

SOURCE Undergraduate Symposium and Poster Session
April 14-15, 2005
Thwing Center

THURSDAY, APRIL 14

Paper Presentations, Thwing Meet Room B

12:15-12:40 **Joshua Ehrenreich**, *An Investigation into Meaning: Language and Context*
Project Mentor: Professor Laura Hengehold

12:45-1:10 **Katy Lee**, *Effects of (Micro) Structural Characteristics on the Mechanical Properties of Open-Cell Nickel Foams*
Project Mentor: John J. Lewandowski

Poster Presentations, Thwing Ballroom

Noon-2:30 pm

FRIDAY, APRIL 15

Posters available for viewing by Prospective Students and their Families until noon.

AWARDS

SOURCE PROVOST AWARD – One \$200.00 and One \$100.00 award will be given in each of the seven categories: Arts, Engineering & Computer Science, Humanities, Natural Sciences & Mathematics, Nursing, Social Sciences, Management & Accounting.

Friday, April 22, Community Hour,

Awards will be announced at the Honors Convocation.

PARTICIPANTS
SOURCE Undergraduate Symposium and Poster Session
April 14, 2005
Thwing Center

Student	Faculty Mentor/Endorser
Anton Alekseyenko	Professor Robert Harris Department of Chemical Engineering
Rachna Arora Jenny Dvorkin Erin Edmiston	Professor James Zull Department of Biology
George Asaad	Professor Elizabeth Short Department of Psychology
Sumantha Bhatt Erin Jones	Professor James Zull Department of Biology
Amanda Bringard	Professor Bruce Lamb Department of Genetics
Nicholas Callahan	Professor Menachem Shoham Department of Biochemistry
Eric Carnevale	Professor Peter Zimmerman
Ryan Conrad	Professor Mark Votruba Department of Economics
Kevin Day	Professor Alexis Abramson Department of Mechanical and Aerospace Engineering
Joshua Ehrenreich	Professor Laura Hengehold Department of Philosophy
Nicholas Dorsey	Professor Ajai Singh Banking and Finance
Lynn Fairchild	Professor Elizabeth Short Department of Psychology

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Jason Funt
Joseph Tan
David Howard
Patrick Gray

Professor Roy Ritzmann
Department of Biology

Shaan Gandhi

Professor Narendra Narayana
Department of Biochemistry

George Haag

Professor Focco van den Akker
Department of Biochemistry

Matthew Hagy

Professor Elena E. Dormidontova
Department of Macromolecular Science
And Engineering

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Wilson Freeman
Karthik Raman

Professor Mari Rege
Department of Economics

Daniel Howe
Matthew Cross
Vinay Majjigi

Professor Ken Loparo
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Nikhil A. Huprikar

Professor Andrew Rollins
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Professor John Moore
Department of Pediatrics and Reproductive Biology

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Professor Susan Tullai-McGuinness
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Professor Ruth A. Keri
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Department of Mechanical and
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Margaret Wuerdeman

Professor Beth McGee
Department of Theater and Dance

Elliot Yamaguchi

Professor Morton Litt
Department of Macromolecular Science and
Engineering

Mark Zimmerman

Professor Darrin Young
Department of Electrical Engineering
And Computer Science

Analyzing Residual Moisture and Alcohol in the Freeze Dried Products Using Near-Infrared Technology

Anton Alekseyenko - Department of Chemical Engineering
Douglas Brown, James Cradock, and Gyongyi Gratzl - Venue Laboratories, Inc. Bedford, OH
44146

ABSTRACT

Purpose. One of the concerns in pharmaceutical drug development is analyzing the final moisture content in the lyophilized product. Currently companies use destructive methods such as Karl Fisher (KF) or loss-on-drying (LOD) to quantify moisture. Near-Infrared (NIR) technology is a nondestructive technique for moisture quantification that has been recently introduced for the pharmaceutical scientists. Purpose of this project was:

- 1) To study NIR quantification moisture analysis and to prove that it is more efficient than KF,
- 2) To quantify residual tertiary butanol (TBA) and water in the lyophilized products as well as study their interference between each other,
- 3) To prove that NIR analysis can be performed in the clear as well as amber vials.

Methods. Broad water bands (13158, 10309, 8403, 6897, and 5155 cm^{-1}), in the NIR fingerprint region, allow correlating area of the peaks to the introduced amounts of water in the sample, using NICOLET TQ Principal Component Regression. Product specific standard curve can be used for the future nondestructive quantification analysis.

Results. While water can be identified in the products with traces of alcohol, TBA amounts can be quantified in the product as well. Water overtone peaks are unique in NIR region and will not be influenced by more polarized OH groups in the quantification method, while other polar organics such as TBA can be separately quantified as well. Standard curve should be obtained for each product configuration change.

Experiment	Water in Mannitol	Water in GP100	Water in TBA Product	TBA Product		Clear Glass	Amber Glass
				TBA Analysis	Water Analysis		
Correlation Coefficient	0.98180	0.99281	0.99999	0.92179	0.99999	0.99621	0.99768
RMSEC	0.181	1.03	4.07E-07	0.054	1.12E-07	0.193	0.0732

Conclusions. Moisture is equally distributed in the lyophilized cake. Although, NIR is a qualitative technique, it can be used for moisture quantification. Size of the vial and color of the glass does not interfere with analysis. Polar substances will not interfere with moisture analysis and can be identified in the lyophilized product as well. NIR analysis is inexpensive, nondestructive, reliable, reproducible and user friendly method.

Project Proctor: Robert Harris, Adj. Professor, Chemical Engineering

The Implications of Bilingualism on Education

Jenny Dvorkin, Departments of Biology and Religion; **Rachna Arora**, Department of Sociology; and **Erin Edmiston**.

Language in the brain has been considered one of the most intriguing aspects of the human beings. Even more fascinating is the nature of bilinguals. One particular issue studied is the age of acquisition of the second language with respect to the critical period. The critical period hypothesis states that brain plasticity progressively decreases with maturation. Brain plasticity is the ability of the brain to undergo constant structural changes due to experience. Therefore, there is a common tendency for teachers and parents to teach language during this critical period, between infancy and puberty. A number of studies have been done to try understand the structural and physiological differences of the brain between “early bilinguals” and “late bilinguals,” that is, those who acquired the second language before the critical period and those who acquired the second language after the critical period. Other studies have placed an emphasis on the proficiency of the second language. Proficiency as we have defined it is the ability to not only comprehend the second language but also to be able to speak with a high degree of competence. Furthermore, importance has been placed on the structural brain differences between “equal” and “unequal” bilinguals. “Equal” bilinguals refer to those who have the same proficiency of both their native and second languages, while “unequal” bilinguals refer to those who are more proficient in their native language. We propose that these findings can have a significant impact on education of not only second language acquisition but also of other systems of symbols such as mathematics and music.

Project Mentor: Professor James Zull, Department of Biology

Long Term Consequences of Drug Therapies with Infants Diagnosed with Bronchiopulmonary Dysplasia

George Asaad, Department of Psychology

Bronchopulmonary Dysplasia (BPD) was first observed in 1964 and was initially thought to be a severe case of Hyaline Membrane Disease (HMD). Today, BPD stands as the leading cause of chronic lung disease in infancy in the United States. Risk factors include: preterm birth, immaturity of the pulmonary parenchyma, barotrauma from positive pressure ventilation, surfactant deficiency, pulmonary edema, and pulmonary air leak³. While considerable information has been gathered about the short-term (2-3 years) outcomes of infants with BPD, little is known about the long-term (10-20 year) prognosis.

A prospective follow-up study from birth of very low birth weight infants with Bronchopulmonary Dysplasia (BPD; n=94) was conducted at three and eight years of age. Four groups of BPD children were formed based on the type of medical management received. That is, BPD children either received no drug intervention (n=36), surfactant only (n=29), steroids only (n=13) or both surfactant and steroids (n=16).

Treatment employed was related to the duration of time on the ventilator and the total amount of oxygen received, with infants receiving the combination of surfactant and steroids requiring more oxygen and more time on the ventilator than infants receiving no medical intervention or surfactant only. Mean differences in intelligence and language at ages three and eight were examined as a function of medical treatment, as well as differences in reading and math achievement at age eight. The BPD group who received either steroids alone or steroids in combination with surfactant demonstrated performance deficits compared to BPD children who received no medication or surfactant only.

Our results suggest that BPD has adverse effects on academic achievement, with BPD children who required the application of steroids in conjunction with surfactant demonstrating significantly greater impairments.

Project Mentor: Elizabeth Short, Department of Psychology

Gender and Intelligence: A Grey Matter?

