Purdue University Chapter

The Society of Sigma Xi

Stewart Center, Rooms 218 A-D
February 14, 2017

2:30 to 4:30 p.m. – Poster Setup & Viewing
6:00 to 9:00 p.m. – Viewing and Judging

Purdue University Chapter
The Society of Sigma Xi

Poster Competition

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Graduate Student Posters

BEHAVIORAL AND SOCIAL SCIENCES

B1.

Mobile Applications for Preparation for Standardized Tests

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Dr. Mary E. Johnson

Mobile devices have become a part of everyday life for students. Developers have recognized this and have created test preparation software to be used for the Federal Aviation Administration Airframe & Powerplant written examinations. Mobile devices, along with the applications developed for them, keep college students connected to the world around them. Devices can be used for social needs, technical needs, information needs, and much more. The advance of mobile devices allows students the ability to incorporate their education needs with their use of mobile devices. The key benefit of mobile devices is the ability to access large amounts of beneficial information required for study while away from the classroom. The purpose of this review is to understand the importance of mobile devices when discussing application based learning and to list the available applications for airframe & powerplant test preparation on multiple mobile operating systems and compare their key features.

B2.

Issues for International Students' Flight Training in US

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The US has thousands of airports and a well-developed framework for flight training. In 2015 there were 122,729 student pilot licenses issued by the Federal Aviation Administration. In addition to the many Americans who take flight training, there are many international students who take flight training in the US. This includes both individuals who take flight training, and countries and companies that contract with US flight schools for flight training. While the quality of US flight training and the successful outcomes is well documented, there are potential challenges that must be addressed for international flight training students. This research documents the framework for international flight training, and identifies some challenges that are faced by international student pilots, the Certified Flight Instructors and Air Traffic Controllers. Potential challenges include communication issues and cultural issues. This research also identifies potential recommendations to overcome these communication challenges for international flight training students.

B3.

Dyadic Synchrony and Responsiveness in the First Year – Associations with Autism Risk and Later Diagnoses

Kellerman, A.M.[1], Abu-Zhaya, R.[1], Young, G.S.[2], Miller, M.[2], Ozonoff, S.[2] & Schwichtenberg, A.J.[1]
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Dyadic play interactions are a cornerstone of early development. Difficulty developing competence in these early social building blocks has been linked to later autism spectrum disorder (ASD) diagnoses. Within the present study, interactions within the first year were evaluated to (1) assess dyadic synchrony and responsiveness in families raising children with ASD, and (2) to assess if early difficulties with social responsiveness or synchrony proceed ASD diagnoses. As part of a prospective study, infants and their mothers were recorded during a standardized play task. Using predefined codes, theory-driven composites were generated for dyadic synchrony and responsiveness. Dyadic synchrony was significantly lower at 12 months; however, no significant outcome group differences emerged. Thus children who received an ASD diagnosis later in development did not present with significantly less social responsiveness or synchrony within the first year. The lack of robust behavioral differences prior to 12 months is consistent with previous research.

B4.

Data Visualization Complexity and Intelligibility

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Data visualization is a tool to help people understand complex data by visualizing them. However, many visualization forms today are hard for people to understand. Our research used a mixed research method of quantitative and qualitative to explore how visualization forms evolved, the readability of visualization forms, and how accurately the users access the information. From the results, we found that the visualizations like bar, pie, line, and scatter charts have been distributed in areas which are relatively simple in design and easy to read. Nonetheless, visualizations like the parallel coordinate, sunburst, box plot and Sankey graphs have been concentrated in the regions of relatively complex in design, and are difficult to understand. In addition, the visualizations, including stacked bar, word cloud, and theme river that frequently appeared in the middle region of the grid, embodied the transitions of visualization design from simple to complex, and easy to hard.

B5.

How Physicians' Medicine Choices are Influenced by Promotion Methods

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Yingjie Chen, Vetria Byrd

For a disease, there are so many brands in the market with similar efficacy that the competition is intense. Physicians' prescriptions can influence the market share of a drug greatly. It's important to know how physicians' medicine choices are influenced by promotion methods. The research visualized the medicine marketing data with tableau to answer the questions of how personal selling and advertising influence the doctors' medicine choices. The visualization results show that personal selling can influence physicians' prescriptions greatly. While advertising's influence on physicians' prescriptions is limited. However, it should be noticed that advertising has influence on patients who may ask doctors to give prescriptions of a specific drug. The finding of this study provided insights into the possible marketing investment for medicine companies.

B6.

