Campus-wide Summer Research Poster Session Abstracts 2017

Induction of ALDH1A1 in Ovarian Cancer Cells Leads to Chemoresistance

Umer M. Khan

Anirban K. Mitra, Indiana University School of Medicine, Indiana University, Bloomington

Ovarian cancer is the most lethal gynecological cancer and is the 5th leading cause for cancer related deaths among women in USA. Most patients respond well to chemotherapy initially but cancer stem cells survive and finally cause lethal relapse. There has been a lot of research done but no major improvement on 5-year survival expectation has been seen for the past three decades. ALDH1A1 is a suitable marker of ovarian cancer stem cells and ALDH1A1 high expression is associated with poor cancer prognosis (Tomita et al., 2016). Cancer cells that are resistant to carboplatin have shown a higher ALDH1A1 expression. In this study we focus on the viability of ovarian cancer cells with higher ALDH1A1 expression after carboplatin treatment.

More copies of plasmid containing ALDH1A1 reporter were amplified via molecular cloning which were then introduced into HeyA8 cells. HeyA8 cells with fluorescent reporter were cultured and treated with 50mM of carboplatin. More cells showed resistance to carboplatin and survived with higher expression of ALDH1A1. Our result indicates ALDH1A1 induction could potentially lead to stemness in ovarian cancer. Some other techniques that were learned in this research were western blotting, MTT assay, and IC 50 determination.

The Spirit of Indiana University

Hannah Bourne

Dr. James Capshew, University Historian, Indiana University

Indiana University has a rich history that deserves to be acknowledged, explained, and celebrated. This summer I had the opportunity to contribute to several projects in preparation for the IU Bicentennial celebration in 2019-2020. I contributed to the study of minority history on campus by digitizing and expanding a directory of African American faculty and staff from 1972-73. I selected a group of photographs from the Bridgwaters and Drake collections in the Mathers Museum to assist in creating a display to highlight the under-represented experiences of African Americans in Bloomington. I also researched the biographies of past IU faculty and staff who wrote, edited, and compiled historical volumes about Indiana University from the 1880s to the 1970s. These sketches will eventually be revised, lengthened, and compiled into a larger essay to acknowledge the contributions these individuals have made in understanding IU's past. I learned to research more effectively by utilizing the University Archives and its online resources. I also had the opportunity to explore the Herman B Wells library and use the multitude of resources available through IUCAT to enhance the depth and quality of my research. I met and gained inspiration from the team of historians working on Bicentennial projects. This summer I obtained a greater understanding of the spirit of Indiana University by immersing myself in the history and culture of the diverse people, programs, and places that built IU into the world-renowned institution it is today.

Racial ambiguity and race essentialism in interracial interactions: perceptions, expectations, and identity contingencies

Glenn Giles Jr

Shahana Ansari, Mary C. Murphy, Department of Psychological and Brain Sciences, Indiana University

Previous research suggests that people expect to be perceived more negatively and stereotypically during interracial interactions compared to intraracial interactions (Shelton, Richeson, & Vorauer, 2006). People holding entity theories of human traits (like biological lay theories of race) are more likely to believe stereotypes of outgroup members and to attribute those qualities as more innate (Levy, Stroessner, & Dweck, 1998), but exposure to racial ambiguity may decrease biological lay theories of race (Sanchez, Young, & Pauker 2014). Therefore, the current research examines perceptions, expectations, and identity contingencies of White participants when anticipating interactions with White, Black, or Black/White Biracial partners. Results show that White participants want to appear unbiased on explicit measures of perceptions of Black and Biracial partners, but still show the most anxiety when anticipating interaction with Black partners and the least anxiety when anticipating interaction with White partners. Findings also suggest that White and Black partners are expected to have a significantly higher probably of saying something offensive as compared to Biracial partners. Future research should look at anticipated interaction with biracial partners who have different component racial groups as well as interactions across different settings.

The Upper Country: French and Native American Experiences in the 17th Century

Jennifer Kucharski

Dr. Konstantin Dierks, History Department, Indiana University Bloomington

The Great Lakes region, known to the French as the *pays d'en haut*, was part of the vast and loosely controlled French colonial empire in North America. Through trade, a complicated network of alliances, wars waged against common foes, religion, and intermarriage the French settlers and the Native American inhabitants of the region created and shaped the region in ways that were very different from how the British and Spanish colonies developed elsewhere on the continent. The Native American tribes of the region acted with agency and were not the passive, grateful, and subordinate allies that European accounts paint them to be. They acted according to their interests and customs, seeking trade, power and allies. The Odawa and Ojibwa, by virtue of geography, were at the heart of the trade network that the French established in the Upper County, though they were far from the only tribes that trades with the French. The balance of power between the French and Native Americans was delicate and though one might assume that the French had the upper hand, the truth is that the French were co-dependent on their Native American allies in trade, waging war, and in diplomatic dealings.

Political Orientation and Perceived Social Norms of Prejudice towards Christians, Jews, and Muslims

Mohamed Z. Abdirisak

Dr. Mary C. Murphy, Department of Psychological and Brain Sciences, Indiana University

We are living in an increasingly multicultural society, with various groups interacting on a regular basis. The purpose of this study is to analyze how Indiana University undergraduates who identify with liberal or conservative political orientations view the social acceptability of prejudice towards three religious groups: Christians, Jews, and Muslims. A 2 (liberal vs. conservative) x3(Christian vs. Jewish vs. Muslim) ANOVA was conducted and revealed a statistically significant main effect of political orientation on perceptions of social norms of prejudice towards religious groups. An ANOVA revealed a significant main effect of religion $F(1.93,2503)=30.8$, $p< .001$. An interaction effect between religion and political orientation $F(11.59,2503.4)=3.066$, $p<.001$ was also observed. This study opens the door for future studies to evaluate why adherents of specific political orientations differentially perceive social norms towards religious groups. Such studies have the potential to shed light on intergroup relations in American society.

The effect of degree and direction of handedness on white matter

Jordan Begay

Hu Cheng, Ph.D., & Sharlene Newman Ph.D. Department of Psychological and Brain Sciences, Indiana University Bloomington

The goal of this research project is to examine the relationship between handedness, both the degree and direction, and brain structure. It has long been demonstrated that direction of handedness (i.e., left- versus right-handed) has an impact of which hemisphere language is lateralized to in the brain with right-handed individuals being left hemisphere dominant and left- handed individuals having a higher rate of right-hemisphere dominance or bilateral localization for language. Additionally, researchers have shown that the degree of handedness also impacts language processing with Newman and colleagues (2014) showing that the degree of right- handedness affects sentence level comprehension. In the current study, we focused on examining the relationship between both degree and direction of handedness on brain connectivity. The data used were diffusion tensor imaging (DTI) scans from the Human Connectome Project. 146 participants were examined with an equal number of left-handed and right-handed individuals to ensure that there was no bias for handedness. Degree of handedness was assessed using the handedness inventory. The inventory assigns a score that ranges from - 100 (pure left hand) to 100 (pure right handed). The average of right-handed group was 55.34. In addition, the standard deviation was 28.3271. The average of the left-handed group was - 58.46; standard deviation was 30. 4553. The number of female subjects in the study was 74; males were 72. We first examined gender differences by using a t-test. Differences were observed in the FA contrast that resulted from the t-test. Differences between left- and right- handed groups were also examined; no differences were observed. Finally, regression analyses were performed to determine whether degree of handedness was related to DTI measures. No significant correlation was observed for either the right- or left-handed groups. Our next steps are to determine whether gender is interacting with degree of handedness. To summarize, 146 subjects from the Human Connectome Project were exhaustively analyzed to examine if there was a correlation between degree of handedness and direction and brain connectivity. Results revealed that there is no correlation.

A New Introduction to Image Processing and Data Analysis: Learning to Use MicrobeJ

Imani Breckenridge-Peete
Ryan Borman, Xingchen Ye, Department of Chemistry, Indiana University Bloomington

When analyzing millions of bacteria through digital images many researchers run into the problem of not being able to study their shapes and irregular forms. Often times bacteria contains information that can't be necessarily acquired by the naked eye or human hand. MicrobeJ is a computer program designed for detecting bacteria features, based on digital images generated from microscopy, which solves this major problem. The program analyzes the complexity and tabulates feature statistics which enhances accurate and precise data collection.

MicrobeJ is a plugin for ImageJ, the popular National Institutes of Health imaging software that uploads images into a simple graphical user interface for automated feature detection. ImageJ facilitates MicrobeJ to perform functions such as the edge detection, segmentation, maxima, and polarity of bacterial populations. For example, the maxima in MicrobeJ is designed to reject background noise as a source of thresholding. Furthermore, MicrobeJ has fluorescence foci that can be analyzed, which helps distinguish the difference between bacteria and background noise through an arrangement of pixels.