Sumantha Bhatt and **Erin Jones**, Department of Biology

When assessing intelligence, the question arises whether there are differences in intellectual ability among men and women. Although it has been shown that men and women do exhibit differences in brain structure, anatomical dissimilarities do not establish deviations in levels of general intelligence. It is due to, rather, in the distribution of grey matter and white matter; with grey matter being responsible for the processing of information and white matter for the signaling of information. Extensive research has been conducted on the correlation between grey matter and intelligence, our study, however, focuses specifically on the distribution of grey matter in the frontal, parietal regions of the brain as well as Wernicke's and Broca's area. A recent study on neuroanatomy and gender, (Haier, et al., 2004) designates these regions as the "intelligence centers" of the brain. In Haier's study, individuals of similar IQ were given verbal and nonverbal tasks designed to test regions throughout the brain. Results showed that females exhibited greater concentration of gray matter in the right frontal lobe and in Broca's area, whereas men exhibited greater gray matter concentration in the bilateral frontal lobes and in the left parietal lobe; Wernicke's area. Haier concluded that men and women do not differ in their basic level of intelligence, but rather in their processing/transmission of information in specific areas of the brain, with the depth and speed of processing/ transmission dependent upon the concentration of grey and white matter. Our literature study further investigates the significance of grey and white matter distribution in these critical regions.

Project Mentor: Professor James Zull, Department of Biology

Complement Deficiency Delays Pathology Development In a Mouse Model of Alzheimer's Disease

Amanda Bringard, Department of Biology

Alzheimer's disease is a major cause of dementia in the elderly. Pathological hallmarks include A β deposits, neurofibrillary tangles, and inflammation in the brain. However, the relationship between inflammation and A β deposition has been the subject of debate. Evidence supporting a role for inflammation in AD includes the upregulation of inflammatory and complement molecules within the AD brain and epidemiological data suggesting that non-steroidal anti-inflammatory drugs are protective against AD. The complement system is one of the mediators of the inflammatory response and functions as part of both the innate and acquired immune responses. To study the effects the complement system has on AD, we generated a mouse model of AD with the R1.40 transgene that is also deficient in C5. R1.40 animals typically develop amyloid pathology as early as 13.5 months. To explore the effects of C5 deficiency on pathology development in these animals, we looked at plaque formation in their brains at 17, 20, and 24 months. Strikingly, at 20 months, when the parental line exhibits considerable A β deposition, only 4 of 8 animals exhibit A β deposition. Only in later ages does significant A β deposition occur. We also found that males tended to have more plaques than females, opposite of what is seen in the parental line. These studies suggest that alterations in the complement pathway can delay A β deposition and may provide an important target for intervention in AD pathogenesis.

Project Mentor: Prof. Bruce Lamb, Department of Genetics, Karen Mann, PhD Candidate

Modeling the Vasopressin V2-Renal Receptor and Predicting Interaction with Non-Peptide Antagonists

Nicholas Callahan, Department of Biochemistry; Rosemarie M Dazard, Department of Biochemistry; and Menachem Shoham, Department of Biochemistry

Vasopressin is a peptide hormone implicated in kidney, heart and brain function. The Vasopressin-2 receptor is a seven-helix transmembrane G-protein coupled receptor, which plays a role in water reabsorption and vasodilatation. This research is concerned with creating a computer model of the Vasopressin-2-renal receptor, then using this model to predict how vasopressin and non-peptide antagonists dock to the receptor. We have also investigated how mutations in the receptor would alter the affinity of the antagonists to the receptor. Experiments are underway to experimentally measure the affinity of the compounds to wild type and mutant receptors. The antagonists are OPC21268, OPC31260, OPC41061 obtained from Otsuka Pharmaceuticals (Japan) and SR49059, SR121463B, and SSR149415 obtained from Sanofi Pharmaceuticals (France).

Project Mentor: Professor Menachem Shoham, Department of Biochemistry

A Multiplex PCR-LDR Assay for Polymorphism Determination in *Plasmodium falciparum* pfmdr1 Gene

Eric Carnevale, Department of Biology

Resistance to antimalarial drugs such as chloroquine (CQ) has significantly increased the mortality rate of malaria infections in the past several decades. Because of this a greater understanding of the mechanisms behind CQ resistance is required, and specifically the role played by the *Plasmodium falciparum* gene pfmdr1. Single nucleotide polymorphisms (SNPs) have been identified in this gene, that are thought to contribute towards the parasite's ability to withstand treatment. Because of this we are developing an assay that can identify supposed resistance genotypes quickly, reliably, and with the capacity for processing many samples at once. A standard PCR amplifies target DNA, which is then followed by a ligase detection reaction (LDR). The LDR interrogates the SNP by binding an upstream probe that is allele specific and tagged with a 5' sequence to hybridize to a polystyrene bead, and a downstream probe that anneals to a conserved sequence and is bound to biotin on the 3' end to hybridize to a fluorescent molecule. Detection involves hybridizing the LDR product to fluorescent r-phycoerythrin for quantification, and to a unique, fluorescent, polystyrene bead for allele identification. The process has been shown to accurately identify the pfmdr1 genotype in five SNPs simultaneously, with up to a 100:1 signal to noise ratio. When fully developed, a single operator would be able to analyze samples at a rate of one per minute and a half, amounting to thousands per day. For malaria treatment, this translates to detailed and current knowledge of parasite resistance capabilities within a region or country, allowing governments and health ministries to effectively direct treatments, at a cost that would be feasible in the developing world.

Project Mentor: Dr. Peter Zimmerman

Faculty Sponsor: Professor Nancy Dilulio, Department of Biology

The Effects of Medicare Prescription Reform on Pharmaceutical Research and Development

Ryan Conrad, Department of Economics

Starting in January, 2006, there will be a federally sponsored Medicare program that will provide Americans aged 65 and older with prescription drug insurance. The new insurance will lower the out-of-pocket expense for prescriptions drugs for millions of elderly Americans. As a result, market demand for drugs treating conditions prevalent among the elderly is expected to increase dramatically when the new coverage becomes available. Pharmaceutical developers would rationally take the expected demand increase into consideration when deciding how to allocate their research and development budgets. Assuming such decisions are made to maximize the profits of drug developing firms, we would expect an increase in drug development activities for medicines treating elderly-prevalent conditions. Moreover, we would expect the change in drug development activities to precede initiation of the program since developing a new pharmaceutical takes around fifteen years (from inception to FDA approval). Combining data on the number of drugs in trial, broken down by condition class and FDA trial stage, with data on disease prevalence by age group, we test the hypothesis that drug developers have re-optimized their development activities by focusing greater effort towards drugs treating elderly-prevalent conditions.

Project Mentor: Professor Mark Votruba, Department of Economics

Experimental And Computational Studies Of Thermal Transport In Nanocomposites

Kevin Day, Department of Mechanical and Aerospace Engineering; Philip Hegedus, Graduate Student; and Steve Hostler, Post Doctoral Fellow; Department of Mechanical and Aerospace Engineering

Materials with features constrained in one or more dimensions on the nanometer level have demonstrated improved thermoelectric properties due to quantum confinement. This work has studied this effect with nanoparticles embedded in a conducting polymer matrix. The thermal and electrical conductivities of thin films of polymer with different volume fractions of nanoparticles were measured. The thermal conductivity was measured with the 3-omega method and the electrical conductivity with a four-point probe. Computer simulations have also been used to model the thermal conductivity of nanoparticles in a matrix. This work has also been extended to include a composite of nanoparticles without a supporting matrix.

Project Mentor: Professor Alexis Abramson, Department of Mechanical and Aerospace Engineering

An Investigation into Meaning: Language and Context

Joshua Ehrenreich, Department of Philosophy

Philosophers have long investigated the nature of meaning, and with contemporary philosophy often having a more linguistic focus, now, more than ever, the nature of meaning is a debated topic. Ludwig Wittgenstein, throughout the *Philosophical Investigations*, presents many questions to illustrate certain holes in previously unquestioned philosophy. This paper seeks to answer many of these questions by answering a larger question; what is the nature of meaning? Often times, meaning is inaccurately thought to be entirely housed within language. This view of meaning is unable to account for certain problems, such as explaining the phenomena of learning, or the fact that we usually believe there to be a 'correct' meaning, despite what other people may say (we all can identify with getting in an argument over a misunderstanding of meaning). Also, there are certain aspects that have meaning which lie outside of language; nonverbal cues can complement or work independently of language, different situations can lead to different meanings, and time and space certainly have an effect upon the creation of a meaning.

So, if meaning does not reside purely in language, what else could there be to house it? I argue in this paper that meaning is a combination of both language and what I term context. Context, simply put, contains all the non-linguistic elements that affect meaning, whether these elements are intentional or unconscious. It is important to realize that, in the same way that language alone does not contain meaning, context alone also does not contain meaning fully; language and context are both utilized to create an understandable and desirable meaning.