Impact Of Surface Stability On Sitting Postural Sway In 15-Month-Old Infants At Low- And High-Risk Of ASD

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Autism Spectrum Disorder (ASD) commonly remains undiagnosed until 3-years. Identifying early risk-markers would lead to earlier diagnosis and more effective therapies. Since older children with ASD exhibit more postural sway under challenging conditions, postural sway differences in infancy could be an early risk-marker. Therefore, we had 15-month-olds sit on a Wii Balance Board to collect center of pressure data during easy (solid surface) and difficult (foam surface) postural tasks. There were 4 low-risk (LR; having only typically developing older siblings) and 8 high-risk infants (HR; having an older sibling diagnosed with ASD). Regardless of risk, infants increased postural sway when sitting on foam. No main effect for risk was observed. Thus, sitting on a foam surface is challenging for both LR and HR infants. Risk differences in postural control may be larger at younger ages. We hope to identify additional individual differences in postural sway upon obtaining ASD diagnoses.

B7.

Reciprocal Relationship between Parental Psychological Aggression and Adolescent Externalizing Problems: Does the Reporter Matter?

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Reciprocal relationship between abusive parenting and children's externalizing problems are commonly found in research. However, how the results could be different by who reported the parents' and children's behaviors has not been discussed. The current study used 591 youth and their biological mothers' responses from the NSCAW data sets. Results showed that mothers tended to report their psychological aggression higher than youth reported. Although girls reported similar levels of their externalizing problems to their mothers' reports, boys tended to report a lot lower levels of their externalizing problems than their mothers' reports. Results from the cross-lagged panel models showed that the path from parental psychological aggression at Time 2 to girls' externalizing problems at Time 3 was significantly in all reporter combinations, whereas it was only significant when the same reporter reported both for boys. The within-time correlations were higher in the same reporter combinations than the different reporter combinations.

B8.

Pentagram of Habits: Considering Science Teachers' Conceptions of "Habits of Mind" Associated with Critical Thinking in Several of Iran's Special Gifted Schools

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Dr. Gentry

This research study aimed at the exploring the problem of domain-general vs. domain-specific tension associated with the definition and fostering critical thinking (CT). We examined Iranian science teachers' conception(s) of this tension. Using our classroom observation scale, through the lenses of The Critical Thinking Consortium's pedagogical framework (TC2) as a theoretical framework, we observed N=27 gifted science classroom to evaluate teachers' instructional strategies in terms of developing CT abilities. Applying purposeful sampling, we interviewed expert teachers based on the observational phase, to investigate their understandings of CT's general-domain habits of mind. Applying 4+1classical elements as a conceptual framework, we examined various dimensions of these science teachers' conceptualization of thinking critically. Traditional gradual reduction of interviews resulted in the development of a culturally informed five-elemental pentagram of habits of mind shared by these educators. Further, these teachers addressed some instructional strategies to embed CT in the science classes.

B9.

Preliminary Efficacy of Service Dogs for Posttraumatic Stress Disorder (PTSD) in Military Veterans

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Psychiatric service dogs are an emerging complementary treatment for military veterans suffering from posttraumatic stress disorder (PTSD), but empirical research on their efficacy is limited. Our objective was to evaluate the psychosocial effects of service dogs for post-9/11 military veterans with PTSD. A longitudinal efficacy trial with a cross-sectional survey was conducted with 141 veterans (n=66 waitlist, n=75 with a service dog). Mixed model analyses revealed clinically significant longitudinal reductions in PTSD symptoms following being placed with a service dog, but not while receiving usual care alone. Though clinically meaningful, average reductions were not below the diagnostic cutoff for PTSD. However, significant cross-sectional group differences were found in depression, quality of life, social isolation, and sleep quality. This study provides initial proof-of-concept for the therapeutic efficacy of service dogs for military veterans with PTSD, though this practice should remain a complementary, rather than standalone, treatment option in its current format.

B10.

Thing Orientation Predicts Better Recall of STEM Topics

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Some people are particularly attuned to their social environment, noticing and responding more to the people around them. Others are particularly attuned to their physical environment, noticing and responding more to the objects around them. These tendencies are personality traits known as Person Orientation and Thing Orientation. Notably, these factors predict whether students choose majors in STEM or non-STEM fields. However, very little work has examined how they relate to cognitive processes. The current study examined whether Person and Thing Orientations predict memory performance. Participants (N = 472) read educational texts about STEM-related topics, then completed personality scales and a memory test over the material. Person Orientation did not predict performance, but people higher on Thing Orientation remembered significantly more information. Gender differences and previous knowledge did not explain these effects. The findings have implications for STEM education, particularly regarding the approachability of instructional materials.

ENGINEERING SCIENCES

E1.

Statistical Analysis of Student Academic Performance Based on SAT-Math Scores and Attendance in Supervised Homework Sessions

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Ancillary learning opportunities outside the classroom take different forms such as peer-led team learning (PLTL) and supplemental instruction (SI). To gain the benefits of ancillary sessions with less overhead than PLTL and SI, we facilitated optional weekly supervised homework sessions for AAE 35200, an aerospace structural mechanics course at Purdue University. In these sessions, a teaching assistant used the assigned homework problems to demonstrate key concepts on structural mechanics. In order to understand the attributes of the participants, a survey was administered. Also, session attendance was recorded and compared against the exam and homework results. Based on the collected data, we have reached the following conclusions: a) attending the supervised homework sessions does not significantly affect the exam score, whereas the opposite is true for the homework scores and b) SAT-Math scores do not seem to have a strong influence on both the exam and homework scores.

