural cavities and the contents of the mediastinum. Further study of the heart revealed that it lacked a foramen ovale and had thickened atrial-ventricular valve leaflets. It is not clear at this time what caused this pathology but further study may reveal other abnormalities.
The growth and progression of cancer is dependent upon enhanced energy supplies and metabolism of the cancerous cells. To sustain unchecked growth, cancers have long been known to switch from oxidative metabolism to anaerobic metabolism (glycolysis)-a phenomenon known as the “Warburg Effect,” after Otto Warburg, the scientist who first described it in the 1930s. Indeed this metabolic shift has been exploited to image for cancer in the form of positron emission tomography (PET) using radioactive glucose. This project tests the role of the Warburg Effect in the growth of human liver cancer cells-something that has not been tested systematically to-date. To achieve this goal, a broad panel of 10 human hepatocellular carcinoma (HCC) cell lines representing a well-characterized spectrum of human liver cancers is tested for their ability to grow under varied oxygen conditions (2% O₂ vs. 20% O₂), and to grow in the presence of glycolysis chemical inhibitors. Collectively, the results will indicate to what extent specific types of liver cancer rely on glycolysis (the Warburg Effect) for growth. A better understanding of liver cancer’s metabolic wiring and demands will help lead to specific, targeted therapies for patients-perhaps exposing the “Achilles’ heel” of this cancer.
Snake Ecology and Conservation in Northern Illinois

Authors: Samantha Melton, Patrick Larson, Mike Blackowicz & Andrew Moore
Faculty Mentor: Richard King
Department: Biological Sciences
Research Category: Science, Technology, Engineering, Math
Judging Time: 9:00-10:15AM

The Common Gartersnake (Thamnophis sirtalis), DeKay’s Brownsnake (Storeria dekyai), and Red-bellied Snake (Storeria occipitomaculata) are probably the most common snake species in Northern Illinois. Despite this, key aspects of their life history remain poorly known. To address this data deficit, and to provide NIU undergraduates with training in wildlife ecology, a capture-mark-recapture study of these species was initiated at Potawatomi Woods Forest Preserve in northern DeKalb County, Illinois. In fall 2008, an array of rubber mats (cut from used conveyer belt) were deployed in suitable grassland and sedge-meadow habitat. These mats are used by snakes as retreat sites, providing a passive means of population monitoring. Upon capture, snakes were measured and individually marked by clipping a unique combination of ventral scales. Field work during 2008, 2009, and 2010 resulted in 609 captures of 392 individual snakes (353 captures of 225 Common Gartersnakes, 168 captures of 96 Brownsnakes, 88 captures of 71 Red-bellied snakes). Analyses presented here focus on the reproductive ecology of these species. All three species are live-bearing and gravid females were captured from May to August. Estimated minimum size of female sexual maturity was 460 mm snout-vent length (SVL) for T. sirtalis, 227 mm SVL for S. dekyai, and 193 mm SVL for S. occipitomaculata. Proportions of gravid vs. non-gravid adult females were nearly equal for the three species, ranging from 86-88%. Information on reproductive parameters allows demographers to better model population growth, aiding in wildlife management decisions.
Antibodies are macromolecules which play an important role in the immune response. Their ability to bind target molecules with high affinity and specificity has also expanded their use in a wide range of applications, including diagnostics, therapeutics, and chromatography. Previous work in the Horn Lab generated a highly pH sensitive single domain VHH camelid antibody. This was accomplished through a combinatorial histidine scanning library which sampled histidines throughout the antibody interface. Here, we use x-ray crystallography to solve the structure of the highly pH sensitive anti-RNase A clone in complex with its target, RNase A. This technique reveals atomic-level details of the antibody/antigen interface. Overall, despite considerable interface remodeling, only minor structural changes were observed. These results help suggest that the histidine-scanning libraries may be a general method to generate highly pH dependent affinity reagents.
Generation and phenotypic analysis of Arabidopsis thaliana plants bearing mutations in DRG and DFRP genes.

Authors: Ryan Kuebler
Faculty Mentor: Joel Stafstrom
Department: Biological Sciences
Research Category: Science, Technology, Engineering, Math
Judging Time: 11:30AM-12:45PM

DRG genes encode GTP binding proteins that occur in all eukaryotes. The sequences of DRG genes are highly conserved, suggesting that they play important roles in the physiology of all cells. DFRP genes encode proteins that specifically interact with DRG proteins, i.e., DRG1 with DFRP1 and DRG2 with DFRP2. The focus of this research is aimed at understanding the functions of DRG genes and related genes. One approach is to analyze the phenotypes of recessive loss-of-function mutations in the model plant Arabidopsis thaliana. Experiments have shown that single mutants have no apparent phenotype, but that two types of double mutants show slower root growth and other features. The goal of this project is to use the polymerase chain reaction (PCR) and related techniques to screen for plants containing different gene combinations of the wild type and mutant forms of DRG1, DRG2, DFRP1, and DFRP2. Through the acquisition of these different genotypes, the physiological attributes of these genes can be assessed, which can ultimately lead to the discovery of their roles in eukaryotes.
The control of pest flies is a major problem for livestock rearing facilities such as dairy farms. The stress that is induced by the painful bites of the flies has been associated with lower weight gains and reduced milk flow in dairy cattle (Catangui et al., 1993). As a solution to this problem, pesticides are widely used in agriculture (LeDoux, 2010). However, an alternative is the introduction of natural enemies such as parasitoid wasps. Adult female parasitoids lay their offspring in the pupal stage of the pest flies, and the parasitoid offspring feed on the fly pupa, causing its death. The purpose of the present study was to examine whether the type of bedding that is used for livestock affects the rate at which the parasitoids can potentially kill the flies. This study focused on two different species of parasitoid wasps and four common bedding types, corn cob pellets, wood pellets, cedar shavings, and pine shavings, for a total of eight treatments. Each treatment was replicated ten times. In each replicate, an adult female parasitoid was placed in a jar containing a layer of bedding over fly pupae, which were on simulated manure. After allowing four days for parasitization, the fly pupae were collected, and fly and parasitoid development was allowed to complete. The number of flies killed and wasps emerged were recorded and compared among treatments. Additional experiments are being conducted with pine shavings versus cedar shavings to test for effects on the survival and preference of adult wasps. Catangui, M. A., Campbell, J. B., Thomas, G. D., and Boxler, D. J. 1993. Average daily gains of Brahman-crossbred and English X exotic feeder heifers exposed to low, medium, and high levels of stable flies (Diptera: Muscidae). Journal of Economical Entomology. 86: 1144-1150. LeDoux, M. Dec. 2010. Analytical methods applied to the determination of pesticide residues in foods of animal origin. A review of the past two decades. Journal of Chromatography A. 1218: 1021-1-36.
Imaging Cytometry of HMGB1 in Human Brain Cancer Cells

Authors: Jay Highland & Anne Wyer
Faculty Mentor: Linda Yasui
Department: Biological Sciences
Research Category: Science, Technology, Engineering, Math
Judging Time: 9:00-10:15AM

The multifunctional protein, high mobility group box 1 (HMGB1) functions in a number of central, cohesive roles in cells depending upon its subcellular or extracellular localization. Significantly, HMGB1 can regulate apoptosis, autophagy and necrosis when it is retained in the nucleus, is located in the cytoplasm or is released extracellularly, respectively. Therefore, to direct cells towards a pro-apoptotic strategy of cell killing, it is important to more fully understand HMGB1 release or retention in the nucleus. Human brain tumor, glioblastome multiforme (GBM) cells were studied. Inhibition of release of HMGB1 from chromatin in GBM cells was achieved using ethyl pyruvate at non-toxic concentrations. Imaging cytometry showed that gamma irradiated GBM cells released HMGB1 from their nuclei or HMGB1 was retained in chromatin in tumor cells treated with ethyl pyruvate. The combination treatment of gamma irradiation with ethyl pyruvate resulted in nuclear retention of HMGB1. Intensity measurements of immunofluorescently labeled HMGB1 confirmed these findings. Gamma irradiation (10 Gy) in combination with ethyl pyruvate treatment in GBM tumor cells was slightly more effective at killing these cells than gamma irradiation alone, suggesting that retention of HMGB1 in chromatin may offer some benefit to GBM patients undergoing radiation therapy by the avoidance of necrosis, a dangerous way for tumor cells to die.
Supplemental Lighting Effects on Growth of Microalgae used as Feedstocks for BioFuel

Authors: Matthew Kispert
Faculty Mentor: Gabriel Holbrook & Scott Grayburn
Department: Biological Sciences
Research Category: Science, Technology, Engineering, Math
Judging Time: 10:15-11:30AM

Demand for biodiesel is increasing as petroleum based oil supplies decline or become restricted. Current feedstocks for biodiesel include soybeans and corn. The use of algae as a feedstock has attracted worldwide interest with research focused on maximizing its output. Cultivating algae has four main requirements: Nutrients, light, water, and heat. This research is part of a larger ongoing project utilizing waste water from the DeKalb Sanitary District as a source of nutrients and water. The native microalgae Chlorella sp. is being used in these experiments as our research has shown it to have the highest oil content of the locally occurring strains. The research presented focuses on determining the effectiveness of underwater lighting on algal cultures grown in large 75 Gallon stock tanks which serve as a means of growing a mass quantity of algae in a confined, easily harvestable container. Light is thought to be a limiting factor in containers of these sizes. Supplemental lighting in the form of waterproof LEDs will be added to certain tanks and the growth monitored. Future research will focus on further additions/modifications of the growth environment for algae with the goal of attaining the most productive and easily maintained conditions possible.
Kathryn Owens & Yee Her

*Gamma Irradiation Induced Necrosis in Glioblastoma Multiforme and Normal Human Astrocytes*

Authors: Kathryn Owens & Yee Her  
Faculty Mentor: Linda Yasui  
Department: Biological Sciences  
Research Category: Science, Technology, Engineering, Math  
Judging Time: 12:45-1:30PM

The mode of cell death in gamma irradiated human glioblastoma multiforme (GBM) and normal human astrocyte (NHA) cells was investigated. Cells that die by necrosis release danger signals that induce an inflammation response leading to gliosis and poor patient prognosis. Therefore, a significant long term goal is to develop alternative therapeutic strategies for GBM tumors that reduce necrosis. In this study, the development of necrosis induced by gamma irradiation was investigated in human U87 GBM cells and NHA cells. Positive glial fibrillary acidic protein (GFAP) staining in both U87 and NHA cells confirmed their identity as glial cells. Also, clonogenic survival data showed that gamma irradiation killed U87 cells. Transmission electron microscopy (TEM) studies offered definitive proof for the presence of autophagy and necrosis in U87 and NHA cells. The percentage of autophagy and necrosis determined from the TEM images indicates that necrosis occurs in the background of autophagy. Further, a greater proportion of cells died by necrosis as dose and time increased in both U87 and NHA cells. These data provide an image data base describing the development of necrosis in tumor versus normal human brain cells.
Conversion of Carbon dioxide to Few-layer Graphene

Authors: Jennifer Skrabutenas, Laura Paulson, Amartya Chakrabarti & Zhili Xiao
Faculty Mentor: Narayan Hosmane
Department: Biological Sciences
Research Category: Science, Technology, Engineering, Math
Judging Time: 11:30AM-12:45PM