The hardest part of maxima thresholding is determining appropriate tolerance values. If the tolerance value is set too high, important bacteria that is crucial to the data analysis will be excluded, making data not representative of the bacteria distribution. In the future, the goal is to continue working with MicrobeJ and other program called MATLAB, to develop customizable imaging algorithms that can fit experimental needs. Ultimately, the goal to learn more about imaging processing through programming to create new software.

Male mouse vocal response to auditory female rejection and estrous state

Eden Long

Kayleigh Hood & Dr. Laura Hurley, Center for the Integrative Study of Animal Behavior, Indiana University

This research project is in the field of social communication, looking specifically at the relationship between "squeaks" and "ultrasonic vocalizations" (USVs) of lab mice. Previous work in the Hurley Lab established that the rejection "squeaks" of female mice altered the quantity of male courtship USVs made. Using randomly assigned male-female pairs (n=6), we performed a behavioral investigation of what squeak qualities are causing a behavioral change. This experiment considered the stage of the female's reproductive cycle (estrous) at time of exposure to male and the squeak structure (amount of nonlinearities in the playbacks of squeaks). Two lab-created hybrid squeaks (and one unmanipulated averaged squeak) were made from one naturally recorded 20 minute interaction between a male/female pair that had shown to decrease USVs. Each instance of a rejection squeak was replaced either with artificially High nonlinearity, Low nonlinearity, or Average squeak. These, with the added variable of a silent playback for control, were randomly presented through a speaker to the pairs in a specially designed cage during 72 (12 per male) total recording sessions. We also recorded video of the pair's behavior and the estrous stage of each female on each day. The results of this experiment showed that, compared to silent controls, the quantity of USVs increased with Low nonlinearity, and decreased with the Average. The High nonlinearity did not show significant change, and there were mixed results regarding estrous stage and vocal behavior's influence.

Aumunique Page

Jason Tennessen, Department of Biology, Indiana University

This experiment focused on which metabolic genes are important for differentiation in drosophila. By disrupting the expression of the genes, we are interested in, we can determine if that particular gene is important for differentiation. To disrupt the expression, we used the Gal 4/UAS system which allows for a gene to only be expressed in the presence of Gal 4. We crossed virgin females from three drivers, eya composite Gal 4, GMR Gal 4 and Vg Gal 4, with RNAi males with a disrupted metabolic gene. We then observed their offspring and checked eyes and wings for any defects that may have occurred. We found that the genes that exhibited a phenotype were related to the electron transport chain and phosphatidylinositol metabolic pathway. This led us to believe that differentiation requires electron transport chain and oxidative phosphorylation.

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Seed Mediated Synthesis of Gold---Copper Bimetallic Nanoparticles

LeAndra Slayton

Xingchen Ye, Department of Chemistry, Indiana University

This study forms homogeneous gold nanoparticles by reducing $Au^{3+} \rightarrow Au^{0}$ with the reducing agent borane---tertbutylamine (TBAB), capping reagent (olelyamine), and gold precursor ($HAuCl_4$). The prepared gold nanoparticles were combined with tri--- n---octylamine, copper acetate, and dodecylphosphonic acid (DDPA) to produce bimetallic gold---copper alloy nanoparticles. Both nanoparticles were collected by purification twice with ethanol by centrifuge at 5000 rpm for five minutes

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Development of iron oxide based nanoparticle vaccines for the HPV-16 virus

Regine H. Vincent

Austin Reilly, Jasper Dittmar, Barry D. Stein, Lyudmila M. Bronstein, Department of Chemistry, Indiana University, Bloomington

The project concerns the development of thermally stable iron oxide nanoparticle-based vaccines for the HPV-16 virus through the assembly of L1 protein pentamers on the surface of functionalized iron oxide nanoparticles. Although several effective vaccines exist against the HPV-16 virus, such vaccines are often expensive and often lack thermal stability, thus presenting delivery and distribution problems for the developing nations that utilize these vaccines. Nanoparticle functionalization was conducted by utilizing three types of PEGylated phospholipids with thiol, carboxyl, and amino terminal groups. Protein attachment with the SH and NH_2 functionalized nanoparticles was achieved through the use of an NHS crosslinker and covalent attachment. The COOH functionalized nanoparticles utilized an electrostatic self- assembly process to conduct HPV protein attachment to the nanoparticle surface. Attachment conditions were studied by varying pH and ionic strength of the solution, as well as by modifying protein to nanoparticle to crosslinker ratios.

Upon functionalization, transmission electron microscopy (TEM) was utilized to observe the efficiency of phospholipid coating. After protein attachment, immunogold staining as well as TEM were utilized to determine the presence of virus protein on the nanoparticle surface.

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Synchronous cell division in temperature-sensitive dnaA *mutants of* Streptococcus pneumoniae

Carley Berg

Malcolm Winkler, Department of Biology, Indiana University

Streptococcus pneumoniae is a Gram-positive, opportunistic human respiratory bacterium.
In *S. pneumoniae*, multiple proteins are involved in cell division and peptidoglycan (PG) synthesis, and play significant roles in virulence. Of specific interest to this project is the divisome, which constitutes all the proteins involved in cell division. Currently, *S. pneumoniae* is grown in batch cultures that exist in a mixture ranging from newly divided cells to a diplococcus almost ready to divide. Any study on protein interactions that occur at one stage but not another is obscured by the mixture of cells in different stages of division. The goal of this work is to develop a method to achieve synchronous growth by generating temperature sensitive strains, to allow for the testing of phenotypes or events specific to a discrete stage of division. Studying peptidoglycan biosynthesis and cellular division in synchronized populations (in which a majority of the cells are in the same stage of growth) will allow for greater clarity in the understanding of protein interactions in dividing cells over time. It was observed that in a temperature sensitive (ts) *dnaA* mutant strain, 70% of the cells were in stage 1, compared to 45% in the wild type strain. Future work will seek to optimize synchronization conditions, and develop methods to quantify synchronicity. This data represents the first observed occurrence of synchronization in *S. pneumoniae* and will be an extremely useful tool for studying transient and rapid protein interactions throughout the entire *S. pneumoniae* division cycle.

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Cranial Window Surgery for Longitudinal Imaging in Mice

Jessica Felker

Hui-Chen Lu, Linda and Jack Gill and Department of Psychological and Brain Sciences, Indiana University

Fast communications among a large number of neurons within the brain is critical for human cognitive functions and behaviors. Detecting such communications within neural circuits is becoming possible with multiphoton microscope imaging in awake behaving mice. It is known that intracellular Ca^{2+} levels rise significantly during neuronal firing, so the presence of a molecule that fluoresces in response to Ca^{2+} influx allows the measure of neuronal activity in real time via multiphoton microscopy. Before imaging, a cranial window surgery must be performed. This entails removing a small portion of the skull and replacing it with a 2mm glass coverslip. If the window remains clear, neural activity of the same animals at different testing periods or using different drugs can be monitored. This summer, the cranial window surgery was practiced on transgenic mice expressing a genetically encoded calcium indicator. This calcium indicator labels active neurons. For practice, the astrocytes were labeled with an easy to inject cell label dye. Images that reached a depth of 271.575µm into the brain were obtained. Our Future goal is to examine whether chronic exposure to marijuana psychoactive compound Δ9-THC during adolescence will have long lasting impacts on neural communications.

Modeling of Bacterial Growth in the Presence of Bacteriocin

Emma McCardwell

Sima Setayeshgar, Department of Physics, Indiana University Bloomington

Bacteriocins are chemicals that bacteria produce that can kill other closely related species. To better understand these toxins and how they affect their surrounding environment, we searched to find a model of bacterial growth that included the effects of bacteriocin on a population. From the Bashey lab, results showed an increased lag time of the sensitive population with an increase of bacteriocin concentration. We searched to find a model that would include this finding and decided to use the Markov model as a basis. The Markov model uses a reaction scheme to describe the growth of bacteria. To include bacteriocin, several variables had to be added to the model. The first was a depletion of the sensitive cells due to the presence of the bacteriocin. In addition, there is an appearance of resistance due to a mutation in the sensitive cells. By adding in these variables, we found the graph showed the same trend as the experimental data in that a higher concentration of bacteriocin caused an extended lag as well as a lower peak in the growth of the cells. For the model to be further utilized, there are still unknown parameter values that need to be determined. The next steps in this research would be to fit the model to the data and then use it to answer some questions by altering different conditions.