Project Mentor: Professor Laura Hengehold, Department of Philosophy

Equity Carveouts

Nicholas Dorsey, Department of Accounting

A company looking to raise capital through the issuance of stock has some flexibility in choosing what equity interest it wants to sell. Rather than issuing additional shares of their own common stock, many companies have chosen to raise funds by selling at least part of their interest in a *wholly owned subsidiary* to the public. The resulting subsidiary is known as a carveout. Recent well-known carveouts include Palm (3Com), First Data Corp (American Express), PacTel Corp (Pacific Telesis), and Allstate Corp (Sears). A recent study indicates that carveouts, in contrast to “traditional” IPOs, do not underperform over a three-year period following the public offering. I have expanded the previous study by drawing distinctions between independent, parent-controlled, and third-party controlled carveouts to ascertain whether different types of carveouts experience different levels of performance. I traced institutional and insider equity holdings before and after the public offering to determine if either group prefers to invest in the parent or carveout. I have also looked for a predictive relationship between institutional and insider ownership following the carveout and the carveout’s two-year performance.

Project Mentor: Professor Ajai Singh, Banking and Finance

Longitudinal Prediction of Behavior Problems in Prenatally Cocaine-exposed Six-Year-Old Children

Lynn Fairchild, Department of Psychology; Elizabeth J. Short, Department of Psychology; Sonia Minnes, School of Medicine; Adelaide M. Lang, Psychologist-Case Western Reserve University; H. Lester Kirchner, School of Medicine; Suttida Satayathum, School of Medicine; and Lynn T. Singer, School of Medicine

Background: Prenatal cocaine exposure has been linked to negative outcomes in infants. However few studies have looked at the long-term behavioral consequences of prenatal drug exposure. Earlier work on this sample, at age four, suggested some behavioral problems in our cocaine-exposed group. As children enter the school age period where the demands for behavioral self-control appear to increase, it is likely that more significant behavioral problems will surface. **Objective:** To examine the prevalence of behavioral problems in cocaine-exposed six year olds, as well as the longitudinal stability of these problems. **Design/Methods:** Caregiver reports of behavioral problems were assessed using the Achenbach Child Behavior Checklist (CBCL) in a sample of 381 children (194 cocaine-exposed [CE] and 187 non-exposed [NE]) who were primarily poor, urban, and African-American. All children have been followed prospectively from birth to six years of age. **Results:** Preliminary analyses revealed no differences between CE and NCE children on parental reports of behavior. Most parental reports of behavior seemed to improve with age. That is fewer problems in behavior at age six as compared to age four according to parental report. Consistent with the nature of this high-risk sample a sizeable number of both our CE and NCE children were reported to have behavioral problems in the borderline and clinical range. It was also found that behavioral problems appeared to be moderately correlated between age 4 and 6. These data will be examined in greater detail, particularly as they relate to earlier measures of child behavior. **Conclusions:** The behavioral problems of CE children appear to be of concern in the literature, and given the moderate degree of correlations between scores at age 4 and 6, clinicians and educators should target high-risk preschoolers for early intervention.

Project Mentor: Professor Elizabeth Short, Department of Psychology

Examination of Foot Attachment in the Cockroach *Blaberus giganteus*

Jason Funt, Joseph Tan, David Howard, & Patrick Gray, Department of Biology

Insects have remarkable abilities to walk over a range of substrates as well as up walls and even over ceilings. To accomplish this, they use various different attachment devices that can be grouped into two sets. Beetles have hairy pads that greatly increase the surface for attachment. Locusts, crickets and cockroaches use flexible pads that increase friction and release small amounts of adhesive fluid. Our team examined the foot structures found on the tarsi (feet) of a very large cockroach, *Blaberus giganteus*. We used high speed video to image the tarsi as the animals walked on horizontal surfaces as well as on inclined tracks. The substrate was glass, acetate or, in some trials screen that allowed claws to be engaged. The insect pushes its tarsi down onto the substrate and attempts to push its claw into the material or around screen. We examined the effect of damaging or covering the pads and found that the cockroaches slipped on inclines and in some cases on horizontal surfaces. We have also examined the effects of load, and leg posture associated with foot adhesion. Finally, we took measurements of pad and foot dimensions and provided these data to engineers in our group who are designing tarsal prosthetic feet for use on a large hexapod robot.

Project Mentor: Professor Roy Ritzmann, Department of Biology

Ezrin Plays a Role in Anti-Apoptotic Signaling in Ewing's Sarcoma

Shaan Gandhi, Department of Biochemistry

Ezrin is an important cytoskeleton linker protein, playing a role in interactions between actin fibers and the plasma membrane and in transduction pathways. Recent studies have implicated overexpression of ezrin in cancer metastasis, implying a role for ezrin in metastatic signaling pathways. To elucidate the role of ezrin in Ewing's sarcoma, activation of two key proteins in the anti-apoptotic phosphatidylinositol-3-kinase (PI3K) pathway, Akt and 4E-BP1, was analyzed. Western blot analyses of phosphorylated and total protein for Akt and 4E-BP1 were conducted using lysates from Ewing's sarcoma cell lines transfected with dominant-negative T567A ezrin or vector control. Results indicated that serum stimulation of the dominant-negative cell line was associated with downregulated expression of phosphorylated Akt and 4E-BP1 as compared to the control cell line, while total protein expression remained constant across both lines, showing a role of ezrin in PI3K signaling in Ewing's sarcoma.

Project Mentor: Professor Narendra Narayana, Department of Biochemistry

Crystallographic Refinement of Wild-Type β -lactamase Enzyme Crystal Soaked with Tazobactam Inhibitor

George Haag, Departments of Biochemistry and Chemistry

β -lactamase is an enzyme of medical importance because it is the primary agent of bacterial resistance to the penicillin class of antibiotics. Inhibitors of β -lactamase are often administered alongside penicillin class antibiotics to prevent the breakdown of the antibiotic and increase its effectiveness against antibiotic-resistant strains of bacteria. Tazobactam is the latest in a line of inhibitors including clavulanic acid and sulbactam to target β -lactamase clinically. Our lab has previously determined tazobactam's structure bound to a deacylation deficient variant of SHV-1 β -lactamase. This structural work was guided by Raman crystallography and allowed to successfully trap the trans-enamine intermediate. Our new goal is to obtain a crystal structure of a similar tazobactam intermediate bound to the wild-type protein and this work describes our first efforts towards this goal. To refine a crystallographic model of β -lactamase bound to the tazobactam inhibitor, the model had to be manipulated manually and computationally using modern crystallographic computing interfaces. The model was graphically reviewed and manually edited in graphic display software, and then refined further using computer minimization protocols, in an attempt to bring the model into a chemically accurate agreement with the experimental data. Preliminary results indicate a marked improvement in the accuracy of the model to fit the experimental data. The R-value, used to assess the difference between the model and the data, was systematically reduced from a value of 0.3689 to a value of 0.1912, indicating significant progress in establishing a working computational structure of β -lactamase soaked with the tazobactam inhibitor.

Project Mentor: Professor Focco van den Akker, Department of Biochemistry

Analytical and Computational Modeling of Ring to Chain Equilibrium in Reversibly Associated Polymers

Matthew Hagy, Chun-Chung Chen, & Elena E. Dormidontova, Department of Macromolecular Science and Engineering

At low concentration of reversibly associated polymers the ring species make a significant contribution to the total degree of association. Through application of Monte Carlo simulations and thermodynamic calculations we study the influence of the individual system parameters and their combined net effect on ring formation and ring-to-chain equilibrium. We found that the entropic cost for chain formation decreases exponentially as a function of polymer concentration. For flexible polymers (having no limitations on the bonding angles) the main factor influencing the ring formation is the spacer length. For constrained polymers exhibiting rigidity of association, there is a considerable limitation on bonding angles. As a result, smaller oligomers with stronger limitations on bonding angles were less likely to form rings, despite having a lower entropic penalty for end group association. This effect considerably decreases as oligomer length increases, eventually reaching a flexible-polymer-like behavior. An analytical model that is currently under development provides insight into the mechanisms of ring formation and allows the prediction of ring-to-chain equilibrium conditions.

Project Mentor: Professor Elena E. Dormidontova, Department of Macromolecular Science and Engineering

**Richard Shatten Public Policy Case Competition:
Contingent Valuation Study of the West Shoreway Project**

Daniel Howe, Wilson Freeman, Karthik Raman, Department of Economics

The Cleveland West Shoreway project was proposed in 2002 as part of the larger “Connecting Cleveland- The Lakefront Plan” initiative. The \$48 million project will convert the existing freeway into a landscaped boulevard with improved access to the lakefront for residents of the surrounding neighborhoods.

The Spring 2005 students of ECON 395 have undertaken a contingent valuation study of the proposed reconstruction project in an effort to evaluate the value the public places on the renovations. Contingent valuation studies are used to place a monetary value on a public good based on the individual preferences of the affected population. A survey has been conducted amongst those directly affected by the project, and the respondents have been asked to place a monetary value on their “willingness to pay” for the project.