Graphene is a one atom thick sheet of carbon atoms with applications in the fields of chemistry, biology, physics, and engineering including sensors, nanoelectronics, composites, hydrogen storage and lithium-ion batteries. Few-layer graphene was successfully synthesized in our laboratory by burning magnesium metal in a dry ice environment. This new methodology can be easily scaled up to convert CO2 directly into useful few-layer graphene. The experiment involved isolation and structural characterization of the carbon materials, formed during combustion, via Raman spectroscopy, energy-dispersive X-ray analysis, X-ray powder diffraction and transmission electron microscopy.
As one of the most important IV-VI semiconductors, SnS2 has been known for its strong anisotropy of optical properties and potential applications in solar cells as well as electrical switchings. Nanocrystalline tin (IV) sulfide (SnS2) with diverse morphologies were controllably synthesized using organic additives, such as cetyltrimethylammonium bromide, sodium dodecyl sulfate, and p-benzenedicarboxylic acid in ethanol solution under mild reaction conditions. By adjusting the type and concentration of the organic additives, different nanostructured SnS2 were prepared including flower-like, fiber, layer-rolled and sheet-like forms. Some other factors on the morphology, size and crystallization of the prepared SnS2 nanostructures were also investigated, including reaction time and temperature. Various techniques were applied to characterize the prepared SnS2 nanostructures including X-Ray Diffraction, Transmission Electron Microscopy and UV-Vis spectroscopy. Employing different ways of synthesizing SnS2 along with diverse morphologies could prove advantageous for future battery production.
Rubisco is a primary carbon fixing enzyme that plays an important role in photosynthesis in all plants. As leaf tissue ages, rates of catalysis by Rubisco decline, which slows carbon fixation and plant productivity. Most plants produce CA1P, a regulator of Rubisco, which binds to the enzyme in darkness. CA1P may also stabilize Rubisco and slow its breakdown by proteases during senescence. Certain plant species accumulate more CA1P than others, such as the difference in soybeans and pea plants. Therefore, we wished to compare activity loss via the degradation of Rubisco in plants, with high vs. low levels of CA1P. Detached leaves were used on a senescence model, where slow loss of photosynthetic activity can be related to decreasing Rubisco catalysis, due to proteolysis. Protection of Rubisco from proteolysis by endogenous CA1P could lead to a delay in senescence and greater crop productivity by certain plant species. This prediction was addressed in the USOAR project presented.
Lindsey McKinney

Isolation and analysis of Arabidopsis thaliana lines bearing DRG knock-out mutations and overexpressing GFP protein fusions: Are wild-type DRGs necessary for heat stress granule formation?

Authors: Lindsey McKinney & Ryan Kuebler
Faculty Mentor: Joel Stafstrom
Department: Biological Sciences
Research Category: Science, Technology, Engineering, Math
Judging Time: 10:15-11:30AM

DRG genes encode a highly conserved group of regulatory proteins that occur in the genomes of all eukaryotes, suggesting that they play key roles as physiological regulators in cell development. The focus of this study is aimed at understanding the functions of proteins encoded by DRG genes in the model plant Arabidopsis thaliana. One approach to understanding protein function is to determine protein location under normal growth conditions and after altering various environmental signals. DRG1 and DRG2 proteins were fused with green fluorescent protein (GFP) in order to study their localization in living cells using confocal microscopy. It was found that DRG1-GFP and DRG2-GFP fusion proteins normally disperse in the cytoplasm. Following heat stress, fluorescence quickly aggregate into large bodies known as heat stress granules (HSGs). The goal of this project is to determine whether HSGs can still form in response to heat stress if one or both of the DRG genes is mutated. Relevant mutants include single mutants drg1 and drg2, and double mutant drg1, drg2, which were crossed with plants containing either DRG1-GFP or DRG2-GFP. Methods utilized in experimentation include the polymerase chain reaction (PCR) and gel electrophoresis to screen for plants containing the desired combination of genes. The next step will be to analyze the phenotypes of these lines using a root-growth assay in order to study the relationship between phenotype and genetic composition. The main objective is to determine whether any mutant combination inhibits the formation of HSGs following exposure of plants to heat stress.
The Role of Nitric Oxide in Pancreatic Secretion

Authors: Kaylee Walters & Cole Lightfoot
Faculty Mentor: Kenneth Gasser
Department: Biological Sciences
Research Category: Science, Technology, Engineering, Math
Judging Time: 11:30AM-12:45PM

Secretion of digestive enzymes relies on signal transduction to control the migration of vesicles to the plasma membrane. Work in our laboratory demonstrated that the pancreas produces nitric oxide (NO) in response to stimulation with the hormone cholecystokinin (CCK). Secretion of digestive enzymes was subsequently blocked when the pancreas was pretreated with a NO inhibitor L-NAME. The goal of the current project was to investigate the role of NO, the peroxynitrite producing enzyme NADPH oxidase NOX-4, and the nitrosylation of target proteins on the vesicle membrane. The NOX-4 enzyme was shown to reside on vesicles and inhibition of NOX-4 blocked secretion. Potential targets were identified by western blots using nitrotyrosine specific antibodies. A reproducible nitrosylated band was identified following stimulation of the pancreatic with CCK. The nitrosylation time course peaked at 5 minutes after stimulation with CCK, matching that for NO generation. Rac is a 21 kD G-protein that influences cytoskeletal reorganization and superoxide formation. Pancreatic vesicles were isolated from both control and CCK-stimulated pancreatic cells and probed for Rac activity by western blots. The results show a significant increase in the Rac following stimulation, suggesting an increased level of superoxide production when cells are stimulated. NO produced by the pancreatic cells could combine with superoxides localized on the vesicle membranes in order to form the peroxynitrite required to nitrosylate tyrosine on the vesicle membrane. Western blotting also showed that the Rac-associated cytoskeletal reorganizing protein, Nck, partitions to the granules in a pattern similar to that of Rac. Our model then proposes that CCK stimulates NO production in the pancreas. The NO combines with superoxides, formed by the action of both Rac and NOX-4, to form peroxynitrites. These peroxynitrites bind to tyrosines on target proteins required for secretion. One such protein may be Nck, which is known to cause reorganization of the cytoskeleton. (Supported in part by a USOAR grant to KW)
Massage therapy has benefitted humans, as well as animals throughout history by providing relaxation and enhanced performance. In recent years, practitioners of equine massage therapy have been attempting to gain greater public acceptance of the technique, but many people are still skeptical of its value in horses. To demonstrate massage’s benefits, changes in horses’ gaits were analyzed in an attempt show that massage allows the horses to increase muscle extensions and move more efficiently.

To gather the data, the horses were videotaped at the walk, jog, and trot immediately before and after a massage.

The video clips were then analyzed with sports video analysis software. Statistical analysis and individual comparisons were done to determine whether or not there was any distinct improvement in the horses from the massage. The statistical analysis results were inconclusive, but this might be expected, since there were many additional variables that may have influenced the results. Individual comparisons, however, did show that, in some cases, there were definite improvements following the massage.

Despite the fact that the research was inconclusive, the individual improvements were noticeable and demonstrate the potential that massage has to benefit the equine athlete.
Advancement in cancer therapy relies mostly on the development of drug delivery systems. The major challenge in the drug delivery system is the increment in the efficiency of the agent by delivering maximum amount of doses to the tumor cells. Among the different boron-rich drug carriers that are being investigated for Boron Neutron Capture Therapy (BNCT), carborane-appended molecules have proven to be highly effective in tumor targeting. In our laboratory, we have synthesized adenine-enriched carborane compounds where two adenine moieties are being attached to a single carborane cage. Characterization of these compounds and bio-distribution studies will also be presented.
An approach for the treatment of cancer that is used in this research is Boron Neutron capture therapy (BNCT), which involves a neutron source and a cancer specific boron drug. There have been many studies done on carborane-sugar moieties that have been evaluated as a BNCT agent. Carborane clusters are important because they are boron sources for BNCT drugs and their stability for biological degradation and their ability to be deboronated to their corresponding water-soluble derivatives. Specifically for the purpose of this research we are using thio-sugar because it is known to be non-toxic and can easily be excreted from the body. The current biological evaluation of the carborane-appended-5-Thio-D-glucopyranose, where the carborane cage was attached to the thio-sugar moiety through an ether linkage, was found to be extremely toxic. Currently we are working on the syntheses of the carborane-appended-5-Thio-D-glucopyranose where, we are trying to attach the carborane cage to the thio-sugar moiety without an ether linkage. The next step of this research is to compare the biological evaluations of both the compounds. The results of the syntheses of the carborane-thio-sugar conjugates and their biological evaluation for BNCT applications will be presented.
Caffeine (1,3,7-trimethylxanthine) is a widely used stimulant found in coffee, tea, and many carbonated beverages, as well as modern energy drinks. Consumption of caffeinated beverages is on the rise amongst American youth (Preidt, 2010). Popular energy drinks contain the caffeine equivalent of one or more cups of coffee. Research describes an increase in renal excretion of Calcium (Ca$^{2+}$) and Magnesium (Mg$^{2+}$) ions upon ingestion of caffeine (Kynast-Gales and Massey, 1994). Renal excretion of Ca$^{2+}$ and Mg$^{2+}$ may deplete valuable mineral reservoirs in the developing bones and teeth of children (MedlinePlus). Increased risk of kidney stones is also associated with excessive caffeine consumption, and an elevated incidence of kidney stones in juveniles has recently been reported by the National Kidney Foundation. Given the potential for such pediatric health concerns, this study investigated the effect of popular caffeinated beverages on the renal excretion of Ca$^{2+}$ and Mg$^{2+}$ using EDTA titrations of urine.
Boron nitride nanotubes (BNNTs) found their application in several fields, since their first synthesis in 1995. Most commonly used methods for preparation of BNNTs require drastic reaction conditions like high temperature (1000°C or more), expensive and complicated setups. A simpler technique of pyrolysis to produce BNNTs using a Fe/Zn catalytic mixture at lower temperatures has been employed recently, but the grey product obtained from this process contained a significant amount of the catalyst. We investigated different catalyst systems following similar reaction protocols. The magnesium (Mg) metal has been proven to be useful as a catalyst to produce BNNTs on large scale. The purified white product was characterized via FT-IR spectroscopy and transmission electron microscopy (TEM) whose images show the presence of abundant nanotubes in the product with a very few nanocages.
Targeted drug delivery system is of great demand for Boron Neutron Capture Therapy (BNCT) in cancer treatment. Among several attempts to prepare adenine incorporated carborane compounds, a new synthetic methodology has been designed as an alternative strategy for the formation of carborane cage-appended drug delivery system. This new method involved linking the one end of dibromoalkane to adenine, while the other end to the ortho-carborane moiety. The compounds are being characterized by using standard spectroscopic techniques and their bio-distribution studies explored. The results of this investigation will be presented in details.