Articulatory and Acoustic Correlates of Tongue Root Contrasts in Gua

Samantha Myers

Kelly Berkson, Department of Linguistics, Indiana University

Vowel systems in West African languages are often noted for their use of tongue root (TR) contrasts rather than the tense/lax distinctions of a language such as English (e.g. the vowel /i/ as in *beat* vs. the vowel /ɪ/ as in *bit*). In some of these languages (e.g. Igbo), pairs of vowels such as /i/, /ɪ/ differ only with regards to tongue root position—the height of the tongue body is quite similar—while in others (e.g. Akan) such pairs differ both in terms of tongue root advancement and in terms of tongue height (Ladefoged and Maddieson 1990). One question of interest is whether TR advancement can be controlled independently of changes in tongue height—data from some languages indicate that the answer is yes, but imaging data from additional languages will prove informative. I present 3D ultrasound data from Gua, a Kwa language from the Niger Congo family spoken in coastal Ghana (Simons and Fennig 2017, Yeboah-Obiri 2013). This is a critically under-documented language which is reported to contain TR contrasts in all high and mid vowels (Advanced TR: /i e o u/; Retracted TR: /ɪ ɛ a ɔ ʊ/). Results from articulatory and acoustic data confirm the presence of tongue root advancement contrasts. Differences in tongue height in addition to TR advancement are often, but not always, present.

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Perceptions on Marital Surname Choice

Amber Nelson

Kristin Kelley, Department of Sociology, Indiana University

The purpose of this project is to utilize the perceptions surrounding the choices that men and women make regarding marital surname upon marriage in order to get a glimpse at the current state of marital name choice standards, and the relation which those standards have to gender and income. A total of 439 men and women from across the United States read a brief description of a heterosexual couple, which included their plans for surname upon marriage and their income. There were five different surname conditions, which included where the woman takes man's name, both keep birth names, woman hyphenates and the man does not, both the man and woman hyphenate, or the man takes the woman's name. Participants were told that the couple's household income would be either $40,000 or $110,000. Participants then rated the man and women separately on a range of characteristics and answered a few open ended question. Preliminary descriptive statistics show that women are viewed as more dominant in scenarios where the women keeps her name and the man engages in some sort of surname change. Additionally, the man was rated as being more committed than the woman in every scenario, except the traditional scenario where the woman takes her husband's name. The same was true for general and personal likability. These results held steady when the couple was given a working class income as well as when they were given an upper class income.

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Roles of RNA pseudouridylation in thermal nociception in Drosophila

Neha S. Patel

W. Daniel Tracey Jr. PhD, Department of Biology, Indiana University

Pain serves an indispensable, protective role in humans, but it also has a major negative impact on human life. It is of urgent importance to make research efforts to uncover the basic molecular and cellular mechanisms involved in pain to understand and better treat it. Previous work in the lab has indicated the involvement of RNA pseudouridine synthase RluA---1 in thermal nociception using the Drosophila larval model system. RluA---1 and RluA---2 are located side by side in the Drosophila genome; thus, it is likely that RluA---1 resulted from the gene duplication of RluA---2. By generating the fluorescent GFP gene tags and protein tags in RluA---1 and RluA---2, we will be able to assess their endogenous gene expression and protein localization. It will also enable us to monitor and knock down their gene expression by using an anti---GFP strategy. The study will be able to illuminate the molecular and cellular mechanisms underlying the roles of RNA pseudouridylation in the nociception process.

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Ascorbic Acid Combined with the Anti--Diabetic Drug Metformin Synergistically Induce Cell Death in Breast Cancer Cells

Shweta Saxena

Saleha B. Vuyyuri, Mira Prabhakar, Keith R. Davis, Biotechnology Program, Department of Biology, Indiana University

Breast cancer remains a serious problem, with an estimated 1.7 million new diagnoses annually world--wide, with ~250,000 new cases being diagnosed in the United States. The present conventional therapies not only kill the tumor cells, but also damage surrounding normal tissue, which leads to deleterious side effects in patients. Metformin, an anti--diabetic drug, has been shown to have anti--tumor activity and target cancer cells by activating AMPK or via mTOR inhibition of protein synthesis and subsequent reduced tumor cell proliferation. We showed that pharmacological doses of ascorbic acid (AA) are selectively toxic to non--small cell lung cancer (NSCLC) cells through a ROS--dependent mechanism and that AA combined with a glycolysis inhibitor synergistically induce apoptosis. We have extended these studies by investigating the effects on breast cancer cells (MCF--7) of AA alone or in combination with Metformin at physiological glucose concentrations. Cell viability assays were used to study the effect of AA, metformin or combinations of both on MCF--7 cell proliferation. The major significance of these studies is that pharmacologic concentrations of AA selectively synergize with Metformin and that cell death is enhanced at the lower glucose levels commonly found in tumor microenvironments. The study suggests that this combination treatment may represent a promising therapy for breast cancer patients.

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Controlling Anion Affinity

Sydney Stutsman

Amar Flood, Department of Chemistry, Indiana University

The ability to regulate anions is necessary for the safe and sustainable production of energy from nuclear power plants. Anions, such as the radioactive pertechnetate, can be found in nuclear waste and hinder the treatment of the waste. While anion receptors like macrocycles effectively bind anions, the stripping process to remove them is not effective as a result of the anion's affinity for the macrocycle. To create an efficient extraction process, the anion receptor must be able to controllably release the anions after they are bound. Foldamers, unlike macrocycles, have large degrees of freedom and are not conformationally restricted. Using photoswitches, the foldameric conformations can be controlled with light through isomerizations. The first generation foldamer used azobenzene[1] as a switch and had an eight-fold decrease in binding strength upon isomerization allowing it to release the anion as desired. To enhance the binding differential between the binding and releasing conformations a new photoswitch with a more efficient isomerization, like arylazopyrazole,[2] needs to be used. The new foldamer is being synthesized through a new pentad method which will create a universal building block for future foldamers.

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Site-specific Incorporation of CN Probes for Characterization of P450 Dynamics

Katherine Thibodeau

Marissa Dobulis, Edward Basom, and Megan Thielges, Department of Chemistry, Indiana University, Bloomington

Cytochrome P450s (P450s) are a class of enzymes that catalyze hydroxylation of unactivated hydrocarbons, and as such, P450s play integral roles in the metabolism of many pharmaceuticals. However, the mechanisms by which P450s control specificity and regioselectivity of their activity are incompletely understood due to spatial heterogeneity and the broad timescales of protein motions. Toward addressing this challenge, infrared (IR) spectroscopy is employed to characterize dynamics with high spatial and temporal resolution.

However, protein IR spectra are inherently congested due to the large number of functional groups in proteins. To alleviate this, we applied the *in vivo* amber codon suppression technology to incorporate vibrational probes into the archetypal cytochrome P450cam. These probes have spectrally isolated frequencies and local mode character which enables analysis of protein dynamics and environments. Specifically, *p*-cyano-L-phenylalanine (CNF) was incorporated at residues Y96 and F87, which provides IR probes in close contact with the substrate in the P450cam active site. According to previous studies from our lab, incorporation of CNF at the Y96 position affects confrontational heterogeneity, but does not affect regioselectivity of P450cam hydroxylation. The goal of future studies is to further investigate this observation via two-dimensional infrared vibrational echo spectroscopy in order to site-specifically characterize the role of P450cam active site dynamics in P450cam function.

Gender Differences in Norms Used During Charitable Giving

Shilyn Alexander

Julie Eyink & Dr. Edward Hirt, Department of Psychological & Brain Sciences, Indiana University

Social norms often guide our behavior. Two types of social norms have been discussed in the social psychological literature: injunctive norms and descriptive norms. Injunctive norms describe what behavior is the right thing to do; descriptive norms inform us as to what behaviors most others are doing. The purpose of this study was to examine gender differences in the use of injunctive and descriptive social norms in the context of charitable giving. We hypothesize that women would be more likely to follow injunctive norms, whereas men would be more likely to follow descriptive norms when it comes to charitable giving. In the present research, we conducted a survey on Amazon Mechanical Turk that used a cover story describing how the Amazon CEO was soliciting users' opinions as to which charities his large donation should be given. Additionally, MTurk users were given information about one charity (the Red Cross) that manipulated both the injunctive norm (it was a good charity or a bad charity to donate to) and the descriptive norm (most other participants donated or did not donate to the Red Cross). Participants were given $100 to donate among three options: the Red Cross, Direct Relief, and Internet and Hotspot Fund. Results indicated that both men and women followed the injunctive norm. MTurk users donate more to good charities than to bad ones, and were unaffected by the descriptive norm. Discussion focuses on reasons why we did not find the predicted interactions with gender, as well as implications for ways to increase charitable giving.