The survey was designed by the students of the class based on the latest research on techniques to minimize the influence of survey implementation biases and to obtain a representative sample of the population. Approximately 360 respondents were mailed an information packet about the project, then interviewed via telephone.

A regression analysis has been performed on the survey data and the overall value that the community places on the project will be calculated. This information will be used to judge the cost effectiveness of the project and the time required to recover the monetary investment in terms of public use.

The course is named the Richard Shatten Public Policy Case Competition. The student teams will present their findings to community and civic leaders on April 21st, 2005.

Project Mentor: Professor Mari Rege, Department of Economics

Case Formula S.A.E. Data Acquisition System

Daniel Howe, Matthew Cross, & Vinay Majjigi, Department of Electrical Engineering and Computer Science

A portable data acquisition system (DAQ) has been developed for the Case Formula SAE race car team. The DAQ system is a tool for measuring, logging, and evaluating the vehicle's performance during testing and competition. The DAQ was designed and fabricated by three senior electrical engineering students as part of their senior project.

Engine and vehicle sensors provide information about the throttle position, steering wheel position, engine speed, vehicle speed, fuel-to-air ratio, temperature, and three-dimensional acceleration. The DAQ utilizes a Programmable System on a Chip (PSoC) to provide input gain and filtering, to measure the input signals, and store the data. A 256MB CompactFlash (CF) memory card is used to store the sampled data in a Windows-compatible hard drive format. The CF card can then be removed from the DAQ, inserted into a laptop PC, and loaded into a custom MATLAB program for signal conditioning and data analysis.

The other groups of the Case FSAE team can use the acquired data to make adjustments to the vehicle to improve performance and to evaluate the driving skills of each driver on the team. The DAQ can log over 2 hours worth of data while taking 200 samples per second, which is significantly better performance than other commercially-available racing vehicle data acquisition systems.

The FSAE DAQ won Circuit Cellar Magazine's "Distinguished Excellence" award in the 2004 PSoC Design Challenge. The DAQ will also be evaluated in the FSAE National competition in Pontiac, Michigan this May and will be entered into several other design competitions this spring.

Project Mentor: Professor Ken Loparo, Department of Electrical Engineering and Computer Science

Imaging Myocardial Infarction with Optical Coherence Tomography

Nikhil A. Huprikar¹, M. W. Jenkins¹, Y. Cheng², and A. M. Rollins¹

¹*Department of Biomedical Engineering, Case Western Reserve University, Cleveland, Ohio 44106*

²*Department of Cardiovascular Medicine, Cleveland Clinic Foundation, Cleveland, Ohio 44195*

Optical Coherence Tomography (OCT), an emerging imaging modality analogous to ultrasound, uses low coherence interferometry to image tissue with a resolution of 2-15 μm and a penetration depth of 1-3 mm. Myocardial infarcts (MI) are a result of necrosis of the myocardial tissue, which is caused by a lack of oxygenated blood reaching the tissue. The occurrence of arrhythmias has been shown to be related to the tissue surrounding the MI, the border zone (BZ). Our data (figure 1) represents OCT's ability to distinguish MI and BZ from healthy tissue. In the future, OCT guidance will hopefully improve RF ablation therapy, a correction procedure for MI.

To create an infarction, a rabbit heart was ligated along the descending branch of the left circumflex artery and allowed to heal for 4-6 weeks, after which the heart was excised. OCT images were taken of the transmural infarction and then correlated to histological slices (Masson's Trichrome). In conclusion, the infarcted myocardial tissue, due to its less dense, non-homogenous nature, arising from different backscattering properties allowed the light to scatter more, thereby appearing more disorganized than healthy tissue.

Acknowledgement: This research was funded by the Case Western Reserve University Biomedical Engineering Summer Research Fellowship.

Project Mentor: Professor Andrew Rollins, Department of Biomedical Engineering

Cis Regulatory Polymorphisms in A/J and C57BL/6J Mice

Jeffrey M. Kidd, Department of Biology; Gabrielle Nickel and Mark D. Adams, Department of Genetics

The precise nature of the regulatory networks responsible for controlling gene expression is not clear. Differences in gene expression are an important factor in evolution and may play a significant role in determining susceptibility to complex diseases such as stroke and diabetes. An analysis of regulatory polymorphisms offers insight into the structure of the overall regulatory network. Regulatory polymorphisms can be divided into two classes: cis-acting variations in the sequence flanking a gene and trans-acting variations, such as changes which alter the amino acid sequence of a transcription factor, that are not proximal to the gene.

The presence of polymorphisms on a differentially expressed transcript allows for the direct examination of regulatory variation. In a heterozygous organism both alleles are exposed to the same cellular environment and collection of regulatory factors. A difference in the expression of the two alleles in a heterozygote therefore indicates the presence of cis-acting polymorphisms. A comparison of the relative expression level in a heterozygote with that in homozygous parents also allows for the quantification of the effect of trans-acting changes.

In this study, approximately 20 genes expected to show different expression levels in the livers of A/J and C57BL/6J mice were tested. Known single nucleotide polymorphisms on the expressed mRNAs were used as tags and Applied Biosystems's SNaPshot single base extension assay was used to measure the relative expression levels of each gene in F₁ mice. Analysis of the results indicates the presence of cis acting polymorphisms in many of the genes.

Project Mentor: Professor Mark Adams, Department of Genetics

Molecular Modeling of Reversible Supramolecular Complexes

Jessica Kingsberg, Elena E. Dormidontova, & Chun-Chung Chen, Department of Macromolecular Science and Engineering

Recent progress in synthesis of reversibly associated polymers made available a new class of materials, which can be used in molecular recognition, catalysis, transport, and the design of nanomolecular patterns. Because of their self-organizing capabilities, these polymers are able to spontaneously generate well-defined structures depending on the external conditions. Molecular modeling allows us to gain insight into the details of complex formation and to predict its properties and limitations. Using MacroModel (by Schrödinger) we study two associative motifs: complementary arrays for multiple hydrogen bonding and metal-ligand complexes. For hydrogen bonded arrays we found that energetically most favorable donor-acceptor arrangement is not always the first complex formed. Formation of the complexes, which require preliminary conformational or structural reorganization of the arrays, occurs noticeably less frequently and with poorer alignment than those, which are “ready to associate.” Other factors influencing association are the length of the spacers and the presence of bulky side-chains, which may prevent self-complexation and/or stimulate formation of complexes of a particular type. A minor hydrogen bonding pathway as well as 3:1 ligand-metal complex may lead to the branch point resulting in gel formation. Results of our studies can be used to direct further experimental or large-scale simulation efforts devoted to supramolecular polymers.

Project Mentor: Professor Elena E. Dormidontova, Department of Macromolecular Science and Engineering

Contingent Valuation Study of West Shoreway Reconstruction

Chris Kolibaba, Department of Sociology

Kevin Day (undergraduate student)

Amy Ewing (undergraduate student)

This primary focus of this project concerns the impact of a public policy proposal on the residents of the city of Cleveland. Specifically, the reconstruction of Cleveland's West Shoreway and its potential impact on local residents is the focus of this project. This project is also an exercise in contingent valuation, as student researchers determine the monetary value of a community's benefit from a public good. Two research questions concern this project: Do potential benefits of the project outweigh 1.) the estimated \$49.8 million cost of construction and 2.) the cost of increased travel time for local commuters? In this study, students measure the willingness to pay of potentially impacted residents by utilizing survey methodology. The particular survey methodology utilized in this study is the phone-mail survey, in which students called residents selected from a sample frame inclusive of the areas determined to be most directly impacted by the project. The students employed random-digit dialing to determine survey participants and ascertained area residents' potential participation in a survey. Students then mailed the surveys and followed up with a phone call to participants to discuss the survey, at which times students recorded the participants' answers to specific contingent valuation and demographic questions. Data analysis will be divided into interpreting both the contingent valuation and demographic data. As well, students will also ascertain the correlation between the contingent willingness to pay and several demographic variables. Public policy recommendations will then follow from the results of the contingent valuation data.

Project Mentor: Professor Mari Rege, Department of Economics

Cognitive, Social, and Affective Self-Regulation: Learner and Domain Differences

HyeJoo Lee, Elizabeth Short, Meena Dasari, and Teresa J. Linares, Department of Psychology; Michael, J. Manos, Cleveland Clinic.

Objective: To compare children with and without Attention Deficit Hyperactivity Disorder (ADHD) in their self-regulation strategies used in four domains: memory, social, mad, and worry.

Design/ Methods: 29 children diagnosed with ADHD and 29 without ADHD participated. All subjects were asked to complete the vocabulary subtest of the Wechsler Intelligence Scale for children (WISC-III), the Self Regulation Interview (SRI), and the Motivated Strategies for Learning Questionnaire. Teachers and parents rated children on the Conner's Rating Scale (CRS).