E2.

Electrically delivered curcumin for triple negative breast cancer treatment: An in vitro model study

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With 1.7 million new cases (11.9%) in 2012, breast cancer was the second most common cancer and ranked 5th with 522,000 deaths (6.4%). Triple Negative Breast Cancer (TNBC) contributes to about 12% to 17% of all invasive breast cancers in western populations. Conventional treatments do not work for TNBC due to lack of three receptors, the estrogen, progesterone, and human epidermal growth factor receptor 2. Towards this we propose curcumin, the yellow pigment of turmeric, the natural herb used for over 5000 years, loaded with anticancer phytochemicals, and possesses almost no side effect. Electrical pulses can be used to enhance the uptake of curcumin against the cell membrane. In this study, electrical pulses of different intensity and duration are used to deliver curcumin (5μM) against MDA-MB-231 cells. The cell viability reduces to 3.06% for 500V/cm, 25ms, 8pulses and 2.74% for 500V/cm, 20ms, 8pulses as compared to 69.51% with curcumin alone.

E3.

Real-time intravascular photoacoustic-ultrasound imaging of lipid-laden plaque at speed of video-rate level

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Intravascular photoacoustic-ultrasound (IVPA-US) imaging is an emerging hybrid modality for the detection of lipid-laden plaques. The clinical utility of IVPA-US technology requires real-time imaging and display at speed of video-rate level. Here, we demonstrate a compact and portable IVPA-US system capable of imaging at up to 25 frames per second in real-time display mode. This unprecedented imaging speed was achieved by concurrent innovations in excitation laser source, rotary joint assembly, 1 mm IVPA-US catheter, differentiated A-line strategy, and real-time image processing and display algorithms. By imaging pulsatile motion at different imaging speeds, 16 frames per second was deemed to be adequate to suppress motion artifacts from cardiac pulsation for in vivo applications. The translational capability of this system for the detection of lipid-laden plaques was validated by ex vivo imaging of an atherosclerotic human coronary artery at 16 frames per second, which showed strong correlation to gold-standard histopathology.

E4.

Computational Model of the Calcium/Calmodulin-dependent Protein Kinase II Holoenzyme using Rule-based Methods

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In the brain, memories begin by a process called synaptic plasticity. In synaptic plasticity, specialized connections between neurons dynamically shift in size and cation conductivity. These shifts are delicately controlled within neurons by calcium-dependent protein signaling mechanisms. Characterizing these signaling mechanisms experimentally requires extreme spatiotemporal resolution. Therefore, mathematical models are increasingly used to complement experimentation. Problematically, minimalist mathematical models consistently disagree with experimental results. However, computational expense accrues rapidly with additional spatial parameters or protein interactions. In particular, rigorous descriptions of calcium/calmodulin-dependent protein kinase II (CaMKII) cause models to explode in complexity. To reduce computational expense and retain biological reality, we use rule-based methods with the software MCell. With this tool, we present the first spatial-stochastic model of CaMKII as a complete multi-subunit enzyme. In the future, we will

use rule-based modeling to more effectively characterize the molecular mechanisms behind memory formation.

E5.

Career Mapping Visualization System

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In the modern era of big data, we are confronted with more and more data as a part of our daily lives. We look forward to more effective and efficient ways to communicate the complex information. Data visualization, the conversion of data into graphic, gives full play to humans' broad visual pathways and help people to access, explore, and understand the ubiquitous data. The main goal of our system is to help high school students, who have questions about how to choose their college majors wisely and how to achieve their dream occupation opportunities. In our system, we visualized students' career transitions from college majors to occupations, and the characteristics of majors and occupations, using student employment data from Purdue University and national labor survey data. The system provided a visual tool to help students, parents, and educators to know more about career.

E6.

Testing Membership in Lattices

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Lattices are discrete additive subgroups of n-dimensional real space. These discrete algebraic structures find application in many areas of mathematics and computer science like algebraic number theory, communication and storage, cryptography etc. The well-studied questions on lattices can be broadly categorized into two specific computational models: the classical global model in which the algorithm can access its entire input, and local model in which the algorithm has partial access to its input via coordinate queries to its entries. In this work, we initiated a systematic study of local testing for membership in lattices. The problem is of practical relevance, with applications to integer programming, error detection in lattice-based communication and cryptography. We studied this problem with an aim to understand testable families of lattices and give some preliminary results with interesting future research direction.

E7.