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Decoupling an Endosymbiotic Mutualism

Will Austin

Zoe Dinges & Dr. Curt Lively, Department of Biology, Indiana University

The purpose of this experiment is to breed *Steinernema* nematodes that are isolated from their naturally-occurring endosymbiotic bacteria *Xenorhabdus.* The process of developing axenic nematodes is the first step to evolving novel nematode and bacteria lines. We plated bacteria and added nematodes in order to obtain nematode eggs. The eggs were bleached, clearing them of bacteria, and then placed on liver agar plates to develop. We successfully developed a strain of nematodes free of their endosymbiotic bacteria. Our results allow for the selection of combinations of nematodes and bacteria, which may be utilized for evolutionary research, environmental research, and potentially offer farmers an eco-friendly pesticide.

Social Norms and Charitable Donations

Meagan Borchelt

Julie Eyink & Dr. Edward Hirt, Department of Psychological & Brain Sciences, Indiana University

Social norms are what is seen as acceptable behavior by society. Two social norms that have been extensively studied are injunctive and descriptive norms. Injunctive norms are behaviors seen as the right thing to do, whereas descriptive norms are characterized by changing one's own behavior to match the behavior of the majority of others. We are testing these norms in a charitable donation setting to see how people respond when both are present and in conflict; specifically, we examined if the responses of men and women differ. Participants took an online survey through Amazon Mechanical Turk in which they read information that varied both the injunctive and descriptive norms about donation to a specific charity (Red Cross). Then, participants were asked to decide how to allocate $100 given to them to three different charitable organizations (Red Cross, Direct Relief, Internet Hotspot Fund). Results revealed there was a significant main effect on the injunctive norm, but the descriptive norm had no effect on charitable donation. Our findings indicate that men and women responded the same to the injunctive norm and clearly favored doing the right thing. The implications of these findings for the use of social norms to direct behavior are discussed.

Social Norms & Personal Prejudices: Differences in perceptions of mothers and fathers who stay at home or leave their families

Fabiana Cotton

Katie Kroeper, Shahana Ansari, Ben Oistad & Dr. Mary Murphy, Department of Psychological & Brain Sciences, Indiana University

This study examines the social norms and personal prejudices towards mothers and fathers who stay at home and mothers and fathers who leave their families. The aims of this study is to explore the familiar stereotypes of the "Deadbeat Father", and if the same sentiment applies to mothers who leave their families. Participants (N=461), recruited from Amazons Mechanical Turk, were surveyed about the social norms regarding prejudice and their personal prejudice towards these groups. Consistent with our hypotheses, we found two main effects: (1) Across all groups, social norms were perceived more negatively than personal prejudice. (2) Participants rated perceived social norms and personal prejudice towards absent parents (both mothers and fathers) more negatively than stay at home parents. The main effects were qualified by an interaction between the different groups and type of prejudice in which, participants rated perceived social norms more negatively for stay at home fathers than stay at home mothers, with no difference in ratings of personal prejudice. Lastly a significant difference was found that in general, absent fathers were rated more negatively than absent mothers. These results suggest more negative stigma towards absent parents, specifically absent fathers, possibly supporting the common narrative of the "Deadbeat Father" that might have affected our results. Future research intends to examine the effects that race, household income/ employment, and political orientation have on these prejudices.

Social Norms and Personal Beliefs

Shakeela Dozier

Katie Kroeper, Shahana Ansari, Ben Oistad & Dr. Mary Murphy, Department of Psychological & Brain Sciences, Indiana University

This study was conducted to examine the relationship between the expression of personal prejudice and the perceived social norms surrounding this prejudice towards lesbian, gay, bisexual and transgender (LGBT) individuals. A sample of 466 participants took an online survey, asking them to rate to what extent society thinks it's socially normal to express negative views towards LGBT individuals as well as their own expressed prejudice towards these same sexual minorities. Participants felt that Americans feel it is significantly more socially acceptable to express negative views towards LGBT individuals than they personally feel is acceptable. People perceive it to be more socially acceptable to hold prejudice against sexual minorities than the prejudice they hold personally. Participants expressed greater personal prejudice and believed it to be more socially acceptable to express these prejudices towards transgenders significantly more than other sexual minorities. These findings aid in understanding prejudice against transgender individuals in relation to other sexual minorities and can help lay a foundation for future research to help understand and combat anti-transgender prejudice.

Handwriting during Literacy Development

Amanda Ellison

Sophia Vinci-Booher & Dr. Karin Harman, Department of Psychological & Brain Sciences, Indiana University

Handwriting is an important part of early education. The purpose of this research is to learn more about the relationship between handwriting and the development of skills targeted by early education. The goal is to select handwriting parameters that best measure handwriting ability and to determine if these parameters correlate with the development of skills targeted by early education, such as letter recognition, visual-motor integration, and overall literacy. We gave younger children (ages 4.5 - 6.5 years), older children (ages 6.5 - 8.5 years), and adults behavioral assessments using a digital writing tablet that collected twenty-seven handwriting parameters. We selected three handwriting parameters, pressure, duration, and pen angle, for further analyses based on how well the parameter distinguished between writers from the three age groups. We then performed correlation analyses between each handwriting parameter and the scores on the three behavioral assessments in only the child samples, controlling for age. We found that overall literacy correlated with duration and pressure and that visual-motor integration correlated with duration. Our results indicate that there is a relationship between handwriting and the development of skills targeted by early education.

Electronic Wearables for Nonverbal Children

Briana Hollins

Katie Siek, School of Informatics and Computing, Indiana University

This paper explores the scope of electronic wearables in equine therapy, preferably with children in equine therapy, using LilyPad Arduino. The two prototypes that were created, prototype two is still in the process of being completed, were meant to assist children and/or adults during equine therapy. The prototypes are called leg strap communicators and consists of four phrases that are commonly used during horseback riding for the horse and the constructor. Our research consisted of opinions that will be given by the participant and the therapist who accommodates the participant while using the prototype. Learning from the first prototype gave us a margin for creating the second prototype, which is the prototype that is being used to test with the participants. The assumption of which versions of communication the nonverbal children and/or adults. With no current results, our hope is for positive feedback from the therapist and participants. A survey will eventually be given to the participants that will we will use to improve the leg communicator.

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Trait Integration in the Limbs of Flying and Flightless Birds

Ali Lacer

Spencer Hellert & Dr. P. David Polly, Department of Geological Sciences, Indiana University

The purpose of this study is to discover if the evolution of flightless bird limbs is constrained due to integrated traits and if so, find the cause of that integration. Causes include genetic and developmental factors (e.g. one gene controlling more than one trait) or functional factors (e.g. two or more traits are involved in the same biomechanical function). Trait integration can result in the constraint of evolution, because natural selection may not be able to optimize animal form. The evolution of trait integration patterns in bird limbs and the factors underlying those patterns will inform our understanding of how evolution is constrained and the consequences of constraint, including extinction. To do this, we used geometric morphometric methods to quantify and compare trait integration within and between the major skeletal elements of flying and flightless bird limbs. After analyzing the results, it was evident that there were no significant differences between the leg bones of either flightless or flying birds. There were more differences within the arm bones of flying and flightless birds than in the leg bones. The Humerus and Manus comparison was more significant than the Humerus and Ulna comparison, but only the Ulna and Manus comparison were significantly different within the evolutionary relationship between the shape of the bones in flying and flightless birds. In conclusion, developmental/ genetic factors underlie the trait integration in the limb bones of all birds, except for the manus and Ulna bones in which the evolutionary relationships of trait integration may be broken in flightless birds by the relaxation of the biomechanical requirements of flight.

Examining Authentication Practices via Login Logs

Henry Lin

Jacob Abbott & Dr. Sameer Patil, School of Informatics and Computing, Indiana University

The purpose of this research project is to look how acceptable two factor authentication is optional compared to when it mandatory at different levels. The data for the research set was gathered from UITS (University Information Technology Service) which is private data. The data set was analyzed using R Studio a software used for statistical computing and graphics. From this research, we show the percent of use of different types of two factor authentications and the success and failure rate of user when attempting to login. Two factor authentication is applied at IU as a form of IU Duo that is a two-step process when logging to improve the security of private information.

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Ubiquitin Carboxyl-Terminal Hydrolase 1 Acts as an Oncogene in High-Grade Serous Ovarian Cancer

Stephanie Marroquin

Dr. Sumegha Mitra, Medical Sciences Program, Indiana University

High Grade Serous Ovarian Cancer (HGSOC) is the most malignant type of ovarian cancer. HGSOC is highly metastatic and most patients develop chemo-resistant tumors. 96% of patients have mutations in tumor suppressor gene *TP53*. This research focused on Ubiquitin Carboxyl-Terminal Hydrolase 1 (UCHL1), which is a cancer-associated deubiquitinating enzyme. We observed high levels of UCHL1 in metastatic tumors of HGSOC patients. This research is conducted to understand the functional role of UCHL1 in HGSOC progression. We silenced UCHL1 gene using siRNA to silence the UCHL1 gene expression. A transwell migration assay was performed to check if UCHL1 is involved in cancer cell migration.