Tressa Sharma

*Engineering pH-sensitive protein binding*

Protein affinity reagents, such as antibodies, are used in numerous applications across the life sciences, including therapeutics, diagnostics and biosensors. Typically such reagents are limited to a simple, one-time binding event, in which there is little control of the antibody-target interaction. The focus of this research has been to develop and characterize highly pH-dependent antibodies, thereby opening new opportunities in antibody applications. Using a model camelid single domain (VHH) anti-RNase A antibody, a novel, combinatorial library was developed to introduce significant pH dependency. Analysis of the generated antibodies revealed these antibodies maintained the wild-type affinity at physiological pH, yet binding could be effectively abolished with only minor decreases in pH.
Formation of Gas Phase Tyrosine Radical Cations

Authors: Caitlan Ayala
Faculty Mentor: Victor Ryzhov
Department: Chemistry and Biochemistry
Research Category: Science, Technology, Engineering, Math
Judging Time: 12:45-1:30PM

Radicals play an important role in protein damage, and as a model to study radical behavior in larger protein systems, the formations of stable tyrosine radical cations were investigated. A tyrosine radical cation is a positively charged version of tyrosine containing one less electron. Gas phase complexes containing a metal, ligand, and the amino acid tyrosine were examined through collision induced dissociations (CID) in Mass Spectrometry. This objective of achieving the radical cation, however, was dependent upon the stability of the ternary ligand-metal-tyrosine complex. The cleavage of the metal-tyrosine bond promotes the oxidative dissociation necessary to produce the tyrosine radical cation. The metals Copper (II), Iron (II), Cobalt (II), and Iron (III) were analyzed in association with 2,2’-dipyridine and Salen as ligands. Initial trials containing only the amino acid were utilized to produce the radical cation, and di- and tri-peptides alanine-tyrosine and valine-tyrosine-valine were studied to facilitate the CID fragmentation as well. The most stable ternary complex was comprised of Copper (II), tyrosine, and 2,2’-dipyridine; although radical cations have not yet been obtained from further isolation and fragmentation.
Protein-protein interactions form an important core of biological regulation and function. An improved understanding of the physical properties of these interactions, through the study of protein energetics and structure, can enable the design of small molecules capable of inhibiting these interactions and impeding their harmful down-stream effects. Apoptosis is a highly regulated pathway for programmed cell death which lies in the balance of both anti-apoptotic proteins, such as Bcl-xl, and pro-apoptotic proteins, such as Bax and Bad. As Bcl-xl is an anti-apoptotic protein, overexpression can lead to too little cell death and hence cancerous growth, rendering it an excellent potential target for small molecule and peptide inhibitors. Insight into the mechanisms by which Bcl-xl functions is essential to effective drug design, which includes understanding the effects protein structure has on binding. A subcloning procedure was designed to relocate the gene which encodes for Bcl-xl into a bacterial DNA vector. To aid expression and x-ray crystallography studies, a portion of the Bcl-xl sequence that encodes a nonessential-flexible loop was removed using Kunkel mutagenesis. The Bxl-xl protein was expressed using E. coli. In addition, the Bad peptide, a pro-apoptotic member of the Bc;-2 family, was expressed by means of a ubiquitin-peptide fusion expression system. Isothermal titration calorimetry revealed that both the Bcl-xl protein and the Bad peptide are expressed as functional binding partners.
Radical molecules, biochemical species that contain an unpaired number of electrons, are important molecules for chemical inquiry. They are involved in many biological pathways, including antibiotic mechanisms. However, due to their reactivity, they can also contribute to protein damage. A quantitative method was designed to study the generation of DL-homocysteine radicals using quadruple pole ion-trap mass spectrometry. Normal homocysteine radicals form at the sulfhydryl terminus of the amino acid; however, they are prone to rearrangement with a radical forming at the alpha-carbon of the acid. In order to promote alpha-carbon radical stabilization, the amino-terminus of the homocysteine was acetylated using a solution of concentrated acetic anhydride, and then subsequently nitrosylated using tert-butyl nitrite. MS was then used to check to see if the product was produced in a high enough yield. DL-homocysteine has two possible acetylation sites: the nitrogen atom, and the sulfur atom. The data of the nitrosylation showed that the sulfur group was getting acetylated, along with the nitrogen. In order to prevent this, similar experiments will be conducted with DL-homocysteine thiolactone (THL).
 Increased use of biofuels has led to exploration of alternative feedstocks which do not compete with food crops like soybean and corn. Algae produce many lipids which could be extracted and converted to biodiesel. We are interested in growing microalgal species found locally in Illinois, and taking advantage of wastewater as a source of nutrients. Once algal species are grown to acceptable densities in media, several challenges have to be overcome to enable fuel production. The first involves harvesting the algae which are very small organisms with cell dimensions as small as 1 micrometer. We have developed a method of cell flocculation, filtration, and dewatering which allows algae to be processed for lipid extraction. Techniques are being worked out to break the cells, and allow lipid release for subsequent methanolysis and the production of Fatty Acid Methyl Esters (FAME’s). We are interested in discovering the characteristics of such FAME’s (e.g. Hydrocarbon chain length and degree of saturation) and intend to perform analysis by Gas Chromatography with a view to converting the extracts to algal biodiesel which will be tested in a stationary diesel engine in the NIU Department of Technology.
LaRu2P2 is a layered solid material, which exhibits superconductivity at 4.1 K. It has been postulated that the P-P distance that connect the layers plays an important role in determining the superconducting transition temperature of this compound. Our research is therefore the synthesis of high quality, large crystalline LaRu2P2 for physical property measurement, in particular superconductivity-pressure LaRu2P2 relationship. We have applied flux growth method for the synthesis. KCl, Sn and Ga fluxes were used in our study. In this poster, we report the result of our investigation, especially the purity and crystal size of LaRu2P2 as a function of synthesis temperature, duration and type of flux.
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This research project is two-fold; the first half deals with the analysis of creative nonfiction as a genre, and the second half is my personal work within the genre incorporating the tragedies mentioned in the title. Creative nonfiction, in short, is nonfiction prose with attention paid to literary qualities, and the general works that are associated with this genre are essays and memoirs. My personal writing piece will be considered a hybrid of an essay and memoir, for it will be much too long to be considered an essay but much too short to be considered a memoir. The dates mentioned - October 25th, 1995 and 2006 - are the dates in which two separate tragedies occurred in the same railroad intersection in Fox River Grove, Illinois. October 25th, 1995 marks the death of seven students of Cary-Grove High School due to a bus being struck by an oncoming locomotive; October 25th, 2006 marks the death of a high school classmate of mine being struck by an oncoming locomotive. Articles, personal interviews, and my own relevant experiences from these two separate dates take a huge part in the creation of my creative nonfiction piece.
Are politicians who display contempt more successful at gaining support from their own party constituents? In this project, I will test that question with a laboratory experiment. Undergraduate participants will be shown a video clip of a politician of their own political party. Depending on group assignment, the politician will either display or not display contempt. Participants will then be asked a series of questions to measure the extent of ingroup loyalty to their political party. Mean scores of ingroup loyalty will be compared between the contemptuous and the non-contemptuous condition. The emotions signaled in the stimulus videos will be FACS coded. Further, a logistic regression will be run to determine whether subjects are less likely to support a politician that signals contempt, while controlling for variables such as political ideology, sex, race, and religiosity. The role of contempt in electoral politics has both political and psychological implications that will be addressed.
In a time when high partisanship in Washington D.C. stymies the flow of legislative productivity, I seek to determine the success of President Obama and the 111th Congress in addressing “controversial” policy topics. President Obama entered office with a wide range of goals, and also pledged to implement a “post-partisan” style of politics. Using policy topics from the Congressional Digest, a publication that has provided nonpartisan policy coverage since 1921, I seek to determine how successful President Obama and the 111th Congress were in crafting new public laws. In order to measure demand for controversial legislation, the number of topics covered by the Digest during Obama’s first two years in office, plus the number of topics from the previous four years that had not seen any legislative action, were counted. Statutes at Laerge are, then, consulted to learn if any new laws passed in the 111th Congress to address these controversial topics. Using the Congressional Digest agenda to determine legislative success is distinguished from earlier works that utilize “presidential box scores,” which are criticized for failing to check presidential success on meaningful legislative topics. This research on legislative gridlock is especially important during a time when many feel the partisanship between the two major parties in Congress has reached a crisis level.
To Sanction or Not to Sanction--That is the Question: A Study of Contemporary U.S.-Iranian Relations

Authors: Kathryn Green
Faculty Mentor: Christopher Jones
Department: Political Science
Research Category: Social Science, Humanities and Arts
Judging Time: 10:15-11:30AM

This study examines contemporary U.S.-Iranian foreign relations through an original case study. Specifically, the paper explores the Obama administration’s decision to secure a range of harsh sanctions against Iran following the release of an International Atomic Energy Agency (IAEA) report in February 2010. This stand constituted a reversal of the Obama administration’s initial commitment to engage Iran and was a direct result of the report’s finding that Iran was not cooperating fully with the IAEA to “confirm that all [its] nuclear material [were tied to] peaceful activities.” The Obama administration was also frustrated by Iran’s broader foreign policy, which challenged U.S. national interests related to Iraq, Israel, and Afghanistan. Were sanctions the best means to deal with a problematic Iran or were more appropriate options available to the Obama administration? This policy dilemma lies at the center of the February 2010 decision and continues to affect current relations between the United States and Iran. The case study will be written in a manner consistent with the style of the Pew Case Studies published by Georgetown University’s Institute for the Study of Diplomacy.
The research will investigate voter turnout rates in the countries of Southeast Asia. More specifically, the objective will be to determine variables that influence variation in voter turnout in the 30 year period from 1980 to 2010. Voting in many Southeast Asian countries is relatively new therefore it is necessary to limit the study to only the three most recent decades. Even more specifically, the research will test the attrition or drop off in voter turnout rates as the new democracies in the region mature. In addition, the research examines the pragmatic considerations such as the frequency of voting, the difficulty of voter registration, rest day voting, and mandatory voting laws. The first two considerations are believed to reduce voter turnout, while the later two ought to be associated with higher voter turnout, on average.
Determining the Variations in the Distribution of the Heating Degree Days Over a Period of 60 Years (1950-2010)

Authors: Sara Schultz & Joe Hooker
Faculty Mentor: David Changnon
Department: Meteorology
Research Category: Science, Technology, Engineering, Math
Judging Time: 11:30AM-12:45PM

Weather and climate play a vital role in everyday activities, especially when it impacts energy resources such as natural gas. Heating Degree Days (HDDs) and Cooling Degree Days (CDDs) are tools used to predict future demand on natural gas, which assists with any financial decisions confronting Chesapeake Energy Corporation. Various statistical analyses were employed using the HDD 60-year data set (1950-2010) to identify if any changes had occurred in the shoulder months for the U.S. The analyses were also conducted for three natural gas regions of the U.S., the west, east, and producing regions. The shoulder months (November and March) generally experienced a decrease in the number of HDDs across all three regions and the U.S. March’s decrease was found to be greater than November’s and statistically significant. The HDD peaks showed an earlier peak occurrence in the later period, with the west region showing the most prominent change.
Previous research has examined the spatiotemporal distribution of mortality attributable to thunderstorm hazards such as tornadoes, nontornadic winds, lightning, and floods. In this investigation, we expand upon these findings by updating the mortality analyses through 2010, as well as depicting historical national and regional analyses of mortality normalized by population for the respective spatial metrics. In general, prior investigations have illustrated declining deaths (both absolute and population normalized) for most hazards at the national level. However, examining these mortality rates and their trends from a national perspective, and prescribing those same rates at regional scales, can be deceptive since there are many regions and, therefore, populations that have relatively low risk to thunderstorm hazards. In extending the record, we explore if the established trends in mortality have stalled for the four convective hazards of tornadoes, winds, lightning, and floods. Analyses demonstrate how vulnerability and risk can commingle at much smaller, regional scales to reveal divergent results from those found nationally. Mortality and morbidity could be reduced by focusing mitigation efforts in areas that have relatively high absolute and normalized death rates.
Managing Risk Related to Weather Perils: Using Climatology to Calculate Risk