Heuristic Approach to the Efficient Control of Complex Networks

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The ability to control natural or technological systems depends on our understanding of the fundamental laws that govern their behavior. Recent research has applied control theory to large systems modeled as networks of communicating components. Such a control costs in terms of identifying the number of driver nodes, and the number of steps required to control. Complex systems modeled as complex networks exhibit emergent behavior that is hard or prohibitive to predict, analyze, and control. Even when theoretically feasible, analytical approaches are not computationally prohibitive. Yet, optimal control is not necessary for many applications. We develop a cost effective heuristic approach to controlling a system by seeking a tradeoff between the amount of work required to design the control, the percentage of the network controlled, and the cost of exercising the control. We establish cost spectra that allow users to select the tradeoff that meets their application needs.

E8.

Detection Of Sepsis Causing Bacteria On Paper Test Strips From Whole-Blood Samples

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In low- and middle-income countries, 42% of neonatal deaths are caused by bacterial pathogens entering the blood stream and causing sepsis. Early onset neonatal sepsis (EONS) diagnosis currently requires 24-48 hours of blood culture incubation and infrastructure that is frequently inaccessible to delivery bedsides or district level hospitals of developing countries. Alternatively, isothermal amplification of pathogens' nucleic acids offers a rapid, sensitive, and minimal resource method to detect sepsis for treatment. Here, we have integrated sample preparation and nucleic acid amplification onto a paper-based platform for rapid, low-cost bacteria detection. Ultimately, we will multiplex the detection of EONS-causing E. coli, S. agalactiae, and K. pneumonia onto this whole-blood sample-to-answer molecular diagnostic device.

E9.

Multi-functional Wrist Orthotic for Wireless Gesture Based Control and Physiological Feedback

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Individuals with cervical spinal cord injuries(SCI) often have difficulties performing activities of daily living (ADL) which require fine motor control, due to paralysis in the hand muscles. Current tools to stabilize flaccid wrists after a SCI, such as wrist splints, primarily provide support without too much additional functionality. We developed and tested a multi-functional wrist orthotic (MFWO) which uses a machine learning algorithm to allow individuals with SCI to perform a wider range of ADL. The MFWO is controlled by customized gestures performed by the user and is highly accurate in the detection of these gestures. Moreover, the MFWO can also provide a user with SCI with feedback about various physiological parameters such as heart rate, skin temperature, which can alert them of potential secondary health conditions. The system can be adapted by adding a variety of actuated tools to expand the ability of wearers to perform various ADL.

E10.

Development of Novel ELP-Based Transcriptional Regulators for Improved Biomanufacturing

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Microbial chemical factories that sustainably produce commodity chemicals and biofuels are not yet fully realized due to low yields. Production may be enhanced by genetic circuits capable of redirecting resources toward desired products. However, this redirection of flux towards product must be balanced with resources for cellular health to sustain optimal performance. Therefore, we propose novel ELP-sigma factor constructs as synthetic regulators that recognize cues of cellular health and autoregulate expression of bioproduction pathways for improved health and production. Elastin-like polypeptides (ELPs) make ideal sensors since they exhibit a sharp, inverse phase transition to indicators of cellular health such as pH and ionic strength, and external stimuli such as temperature. Initial designs successfully alter gene expression by 15-30% in response to temperature. We anticipate refinement of this design and combinatorial construct libraries will generate various regulators with diverse outputs that may be integrated in bioproduction pathways for improved performance.

E11.

Modelling and Simulation of Residual Stresses and Ultrasonic Impact Treatment of Welded Joints

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Most structures are fabricated using welded joints because of low cost, structural strength and geometric flexibility. Welding is considered a highly complex metallurgical process that induces material imperfections/flaws and tensile residual stresses. Tensile residual stresses and stress concentrations resulting from the weld process have a significant impact on fatigue life of structures, and thus a topic of great concern in product design. Ultrasonic impact treatment (UIT) is considered as one of the most effective post welding treatment techniques to enhance fatigue life of welded structures. UIT aims to introduce fatigue-beneficial compressive stresses by plastically deforming the weld toe and reduce stress concentrations by modifying local weld geometries. 3D finite element modeling of weld joints was performed to simulate welding process and UIT to predict weld residual stresses. Numerical results were correlated with experimental data. UIT has potential applications on fatigue design of welded structures, can lead to lighter structures/products.

E12.

Anaerobic Fungal Enzymes Efficiently Degrade Diverse Agricultural and Food Wastes For Bioenergy

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Identifying inexpensive and reliable methods for lignocellulosic hydrolysis are key to developing this abundant and renewable substrate as a useable feedstock for the bioeconomy. Diverse enzymes produced by anaerobic fungi efficiently break down and ferment cellulosic substrates into simple sugars and hydrogen gas, both having high value for bioenergy. Here, we demonstrate that a new anaerobic fungal isolate, *Piromyces indianae*, degrades and grows on woody forestry products such as poplar, and an array of agricultural and food wastes. Importantly, fungal growth is robust to lignin composition. Unlike the industry standard *Trichoderma reesei*, whose enzymes are inhibited up to 50% by increases in select lignin constituents, our isolate exhibits no more than a 20% decrease in growth. This resiliency to lignin composition makes anaerobic fungi particularly attractive as microbial platforms for enzymes that overcome lignocellulosic recalcitrance. Isolation of these enzymes may allow for economical, more efficient methods of biofuel production.