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A genetic screen to identify metabolic enzymes that control Drosophila melanogaster *development*

Joy Morounfolu

Rose Massey & Dr. Jason Tennessen, Department of Biology, Indiana University

This research involves the identification of metabolic genes required in *Drosophila melanogaster* eye and wing development. In this project, we used the Gal4/UAS system to eliminate target gene expression using RNAi. The flies are then scored once offspring eclose. GMR Gal4, eya composite Gal 4, and Vg Gal4 are the three drivers used in this experiment. Five virgin females containing the driver (GMR Gal4, eya Gal4, or Vg Gal4) are put in a new food vial. If there is no phenotype seen in the control (GMR), but there is a prevalent phenotype in the pre-differentiation driver (Gal4 eya), the targeted gene potentially regulates tissue development. In the ten stock numbers of fruit flies that displayed phenotypes, eight of those ten produced phenotypes in >50% of flies. Most of the identified genes encode components of the electron transport chain and phosphatidylinositol metabolism. Five of the genes are members of the electron transport chain. This result suggests that oxidative phosphorylation is required for differentiation to occur. There are three inositol phosphate metabolism genes that were identified. The importance of phosphatidylinositol to differentiation is still unclear and requires further study.

Effects of participation in a high-impact sport on multiple compartments of white matter

Leilani Ruiz

Bradley Caron & Franco Pestilli, Department of Psychological & Brain Sciences, Indiana University

In athletics, a problem of growing concern is subconcussive impacts, when people receive multiple hits to the head without having common symptoms of a concussion, and their effects on the brain. The purpose of this study is to determine if there are differences in white matter structural integrity in athletes involved in a high-impact sport compared to athletes not involved in a high-impact sport and non-athletes, using diffusion magnetic resonance imaging (dMRI). To do this we recruited 4th and 5th year varsity Indiana University football players. We compared them to varsity IU cross-country runners and to non-athletes with a matching socioeconomic status. We used dMRI along with advanced tractography techniques to measure the structural integrity for multiple cellular components of white matter. This will allow us to determine which components are affected most following participation in a high-impact sport, which will help us understand the pathophysiology of brain trauma.

Is there a sticker price on personal information?: People's Valuation of Personal Information on Social

Lane Skutt

Sanchari Das & Dr. Sameer Patil, School of Informatics and Computing, Indiana University

Data aggregation companies exist. There is a vast market that consumes an abundance of information from people on social networking sites (SNSs). This information is easily collected for free, without permission of the providers, who lack asset consciousness. At this point in time, there is little information on how people value their personal information, especially after discovering that there is a market. When people release their personal information, then are primed with the knowledge of data aggregation companies, people suddenly become defensive and express attachment. By surveying Facebook users, we investigated this switch in behavior as the psychology of ownership—a great influence to the valuation of information.

Dog's Interaction with Technology

Cole Smith

Dr. Patrick Shih, School of Informatics and Computing, Indiana University

This research looks at dog's interaction with technology and the dog owner's perception of that technology. This is important to discover if technology helps or harms human-dog bonding. How do people perceive and use digital technology to interact with their pets? This is the specific question asked to see the effects of technology not just on the dog but the owner as well. We did an extensive literature review and used that knowledge to form survey questions. We then gave participants one of the two smart dog toys (GoBone or PupPod) for two-three days and recorded their survey responses. The GoBone tests the effects of movement on the perception, behavior, and bonding experiences between the pet and the owner while the PupPod tests the effects of audio and light. I anticipate these toys will negatively affect human-dog bonding by providing an additional barrier between pet and owner.

Dog's interaction with technology: How people perceive and use technology to interact with their pets

Ali Talib

Dr. Patrick Shih, School of Informatics and Computing, Indiana University

We studied dog computer interaction to understand how the use of technology can perceive and influence dog behavior. Our main objective is to learn about the implication of the interaction of human-dog-technology and what could come out of our understating of their special bonding. Finding the effect of technology on human and dog interactions will give us a deeper understanding of how technology could influence their bonding experience. We will use PupPod and GoBone to study how robots emitting audio and light signals and physical movements could affect the perception, behavior, and bonding experience between the pet and the owner. We anticipate a positive interaction, yet there is still a possibility of the device being a barrier between human and dog interaction, due to the dog inability to recognize who is controlling the device. This research will mainly be focused on the effect of technology on dog and human interaction.

Electronic Wearables for Nonverbal Children

Arsema Teklezghi

Katie Siek, School of Informatics and Computing, Indiana University

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Sensorimotor neurophysiology: normative data in proprioceptive measurements using a custom tablet-based tool

Jean Paul Villalobos

Dr. Hannah Block, Department of Kinesiology, Indiana University

The main purpose of this study is to find the normal range of proprioception in different age groups. The different age groups we have tested are 18-49 year olds (referred to as the younger age group) and 50-95 year olds (referred to as the older age group). 40 people were tested using an experimental tablet based procedure-the Adaptive Staircase, a less subjective version of the Passive Motion Direction Discrimination (PMDD), and the Purdue Pegboard test. Although we have not tested the desired amount of people, we have a general idea of the normal range in different age groups.

Surface Curvature Affects Macrophage Uptake of Microparticles

Leah Buck,*[1]

Pariichay Limbodia,*[2] Samantha Lisy,*[3] Wenqian Li, [4] Lucero Sanchez, [3] and Yan Yu[3] * These authors contributed equally to this work[1] Department of Chemistry and Physics, Saint Mary's College, Notre Dame [2] Department of Chemical Engineering, Indian Institute of Technology Bombay, Mumbai, India [3] Department of Chemistry, Indiana University, Bloomington [4]Department of Cellular and Molecular Biochemistry, Indiana University, Bloomington

Use of microparticles for drug delivery has been investigated for the last several decades. In order to develop effective pharmaceutical carriers, it is imperative to understand how altering particle properties affects immune cell-particle interaction. While extensive research has been completed on how size, surface chemistry, shape, and polymer makeup influences macrophage uptake of microparticles, there is limited information on how surface curvature affects phagocytosis.[1-3] This work investigates the internalization efficiency, route of internalization, and intracellular distribution of 1 micron polystyrene particles of varying curvatures. Particles were functionalized with fluorescently labeled immunoglobulin G (IgG) antibodies and cell-particle interactions were observed using live cell fluorescence microscopy. Results indicate that particle internalization efficiency varies with surface curvature, but increases across all surface curvatures with increased incubation time. Particles of differing curvatures further exhibit distinct patterns in their cell entry route; the displacement and rotation patterns tracked during cell entry vary between particles. These results may lead to an increased understanding of macrophage-particle interactions and may be applied to design particles to either target or evade macrophages, based on biomedical application.

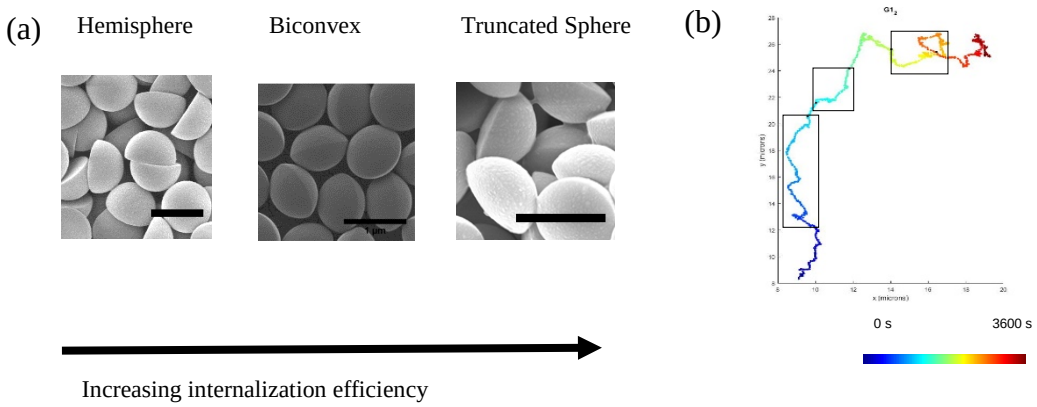

Figure 1. (a) SEM images of microparticles of varying surface curvature of increasing internalization efficiency over 10 minutes. Scale bars are 1 μm[4] (b) sample particle trajectory during internalization. Time is indicated by the color gradient. Boxes indicate areas of observed rotation.