Results: Differences between ADHD children and typical children were found in all four domains. For strategy use in the memory domain, 41% of typically achieving children used peers to help them remember important information as compared to only 14% of ADHD children. More of the ADHD children relied on ineffective strategies to manage their social behavior than normally achieving children. In the mad domain, there were significant differences between ADHD and normal children, with 41% of the ADHD children employing distress strategies when confronted with anger as compared to only 10% of typical peers. In the worry domain, ADHD children appeared to use more distress-oriented strategies than their typical counterparts, with 41% of ADHD children, crying or screaming in response to anxiety situations as compared to only 3% of normally achieving children. Also ADHD children were less self-regulated and more likely to attribute their successes and failures to external causes than their normally achieving peers.

Conclusion: ADHD children in the present sample reported experiencing fewer memory, social, and emotional demands than their normally achieving peers. In addition, ADHD children reported fewer strategies to assist themselves in coping with the demands in each of the domains than their normally achieving counterparts, with these differences most pronounced for the memory and anxiety domains. Regulation deficits in ADHD children appear to not be specific to the emotional domain but rather appear to be quite global. That is, these self-regulation deficits affect the cognitive, social and emotional functioning of children.

Project Mentor: Professor Elizabeth Short, Department of Psychology

EFFECTS OF (MICRO) STRUCTURAL CHARACTERISTICS ON THE MECHANICAL PROPERTIES OF OPEN-CELL NICKEL FOAMS

Katy Lee, John J. Lewandowski, Department of Materials Science and Engineering

Previous investigations on the relationship between the mechanical properties and the (micro)structure of metal foams have mainly been related to the compressive response of closed-cell aluminum foams. In contrast, little research has been conducted on the tensile properties of open-cell metal foams. A major aim of this investigation is to examine the effects of changes in foam density, cell size, grain size, and strut size on the ultimate tensile strength (UTS) of electro-deposited nickel foams, provided by Eltech Systems. Preliminary studies were conducted using the scanning electron microscope to determine the cell size, grain size, and strut size of nickel foams. The primary factor controlling the UTS of the nickel foams tested appears to be the relative density, with increases in foam density accompanying an increase in the UTS. However, there were samples which deviated from this relation. The foams investigated in this experiment had relative densities (density of the foam/density of the solid material) of 0.035–0.083, with UTS values ranging from 0.85–3.53 MPa. The UTS values obtained correspond very well with predicted values. The poster will summarize the structural characterization and mechanical properties of the nickel foams tested. In addition, these values were compared to available models for strength of open-cell foams. Work funded by ONR–N00014–03–1–0351 and Ohio Space Grant Consortium Scholarship.

Project Mentor: Professor John J. Lewandowski, Department of Materials Science and Engineering

Mental Health Symptoms in Women Who Use Cocaine During Pregnancy-Longitudinal Evaluation Over a Six Year Period

John Mack, Department of Psychology; Sonia Minnes, General Medical Studies; Lynn T. Singer, Department of Pediatrics, & Elizabeth Short, Department of Psychology

Cocaine use during pregnancy places women at a higher risk for severe post-partum mental health symptoms. However, the nature of these effects and their long-term course is poorly understood. The purpose of the present study was to assess long-term psychological effects of women who used cocaine during pregnancy versus women who did not by studying a sample of 207 cocaine-using (C+) women and 195 non-exposed (C-) women (n=402). The sample was primarily African American and of low socioeconomic status, who were recruited at the infant's birth from a large, urban, teaching hospital in the Midwest. Cocaine use was identified by urine analysis, infant meconium, and self report. Maternal mental health symptoms were assessed using the Brief Symptom Inventory (BSI), a 53 item self-report questionnaire that yields 9 subscores of psychiatric symptoms (somatization, obsessive-compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, psychoticism) and 3 global indices of symptom severity including the Global Severity Index (GSI). The BSI was administered at 6 time points, including infant birth, 6.5 months, 1, 2, 4, and 6 years of age. BSI subscales were normalized and dichotomized into borderline clinical and above/non-clinical ranges and analyzed longitudinally. Though most BSI scores decreased over the 6 year period for both groups, the C+ group reported higher mean symptoms and higher percentages above the clinical cutoff for all subscales at birth and all time points. Notably, C+ women had clinically elevated scores for psychoticism and paranoid ideation as compared to C- women. Women using cocaine during pregnancy are at significant risk for psychological symptoms post-partum and over a six year period.

Project Mentor: Professor Elizabeth Short, Department of Psychology

Ongoing Theory of the Role of ACC in Cognitive Control

Pritesh Mehta, Department of Psychology; **Charles Van Slambrouck**, James Zull, Department of Biology

This presentation will highlight some of the most current research on the Anterior Cingulate Cortex (ACC) and its role in motivation, goal formation, and learning. We will address the current debate of whether the ACC serves as a mediator of cognitive control, or whether it serves as the source of cognitive control. Previous research has implicated that the ACC signals the Lateral Pre-Frontal Cortex (LPFC) which then directs attention and cognitive control (Roesch et al.). In addition, the ACC has been found to have increased activity during negative situational outcomes (Gehring et al.). On the contrary, Brown et al. found that increased ACC activity during high error situations may be more indicative of its true role in directing cognitive control. This difference highlights the conflict between the ACC's role in —specific detection functions (Gehring)“ versus a —general error likelihood hypothesis (Brown)“ which states that the chance of making an error is more critical to ACC activity than the actual positive/negative outcome.

The mechanism for how the ACC recruits cognitive control is currently unclear. We propose that within the ACC, its medial-frontal region provides emotional input, and the dorsal-caudal region provides error-detection input, which then combine to form the motivation, ultimately directing cognitive control through the LPFC. We also propose that in order to strengthen the connection between the ACC and the LPFC, either emotional input or the involved risk must increase.

Project Mentor: Professor James Zull, Department of Biology

Heart Development in *casanova* Mutant Zebrafish

Diana Meredith, Department of Biomedical Engineering; **Lauren Brown, Leina Doleh, and Kristine Ilagan**, Department of Biology

Zebrafish are a beneficial model organism for studying heart development due to their translucence and the ease of keeping large numbers of fish for genetic and morphological experiments. Further, studies of zebrafish heart formation can give insight into development of the human heart. *casanova* mutant zebrafish have morphogenetic defects that include cardia bifida: the heart tissue is divided into two distinct regions on opposing sides of the embryo. *casanova* mutants also have severely inhibited endoderm development, and it is therefore thought that endoderm is required for migration of the cardiac precursors towards the center. Heart specific markers will be used to explore the characteristics of the hearts that form in *casanova* mutants. We hypothesize that there will be no migration of the cardiac precursors. In addition, we predict that the two presumptive heart domains in the mutants will still form heart tubes that contain both atrial and ventricular cell types. In contrast, the direction of heart looping, which normally occurs to the left, will be randomized.

Project Mentor: Professor Jennifer Liang, Department of Biology

**Pheromone-Mediated Tracking Behavior in Moths:
M. sexta Orientation Along Plumes of Increasing Width or Height**

Elizabeth Morrison, Mark Willis, Department of Biology

It is known that male *Manduca sexta* moths respond to plumes of female sex pheromone by flying upwind in a zigzagging pattern. The current model explaining the odor-tracking behavior of *M. sexta* is an odor-modulated anemotaxis, whereby an odor stimulus alters the moth's preferred orientation to the wind. Odor contact also activates a pre-programmed sequence of side-to-side turns which, when combined with the orientation to wind, results in the zigzagging flight track. According to this current model, changing the horizontal or vertical extent of a plume should not cause the tracking pattern, including horizontal and vertical track amplitudes, to change significantly. The aim of this experiment was to examine how *M. sexta* responds to structurally equivalent, dynamic plumes that differ only in the width or the height of their time-averaged edges. We challenged male moths to track plumes of different widths and heights upwind to their sources in a laboratory wind tunnel while we video-recorded their behavior. The video-taped performances were then digitized and analyzed to determine various quantifiable parameters. When structurally equivalent plume sources are used, we found that the moth's tracks became significantly wider with wide plumes but did not become significantly taller with plumes of increased vertical extent. Our findings suggest that, while contact with wind and pheromones are requirements for *M. sexta* to track to a pheromone source, a third parameter (i.e. the boundary of the plume) could additionally contribute to the tracking mechanism of these moths.

Project Mentor: Professor Mark Willis, Department of Biology

The Comparison of Biophysical Properties of Intact Fetal Membranes with Separated Amnion and Chorion Components

Ryan Novince, Departments of Biology and Chemistry, John Moore, Department of Pediatrics and Reproductive Biology

Preterm delivery onset by preterm premature rupture of membranes (PPROM) results in significant neonatal morbidity and mortality. The mechanism of rupture of membranes is unknown. The mechanical strength and other biophysical properties of the fetal membranes are instrumental in understanding the currently unclear etiology of PROM.