LIFE SCIENCES

L1.

Engineering terpenoids in plants via the archeal mevalonic acid pathway

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Terpenoids, the most abundant and diverse class of metabolites, play important roles in plant processes such as photosynthesis, respiration, growth and development, and pest defense. They are also vital for the production of anti-cancer, anti-inflammatory, and anti-malarial drugs. One pathway responsible for the biosynthesis of terpenoids, the mevalonic acid(MVA) pathway, is localized within the cytosol for the first four steps and then localizes in the peroxisome for the remaining steps before transporting the five-carbon building blocks, isopentenyl pyrophosphate(IPP) and dimethylallyl pyrophosphate(DMAPP), back to the cytosol for terpenoids biosynthesis. Archaea diverge from the traditional MVA pathway at the final steps of this pathway yet still produce IPP and DMAPP. By overexpressing these two enzymes in plants, we were able to divert some flux from the peroxisome and create a purely cytosolic pathway enhancing terpenoid yield up to 100-fold thus creating a platform for some of these medically and economically important terpenoids.

L2.

Elucidating the role of synaptic vesicle protein 2 in volatile organic compound emission

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To be emitted from cells, volatile organic compounds (VOCs) must transverse the cytosol and cross numerous cellular barriers. It has been assumed that VOCs move solely by passive diffusion; however, recent evidences suggest that biological mechanisms contribute to VOC emission. Here we explore vesicle trafficking as a process that shuttles VOCs, which have partitioned into internal membranes, to the plasma membrane. *Petunia hybrida*, our model organism for studying VOC emission, contains a synaptic vesicle protein 2 (SV2) (a hallmark protein found in animal synaptic vesicles) homolog whose expression correlates with VOC emission. We hypothesize that PhSV2 functions in vesicle trafficking contributing to VOC emission. Here we show that PhSV2 localizes to the Golgi and Post-Golgi network and that down-regulation of *PhSV2* results in decreased VOC emission. Identification of VOC

transporters provides targets for genetic engineering of plants to hyper-accumulate or hyper-emit various compounds greatly impacting flavoring/fragrance industries and biofuel extractions.

L3.

Targeting HIV Reservoirs in Brain by Inhibition of P-Glycoprotein at the Blood-Brain Barrier

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A tremendous obstacle to the eradication of HIV is the presence of reservoirs of HIV in the host. Sanctuaries of HIV such as those in the Central Nervous System (CNS), are believed to occur partly due to limited accessibility of antiretroviral therapy (ART) across the blood-brain barrier (BBB). P-glycoprotein (P-gp), an efflux transporter expressed at the BBB, is known to contribute to the limited penetration by ARTs. Inhibiting P-gp is a promising strategy for enhancing brain penetration of ARTs. We present an innovative approach by developing Trojan Horse Heterodimers (TH) based on ARTs. They perform dual functions as (1) P-gp inhibitors at BBB and (2) prodrugs which release corresponding ARTs in the cell environment. As a result, the bioavailability of ARTs across the BBB will be increased, resulting in the successful elimination of HIV reservoirs in the CNS.

L4.

Application of Scanning Open Path Fourier Transform Infrared Spectroscopy (OP-FTIR) to Measure Greenhouse Gas (GHG) Emissions from Agricultural Soils.

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Cliff Johnston and Richard Grant

Agricultural soils substantially contribute greenhouse gases (GHGs, e.g., CO_2, N_2O, and CH_4) to the global GHG burden of the atmosphere, resulting from various agronomic practices. Chamber measurements have been the most common method to determine GHG emissions from soils; however, chamber methods are subject to significant limitations leading to bias and overall underestimations of GHG emissions. Open-path Fourier Transform Infrared spectroscopy (OP-FTIR) is a remote sensing approach to measuring GHGs emitted from area agricultural sources. Since scanning OP-FTIR is capable of measuring the concentrations of multiple gases simultaneously in real time (1-minute sampling intervals) over long paths (order of 100 m) and extended period (days or months), we can provide temporally and spatially representative gas concentrations over multiple area sources. In this study, we used OP-FTIR to determine the concentrations of CO_2, and N_2O emitted from continuous corn fields, and their emissions were determined using the FTIR-determined GHG concentrations within the backward Lagrangian stochastic emissions model (WindTrax®).

L5.