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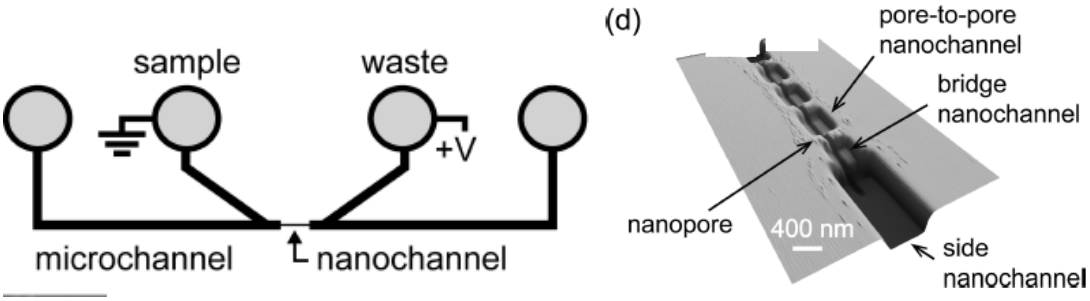
Monitoring Disassembly of Hepatitis B Virus Capsids with Resistive-Pulse Sensing

Aaron Capps

Mi Zhang, Stephen Jacobson, Department of Chemistry, Indiana University

Hepatitis B Virus (HBV) affects over 240 million people worldwide and is the leading cause of hepatocellular carcinoma and cirrhosis.[1] Developing methods to understand virus assembly and disassembly can advance our understanding of virology[2] and anti-viral therapy.[3-5] In contrast to viral assembly, HBV capsid disassembly processes are less well understood, but are crucial to the viral life cycle as they help govern viral genome release and capsid stability. We studied disassembly of HBV with resistive-pulse sensing on in-plane nanofluidic devices with multiple pores in series. Resistive-pulse sensing has an advantage over other in vitro bioanalytical techniques because it can monitor assembly and disassembly kinetics of single viral capsids in real time. We have evaluated HBV capsid kinetics over a range of concentrations of urea in order to monitor capsid disassembly kinetics, determine the thermodynamics of the disassembly products, and observe possible intermediates that form during the reaction.



Left - Schematic of an in-plane glass nanofluidic device with two V-shaped microchannels separated by a nanochannel with four pores in series.[6] Right – Atomic force microscope (AFM) image of a 4-pore nanofluidic device.[6]

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Mapping of Light Propagating through Arrays of Nanoscale Apertures

Andrew G. Dallman

Tine Greibe, Stephen C. Jacobson, Department of Chemistry, Indiana University, Bloomington

The negative-tone photoresist SU-8 2010 is used to generate three-dimensional mapping of light propagating through nanoscale apertures in a metal film.[1] The resulting structures are well- controlled by the dimensions and design of apertures together with light exposure dose through the apertures. Nanoscale apertures (circles) with diameters of 0.1-0.5 μm were milled with a focused ion beam (FIB) instrument in a ~120 nm chromium layer coated onto a glass substrates. After milling, the substrates are spin coated with SU-8 and illuminated with UV light through the apertures. The light exposure and subsequent post-exposure baking crosslink the photoresist where the light intensity was sufficiently intense and leaves a polymer representation of the transmitted and diffracted light upon development. Subsequent sputter coating with a gold palladium mixture allows for imaging with a scanning electron microscope (SEM). A linear relationship between exposure dose and pillar height versus diameter is observed, and constructive and destructive interference patterns form where light emanates from arrays of apertures. Photolithographic mapping captures how light passes through and interacts with nanoscale apertures and offers a high-resolution picture of processes near these apertures.

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Synthesis of Polymer-Based Hydrophilic Magnetically Recoverable Catalysts

Lennon W. Gregor[1]

Barry D. Stein[2], Maren Pink[1], Yaroslav Losovyj[1], Lyudmila M. Bronstein[1], Departments of Chemistry[1] and Biology[2], Indiana University, Bloomington

Numerous catalytic reactions leading to pharmaceuticals or value-added chemicals are carried out in water or alcohols. However, nanoparticle (NP) based catalytic systems which show advances in catalysis are often hydrophobic.[1] In this project, we are developing hydrophilic, magnetically recoverable catalysts based on commercially available polyethylenimine (PEI) and using a one-pot procedure. To achieve that, iron oxide nanoparticles of approximately 6-7 nm in diameter were formed upon decomposition of $Fe(acac)_3$ in boiling triethyleneglycol in the presence of PEI, leading to iron oxide NP clusters of different sizes. The catalytic precursors, $Pd(acac)_2$, $Pd(OAc)_2$, $Pd(NO_3)_2$, $RuCl_3$, or $Ni(NO_3)_2$, were added to the same reaction flask to allow PEI to coordinate with metal species, after which they were decomposed at the reaction temperature. The catalysts synthesized were characterized by transmission electron microscopy (TEM), X-ray powder diffraction (XRD), and X-ray photoelectron spectroscopy (XPS). It was demonstrated that in all cases, iron oxide NPs consist of magnetite. We studied the influence of PEI molecular weight and loading on the magnetite NP size and cluster morphology. In the case of Pd precursor, Pd NP diameters do not exceed 2-3 nm, allowing us to expect high catalytic activity. The presence of magnetite clusters allows easy magnetic separation, making these systems promising for the selective hydrogenation of levulinic acid (LA) to gamma-valerolactone, which will be a reaction of choice in future studies.[1] It is worth noting that LA is obtained by a conversion of cellulose, while gamma-valerolactone is an important platform molecule for the synthesis of biomass fuels.

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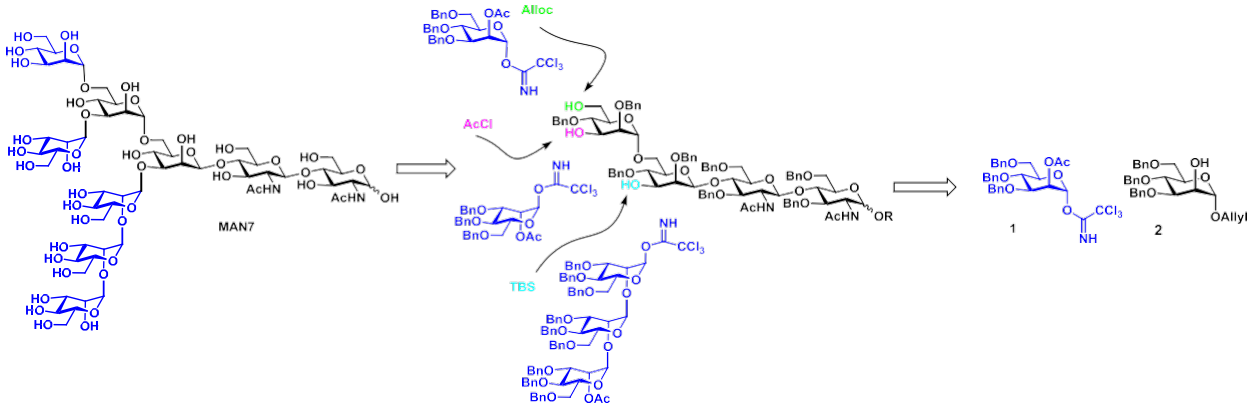
Synthesis of High-Mannose N-Glycan Branches for Library and Biomaterials Development

Kimberly A. Hayes

Chelsea L. Rintelmann, Dr. Nicola Pohl, *Department of Chemistry, Indiana University, Bloomington*

Sugars can be found in the body as long chained polysaccharides, called glycans, which assist in a number of biological functions. The variety of glycans is so numerous that many of them have not yet been designated a function. Determination of a glycan's structure-to-function relationship is a non-trivial process, since these biomolecules are difficult to isolate in appreciable quantities and are hard to characterize due to their structural homogeneity. There are a number of diseases related to defects in *N*-glycan biosynthesis, including Type I and II Congenital Disorders of Glycosylation and Congenital Dyserythropoieic Anemia Type II. To better understand how structural changes in *N*-glycans manifest in various pathophysiological conditions and create biomaterials based on these glycans, a library of potential targets will be developed to study the biological importance of these high-mannose oligosaccharides. Additionally, structurally defined synthetic *N*-glycans will offer analytical standards for comparison to biological isolates. A retrosynthetic pathway was designed to identify the monosaccharide building blocks necessary for forward synthesis (Scheme 1). To synthesize the high-mannose branches, building blocks 1 & 2 were synthesized in effort to model a library- oriented synthesis of high-mannose *N*-glycans.