Authors: Thomas Polivka, Phillip Jagielo, Kristina Rohrbach & Shana Harris
Faculty Mentor: David Changnon
Department: Meteorology
Research Category: Science, Technology, Engineering, Math
Judging Time: 11:30AM-12:45PM

Insurance companies have to plan for multiple types of catastrophes. One growing area of interest is the effect of weather perils such as hail, wind, ice and snow storms on their insured losses. Allstate, one such company, is interested in understanding which areas east of the Rockies’ Front Range are susceptible to these weather perils. This project presents a summary of publications covering those weather perils that provide important weather risk background for the insurance industry. Also included is a data analysis of three inch or greater snowfalls for the same region of the U.S. The analysis defined maximums, minimums, averages, medians, modes, standard deviations, and coefficients of variation to help determine the volatility of snowfalls three inches or greater falling at a location within our region of interest. Features such as the Rocky and Appalachia Mountains, and the Great Lakes, influenced the spatial patterns of risk. With this knowledge, Allstate will be better able to understand which locations are at greater risk for weather perils to occur. Key Words: Insurance, weather perils, risk, volatility, risk management
Evan Reeves & Rebecca Shurgin

Quantitative 3D Analysis of Nanostructures by TEM Anaglyph Imaging Electron Microscopy

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<th>Evan Reeves &amp; Rebecca Shurgin</th>
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It is of increasing importance in the field of electron microscopy to be able to visualize the three dimensional (3D) structural and property information of samples. This 3D information can be hard or impossible to obtain from traditional two dimensional (2D) information. Many modern transmission electron microscopes (TEM) employ computerized tomography to form such 3D images. These systems are very costly and require a significant number of images to be taken and a great deal of processing time for accurate image rendering. Anaglyph imaging, the same process used to produce 3D images in older photographs and films, is an inexpensive starting point to acquire 3D images as a survey tool. Using the basic features of TEM at the Department of Physics along with easy to use software, stereoscopic images of nanostructures were successfully obtained during the last URAP cycle. For this year’s project, by using a well characterized crystalline sample as a calibration reference, we have attempted to focus on the quantitative aspects of the project; more specifically, making accurate depth measurements on the stereoscopic images. This would be complicated, if not impossible, to determine from a single 2D image.
The Large Hadron Collider (LHC) at CERN is currently the leader in high energy particle physics research. A Muon Collider (MC) has been proposed to complement the LHC. The MC is still in the developmental stage and one of problems that needs a solution is which materials to use to shield detectors from the decay products of the muon beams in the collider. The program G4beamline along with the database from Geant4 is used to check the viability of different materials. The neutron cross sections on Boron 10 and Boron 11 used in G4beamline is compared to the known cross sections. This information will verify aspects of the accuracy of the calculations being made when planning for a muon collider.
An investigation into microearthquake activity along buried faults in Northern Illinois was motivated by the Feb. 10, 2010, magnitude 3.8 earthquake near Lily Lake. A temporal analysis of digitally-recorded seismograms from the NIU seismic station was conducted in an attempt to identify foreshocks and aftershocks associated with the earthquake. Windows-based seismogram interpretation software (SCREAM, GEE), and plotting software DRUMPLOT were used to view recordings within different time intervals. Although seismogram review yielded no conclusive evidence of local microearthquake activity some suspect aftershocks were identified by amplitudes higher than “normal background noise” and studied further. A 2008 USGS magnetic anomaly survey, and Bouguer gravity data suggests the source area of the Feb. 10 earthquake contains a significant fault. Known geological structures, when coupled with spatial and temporal distribution of historical earthquakes, also support the idea of a steeply-dipping hidden fault in northeast Illinois. A new series of N-S oriented reflection surveys, new well logging and reprocessing of older seismic reflection data across this area would test this hypothesis. During this study a second event occurred on Aug. 31, 2010, near McCook, IL. A Mohr’s Circle stress analysis, assuming this event is an actual earthquake, suggests removal of rock within the quarry may have led to high differential stresses, triggering the earthquake. Prior rock stability analysis confirm joint and bedding-plane orientations form a rock-block structure on which failure by translational sliding or overturning could occur. Alternately, this event could have simply been a quarry blast.
Conducting research via the internet is an emergent methodology; however, each method encompasses its own opportunities and challenges. Most of the literature discusses using online research to distribute online surveys and observe online forums, blogs, and social media sites. We expand this methodology to include content analysis of website documents; specifically, documents related to HIV/AIDS stigma found on public health websites (PDFs, News Releases, Power Point Presentations, Microsoft Word Documents, Bulletins, etc.). The purpose of this poster presentation is to unravel the opportunities and challenges we have encountered and to compare our findings with other online research. Recently, scholars have argued that online research has provided researchers with a wealth of easily accessible, inexpensive data for analysis. Nonetheless, online research also presents complexities like biased samples and unreliable technology. We have encountered a wealth of available and easily accessible information, a comfortable environment in which to collect data, as well as a variety of helpful search tools to efficiently manage our time. We have also encountered problems retrieving information buried deep within the website, and maintenance issues such as error messages and waiting an extended amount of time to access certain PDFs. Despite the challenges website research may introduce, the opportunities seem to prevail.
The early 1990s was a rich period in feminist history. The changing dynamics of American culture at large and the beginnings of a colorful, in-your-face, girl-centered movement empowered girls across the United States and Europe to change the face of feminism. Paired with the musical revolution of the Riot Grrrl era, homemade, do-it-yourself media spread like wildfire, giving anyone with access to a copier and a Sharpie a newfound voice. These grassroots publications, most commonly in the form of zines, was, in many ways, a media revolution of unprecedented proportion and became central to the third wave of the feminist movement. Zines in the 1990s fostered a sense of community among young queer girls and encouraged readers to love their bodies and themselves; they served as a tool of activism and fat acceptance.
According to Lewis & Fremouw (2001), 1 out of every 5 college students has experienced at least one incident of physical abuse in a dating relationship. Verbal arguments have been shown to precede episodes of physical dating violence perpetration (Riggs and O’Leary, 1996). No known studies, however, have examined the content of these verbal arguments in dating violence situations. Research is needed to investigate the content of verbal arguments that precede episodes of physical dating violence perpetration in order to better understand how conflicts within dating relationships escalate to the point of physical violence. Therefore, the purpose of the current study was to qualitatively examine the content of verbal arguments preceding a recent episode of physical dating violence perpetration. Thirty-three undergraduate students from two regional universities completed in-depth interviews on the events preceding and following a recent episode of physical dating violence perpetration. Interviews were transcribed, coded, and analyzed to identify themes of verbal arguments preceding physical dating violence perpetration. Eighty-two percent of transcripts indicated that a verbal argument preceded participants’ most recent episode of physical dating violence perpetration. Preliminary analyses suggest that the verbal arguments preceding physical dating violence perpetration relate to a variety of topics including jealousy/suspicions of cheating, partner noncompliance, and substance use. Identified themes/subthemes of verbal arguments along with implications for future research will be presented.
The educational system has gone through many technological changes in the last few decades. This study tested the hypothesis that video game attributes (e.g., points, competition, pedagogical agents) affect learning and engagement in a computerized learning environment. Thirty-two undergraduate psychology students were randomly assigned into two computerized learning environments meant to teach aspects of scientific inquiry (e.g., the need for control groups). Both groups read, critiqued and identified flaws in short descriptions of research. One group used a program that simulates a video game environment while the other used a traditional computer-assisted instructional format. Both conditions were given a pre-test and post-test. An interaction between time of test and the game was found, indicating more learning in the game condition than the no-game condition. This suggests that games do increase learning, however there is no indication that they increase motivation and engagement.
People frequently read new articles on the web to come to learn about science and health issues that affect their lives. Health and science reporters are generally very careful in accurately presenting studies in these news stories. However, to attract readers, the editor creates an eye-catching title (headline) and first paragraph (lead) that may or may not be an accurate conclusion for the studies presented in the article. In this study, we wanted to test whether college students are inappropriately influenced by the title. We are giving undergraduates health and science news stories downloaded from the web. We manipulated whether the headline and lead were inconsistent (causal conclusion) or consistent (correlational conclusion) with the findings of a study reported in the article. The study was always clearly correlational. We also manipulated the presence of a plausible explanation for the relationship (explanation vs no explanation). With the article available, students were asked to write a 2 sentence summary of the main point of each article. Then students are asked, without the article present, to briefly describe the study reported and evaluate the study (e.g., strength of evidence, reasonableness of the conclusion). We are in the process of running participants. We expect that both the headline/lead and a plausible explanation will frame students’ interpretation of the study that they read. We will discuss possible explanations such as lack of knowledge of causal terms and lack of knowledge of what makes a causal conclusion.
Many students have difficulty constructing a quality written argument, especially when they must consider an audience. The difficulty may be that they do not possess an adequate schema for constructing an argument. In this study, we will manipulate two conditions: audience type (friendly, hostile, mixed) and instructions (tutor, no tutor) in order to determine the effect they have on number of rebuttals, explanations, counters, reasons, adaptations, appeals, and pejoratives. We hypothesize that participants in the tutor condition will perform better than those in the no tutor condition at all levels of audience type. We also hypothesize that students with a hostile audience will perform better than those with a friendly audience regardless of tutor or no tutor, and that participants with a mixed audience will include a more even range of argument elements than will those with friendly or hostile audiences.
It is estimated that 12,000 people are diagnosed with Dementia of Alzheimer’s Type (DAT) each day. It is difficult to overstate the devastating and costly effects this disease has on those who suffer as well as their caretakers and society as a whole. As the disease progresses, a defining symptom is the loss of spatial orientation, which is essential for sustaining normal daily activities. One source of information used to maintain spatial orientation is radial optical flow, which is used to estimate distance traveled. Deficits in processing radial optic flow have been observed in DAT. The current study investigates whether modification of commonly used behavioral technique would reveal distance estimation capacity in rats. The platform remained in a fixed location, whereas the rats were released at points around the perimeter of the apparatus that varied in distance to the platform. Equal numbers of male and female rats were given four trials a day to find a hidden platform in the water maze over a period of nine days. Rats learned the location of the platform and scaled their movement kinematics relative to the minimum distance between the start and platform locations. These novel observations provide a foundation for future studies investigating the neural basis of distance estimation, which may provide insight to the wandering symptoms associated with the progression of DAT.
A Qualitative Examination of Situational Risk Recognition Among Female Intimate Partner Violence Victims

Authors: Justin Yates, Andrew Sherrill & Nicole Wyngarden
Faculty Mentor: Kathryn Bell
Department: Psychology
Research Category: Social Science, Humanities and Arts
Judging Time: 9:00-10:15AM