Involvement of Cytosolic Chorismate Mutase in Phenylalanine Biosynthesis in Plants

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Phenylalanine (Phe) is an important aromatic amino acid that serves as precursor for benzenoid/phenylpropanoid volatile compounds in plants. Biosynthesis of Phe has been shown to occur predominantly in plastids via the arogenate pathway. However, recent discovery of a cytosolic phenylpyruvate aminotransferase in petunia suggests that Phe biosynthesis may also occur in the cytosol via a microbial-like phenylpyruvate pathway. We hypothesized that, in plant cells, the cytosolic chorismate mutase (CM2) is also involved in the alternative Phe biosynthesis pathway. Phenylacetaldehyde emission fails to increase in the Arabidopsis *AtCM2* T-DNA insertion mutant upon wounding in the leaves. Emission of Phe-derived volatiles and Phe were decreased in the flowers of *Petunia hybrida CM2 (PhCM2)* RNAi lines. Metabolic flux analysis in *PhCM2*-RNAi flowers was used to determine the relative contributions of the cytosolic and plastidial Phe biosynthesis pathways. These results suggest that CM2 contributes to the production of Phe-derived volatile compounds in plants.

L6.

Sex differences in the gut microbiome of mice and its impact on acute TNBS colitis

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Crohn's Disease (CD) is a subtype of Inflammatory Bowel Disease (IBD). The gut microbiota is known to play a role in IBD development. The existence of a sex-bias in the incidence of human IBD is well known. However, the contribution of sex to the gut microbiota and its implications for colitis is not well understood. Mouse models provide a controlled system to investigate these relationships. We hypothesize that sex contributes significantly to differences in the gut microbiome and variation of the response to colitis. To address our hypothesis, we examined the gut microbiota of male and female wildtype *(WT)* and tumor necrosis factor (TNF) deficient *(TNF KO*) mice prior to and after the induction of acute colitis. Results from microbial community analysis and histopathology support our hypothesis and provide evidence for sex-differences and suggest an impact on colitis severity.

L7.

Biphenylthiazoles with Oxadiazole Linker: An Approach to Improve the Physicochemical Properties

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A new series of oxadiazolylbiphenylthiazoles was prepared with the objective of improving the limited solubility of the 1st generation derivatives, while maintaining their antibacterial properties. Studying the structure-activity-relationship at the cationic part provided the piperazine-1-carboximidamide derivative 27 with a MIC (MRSA) value of 1.1 mg/mL, bactericidal mode of action, and a 50-fold improvement in aqueous solubility. Additionally, 27 exhibits a wider safety margin as tested vs. human colorectal cells (HRT-18), and most importantly, a significant improvement in oral bioavailability.

L8.

Glioblastoma Animal Model Comparison Using Multiple Reaction Monitoring (MRM) Profiling Mass Spectrometry

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Glioblastoma (GBM) is the most common and aggressive form of primary brain tumor. In cancer research, subcutaneous and orthotopic murine models are widely used to study human tumors. However, these common models are not able to mimic human tumor heterogeneity completely due to tumor complexity. To compare the commonly used models in GBM and validate the ability of different model system to mimic the human tumors, we performed multiple reaction monitoring (MRM) profiling to investigate lipid expressions in subcutaneous and orthotopic mouse models.

L9.

Theta Oscillations in Primary Visual Cortex Emerge with Familiarity to Visual Stimuli

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While the primary visual cortex (V1) is known to be a feature detector, emerging evidence suggests it may also encode information beyond the physical attributes of a visual stimulus. Using high density 64 channel silicon probes acutely implanted in binocular V1, we recorded visually evoked potentials (VEPs) and action potentials from individual neurons (units) in awake mice responding to visual stimulation. After training mice to a visual stimulus for several days, oscillations in the Theta range (4-8Hz) emerged in VEPs and individual units. Time-frequency analysis revealed an increase in both theta and gamma power, frequency bands which are implicated in working memory. Unit-depth analysis and current source density (CSD) revealed a cortical layer specific distribution of oscillating units. Treatment with the muscarinic acetylcholine receptor antagonist Scopolamine blocked theta oscillations, suggesting that cholinergic tone in V1 may be required for the emergence of oscillatory activity after visual familiarity training.

L10.

Anaerobic Fungi: Regulating Microbial Environments In Ruminant Guts Without Antibiotics

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Emerging antibiotic resistance threatens to rendered common medicines to routine conditions useless. However, unexplored microbial environments are a potential untapped pool of naturally produced antibiotics and other drugs. Because of this, we explore the competitive communities of microbes in the guts of large herbivores. Similar to other fungi, we have observed natural product-rich genomes among anaerobic fungi from the four fully sequenced isolates. Recently, we have isolated a novel anaerobic fungus, *Piromyces indianae,* from the gut of a donkey. We have begun characterizing the genome of this fungus and have optimized a colony PCR method using degenerate primers to isolate natural product clusters that will lead to new drugs. As we develop the ability to manipulate their genomes, these organisms are prime candidates for probiotic and feed-additive applications that are engineered to cultivate a natural healthy community in their native hosts, thus reducing the dependency on antibiotics.