We developed membrane rupture testing equipment consistent with “Ball Burst” ASTM standards to test FM strength. A computer-controlled plunger is lowered perpendicularly to FM pieces secured in a specially constructed ring device. Force applied and resultant FM displacement are continuously recorded. We previously reported that a distinct rupture site was present in vaginally delivered membranes characterized by marked weakness with supporting evidence of tissue remodeling and apoptosis. In this study we have set out to compare the biophysical properties of the intact amniochorion membrane with that of the separated individual components (amnion and chorion).

We have developed an extremely precise membrane cutting procedure that allows re-mapping each piece to its former location and orientation. The map permits us to compare the biophysical properties of individual amnion and chorion components with adjacent intact membranes.

Consistent trends were observed between the amnion, chorion, and intact membranes. The amnion was stronger, stiffer, and more ductile than the chorion. The strength of the intact amniochorion was equivalent to the sum of the individual amnion and chorion. Work necessary to rupture the membranes did not demonstrate an additive relationship. The intact membranes were also found to be more ductile than the individual components but less than their sum.

Project Mentor: Professor John Moore, Department of Pediatrics and Reproductive Biology

Tooth decay in the Cleveland Municipal School District

Melissa Orlando and Ellen Thomas, School of Nursing.

Problem Statement:

Our senior capstone project implemented a plan for improving oral hygiene and nutritional knowledge in the kindergarten and first grade population at the Robert Jamison Elementary School. The need to implement this project was overwhelmingly apparent during the state mandated screenings at Robert Jamison, Adlai Stevenson, Michael White, and Whitney Young schools. Our assessments revealed a high rate of dental caries and a lack of knowledge regarding dental hygiene and nutrition. Of the 267 kindergarten and first graders assessed, 48% of the children showed evidence of tooth decay. Many of these children confided that they had never been to the dentist, while many said that they did not own a toothbrush of their own. When asked about the number of servings of fruits and vegetables they ate, many children reported that they were eaten only once or twice per week. We chose to focus our efforts on this population because it is important implement strong hygiene habits and nutritional knowledge at this age level in order to help the children develop a positive attitude regarding nutrition and hygiene

Intervention:

We formulated a three-tiered plan to address dental hygiene and nutritional knowledge with the kindergarten and first grade at Robert Jamison School. At Robert Jamison School, 49% of the 110 children assessed showed dental carries. Just one school was chosen to implement our intervention due to time and cost constraints First, we educated the children on proper hygiene and nutrition using a smile chart created by the student to track brushing progress, an interactive nutrition game, and a demonstration of proper brushing and flossing techniques. We supplied the children with dental hygiene supplies so that they could practice what they learned at home. Recognizing that parents and teachers are an integral part of successful education programs we provided the teachers with lesson plans and activities for use in continuing the student's dental hygiene and nutrition education. The Parents received a useful information packet, which included a coloring book designed to facilitate child-parent interaction. Also, a list of low cost dental hygiene resources was included for the parents.

Evaluation:

In designing this project, we were careful to prioritize the needs of the children by establishing a caring relationship with the students and respecting their diversity. Our project was grounded in compassion and considered the mental, physical, emotional, and social aspects of health. The implemented strategies were chosen due to the data collected during the state mandated assessments. We created three ways to evaluate our interventions. Ideally we would have had the children return the completed smile chart tracking their progress with brushing. Also, a paper signed by the parents acknowledging the receipt of the information packet would have been returned. Due to time constraints, we were only able to implement the teacher survey designed to evaluate the effectiveness of our teaching strategies. All of the Kindergarten and First grade teachers gave us a glowing report. The children were all very receptive to our teaching, and enjoyed our presentation and art project. They were particularly appreciative of their new tooth brushes, tooth paste, and dental floss. All things considered, we feel that our project was a success.

Implications/Recommendations

We chose to focus our efforts on this young population because it is important to implement strong hygiene habits and nutritional knowledge at this age level in order to help the children develop a positive attitude regarding health and hygiene. It is our hope that our project actions will help to save the children from future dental and weight problems. Our project was successful in teaching the children. At this age repetition is the key to learning, so it is recommended that the teachers and parents continue and build upon the lesson plan that we implemented.

Project Mentor: Susan Tullai-McGuinness, School of Nursing.

Special Thanks to:

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Lisa Jevack, and Dr. Lalumandier of the CWRU Dental School

Surfactants for Polymer-Clay Nanocomposites

Matthew G. Panthani, Department of Chemical Engineering

Polymer composites have been used for decades to enhance the properties of a polymer for commercial applications. A polymer composite consists of filler mixed into a polymer matrix. When the dispersion of the filler is on the nanometer scale, the composite is referred to as a nanocomposite. Polymer-clay nanocomposites have gained attention recently due to their superior performance compared to the virgin polymer or regular composites. Many studies indicate improved thermal and mechanical properties in nanocomposites. Clay is of great interest as a nanocomposite filler due to its high specific surface area and its economical price.

A problem lies in the dispersion of clay on a nanometer scale. In its untreated form, clay is hydrophilic and the platelets will aggregate in the organophilic polymer matrix. To enable nanodispersion, clay is ion-exchanged with a cationic surfactant. Intercalation or exfoliation of the functionalized clay can be achieved. Intercalation occurs when the polymer inserts between the layers of clay, while exfoliation occurs when the clay layers are completely separated in the polymer matrix. Exfoliated nanocomposites generally exhibit the highest enhancement of thermal and mechanical properties. The objective of this project is to synthesize and characterize two polymerizable surfactants, and then apply them into polymer-clay nanocomposite systems. Thermal properties of the polymer-clay nanocomposites are analyzed using thermogravimetric analysis and differential scanning calorimetry. Finally, the clay dispersion is examined using x-ray diffraction. Some measured properties of the nanocomposites will be described.

Project Mentor: Professor Syed Qutubuddin, Department of Chemical Engineering

Academic Achievement of Children Diagnosed With ADHD: The Effects of Medication

Amanda Perkins, Elizabeth Short, Department of Psychology; Michael Manos, Cleveland Clinic

Objective: To assess the effectiveness of stimulants in improving the academic achievement of youth diagnosed with ADHD.

Design/Methods: 75 school-age patients participated in a four-week double-blind medication trial. Conditions of dosage were placebo, 5 mg, 10 mg, or 15 mg, with dosage varying by week. Parents and teachers rated youth on the ADHD Rating Scale (ARS), the Abbreviated Symptoms Questionnaire (ASQ), and the Academic Performance Rating Scale (APRS).

Results: Best Dose condition was compared to placebo condition for all analyses. For this sample, 5% were placebo responders, 24% responded best at 5 mgs, 44% responded best at 10 mgs, and 27% responded best at 15 mgs. Best Dose comparisons on parent ASQ revealed effects for dosage, diagnostic subtype, and a dose by subtype interaction. Less symptomatic behavior was reported at optimal dose, inattentive children were less symptomatic than combined children, and the combined subtype improved more than the inattentive subtype. Only dose effects were obtained with the teacher ASQ, with all children improving on medication. The analyses for Academic Potential, Learning Ability, and Social Withdrawal from the APRS revealed striking dose effects, with medicated children on their optimal dose performing better than children on placebo. The analysis for internal control revealed dose effects, as well as a dose by subtypes interaction. All children improved their internal control while on medication, with inattentive children improving more than combined children.

Conclusions: Stimulants are not only an effective treatment for managing behavior, but also appear to improve academic achievement in ADHD youth.

Project Mentor: Professor Elizabeth Short, Department of Psychology

Evaluation of Alternative Isoforms of IAP1

John Poirier, Department of Biology

Members of the IAP (Inhibitor of Apoptosis) gene family play a role in programmed cell death. Classically, IAPs have been shown to block apoptosis by inhibiting caspases such as caspase-3, -7 and -9. Three splice forms for the IAP1 mRNA were observed in the Keri Laboratory. Of the three identified sequences, only one corresponds to a published sequence. A second splice form contains an 85 bp deletion that is consistent with a mouse expressed sequence tag (EST). It is predicted that this sequence has a premature stop codon as a consequence of a frameshift, resulting in a truncated protein. Contained within the truncated region are a caspase recruitment domain (CARD) and a zinc-binding RING finger. The function of these domains in the context of the full length IAP1 appears to inhibit the anti-apoptotic activity of the protein. Based on published reports of contrived deletion mutants, we anticipate that the truncated protein will have augmented anti-apoptotic activity. A third splice form is predicted to result in a protein lacking only the CARD domain, which would make it similar in structure to XIAP. The broad aims of this research project are to assess the ability of each of the IAP1 isoforms to inhibit apoptosis in tissue culture and assess temporal/developmental expression patterns for the IAP1 splice variants in the mouse mammary gland by RT-PCR.