Although preliminary findings suggest that intimate partner violence (IPV) victims can identify risk factors for future victimization (e.g. Harding & Helweg-Larsen, 2008), less is known about victims’ ability to identify situational factors signaling imminent risk of IPV victimization (i.e. situational risk recognition; Gidycz, McNamara, & Edwards, 2006). Witte and Kendra (2010) conducted the only known study of IPV situational risk recognition, which found female IPV victims were less able to identify situational IPV risk factors compared to female nonvictims. Additional research investigating victims’ situational risk recognition is needed, which may inform the development of IPV risk recognition prevention strategies. The purpose of the current study was to qualitatively investigate IPV victims’ identification of factors signaling imminent risk for IPV victimization. Fifty-one community IPV victims completed interviews as part of a larger study. Each participant was asked to discuss the degree to which she anticipated her partner’s physical aggression during her most recent IPV episode and describe situational factors influencing her anticipation of her partner’s physical aggression. Data collection is complete and analyses are ongoing. Transcribed interviews are being coded independently by three reviewers. Study goals are to determine 1) the extent to which participants anticipated IPV victimization, and 2) the characteristics of the situation that impacted anticipation of IPV victimization. Approximately 65% of women reported anticipating their partner’s aggression. Situational factors signaling imminent risk for IPV victimization preliminarily identified include partner’s demeanor, shared characteristics of current and past IPV episodes, and presence of verbal aggression preceding physical aggression.
This study relies on the paranoid social cognition model (Kramer, 1998) to explain psychological experiences during evaluative situations. According to the model, increased perceptions of evaluative scrutiny, distinctiveness, or uncertainty should yield more self-conscious concern, negative perceptions of others, and negative expectations of how others perceive the self (metaperceptions). Adult participants from an undergraduate participant pool are randomly assigned to expect either a low (20%), moderate (50%), or high (80%) rate of successful employment prior to participating in a simulated job interview in the lab. After completing the interview, they complete measures of general affect, metaperceptions, and views of the present and of future interview experiences. We expect that the higher chance of successful employment will lead to a decrease in paranoid cognition processing. The results from preliminary analysis will be presented.
The Role of College-Student Symptoms of Depression and Anxiety and Dispositional Anger on Their Interactions with a Distressed, Simulated Infant

Authors: Lauren Boddy
Faculty Mentor: David Bridgett
Department: Psychology
Research Category: Social Science, Humanities and Arts
Judging Time: 10:15-11:30AM

Previous research has shown that mothers of infants who were experiencing depression were more punitive and controlling toward their young children (Field, Sandberg, Garcia, Vega-Lahr, Goldstein, & Guy, 1985). Fewer studies have examined the effects of anger on parent-infant interactions. The goal of this project is to evaluate associations between college student symptoms of depression, anxiety, and dispositional anger and their interactions with a distressed, simulated infant. It was anticipated that participants rating themselves as being more prone to anger, having more symptoms of anxiety, or having more symptoms of depression will use less touch, distractions, and/or vocalizing behaviors, based on behavioral coding, in their attempts to calm the distressed-simulated infant. One-hundred participants were recruited from the Psychology 102 subject pool to participate in the current study. For their participation, all Psychology 102 participants received course credit, and at the end of each semester of data collection, were entered in a drawing for a chance of winning $75. All participants completed the Beck Depression Inventory-II, Beck Anxiety Inventory, and an anger measure and interacted with the distressed, infant-simulator for up to 32.5 minutes. Preliminary findings indicate that, consistent with hypotheses, a significant negative correlation exists between depression and vocalizing. In addition, a significant negative association exists between dispositional anger and participant vocalizing behaviors.
Emotional and cardiovascular responses to social isolation in an animal model

Authors: Loren Weese, Neal McNeal, Melissa Scotti, Brett Pinkepank, Suzanne Bates, Danielle Chandler, Parag Dave, Meagan LaRocca & Angela Grippo

Faculty Mentor: Angela Grippo
Department: Psychology
Research Category: Social Science, Humanities and Arts
Judging Time: 11:30AM-12:45PM

The social bonds formed through friendships and other relationships are important aspects of the human experience. The disruption of these bonds can have deleterious effects on mental and physical health. Prairie voles are a useful rodent model to study the beneficial effects of social support because they engage in similar social behaviors to humans, such as forming strong male-female bonds and mating monogamously. In this study, we tested the hypothesis that prairie voles who are separated from a partner would show increased levels of stress and depressive behaviors. Male and female prairie voles were first paired together for five days, followed by five days of either continued pairing or isolation. All animals were then exposed to a forced swim test to measure depressive behaviors, as well as cardiovascular and hormonal responses to stress. Regardless of sex, isolated animals displayed more immobility during the forced swim test than paired animals, indicative of a depression-related behavior. Also, compared to paired males, isolated male animals showed increased heart rate during the swim test. Following the swim test, regardless of sex, isolated animals displayed increased stress hormones compared to paired animals. These results indicate that disrupting an established social bond is stressful for both male and female prairie voles, and more specifically, produces depressive behaviors. Our findings suggest that the lack of social support may negatively affect emotional and physiological responses to stress in humans. Continued studies that focus on animal models will elucidate the underlying mechanisms of this relationship.
Degeneration of basal forebrain structures (i.e., medial septum) has been observed during the progression of Alzheimer’s Disease and is associated with impairments in spatial orientation or wandering behavior. Cholinergic deafferentation of the septohippocampal system in rats has been shown to selectively disrupt spatial orientation. The current study investigates whether spatial orientation is disrupted when the GABAergic component of the septohippocampal system is selectively removed. The food hoarding paradigm was used to characterize the spatial orientation deficits observed in rats with Sham or GAT1-SAP lesions. The food hoarding paradigm provides the opportunity to dissociate rats’ use of environmental and self-movement cues to return to a refuge. During cued and uncued testing, both groups of rats typically made direct returns to the refuge. These observations are consistent with spared use of proximal and distal environmental cues. During dark and new testing rats with GAT1-SAP lesions typically made circuitous returns to the refuge, consistent with impaired use of self-movement cues. These observations support a role for the GABAergic system in self-movement processing and suggest a role for this system in wandering behavior observed during the progression of Alzheimer’s Disease.
The disruption of social bonds in humans can significantly affect mental health, specifically mood and emotion. Environmental enrichment that stimulates the brain (such as cognitive activities, exercise) may be beneficial for individuals who suffer from the consequences of social isolation. The present study was designed to test the hypothesis that environmental stimulation can protect against the negative effects of social isolation using prairie voles as an animal model. This rodent displays social behaviors similar to humans, including forming long-term social bonds. Four groups of female prairie voles were studied: socially isolated + standard housing, socially isolated + enrichment, paired + standard housing, and paired + enrichment. Following four weeks of these experimental housing conditions, all animals were exposed to three behavioral stressors related to depression and anxiety: forced swim test (measures depressive behaviors), elevated plus maze (measures anxiety behaviors), and open field (measures exploratory behaviors). Environmental enrichment protected against depressive and anxiety behaviors in the isolated group during the forced swim test and elevated plus maze, but did not change the behaviors of the paired group. Enriched housing did not affect exploratory behavior in any of the groups during the open field test. These results indicate that environmental enrichment is protective against the adverse effects of social isolation in prairie voles, including behaviors related to both depression and anxiety. The findings suggest that stimulation from the environment can be helpful in preventing depression and anxiety symptoms that result from social isolation or loneliness in humans.
Gender Differences in Interpretation of Aggressive and Playful Behaviors

Adolescents frequently experience aggressive behaviors among their peers, however, they also experience behaviors which appear aggressive but are actually playful. While the majority of research has focused on physical aggression, the present study focused on relational aggression, which utilizes behaviors that seek to damage relationships as a way to inflict harm (e.g., exclusion, spreading rumors; Crick & Grotpeter, 1995). In addition, this study examined the playful counterparts of relationally aggressive behaviors which are superficially similar to relational aggression but are meant in jest (e.g., playful teasing, pretending to exclude a peer; Luckner, Marks, & Crick, 2008). Specifically, this study aimed to examine differences in the way males and females perceive and evaluate relational behaviors. Short video clips of either male or female adolescents demonstrating either playful or aggressive relational behaviors were developed and later shown to undergraduate research participants. Participants answered a series of questions in response to each clip evaluating how they perceived the behaviors, and how often the behaviors occur in real life. Preliminary analyses demonstrate significant gender differences in the evaluation of some of the clips; however, the way in which males and females evaluated each clip varied. For example, female participants were more likely to rate a clip of rumor spreading as more wrong and having occurred more often than males. Male participants, on the other hand, rated a clip of ignoring as more mean than females, but rated the situations’ rate of occurrence lower than females did. Further results and their implications will be discussed.
Katherine Siler

_A Meta-Analysis of Effortful Control and Child Externalizing Problems_

Authors: Katherine Siler, Elizabeth Houghland & Melissa Naso
Faculty Mentor: David Bridgett
Department: Psychology
Research Category: Social Science, Humanities and Arts
Judging Time: 10:15-11:30AM

Effortful control (EC) encompasses the ability to inhibit a dominant response in favor of a subdominant response (Rothbart, 1989) and is important for the regulation of emotion and behavior. Research has indicated the significance of EC for child externalizing problems (EXT). Although numerous studies have examined this association, the effect sizes (ES) have not been synthesized, which would enable an examination of methodological questions that may moderate findings. The goal of this meta-analysis was to summarize existing work examining the effects of children’s EC on EXT outcomes. We predicted that overall effects between EC and EXT would be negative and findings would be moderated by various methodological differences. A literature search was conducted using relevant databases (i.e., PsycInfo and MedLine). Combinations of broad search terms of EC and EXT yielded 574 potential studies, 104 met inclusion criteria. Studies with multiple ES contributed one effect to distributions; for studies with multiple effects, a within-study mean effect was calculated. A random effects statistical approach was adopted. Consistent with expectations, better EC was consistently related to lower EXT. Results indicated that the mean ES (r = -0.31 ) fell between a medium and large effect. Unexpectedly, the homogeneity test was not significant, indicating the absence of potential moderators. The findings reported in this study summarize a large body of published research. Based on these findings the strength of the effect does not appear to be moderated by the method used to measure EC. The implications of these findings will be discussed.
During adolescence, several aspects of identity develop. This study examined adolescents’ ethnic identity through three research questions. First, is there a correlation between adolescents’ ethnic identity and loneliness? Second, is there a correlation between adolescents’ ethnic identity and primary caregivers’ ethnic identity? Finally, is there a correlation between adolescents’ ethnic identity and the ethnicity of their friends? Analyses were conducted on a previously collected data set. Questionnaires were completed by 8th graders and their primary caregivers. The mean age was 13.47 years, and 42% of the adolescents were males. Eighty-six percent of the caregivers were mothers. Ethnic identity was measured using two scales (Phinney, 1992). Affirmation/belonging had 5 items (Cronbach’s alpha = 0.76). Exploration had a total of 7 items (Cronbach’s alpha = 0.77). Loneliness had 16 items (Loneliness Scale Asher & Wheeler, 1985; Cronbach’s alpha = .93). Adolescents were asked to report the ethnicity of their three closest, same-gender friends. The correlation between ethnic identity affirmation/belonging and loneliness (r = -.17, p = ns) was non-significant. The correlation between parent’s ethnic identity affirmation/belonging and adolescents’ ethnicity identity affirmation/belonging was r = .42, p < .001. The correlation between parent exploration and adolescent exploration was r = .27, p < .012. The correlation between parent exploration and adolescent affirmation/belonging was r = .30, p < .005. The correlation between parent affirmation/belonging and adolescent exploration was r = .27, p < .013. Higher levels of parental ethnic identity were related to higher levels of adolescent ethnic identity. The analyses of the relationship between adolescents’ ethnic identity and the ethnicity of three best friends are in progress.
Prior work has noted the importance of parenting for supporting the development of emotion regulation in infants/children. However, studies have not investigated the role of parental executive function (EF) in facilitating caregiving behaviors that support the emergence of emotional regulation in children. The goal of this study was to examine the influence of adult EF on behavioral responses to infant distress. The current investigation used a novel methodological approach, the infant simulator paradigm (ISIM), to evaluate the effects of participant EF on soothing behavior during interactions with an inconsolable, simulated infant. Given the importance of EF in regulation of behavior, it was predicted that participants with lower EF would engage in fewer soothing behaviors (i.e., sensitive vocalizations, soothing touch, distracting, and caretaking efforts) than participants with higher EF.