L11.

A *Lippia origanoides* extract induces cell cycle arrest and apoptosis and suppresses NF-κB signaling in MDA-MB-231 triple-negative breast cancer cells.

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Treatments targeting hormone receptors fail to provide a positive clinical outcome against triple-negative breast cancers which lack expression of estrogen receptor (ER), progesterone receptor (PR) and human epidermal growth factor receptor 2 (Her2/neu). Towards identifying viable treatments for TNBC, we have tested an extract of *Lippia origanoides* (LOE) on the TNBC cell-line MDA-MB-231 to uncover its potential anticancer effects. We show that LOE treatment 1) reduces TNBC cell viability in a dose-dependent manner to a greater extent than in normal mammary epithelial MCF10A cells, 2) halts the cell-cycle in the G0/G1 phase via Cyclin D1 and cIAP2 regulation, and 3) induces apoptosis without promoting necrosis via caspase-8/-3 and PARP cleavage. Constitutive nuclear factor-κB (NF-κB) signaling has been shown to contribute to the inflammatory state and survival in TNBC cells. We also provide evidence that LOE inhibits NF-κB signaling by reducing RelA protein levels. These studies reveal that LOE suppresses key features of the progression of aggressive breast cancer cells and provides a basis for further definition of its underlying mechanisms of action and anticancer potential.

L12.

Elucidation Of Juglone Synthesis In Black Walnut

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Juglone has the potential to serve as a novel, natural product-based herbicide. Juglone is an allelopathic naphthoquinone secreted by black walnut trees and other members of Juglandaceae. Strategies to harness juglone as a natural product-based herbicide are hampered by the lack of knowledge about its metabolism. Based on labelling data, we hypothesize that juglone synthesis branches off the pathway leading to phylloquinone (vitamin K_1), a vital metabolite involved in photosynthesis in all plants. This project is centered on using comparative transcriptomic and biochemical approaches to fully elucidate the juglone biosynthetic pathway and its metabolic connection with phylloquinone. We envision that our results will one day enable production of juglone in resistant, engineered crop systems, circumventing the need to apply synthetic herbicides.

L13.

Repurposing approach identifies two novel drugs against *Clostridium difficile*

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Clostridium difficile is the most common and costly healthcare-associated infection with an estimate half a million cases and approximately 29,000 deaths occurring annually in the United States. Only very limited treatment options are available for treatment of *C. difficile*. A library, containing 4,000 FDA approved drugs and small molecules, was screened against *C. difficile* toxigenic strain. Auranofin (currently approved for treatment of rheumatoid arthritis), and ronidazole (antiprotozoal agent used in veterinary medicine) showed bactericidal activity, in an applicable clinical range, against clinical isolates of *C. difficile*. The minimum inhibitory concentrations at which 90% of clinical isolates of C. difficile were inhibited (MIC_{90}) were found to be 2 and 0.125 μg/ml for auranofin and for ronidazole, respectively. Auranofin was superior to drug of choice (vancomycin and metronidazole) in inhibiting spore formation and toxin production by toxigenic *C. difficile* strains. Ronidazole analogs were synthesized and evaluated against toxigenic *C. difficile* strains. The present study provides a foundation for further development of ronidazole compounds as potential therapeutic agents to address the burgeoning challenge of *C. difficile*. Taken altogether, the results indicate that auranofin and ronidazole warrant further investigation as novel antibacterial agents against *C. difficile*.

L14.

Heat Therapy Alters The Expression Of Myogenic Factors And Accelerates Functional Recovery Following Exercise-Induced Muscle Injury In Humans

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We investigated the effects of heat therapy (HT) on changes in myogenic gene expression and functional recovery following exercise-induced muscle injury. Eleven nonweight-trained adults performed 300 eccentric contractions with both legs. One thigh was treated with HT for 5 days after the exercise bout while the opposite thigh served as a control. Vastus lateralis muscle were obtained 2 weeks prior to and 1 and 5 days after the damaging protocol. Significant reduction in local pain and greater functional restoration were observed in the thigh treated with HT at 4 day post-injury. The expression of VEGF and Ang-1 was higher in the heated thigh 1 day after the initial HT. After 5 days of HT, myostatin mRNA expression was significantly reduced in the thigh received HT. These results suggest that HT accelerates functional recovery following muscle injury, possibly by regulating the expression of myogenic factors during the repair process.

L15.

The Integration Between Posture, Manual Control, and Speech in People With Parkinson's Disease

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Multi-task behaviors such as speaking while leaning forward to reach an object are difficult for people with Parkinson's disease (PD) to perform due to reductions in cognition, mobility, and postural stability. In this study, we examined postural-manual control in people with PD and healthy older adults while speaking. Subjects fit a block into a (small or large) opening, then held the block in the opening while either speaking or not speaking. Individuals with PD took longer to reach peak arm acceleration when speaking compared to older adults. However, when not speaking, arm acceleration towards the target opening was similar between groups. There were no significant differences in postural sway. Speaking appears to alter reaching performance in people with PD, perhaps due to competing cognitive or attentional demands.