Project Mentor: Dr. Ruth A. Keri, Department of Pharmacology, Case School of Medicine

Longitudinal Prediction of Attention Problems in Prenatally Cocaine-exposed Six-Year-Old Children

Ari Rabkin, Elizabeth J. Short, Department of Psychology; Sonia Minnes, General Medical Studies, & Lynn T. Singer, Department of Pediatrics

Background: Prenatal cocaine exposure has been hypothesized to place children at risk for attentional problems. However, few studies have looked at the long-term attentional effects and consequences of prenatal drug exposure. Early work at the age of four suggested sustained attentional deficits and impulsivity problems not related to parental functioning. When children enter the school age period where demands for sustained attention and suppression of impulsivity increase, it is likely that attentional problems will be even more pronounced. Objective: To examine the prevalence of attentional problems in prenatally cocaine-exposed six year old children, as well as the longitudinal stability of these problems. Design/Methods: Children's attentional performance was assessed using the Continuous Performance Test (CPT), a standardized, normative device used to empirically identify attentional problems. The sample consisted of 312 children (162 cocaine-exposed [CE] and 150 non-exposed [NE]) who were primarily poor, urban, African-Americans. All children have been followed prospectively from birth to six years of age. In addition, parental and examiner report of attentional problems were recorded using the Conner's Rating Scale. Results: Data were analyzed using multivariate analyses of variance with group (CE vs NCE) as the between subjects variable. No differences in attentional measures were observed as a function of cocaine status at 6 years, with minimal differences noted at 4 years of age. Although Cocaine effects appeared to be quite modest, all of our high risk children performed more comparably to ADHD controls than typical children. The stability of attentional problems from four to six years was examined, with some consistency in the relationship noted. Conclusions: Children growing up in poverty are at considerable risk for attentional problems, particularly drug exposed children.

Project Mentor: Professor Elizabeth Short, Department of Psychology

Building a Shaking Table to Test Structural Models

David Rucker, Department of Civil Engineering

The purpose of this project was to build a functional shaking table to perform dynamic tests on structural models. The most challenging aspect of the project was the actual assembly of the table. The main materials necessary for building the table were steel, and a hydraulic actuator. The table sits atop rollers, and the hydraulic actuator is used to vibrate it back and forth at varying frequencies and displacements. Building the table required welding, sanding and painting. The assembly of the table consumed nearly the entire fall semester. The first research project done with the table was to determine the effect of a tuned-mass damper on a vibrating structural model. A tuned-mass damper is used to decrease the effects of vibration, or strain, on a structure. Tuned-mass dampers are used in buildings to prevent vibrations caused by wind or earthquakes from destroying them. Vibrations cause the greatest effects (strains) on structures when the frequency of vibration is the same as the natural frequency of the structure. The natural frequency of the model was determined to be 3.15 Hz, and the peak strain occurred at this frequency. For the structural model tested, the peak strain without the tuned mass damper was 1100. With the tuned mass damper, the peak strain was 532. Therefore, the tuned-mass damper was able to decrease the strain in the structural model by half.

Project Mentor: Professor Dario Gasparini, Department of Civil Engineering

Mass Spectrometric Determination of Turnover Rates for Individual Rat Serum Proteins

Puja G. Samudra, Department of Biochemistry

The determination of the physiological turnover rates for serum proteins is critical for understanding a variety of diseases including cardiovascular diseases. The traditional method of determining protein turnover requires the isolation of each protein in pure form and measures turnover rates for only a single protein at a time. A new method of determining protein turnover is being developed which does not require a purified protein sample is capable of measuring multiple protein turnover rates simultaneously using Matrix Assisted Laser Desorption Ionization Time-of-Flight (MALDI-TOF) mass spectrometry. By determining the ratio of the first isotopomer (M1) to the monoisotopic peak area from a mass spectrum over a time course after deuteration of an organism's plasma, a turnover rate constant can be determined. Serum samples from two rats were obtained over a time course of 14 days with an elevated plasma deuterium concentration maintained by inclusion of 5 atom% D₂O in the drinking water. The serum samples were first passed through a Cibacron Blue™ Sepharose column to reduce serum albumin content and then separated by mass using polyacrylamide gel electrophoresis followed by in-gel tryptic digestion. The proteolytic digest was analyzed by MALDI-TOF MS to identify parent proteins by peptide mass fingerprinting and to determine D-incorporation. Several of the peptides analyzed had incorporated deuterium in significant levels over time, confirming the potential of this method to detect protein synthesis.

In addition, small free peptides from the serum samples were obtained by extracting the serum samples with two volumetric equivalents of acetonitrile. The supernatant obtained from this procedure was analyzed using MALDI-TOF and electrospray HPLC-mass spectrometry and the relative deuteration of one of these peptides was also determined over time. The free peptide analysed revealed no significant change in deuteration over a three day time course.

Project Mentor: Professor Vernon Anderson, Department of Biochemistry

Literacy's Effects on Societal Development in the Cleveland Public Schools

Danielle Scharpf, Ashleigh Hussy, & Karen Schwam, School of Nursing

The Educational Testing Service's 2004 report, Literacy and Health in America, points out the connection between literacy and one's quality of health. This report proposes a connection that literacy is one of the main contributors to the disparities in the quality of health care that different individuals receive. (ETS 1) This report also states that through the analysis of many studies from databases such as Health Activities Literacy Scale (HALS) and The National Adult Literacy Survey (NALS) that, "those with fewer years of schooling are more likely to die from a chronic disease or injury and have higher rates of suicide, homicide, cigarette smoking, and heavy alcohol use than those with higher levels of education" (ETS 1). By looking at this proposed trend, it has been shown by the United States Census Bureau in their 2000 census report that "out of the 963,148 individuals over the age of 25 in Cuyahoga County, only 281,285 or 30% have a high school graduate degree (includes equivalency)" (US Census Bureau, 2002). With this being true, if one compares the trends proven by the Educational Testing Service to this population it shows that this population is at large risk for many health problems.

At two different schools examined within the district, George Washington Carver and Carl Louis Stokes Academy, 75% of the kindergarten class were not at the pre-reading level. Kindergartners through third graders did not know their last names, phone numbers, their shapes or alphabet. This is how trends begin, and later result in failing proficiency exams, repeating grades, not graduating and eventually not holding a job. This vicious cycle is a result of poverty, an obstacle that is very difficult to conquer and leads to societal disparities as well as health problems such as obesity, hypertension, diabetes, and many more disease processes that plague this community. The Cleveland Nurses Chapter reinforces this basic need by stating, "You can't educate a child who isn't healthy and you can't keep a child healthy who isn't educated" (Cleveland Nurses Chapter, 2004). Education and Health are directly related to each other, and have to be addressed together as a unit and not as separate amenities in order to solve any issues pertaining to the community as a whole.

Project Mentor: Professor Lynn Lotas, School of Nursing

Impact of Cognition on Health and Functioning Among Assault Survivors with PTSD

Trevor K. Scheetz, Ari N. Rabkin, Department of Psychology, Case Western Reserve University; **Jennifer Goodpaster & Norah C. Feeny**, University Hospitals Health System, Case Western Reserve University; **Lori A. Zoellner**, University of Washington

Posttraumatic stress disorder (PTSD) is one of the most common psychological difficulties that develop in the aftermath of trauma. Assault survivors in particular are at risk for developing this disorder; three months after an assault, 47% of rape victims and 21% of non-sexual assault victims met criteria for chronic PTSD (Rothbaum et al., 1992; Riggs et al., 1995). PTSD is often chronic and is associated with substantial functional impairment. Health problems are also common and are more likely to occur in trauma-exposed individuals with PTSD than in those without PTSD (Davidson et al., 1991). Furthermore, PTSD is associated with worse physical health than panic disorder, generalized anxiety disorder, and major depressive disorder (Zayfert et al., 2002). Several theorists (e.g., Ehlers & Clark, 2000; Foa & Rothbaum, 1998; Janoff-Bulman, 1992; Resick & Schnicke, 1992) have proposed that negative cognitions play a role in the onset and maintenance of PTSD. Specifically, Foa and colleagues (e.g., Foa & Rothbaum, 1998) have hypothesized that elevated perceptions of world-dangerousness and self-incompetence underlie PTSD. In support of this theory, Foa et al. (1999) found that exaggerated perceptions about the dangerousness of the world, and negative thoughts about the self, distinguished individuals with PTSD from both trauma survivors without PTSD and from non-traumatized individuals. Notably, some have also suggested that such beliefs impact physical health as well (e.g., Cloitre et al., 2001). However, we know very little about the relationship between cognitions, health problems, and impairments in functioning. In this poster, we will examine the relationship between trauma related cognitions, health and functioning in a sample of assault survivors with PTSD.