Non-parent college students participated in a laboratory interaction with the ISIM. Participants also completed the Wisconsin Card Sorting Task, and two Stroop-like tasks which assessed aspects of EF. Following a demonstration, participants interacted with the inconsolable ISIM. Interactions were video/audio recorded and later coded for targeted soothing behaviors. Kappa’s for each behavioral code ranged from .70 to .92 (M = .78), indicating that behaviors were elicited and reliably coded from non-parents interactions with the ISIM.

Regression analyses controlling for gender and prior caregiving experience indicated that greater EF difficulties predicted less frequent use of soothing vocalizations. A trend in the expected direction was also found such that greater difficulties with inhibitory control were associated with fewer distraction attempts.
Wandering behavior is characteristic of the progression of Dementia of the Alzheimer’s Type (DAT). The types of deficits mediating wandering are not clearly characterized. Use of environmental cues to maintain spatial orientation has been a focus of previous research. The current set of experiments examines the role of self-movement cues in human spatial orientation in a manipulatory scale version of the Morris water maze. Blindfolded participants searched for Velcro tape hidden within a tabletop bead maze. Experiment 1 examined place training and matching-to-place testing. Participant performance significantly improved across place training trials, as well as in matching-to-place testing. Although these results indicate self-movement cues are sufficient to guide performance on an analogue of the water maze task, the nature of the representation remains to be determined. Experiment 2 investigated performance while participants shifted location around the table and searched for the Velcro tape in either an absolute or relative position. Performance significantly improved across trials when participants searched for Velcro that remained in an absolute position. In contrast, little change in performance was observed over trials when participants searched for Velcro in a constant relative location. Restricting access to self-movement cues at the manipulatory scale appears to bias an absolute representation. These results prompt future research investigating the effects of cue access on the nature of the representation encoded and may provide insight to the spatial orientation deficits seen during the progression of DAT.
Putting effort into learning: Does evaluative focus and motivational intervention play a key role in performance?

Authors: Rebecca Kelley, Anne Britt & Amanda Durik
Faculty Mentor: Anne Britt & Amanda Durik
Department: Psychology
Research Category: Social Science, Humanities and Arts
Judging Time: 10:15-11:30AM

This study will examine two factors related to performance in a learning environment. We are examining the relationship between evaluative focus (i.e. whether participants feel personally evaluated or not) and a form of “motivational intervention” (i.e. whether participants receive information about how much they initially know about the task before the learning opportunity) on learning. According to prior research, it is expected that participants who receive evaluative focus will perform better than those who do not (White, et. al, 1977). It is further expected that individuals who receive the “motivational intervention” on a task will exert more effort leading to better task performance. However, these performance gains may also have consequences for other variables such as task interest and perceived competence. Therefore, we will also measure perceived competence, usefulness/value, interest/enjoyment, effort anxiety, evaluation apprehension, and self-efficacy. In general, we hope that this study will inform instructors how to present tasks in order to maximize both performance and motivation.
Previous research has shown sex differences in spatial learning and memory tasks. Interestingly, the effects of exposure to stress on spatial learning are also sex specific (McFadden et al., 2011). In our laboratory, we have used the water maze task to assess spatial memory after exposure to chronic unpredictable stress (CUS). This task is complex and depends upon many components, including the motivation to locate the target platform and climb out of the water. Water temperature may alter this motivational component of the task, since colder temperatures have been found to improve performance in male rats (Sandi et al., 1997). Therefore, the current study investigated whether CUS exposure influenced performance in the water maze in a sex-dependent manner at 2 different water temperatures or motivational states. Male and female rats were exposed to 10 days of unpredictable stressors and then trained for 5 consecutive days in the Morris Water Maze in either cold water (19oC) or warm water (25oC). Male rats performed better than females overall, but the effects of sex were greatest in the rats trained in warm water. In the cold water, significant effects of stress were observed, and again females showed better performance as a result of CUS exposure. Thus, water temperature was found to significantly influence performance, as related to the effects of both sex and prior CUS exposure. These findings suggest that environmental manipulations may affect male and female motivational states and performance differently, which may have implications for goal-oriented situations.
This study uses a short-term, prospective design to examine the relationships among test anxiety, test performance, students’ standards for success, and students’ test self-efficacy (i.e., performance expectancies). College freshmen (N = 171) enrolled in introductory psychology courses during their first semester of college completed Time 1 questionnaires about one week before their first in-class exam. One hundred and twenty eight participants (75% of Time 1 participants) completed Time 2 questionnaires up to one week after learning the results of their test scores and about two weeks prior to their second class exam. Revised Test Anxiety Scale (RTAS) Irrelevant Thinking scale scores predicted second exam scores, even after controlling for first exam scores. Exam scores predicted subsequent standards, even after controlling for prior standards. However, exam scores also predicted increases in self-efficacy. This study supports past research in so far as it provides evidence that test anxiety predicts changes in test performance but not that test performance predicts changes in test anxiety. The relationship between exam performance and self-efficacy, which has not been the focus in past research, is also discussed. Finally, the relationship between test anxiety and the discrepancy between students’ standards for success and students’ test self-efficacy is explored, and the implications are discussed.
The current study was designed to examine the link between hypermasculinity and aggression toward an ostensible opponent in response to provocation. Hypermasculinity refers to strong adherence to traditional male gender roles often resulting in aggression toward those who violate gender role expectations. To test this, the participants competed against an ostensible opponent in a computerized reaction time game. Gender of the ostensible opponent was randomly assigned and manipulated through the use of pronouns during interactions with participants. Prior to each trial of the game, the level of noise burst to be received by the opponent was chosen by selecting between 1 and 10 on the keyboard. The slower player on a given trial would receive both the noise burst chosen by the opponent (via headphones) and visual feedback regarding the corresponding noise burst number. The winner of a trial did not hear the noise burst but did receive visual feedback regarding the noise that would have occurred. Wins and losses, in addition to the noise bursts from the ostensible opponent, were preprogrammed by the researcher such that participants received gradual increases in noise (provocation) across the 30 trials. Participants’ aggression was measured by the noise bursts they selected for their opponent on each trial. We hypothesized that males who scored high on hypermasculinity (as compared with low scorers) would aggress more toward opponents who violate stereotypical gender roles: provocative female opponents and male opponents who they rank above a zero on the Kinsey sexuality scale.
It was our aim to test several things here involving goal setting and performance on given tasks. We wished to ascertain whether or not a social context (either working alone on a task or with someone else) would have any effect on task performance. Coupled with social context we also manipulated the difficulty of the goal putting people into an easy and a difficult goal setting to see if that would have any effect. We looked at two dependent variables, one to ensure people perceived their goal as difficult or not and the other measuring actual performance on our task. All the participants were from a large Midwestern university looking to get credit in a class. Once in the lab we had them perform a task where they were given the same adjective and had to create a list of nouns that could be described by that adjective. Participants were instructed to write as many as they could in one minute. Six trials in total were used. We were unable to demonstrate a significant difference for social context or the interaction of social context and goal difficulty, but we were able to show a significant difference when it came to actual goal difficulty where more difficult goals led to higher performance. Thus we believe that goal setting while important when we consider the difficulty of the task may not be so important when we compare it to the people surrounding us when we attempt to accomplish that goal.
The purpose of this study is to examine gender differences in the impact of sexual fantasies and behaviors on attitudes about sadomasochism (SM). Current research is inconsistent with respect to sex differences in fantasy and participation in risky sexual behavior. Moreover, there is very little research on how this applies to SM, in particular.

This study proposes three hypotheses: (a) men will endorse more SM related fantasies than will women (consistent with prior research), (b) men will endorse more SM related behaviors than will women (due to reporting bias), and (c) the relationship between SM fantasies and behaviors and SM attitudes will be stronger for men than for women (due primarily to the social double-standard regarding male vs. female sexuality, as well as possible restriction of range regarding women’s SM-related fantasies and behaviors).

Participants were recruited through introductory to psychology and upper-level psychology courses. Participants will be asked to complete a web-based questionnaire regarding (a) their sexual behaviors, (b) their sexual fantasies, (c) their attitudes towards sadomasochism, (d) their attitudes towards sex in general, and (e) demographic information. Data will be analyzed using t-tests (for Hypotheses a and b) and multiple regression (for Hypothesis c).

If results align with hypotheses, men will report significantly greater numbers of SM-related fantasies and behaviors than will women. In addition, gender will interact with number of SM-related fantasies and behaviors such that fantasies and behaviors will predict SM attitudes more strongly in men than in women.
Students face many obstacles when trying to understand the information from text. This task becomes increasing more complex when reading from the Web. In this case, the reader has to integrate related information from many different perspectives and sources. When learning about a historical topic from multiple documents, some information will be controversial and uncertain. In such situations, there is an important temporal order to the events. If the task encourages attention to the controversial events and their causes prior to understanding the temporal order, then they may never create a coherent model of the situation. In this study, we manipulated the initial pre-reading instructions for a multiple source evidence-based argumentation task. All participants were asked to write an argument. However, some participants were first asked to create a timeline of the significant events prior to being given the argument instructions or were given an experimenter-constructed timeline. We hypothesize that participants who generate the timeline will have a more accurate and complete understanding of the situation. We are currently running participants and have begun analyzing their essays for the number of correct concepts, correct inferences, and misconceptions. We will then submit the results to a one-factor between subject ANOVA for each of these measures.
Brittney Wyatt, Katie Laws & Amy Kaitschuck

Development of Infant Temperament from 4 to 12 Months & Toddler Use of Language at 24 Months

Authors: Brittney Wyatt, Amy Kaitschuck & Katie Laws
Faculty Mentor: David Bridgett
Department: Psychology
Research Category: Social Science, Humanities and Arts
Judging Time: 9:00-10:15AM

Prior research has examined the role of attention-based temperament constructs on language development and found that such measures, obtained during infancy, were predictive of language development at 21 months of age (e.g., Salley & Dixon, 2007). Researchers have also reported findings wherein early attention processes support skills important for later language (Gartstein et al., 2008). However, studies have not yet examined the effects of changes in infant attention processes or in early vocalizations across infancy on toddler language use. The current study employs latent growth modeling to examine the effects of developing duration of orienting, perceptual sensitivity, and vocal reactivity on toddler use of language at 24 months. Controlling for factors that could influence temperament and/or language we predicted that higher initial infant perceptual sensitivity, duration of orienting, and vocal reactivity and higher slopes of these infant temperament attributes would be associated with greater language use at 24 months of age. Families were recruited via birth announcements located in newspapers and on hospital websites in four states. Mothers completed a demographics form and a measure of depressive symptoms during the initial assessment 4 months post-partum. When children were 4, 6, 8, 10, and 12 months old, mothers completed the Infant Behavior Questionnaire-Revised (IBQ-R; Gartstein & Rothbart, 2003). Language was assessed using the Child Behavior Checklist’s (CBCL) Language Development Survey (LDS; Achenbach & Rescorla, 2000). As predicted, higher intercepts and slopes of infant duration of orienting, perceptual sensitivity, and vocal reactivity were associated with better language at 24 months of age.
Hormones produced in the body may be important in ameliorating the effects of traumatic stress. Previous research has shown that the concentration of several hormones, such as cortisol, dehydroepiandrosterone (DHEA) and DHEA-sulfated (DHEAS) in a given individual who has been exposed to a traumatic event may be indicative of the likelihood that the individual will develop posttraumatic stress disorder (PTSD). Cortisol is a hormone produced in response to stress or a perceived threat and when produced in excess may be damaging to tissues in the brain. In contrast, DHEA acts as a buffer when cortisol is produced in excess. Studies have indicated support for DHEA and DHEAS being important natural anti-depressants (Maninger, et al., 2010). Therefore, the current study assessed whether higher levels of cortisol in comparison to DHEA and DHEAS could indicate predisposition toward future mental illness following an emotionally stressful event.