Scheme 1 *Retrosynthetic Pathway for a High-Mannose N-Glycan Potential Target*

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Development of Supports for Magnetically Recoverable Enzymatic Catalysts

Bret Lawson[1] and Rigel Jaquish[1],

Barry D. Stein[2], Maren Pink[1], Lyudmila Bronstein*

Departments of Chemistry and Biology[2], Indiana University, Bloomington

Selective oxidation is widely used to obtain synthetic biologically active compounds (i.e. vitamins of B, E and K groups). Thus, the development of highly effective, new-generation catalytic systems through the immobilization of enzymes on magnetically separable inorganic supports received considerable attention. Magnetic separation is needed for easy catalyst recovery and repeated use. In this presentation we focus on two approaches to develop magnetic supports. One of them deals with formation of iron oxide nanoparticles (NPs) in the pores of mesoporous oxides (SiO_2, Al_2O_3, ZrO_2), while the other is based on the formation of iron oxide NP clusters using a hydrothermal method. For mesoporous alumina and silica, the commercial samples have been used, while mesoporous zirconia was synthesized using a silica template. All materials synthesized were characterized by transmission electron microscopy (TEM), X-ray powder diffraction and BET porosity measurements. Figure 1 shows TEM images of Fe_3O_4-Al_2O_3 and Fe_3O_4 clusters.

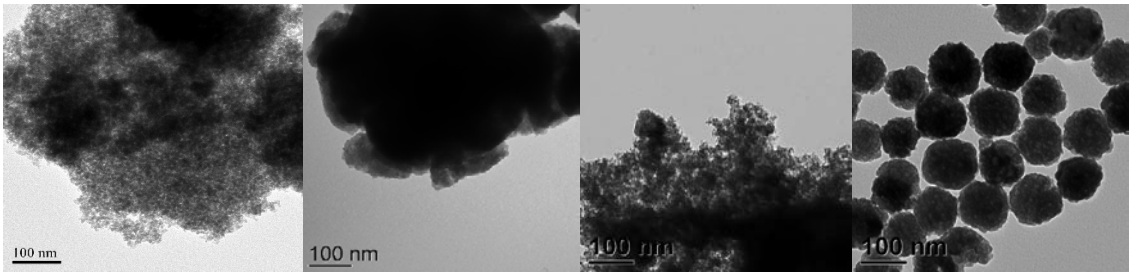

Figure 1: iron oxide- silica

Figure 2: iron oxide- alumina

Figure 3: iron oxide- zirconia

Figure 4: iron oxide nanoclusters

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Hierarchical Viral Capsid Assembly: SpyTag-SpyCatcher-Spider Silk pH- Sensitive Virus-Like Particle Arrays

Charles Maher

William Aumiller, Trevor Douglas, Department of Chemistry, Indiana University, Bloomington

Advancements in the understanding of the self-assembly and behavior of P22 virus-like particles (VLPs) has led to many interesting developments in catalysis and biomimetic chemistry. To build on these discoveries, we explore methods that can be used to bind these VLPs together, to produce materials with collective properties arising from the interaction of many individual VLPs. In particular, we chose to explore how spider silk proteins can be used to bind P22 procapsids together. To functionalize these VLPs with spider silk proteins, we created a fusion of P22 coat protein (CP) with a SpyTag (ST) at the C terminus. Separately, we created a fusion protein consisting of SpyCatcher (SC) and an N terminal spider silk protein (SS) that is capable of dimerizing below pH ~6.3. After isolation of the capsids and protein fusion, they were combined in vitro, which caused ST and SC to form an isopeptide bond, thus functionalizing the outside of the P22 procapsid with the spider silk proteins. Here, we show that these functionalized VLPs can be assembled and disassembled by changing the pH of the system as a result of the pH sensitive interactions between spider silk proteins.

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Production and Reactivity of Thiomolybdate Anion Clusters

Kathleen Nickson

Josey E. Topolski, Jared O. Kafader, Caroline C. Jarrold*, *Department of Chemistry, Indiana University, Bloomington*

The edge sites of bulk MoS_2 are the active sites for generation of hydrogen gas through hydrogen evolution reactions. As such it is critical to identify and understand these active sites in order to further improve the catalyst activity and resilience. New experiments that implement various thiomolybdate clusters to model bulk active sites have initiated, and have already shown interesting size- and composition-dependent chemical activity towards small molecules. The reactivity of thiomolybdate anions toward water (H_2O), carbon disulfide (CS_2), and hydrogen gas (H_2) have been studied using mass spectrometric analysis of products formed in a high-pressure, fast-flow reactor. Preliminary photoelectron (PE) spectra and supporting density functional theory calculations of MoS_2 were also completed to map out the electronic structures of the anions and neutral species. These methods are combined to understand the physical and electronic properties of the active sites and how these properties manifest themselves to produce different reactivities in the clusters.

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Synthesis of Core@Shell Trimetallic Nanocatalysts

Cari Rice

Jocelyn Legere Gamler, and Dr. Sara Skrabalak, Department of Chemistry, Indiana University

The increasing need for sustainable energy platforms, such as direct methanol fuel cells, drive the art of catalyst design. While Pt is commonly used as catalysts in these fuel cells, its high cost and susceptibility to poisoning make it an impractical catalyst. Through the manipulation of particle size, shape, composition, and architecture of nanocatalysts, surface-adsorbate interactions can be tuned to decrease catalyst poisoning and boost performance. Here, size- and shape-controlled core@shell nanoparticles are studied as catalysts for methanol electrooxidation (MEO) in order to systematically examine the contribution of composition and architecture on catalyst performance. Specifically, {100}-terminated PtFe, PtCo, PtNi, PtCu, PtZn, and Pt nanocubes were synthesized and their catalytic properties were compared. PtNi showed the highest mass activity while PtCu showed the highest specific activity. These catalytic results prompted the synthesis of PtNi@PtCu nanocubes. This system introduces strain in a way that other mono- and bimetallic systems would not be able to exhibit that allows for tuning of adsorbate-surface interactions. PtNi@PtCu nanoparticles were prepared by seed-mediated co-reduction, with the goal of transferring the shape of the seeds to the final nanostructures. To achieve this goal, several parameters were varied and include temperature, seed concentration, and capping agent amounts. The bimetallic counterparts, PtNi and PtCu, serve as references to these strained systems, with all samples being characterized by electron microscopy and electrochemical methods. This research will expand the synthetic toolbox and should more broadly accelerate catalyst design.

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Spectral and Time-domain Characterization of Ultrafast Laser Pulses for the Study of Superradiance in Virus-like Particles

Perla J. Sandoval1

Joseph B. Holmes2, Bogdan Dragnea2, 1Department of Chemistry, San Jose State University, San José, 2Department of Chemistry, Indiana University, Bloomington

The current work involves engineering fluorescent virus-like particles that emit light in very short pulses due to superradiance. Superradiance is a quantum phenomenon resulting from an ensemble of fluorophores interacting collectively and coherently in a common radiation field. The characteristic feature of superradiance includes decrease of life-time of fluorescence proportional to 1/N, where N is the number of fluorophores. To study femtosecond lifetimes, ultrafast lasers are used as a pump source and time-correlated single photon counting is used as detection scheme. Before pump-probe spectroscopy can be performed, the femtosecond pulses need to be characterized and optimized by tuning the laser system. Spectral and time-domain information is needed such as pulse duration and spectral bandwidth. Interferometric autocorrelation is used to obtain the pulse duration, and spectral bandwidth will be identified using a spectrometer.

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Effects of Surface Capping and pH on Seeded Growth

Mattea M. Scanlan

Alexander N. Chen, Dr. Sara E. Skrabalak* Department of Chemistry, Indiana University, Bloomington

Nanoparticles (NPs) are an area of interest due to their potential uses in catalysis, chemical sensing, and spectroscopy. For example, symmetrically stellated, or branched, metal nanoparticles can be utilized as a platform for plasmon-enhanced surface spectroscopy because the sharp tips of the branches intensify electromagnetic fields.1 Because many key properties of branched nanoparticles are determined by their symmetry, it is important to understand the factors that affect the symmetry of a nanoparticle. These factors include the use of capping agents, which passivates certain faces of a NP to prevent metal deposition, and the manipulation of the supersaturation. One type of branched structure, previously synthesized by depositing Au and Pd on Pd octahedra, is a 24-branched Au/Pd structure, with four branches growing from each of the six vertices of the seeds. This research examines the relationship between the pH and the amount of capping agent used in synthesizing the 24 branched NPs and how they affect both the shape and size of the product. The parameters of pH and surface capping affected the kinetic parameters of available nucleation sites and supersaturation. This research led to nanoparticles with a variety of morphologies and will advance our understanding of seeded growth processes.