Project Mentor: Professor Norah Feeny, Department of Psychiatry and Psychology, University Hospitals Health System, Case Western Reserve University

D-serine Has an Excitatory Effect on preBötzinger Inspiratory nNeurons in the *in vitro* Rat Respiratory Slice Preparation

Geoffrey O. Shafer, Department of Chemistry and Psychology; **Musa A. Haxhiu**, Department of Pediatrics, Division of Neonatology; **Christopher G. Wilson**, School of Medicine

D-serine (DSER), the stereoisomer of the prevalent L-serine amino acid present in eukaryotic cellular organisms, is an important neuromodulator in the mammalian brain. DSER plays a role in activation of NMDA receptors at the glycine binding site where it binds with an affinity greater than glycine. DSER release from astrocytes near NMDA glutamate receptor-containing post synaptic membranes plays a role in regulation of cellular activity. In the brainstem, we suggest that astrocytes play a role in regulation of preBötzinger complex (pBc) inspiratory cell function. We hypothesize that DSER acts to enhance synaptic transmission in the pBc and may be integral in astrocyte-neuron communication within the pBc. In our *in vitro* rat brainstem slice preparation, we administered varying concentrations of DSER (2 μ M – 20 μ M) and observed an increase in integrated hypoglossal burst area by 10-35% (n=2) with a 25% increase in interburst interval during experimental conditions as compared to baseline fictive inspiratory burst intervals. With the addition of low levels of DSER to the ACSF bath (8mM K⁺) we also observed rhythm recovery following astrocyte metabolic blockade by fluoroacetate administered at 200 μ M in the bath. We believe that the rhythm recovery is caused by enhancement of NMDA receptor activation by D-serine local to pBc inspiratory neurons and/or pBc-local astrocytes, reflected by an increase in respiratory output through hypoglossal nerve recording.

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Project Mentor: Assistant Professor Christopher Wilson, Department of Pediatrics, Division of Neonatology (also joint appointment through Department of Neuroscience)

Alteration of Catecholamine Metabolism in the rat Brainstem during Intermittent Hypoxia

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Hypertension, characterized by elevated systemic blood pressure, has been known to result from increased activity in the sympathetic nervous system (SNS). Key transmitters in the SNS include catecholamines (CA) such norepinephrine (NE). Tyrosine hydroxylase (TH) is the rate-limiting enzyme in CA synthesis, converting tyrosine to L-DOPA. It has become increasingly apparent that CA play a central role in blood pressure regulation, and alterations in CA activity must be associated with a concomitant change in synthesis. TH activity is regulated by both long- and short-term mechanisms via enzyme stability, transcription, feedback inhibition, allosteric regulation, and phosphorylation. TH is also subject to inhibition by the substrate L-Tyrosine, excesses of the cofactor BH₄, and the product L-DOPA.

Sleep apnea, a form of intermittent hypoxia (IH), is a condition in which breathing stops for several seconds followed by normal breathing during sleep. IH caused by such apneas is known to cause hypertension. However, chronic sustained hypoxia, such as at high altitudes, has no such adverse effects.

We suspect that the ensuing transient hypertension caused by sleep apnea will lead to an increase in TH activity. To examine how TH responds to sleep apnea, rats were exposed to alternating cycles of normoxia and hypoxia to simulate the conditions of sleep apnea. It is known that IH is related to elevated CA levels in the adrenal gland and in PC12 cells. This study examines whether rats exposed to IH would 1) exhibit increased TH activity in the brain stem and 2) display altered CA levels.

Project Mentor: Professor Ganesh Kumar, Department of Biochemistry

Insect Inspired Robotic Foot Design

Brian Taylor, Department of Mechanical and Aerospace Engineering; **Mark Wilson**, Department of Electrical Engineering and Computer Science; **Nicole Sharp, & Michael Cohen**, Department of Mechanical and Aerospace Engineering

Insects have remarkable abilities to walk over a range of substrates as well as up walls and even inverted on ceilings, to accomplish this, they use various different attachment devices that can be grouped into two sets. Locusts, crickets and cockroaches use flexible pads that increase friction and release small amounts of adhesive fluid. Our team has used data on cockroach feet, acquired by our biology colleagues, to design foot structures that capture the insect properties. We will attach these feet to the legs of Robot V, a large pneumatic robot and test the robot for improvements in walking. We have examined pad materials that mimic the properties of tarsal pads on the cockroach as well as tendons for engaging claws and freedom of movement at the tibia-tarsal joint. Two foot designs were developed. One uses passive foot movements, while another actively engages the claw. The feet are being constructed using computerized milling machines in Dr. Quinn's Biorobotics Laboratory. Once mounted on the robot, we will test for reduction of slip as the robot walks. We also developed a computer model that demonstrates the actions of the tarsi, that our biology colleagues observed using high-speed video. This model will be useful in future studies of the actions of cockroach feet during walking in different contexts.

Project Mentor: Professor Roger Quinn, Department of Mechanical and Aerospace Engineering

The Buhrer Theater Project: Empowering Inner-City Children Through Theater

Margaret Wuerdeman, Departments of Theater and Spanish

More than the other arts, theater allows children to experience conflict in the first person. By becoming a character they learn to question motivation and ask why. Although there are many ways to foster critical thinking in children, theater can teach children to look at a problem from a different angle. By acting a part, they consider that person from the inside.

I realized in my sophomore year, while working on a program called “Bridging the Digital Divide” with students from the dual-language Buhrer Elementary, that a gap of artistic enrichment needed to be filled in the Hispanic Community. In the fall of 2004 I devised and began a program where a group of 5th graders will work together as a theater company under my direction, meeting for an hour three times a week to produce a 20 minute play.

During the fall semester ten children performed a bilingual play based on a Puerto Rican Folktale, and this semester 13 young company members are preparing to present an evening of Shakespeare on April 28th which will include scenes from A Midsummer Night’s Dream, Sonnet 29 and the Pavanne (a traditional Elizabethan Dance)

The children in the Buhrer Theater Project are learning lessons of commitment, responsibility and mutual support. They are also gaining a strong sense of accomplishment and self worth, either by performing in Spanish, a language integral to their self-image yet often devalued in the public eye, or through understanding and performing the powerful poetry of Shakespeare.

Project Mentor: Professor Beth McGee, Department of Theater and Dance

Synthesizing A New Comonomer To Copolymerize With A Novel Highly Conductive Polymer To Be Used As A Proton Exchange Membrane For Fuel Cells

Elliot Yamaguchi, Department of Macromolecular Science and Engineering

Much attention has been focused on alternative power due to concern with future fuel shortages. One emerging candidate that has recently gained much focus, especially with vehicular power, are fuel cells. Polymer membrane electrolyte fuel cells (PEMFC's) have gained the most attention because of their high power densities and low operating temperatures. Of the PEMFC's the most widely used membranes are perfluorosulfonic acid polymers, such as Nafion. Looking to improve upon Nafion a new class of polymers, poly(phenylene sulfonic acid)s, has been studied^{1,2} and seem to be a promising alternative owing to the polymers' very high conductivity. However, issues relating to their mechanical properties and water swelling need to be addressed before the materials can become a superior alternative to Nafion. The polymer tends to be brittle and the homopolymer is highly soluble at high relative humidity. Previous work addressed these problems by grafting bulky or crosslinkable nonpolar groups² on the polymer backbone. The grafted copolymers were water insoluble and showed very promising proton conductivity and gas permeability properties, but the synthetic procedure been hard to control and define due to the nature of the grafting process. It is the goal of this study to overcome these problems by synthesizing a new family of compounds to be directly copolymerized into the polymer backbone. Direct copolymerization of these new molecules will enable us to have better control over the structure and solid state architecture of the resulting membranes.

Project Mentors: Sergio Granados-Focil and Professor Morton Litt, Department of Macromolecular Science and Engineering

In Vivo RF Telemetry for Advanced Biological Research

Mark Zimmerman, Department of Electrical Engineering and Computer Science

Real time, long term, *in vivo* biological monitoring of vital signs such as blood pressure, temperature, EKG, and activity is essential in modern biological studies, especially in the realms of genetic function identification and experimental treatments for diseases. Previous methods of monitoring such information in small laboratory animals involved bulky batteries or intrusive wires for sustained power, which can impact the behavior of the studied specimen. A fully implantable system that includes two-way telemetry capability with an external computer circumvents these problems and allows improved continuous and long term biological monitoring.

This project focuses on developing radio frequency (RF) powering methods for such an implanted microsystem. A pair of coupled inductive coils is to be designed such that the microsystem can be continuously and efficiently supplied with 4mW power (at 2V and 2 mA DC current). Such a remote powering system also faces the hurdle of the mutual inductance falling off as a function of relative position of the coils and of angle between them. The optimal powering can be achieved by maximizing the mutual inductance between the two inductive coils and finding an optimum frequency balancing the gain against skin effect and other losses that all increase with frequency. Coils of varying shapes and sizes with different numbers of turns and self resonant frequencies were characterized over a range of frequencies to find an optimum, efficient, remote powering setup. The characterization results are currently used to design and demonstrate a reliable RF telemetry system implanted into a laboratory mouse for advanced biological research.

Project Mentor: Professor Darrin Young, Department of Electrical Engineering and Computer Science