Female students from Northern Illinois University provided salivary samples before and following a writing task intended to induce emotional stress. The samples were analyzed for levels of cortisol, DHEA, and DHEAS. Should our hypothesis be supported, future steps may be taken to be proactive in the treatment of individuals who are at risk for PTSD by testing for the levels of these hormones in his/her saliva. This would potentially allow for more successful interventions, a shorter treatment period, as well as easier detection of possible relapse.
What are Themed Learning Communities?

Themed Learning Communities (TLCs) are a group of two or three courses taken the same semester and consisting of the same group of students. A TLC focuses on a common theme across several different classes and disciplines, such as humanities and sciences. This gives students the opportunity to engage deeply with a course theme, connect learning across courses in collaborative and active ways, develop relationships with peers/faculty, and ease the transition into college. Faculty members create assignments that require students to draw on concepts from the other TLC class(es) for an enhanced, integrative learning experience.

How do I sign up for a TLC class block?

When you attend Orientation this summer, let your academic advisor know that you want to sign up for a TLC. Sign up early as TLC class sections are limited to 25 students and fill up quickly!

Where can I get more information about TLCs?

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Join a TLC in Fall 2011 for a great classroom experience!

To see all of the TLCs available for Fall semester, please visit www.niu.edu/engagedlearning
The current study investigated reports of bullying behavior and the agreement across parent, teacher, and student perceptions of that behavior. A sample of 178 students in grades first through eighth were involved in the study. Specifically, 137 students in third through eighth grade were surveyed. Additionally, 138 students’ parents completed surveys and the 8 of the students’ teachers were surveyed.
The perception of utility in tasks has been shown to facilitate performance and interest. In previous literature, an interaction between utility and perceived competence was observed. Participants with low perceived competence performed better when asked to write a short essay on the utility of the activity they were about to engage in. However, this effect did not occur in high-competence individuals. A vast body of research shows that the presence of specific, difficult goals also improves performance. It is possible that giving high-perceived competence participants a difficult goal will increase the challenge in the situation and facilitate performance and interest. This study is a replication and extension of work by Hulleman and colleagues and is a 2 (low versus high perceived competence) x 2 (no goal versus goal) x 2 (no utility versus utility). Participants will be taught a new 2-digit multiplication technique and then assigned to one of the four conditions. The goal assigned will be based off of a set of practice problems. Utility will be manipulated when participants are asked to write a short essay about the usefulness of the new math technique. A 3-way interaction is predicted between utility, perceived competence, and goal level on both performance and interest. These effects will be inspected through the use of a 3-factor ANOVA. Correlations between boredom and the primary variables will also be assessed.
Posttraumatic distress and the presence of post-traumatic growth following a mass shooting: The role of experiential avoidance

Authors: Courtney Moss
Faculty Mentor: Holly Orcutt
Department: Psychology
Research Category: Social Science, Humanities and Arts
Judging Time: 10:15-11:30AM

A growing body of research has investigated the presence of post traumatic stress symptoms (PTSS) and post traumatic growth (PTG) as they relate to experiential avoidance (EA). PTG, or an experience of positive adjustment resulting from a traumatic life event, has received recent attention in the literature as a potential buffer from negative psychosocial outcomes. Recent studies have suggested that people reporting low levels of EA (defined as an unwillingness to be in contact with distressing thoughts and feelings) evidence greater PTG, even when experiencing greater PTSS. The current study will attempt to explore how EA, PTSS, and level of exposure to a potentially traumatic event influence PTG. Data was collected from a prospective study examining the reactions of female NIU students following the NIU mass shooting (N = 672) who completed an online survey follow-up approximately 27 days after the event. After the shooting, approximately 50% of women reported clinically significant levels of PTSS. Preliminary analysis showed that all variables (PTG, EA, and PTSS) were positively correlated. A hierarchical linear regression with PTG as the outcome indicated that exposure to the shooting, as well as PTSS and EA independently predicted post traumatic growth. There were no interaction effects. Implications of these findings for future research and clinical intervention will be discussed.
This research project investigates the relationships between international business practices (mostly in relation to U.S. corporations) and economic embargoes, specifically examining these activities on the island of Cyprus and its contentious and divided environment. For decades, the island of Cyprus has been in an ethnic dispute between the Greek and Turkish communities. The conflict has culminated in a full division between the Republic of Cyprus and a break-away state of Turkish Cypriots. As of today, Turkey is the only nation to recognize the Turkish Republic of Northern Cyprus and an international embargo has existed to prevent businesses from legally trading with the Turkish side of the island. In the past several years, as the Turkish position has gained traction and the division has persisted, international businesses have been appearing in the non-recognized state as recognized franchise, corporate-owned or even fake versions of international corporations (Cyprus Mail 2009). How the Republic of Cyprus and international businesses deal with these copyright and embargo violations creates a challenge of just how legitimate of a government the Northern region holds. But the new existence of businesses ignoring the embargo creates a question of the effectiveness of the decades-old international policy (Cyprus Mail 2010). The project mainly analyzes how corporations treat the embargo, how the Republic of Cyprus treats violations, and if the embargo is doing its intended job of economically crippling the Turkish Cypriots.
The Affects of 9/11 on Chicago

Authors: Mark Wojdyla
Faculty Mentor: Beatrix Hoffman
Department: History
Research Category: Social Science, Humanities and Arts
Judging Time: 12:45-1:30PM

On September 11, 2001 the United States of America changed forever. The terrorist attacks that were brought upon the land of the free shook the foundations of the nation. Although the terrorist attacks on America in 2001 primarily targeted New York City and Washington, D.C., the city of Chicago endured significant indirect effects as well. With a skyline larger than New York City’s, an immense business community, and a large population, Chicago became a city of financial and emotional instability in the aftermath of 9/11. Through an analysis of dozens of manuscripts, several magazine and newspaper articles, and many personal interviews, this study calls attention to the psychological frailty of the city, and the economic suffering of many of its businesses and charities. This study sheds light on the indirect effects of the terrorist attacks and is critical to the full understanding of September 11, 2001.
History 399H, Rebel Music, began as a small honors seminar, but quickly developed into a research project that extended beyond both history and music into the fields of sociology, anthropology, and ethnomusicology. Our research consisted of a two-stage methodology: collective exploration and reasoning during class discussions and independent primary and secondary research. This culminated in thesis papers and formal presentations in small conference setting. During class we debated numerous academic articles, detailing historical ethnomusicology, Korean p’ansori, African-American spirituals, Japanese street singing, and Reggae to name a few. Also, we diversified our collective research by examining specific, self-appointed topics regarding rebel music: bagpipe music’s role in Highlander cultural identity, Norwegian nationalism and music during WWII, Israeli nationalist music, Polish solidarity protest songs, and self-censorship in Russian rock clubs. These efforts grew into a dynamic body of progressive research, exploring the methods employed through creative musical expression when a people, nation, or culture is subjugated or oppressed. More specifically, and perhaps more shockingly, through collective and independent research, we noted specific patterns and repetitions consistent throughout numerous cultures despite differences in time periods, locales, or customs. After examining the full diversity of literature suggested by our professor, Dr. Taylor Atkins, discussing and debating the sources, and conducting our own independent research, we believe the group/individual methodology we employed was extremely effective and strongly suggest to fellow academics, both students and professors, to consider these methods as preparatory research for any major writing project.
Traditional flow direction-based algorithm for extracting streams from digital elevation model (DEM) data often fails to accurately reflect the spatial variation in surface dissection (e.g., O’Callaghan and Mark, 1984; Tarboton and Ames, 2001). Such variations can be captured by morphology-based algorithm (e.g., Luo and Stepinski, 2008) that uses appropriate terrain attribute to find stream as parts of surface having concave upward morphology. Terrain curvature is most often used as such attribute. This paper demonstrates that the new and simpler terrain openness (Yokoyama et al., 2002), defined as the average of zenith angles along 8 compass directions within a specified neighborhood, can be used in lieu of curvature to achieve equally accurate stream extraction. The openness is easier to calculate and size of the neighborhood provides a natural built-in length scale (in number of cells) that offers a new way to compensate for the coarse resolution DEM. Our results indicates that in general finer resolution DEM will generate more detailed streams. However, the coarser resolution DEM can be at least partially compensated by using smaller neighborhood length scale in calculating terrain openness. In other words, similar stream pattern can be extracted from different resolution DEMs as long as the products of DEM resolution and the length scale are similar.
Animal home range size and movement patterns are important for understanding ecology and developing species level conservation strategies. The traditional approach to studying spatial ecology is radio-telemetry. This technique involves surgically implanting or externally attaching a radio-transmitter to an animal and tracking it over time. Although this method can produce detailed information on the individual, the data generated may be biased as radio-transmitters can reduce survivorship and reproductive success, and alter behavior and mobility. Due to the high per-capita effort and mortality risks associated with these methods, radio-telemetry studies generally include a small subset of a population (10-30 individuals), of which detailed individual spatial patterns are extended to make inferences about the population.