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Functionalization of Iron Oxide Nanoparticles for Virus-like Nanoparticle Formation

Zitong Song

Lennon Gregor, Irina B. Tsvetkova, Bogdan Dragnea, Lyudmila M. Bronstein*, Department of Chemistry, Indiana University, Bloomington

Virus-like nanoparticles (VNPs) with magnetic nanoparticle (NP) cores have been developed earlier in collaboration with Prof. Dragnea's group.[1,2] Because monodisperse magnetic cores were hydrophobic, functionalization was needed to make them water soluble and negatively charged. However, for small iron oxide NPs, no successful functionalization was found. In this work we developed coating of 6-7 nm iron oxide NPs prepared in the presence of oleylamine (OAm) with two kinds of negatively charged ligands: 3,4-dihydroxyhydrocinnamic acid (DHCA) and poly acrylic acid (PAA). It is noteworthy that OAm poorly adsorbs on the NP surface and can be easily displaced by other surfactants, for example, by oleic acid (OA). However, when PAA is directly added to NPs coated with OAm, NP aggregation occurs. We developed a procedure replacing OAm with OA followed by replacement with PAA. The presentation will describe the optimization of both procedures and first examples of VNP formation with magnetic NPs synthesized. Figure 1 shows the encapsulated VNPs with particles that were functionalized with PAA. The magnetic VNPs will be combined with VNPs based on gold cores for the development of meta-materials with controlled properties.

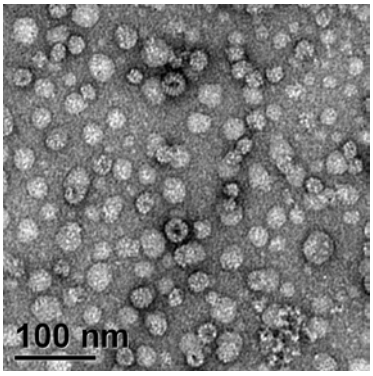

Figure 1. Encapsulated VNPs with PAA functionalized particles

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Size, Geometry and Structure of Iron-Oxide Nanoparticle Synthesis

Anthony J. Soukey*,

Samuel Dagne*, Jun Chen, Xingchen Ye, Department of Chemistry, Indiana University, Bloomington

Nanocrystals and the geometric dispersion of such crystals on the mesoscale open the utility of use for multiple disciplines within materials chemistry. The usefulness of such nanoparticles can be used for technologies such as MRI, [1] Through methods employed in the topic literature, Iron nanoparticles were synthesized through Oleate ligands and analyzed for size with Transmission Electron Microscopy (TEM.)[2] Specific sized nanoparticles can be created based on the particular conditions: heating rate, nucleating agent and reagent ratios between Octadecene and Tri-n-octylamine. Through manipulation of the variables, the nanocrystals produced were 9- 15 nm across. Not only will this create specific sized nanoparticles but specific geometries such as spheres and cubes. Allowing for synthesis of both geometries opens up the usefulness of such nanoparticles. These results open doors to unique knowledge on the assembly of nanomaterials that can be used in further research, from mesoscale assembly to further synthesis of nanoparticle materials.

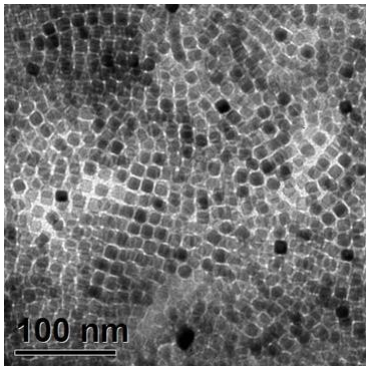

Figure 1: TEM image of monodispersed cubic nanoparticles 11 nm across.

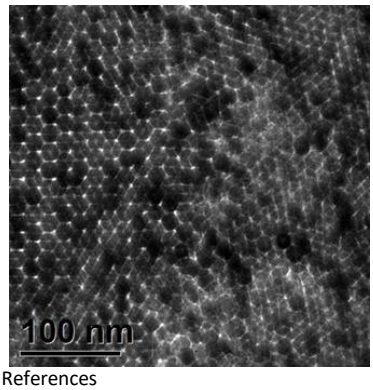

Figure 2: TEM image of monodispersed spherical nanoparticles 14 nm across.

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*Authors contributed equally to the authorship of this work.

Photoelectron Imaging Spectra of 〖O_2〗^-·[Polar VOC] Complexes

Nicholas Stamatkin

Caroline Jarrold, Department of Chemistry, Indiana University

Identification of different electronic structures through spectroscopy can play an important role in understanding how ionic and polar materials are able to self-assemble. Our group studies the energetics of the charge-dipole interactions of 〖O_2〗^- with polar organic compounds complexes, both protic and aprotic, that are commonly found in the troposphere. Using anion photoelectron imaging, we measure the spectra of the different 〖O_2〗^-·[polar organic molecule] complexes that we then use for further analysis of the binding energies. By comparing the binding energies of 〖O_2〗^- with polar organic molecules such as formaldehyde, acetone, and propenol we see a comparative difference in binding energies between complexes that exhibit hydrogen bonding and those that do not. We also find that the 〖O_2〗^-·[formaldehyde] complex exhibits binding properties that go beyond the realm of just charge-dipole interactions and are actually much more complex based on the spectrum.

Towards the Synthesis of Novel Tricarbazolo Triazolophane Macrocycles

Rose D. Taylor

James R. Dobscha, Amar H. Flood*, *Department of Chemistry, Indiana University, Bloomington, IN, 47405, USA*

Macrocycles are cyclic molecules with internal cavities for binding guests and exterior surfaces that can be programmed to enable self-assembly.[1] Macrocycles have found applications in a wide range of areas, such as ion conduction, ion transport across cell membranes, organic electronics, ion detection, and molecular machines. The synthesis of macrocycles in high yields is of particular interest. The shape-persistent tricarbazolo triazolophane macrocycle, or tricarb, demonstrates strong binding to large anions and self-assembles into ultrathin films on graphite surfaces.[1] The alternating carbazole and triazole units enable a high-yielding one-pot synthesis of the macrocycle on gram scales.[1] Here, we present progress in the synthesis and characterization of tricarb macrocycles. Different alkyl groups were added to the outer nitrogens of the carbazole units to explore their impact on the macrocycles' supramolecular properties.

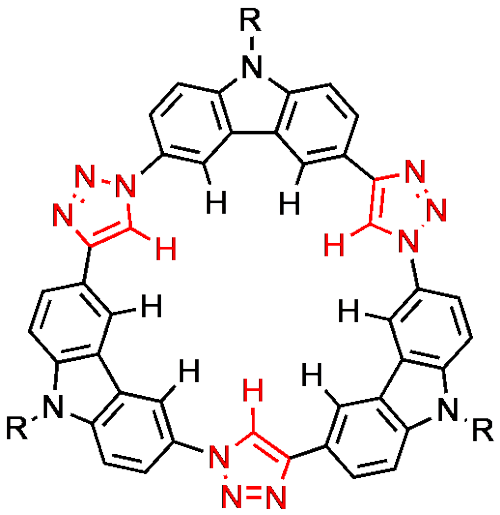

Figure 1. Generic chemical structure of tricarb macrocycle.

References

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Characterization of smoke alarm *and its Role in Nociception*

Samantha Westcott

The concept of physical pain is a common experience across various species, a process often initialized by the sensory activities of pain receptors, known as nociceptors. *Drosophila* serves as an exceptional model for researching nociception due to its simplified nervous system and the unique, easily observed rolling behavior exhibited by the larvae in response to noxious stimuli. Studies of these *Drosophila* nociceptive behaviors have identified a gene called *smoke alarm (smal)* as a potential regulator of noxious thermal sensitivity in *Drosophila*. *smal* has been found to be expressed in the nociceptors and is predicted to encode a transmembrane protein with extracellular domains similar in sequence to mammalian discoidin domains that interact with collagen, leading to the hypothesis that Smal localizes to the nociceptor plasma membrane and anchoring them to the extracellular matrix through collagen interactions. A series of transformations of the smoke alarm cDNA short isoform across vectors were performed to generate a useful tool for viewing the localization of the gene product. A resulting *Drosophila* strain with a GFP-tagged *smal* transgene will enable visualization of the gene product through confocal microscopy. Further characterization of the *smal* gene will be achieved through behavioral assays of larvae with *smal* null alleles by introducing a 42˚C probe and comparing the reaction times of the mutant and wild type larvae. Expanding current knowledge on the molecular pathways in nociceptors, via study of *smal* can greatly improve current methods for treating hypersensitive pain responses in humans.