Here we present a novel approach to studying population level spatial ecology using mark-recapture methodology and Butler’s gartersnake as a model organism. Mark-recapture is a field method designed for estimating population parameters (e.g., survivorship, abundance, and population growth) but is used here to estimate home range size, movement patterns, and capture densities. This unique approach avoids many of the potential biases inherent to radio-telemetry snake studies and permits direct analysis of population (rather than individual) spatial patterns.
Canada’s Lake Superior Provincial Park provides a relatively undisturbed boreal/deciduous forest ecotone where a shift to deciduous forest from boreal forest communities is expected to occur given current climate models. The hardwood deciduous species are modeled to expand their territory northward into the current boreal forest. This poster discusses two of the resident boreal species, balsam fir (Abies balsamea) and white spruce (Picea glauca), and their ability to compete in these new transition zones. In our study sites we measured photosynthetic rates of these two species by measuring carbon dioxide assimilation at specified light levels (photosynthetic light curves). This data was collected utilizing Li-Cor’s LI-6400 Portable Photosynthesis System with a 6400-22 Opaque Conifer Chamber and RGB Light Source. We compare both white spruce and balsam fir living in deciduous versus boreal forests, as well as comparisons between the species. Each species is further analyzed by developmental stage: seedlings, saplings, and adults. Light response curves for each stage are evaluated to extract dark respiration rates, light-saturated photosynthesis rates, quantum efficiency values, and water use efficiency. Comparisons across forest types show that white spruce is more photosynthetically active in the deciduous forest than in the boreal forest, while balsam fir shows no significant difference. Comparisons across species show that white spruce is more active than balsam fir in the deciduous forest, while there is no significant difference between the two in the boreal forest.
Our group is implementing a digital signal processor for an earth-orbit CH4-Carbon Isotope Laser Spectrometer. The CH4-CILS instrument has been designed to detect methane (CH4) in Earth’s atmosphere. Subsequently, NASA has proposed to deploy the instrument on the Mars Science Laboratory; methane is typically an indicator of extant carbon-based organisms. Our processor implements a data compression / analysis algorithm that compresses large data sets into small equations, thus saving bandwidth when transmitting the data, while preserving laser absorption information. Our processor will be implemented using a Field Programmable Gate Array (FPGA), a type of software defined hardware, and programmed using the Verilog hardware description language (HDL). FPGAs are typically employed in space applications as these components are hardened against the effects of ionizing radiation & electromagnetic radiation beyond Earth’s protective magnetosphere.
The goal of this project is to generate a workable Matlab model to simulate the dynamics of an AC 3-pole contactor. The model simultaneously solves the electromagnetic and mechanical equations that define the contactor’s dynamic responses. This model will be used to optimize contactors and will be greatly beneficial to the company sponsoring this project. It was decided to use the Simulink toolbox within Matlab to create this model, as it would best handle the equations required. The Matlab software was interfaced with this Simulink model in order to efficiently run trials on eleven variables in order to find the optimum output.
In today’s society the way in which people retrieve information is becoming faster and easier. The purpose of our design, which we called SmartClock, will be based on this principal. SmartClock is an intelligent and interactive clock that is meant to be used in one’s home. It is able to receive verbal input, interpret it and respond with an audio output. Information that is available to the user as an audio output consists of time, and possibly date and temperature. This task will be accomplished via speakers, microphones, temperature sensor and the main unit which consists of a microcontroller and speech recognition programming. With SmartClock only one unit will be sufficient to spread the information throughout the household. This concept will be made possible by using Zigbee wireless technology. Attached to our different inputs (temperature sensor and microphone) and output device (speaker) will be an Xbee device. Xbee is a cost effective low power wireless transceiver with a relatively fast wake up time. By using this technology we are able to send and receive information wirelessly, this allows our main unit to spread information over a wide area. With this, speakers and microphones, accompanied with a Xbee unit can be mounted wherever a user desires in order to communicate with SmartClock. These extended access points make SmartClock unique and is what separates our design from other interactive clocks.
Our project involves a Rockford, IL based hydraulic component manufacturer SPX and their desire to reduce the time it takes to set up their lathe machines to create different parts. Reducing set up time will keep SPX competitive in the marketplace by reducing the length of time it takes for a customer to receive their order. Happy customers lead to returning customers. The strategies that will be used include utilizing clustering algorithms, and Lean manufacturing principles. Clustering algorithms will be beneficial in creating part families; a collection of parts grouped together based on shared tools required to manufacture them. Once part families are set up, the planner can take them into account by scheduling production of related parts to occur on the same machine to minimize the number of tools required to be removed. Lean manufacturing will help SPX’s effort by eliminating unnecessary actions, decreasing distance travelled, and organizing/labeling tools for quicker retrieval. Machine setups will be documented, broken down into steps, and timed. Once reviewed, these set ups will determine where improvements can be made and what can be eliminated. Less travel distance will provide smaller amounts of time used to gather tools and materials. Time will also be conserved if tooling storage and tool locations were labeled, as well as reduce the time required to gather tools and materials.
Vibration sensors are prolific in many engineering applications. In the disciplines of electrical engineering and mechanical engineering, these sensors measure harmonic signals in structural analysis, security, human gait analysis, seismology and several other applications. The typical vibration sensor is constructed from piezoelectric materials. These piezoelectric sensors employ a fixed lattice structure. As the lattice shifts under mechanical strain, a voltage is induced, thus forcing a change in output. Vibration sensors are mass produced, are fairly sensitive, but not always reliable and inexpensive. We propose an alternate and competitive vibration sensor consisting of optoelectronic devices that work in the infrared waveband. By using various software, the sensor response can be modeled. Subjecting the sensor to varying stimulus, the response may be observed. The intent is to develop a sensor that commercially feasible.
Motorola Solutions is a world leader in radio frequency devices. The focus of their product line is two-way radios, RFID devices, and other communication products. Typical customers of these products include municipalities, local and federal governments, and public safety organizations. This project takes place on Value Stream 5 at Motorola Solution’s headquarters, in Schaumburg, Illinois. The production line (or Value Stream 5) produces printed circuit boards that are used in the assembly of a variety of Motorola Solutions products.

Value Stream 5 consists of three main processes; solder paste application, component placement, and a heating operation. Four Surface Mount Technology machines make up the component placement processes. Component placement is deemed high priority, as the changeover time and component outages are affecting the line negatively.

The goal of this project is to improve the efficiency of the processes that make up Value Stream 5. This will be done through the use of various Industrial Engineering tools, such as Lean/kaizen events, setup time reduction, cycle time reduction, and scheduling. The team believes that through the use of the tools and knowledge gained through the Industrial and Systems Engineering curriculum, at Northern Illinois University, that the overall process efficiency of Value Stream 5 at Motorola Solutions can be improved significantly.
The Tempering Effects of Surface Grinding

Authors: Joseph Vierthaler
Faculty Mentor: Alan Swiglo & Federico Sciammarella
Department: Mechanical Engineering
Research Category: Science, Technology, Engineering, Math
Judging Time: 11:30AM-12:45PM

This project investigates the detrimental effects surface tempering through grinding. Metals, like steel, have a complex composition depending on cooling rate of the molten metal. These composite sections or grain structure can not be seen on a macroscopic scale, but are evident with the use of an etching process and a microscope. As with any deburring process, when surface grinding takes place, the temperature of the target material increases along with the frictional forces. As a result of this, the microscopic grain structure of the metal changes. This can lead to changes in strength of the metal and can even effect it dimensionally. As the manufacturing market pushes towards microscopic accuracy, the need for quantifiable surface tempering will become a necessity.
The Engineers Without Borders (EWB) chapter at NIU is partnering with students in the Tanzania study abroad program in a five-year project to provide solar energy for a school in Nyegina Village, Musoma, Tanzania. During the Summer of 2010, students designed and constructed a solar energy system for five classrooms at the Nyegina Secondary School. Three systems were built which supports two photovoltaic cells (solar panels) each. These solar panels will provide the classrooms with light during power outages due to an unreliable electrical grid. The solar energy system installed will reduce the school’s operating costs of energy, thus maintaining a low cost of tuition. The result of this will enable more students to afford schooling. Future projects consist of assessing the feasibility of solar power for sourcing, auxiliary electrical supply for classrooms and water heaters for the dormitory and staff houses. The Solar Energy Project supports the strategic goals and objectives of the school by providing a sustainable energy system for the new girl’s dormitory. The project supports NIU’s strategic imperatives of interdisciplinary education and global outreach by involving students from two colleges (Liberal Arts and Sciences and Engineering and Engineering Technology) working on a sustainable energy project in Tanzania. It also is integrated in the NGO Studies initiative in the university’s strategic plan.
The purpose of our design is to create a smart network made up of multiple nodes. These nodes are used to collect data about the surrounding environment and the nodes will communicate with one another to manipulate various room conditions, mainly temperature, to the desired settings of the user. All the sensors will be wireless and implemented with Bluetooth technology, due to its practicality of application. The network will be able to collect certain data, analyze it, and control the outputs of independent parameters based on the present input data (current room temperature). The process of our design plan will be outlined in our proposal by explaining our reasoning for choosing our specific design components, as well as mentioning the plan of action we are taking to design and build our network. Our project timeline, costs, and funding sources will also be discussed.
The objective of this research project is to develop mathematical models to aid decision makers in the fabrication department at Caterpillar. The raw material for manufacturing excavators and tractors comes in different sizes and with different material properties. Depending upon the forecasted demand, appropriate raw material needs to be cut to specifications in the fabrication department. A burning cell consisting of laser and plasma cutting machines are used for cutting the raw material. Typically, a cutting pattern(s) is chosen to cut different parts needed for one or more tractors. If not properly planned, wastage of raw material can lead to significant loss to Caterpillar. The model proposed will help the decision maker to decide which cutting pattern to choose and how many times it should be used to meet the forecasted demand. In choosing the cutting patterns, the objective is to reduce material wastage, ensure appropriate inventories are maintained, and reduce handling costs. As soon as the material is cut, they are moved either to an inventory storage location or to second operations where further machining is carried out. The model proposed helps to make decisions with both the cutting process and second operations. The model is implemented in IBM ILOG IDE and experiments were conducted using the data collected from Caterpillar. The results from the model are compared with the current practices followed at Caterpillar and the improvements made are documented.
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**NIU Supermileage Vehicle**

Authors: Clay Phillips, Marina Efanov & Matt Zastrow  
Faculty Mentor: David Schroeder  
Department: Technology  
Research Category: Science, Technology, Engineering, Math  
Judging Time: 11:30AM-12:45PM

The Supermileage competition specifically entails designing, building, and competing with a single-person, fuel-efficient vehicle powered by a small four-cycle engine. The vehicles run a specified course and the highest mile per gallon rating, in addition to design segment points, wins the event. Students also have the opportunity to set a world fuel economy record and increase public awareness of energy consumption and current technologies for reducing fuel consumption. Some of the teams in the past few years have exceeded 3000 miles per gallon!

This year is the second year for the NIU Supermileage team. Last year’s team won third place with 1265 mpg. Since the beginning of this academic school year the team has been planning and developing strategies to be more competitive and we feel the team is on the right track to break 2000 mpg. We are keeping last year’s chassis and motor, but are modifying them to get better efficiency out of the car. In addition, the team will be working in an advanced workshop with new tools, welding equipment, engine dynamometer, exhaust gas analyzer, and machining center. We know that with all of our resources the team will excel this year.
Performing real time measurements in an industrial setting that are accurate regardless of surface finish is very important and is a real issue that troubles industry today. The Macro/Micro Manufacturing (M3) lab at Northern Illinois University was tasked with taking an existing measurement system and solving that system’s biggest issue of not being able to measure anything with a reflective surface finish. The system’s job was to measure the thickness and width of different types of carbon fiber tape being attached to an airplane fuselage as the tape is being placed on the plane; some of these tapes have a reflective surface. This carbon fiber tape is used to strengthen the body of the airplane where passengers sit, otherwise known as the fuselage. The M3 lab was able to solve the problem of measuring reflective surfaces with outstanding success. Using a camera, laser, and mirror, the M3 lab’s improved version of the measurement system is able to take extraordinarily accurate measurements of the carbon fiber tape. The M3 system can measure the tape being placed onto the airplane fuselage regardless of how reflective that tape is to accuracies of about ten-one thousandths of a millimeter, which is approximately equal to one tenth the thickness of a single strand of human hair, without making any physical contact with the tape! This measurement system has near unlimited applications beyond measuring carbon fiber tape in real time that are just beginning to be explored for the future.
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