L16.

Acyl-CoA Synthetase 6-mediated Regulation of Fatty Acid Metabolism and Retinal Neuroprotection

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Diabetic retinopathy is a neurovascular complication of diabetes. Evidence suggests that omega-3 fatty acids (FAs) consumption protects against Diabetic retinopathy. Omega-3 FAs are abundant in the retina, serve as structural components of membranes, and are precursors for protective anti-inflammatory molecules. However, it remains unknown how FA metabolism is regulated in the eye. Acyl-CoA Synthetase 6 (ACSL6) performs a required step for FA activation and prefers omega-3 FAs as it substrate. Our data shows that ACSL6 protein is expressed predominantly in the central nervous system and localized in the endoplasmic reticulum, the site of phospholipid synthesis. We hypothesize that ACSL6 mediates FAs incorporation into phospholipids to regulate membrane fluidity and for the biosynthesis of pro-resolving mediators. Therefore, we generated a conditional knockout mouse ($ACSL6^{-/-}$). $ACSL6^{-/-}$ mice exhibit an increase in GFAP expression in the eye. These data suggest that ACSL6-mediated FAs metabolism may confer retinal neuroprotection by increasing omega-3 FAs bioavailability.

L17.

Ngago Inducibly Represses Gene Expression at Sites Programmed With P-Ssdna

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Popular genome editing tools such as CRISPR enable modification of genomes at programmable target sites adjacent to sequence-specific motifs. This restriction, however, limits target site choices and may be problematic in genomes with biased GC-content. In contrast, Argonaute from Natronobacterium gregoryi (NgAgo) is reported to be free of such restrictions and is proposed as a controversial alternative to modify genomes. Here, we implement NgAgo in *E.coli*. While we have yet to demonstrate direct DNA modification, targeting NgAgo to the coding (sense) or antisense strand of essential genes reduced cell viability suggesting targeted reduction of gene expression via some uncharacterized DNA interaction. Similarly, we observe that targeting *any* plasmid gene with NgAgo inhibits plasmid replication. Our results suggest an unrecognized mode of action for NgAgo and highlights the potential of NgAgo as a novel orthogonal regulator system for programmable control of gene expression.

L18.

Identification of Antimicrobial Peptide from Soy Protein

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Antimicrobial peptides (AMPs) inactivate microbial cells through pore formation in cell membrane. Because of their different mode of action compared to antibiotics, AMPs can be effectively used to combat drug resistant bacteria in human health. In this research, we developed a methodology based on mechanistic evaluation of peptide-lipid bilayer interaction to identify AMPs from soy protein. Initial screening of peptide segments from soy glycinin (11S) and soy β-conglycinin (7S) subunits was based on their hydrophobicity, hydrophobic moment and net charge. Out of several candidates chosen from the initial screening, two peptides satisfied the criteria for antimicrobial activity, viz. (i) lipid-peptide binding in surface state and (ii) pore formation in transmembrane state of the aggregate, as evaluated by all-atom molecular dynamic (MD) simulation. Their antimicrobial activities against *Listeria monocytogenesis* and *E.coli* were further confirmed by spot-on-lawn test. This methodology is also applicable for identification of AMPs from any protein.

L19.

Reversal of azole resistance in *Candida albicans* by sulfa antibacterial drugs

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Invasive candida infections afflict millions of patients annually resulting in more than 350,000 deaths. Furthermore, the extensive use of drugs of choice (azoles) led to the emergence of azole-resistant strains, making the treatment of invasive candidiasis more challenging. In an effort to repurpose FDA approved drugs, we explored 1600 drugs for the purpose of reverting azole resistance in candida. The in vitro screening identified 15 sulfa drugs that were able to work synergistically with azole family and revert resistance in the majority of azoles resistance strains. Interestingly, five sulfa drugs showed synergistic activity, in an applicable clinical range. Our results indicate that the mechanism of synergy between sulfa drugs and fluconazole involve the inhibition of folate pathway in Candida and ultimately decreasing the biosynthesis of ergosterol. This novel combination between azole and sulfa inhibited the biofilm formation on Candida in vitro. Using Caenorhabditis elegans, we demonstrate that this combination retain potent activity in vivo. Taken altogether, the present study provides valuable evidence that sulfa antibacterial drugs have significant promise to offer a safe, effective, and quick supplement to current approaches for treating fungal infections.

L20.

Disease on a Chip for improved design and screening of anticancer therapies via the mimicry of tissue geometry and nuclear morphology

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Carcinomas initiate in the context of a ductal structure within a monolayer of epithelial cells, which likely influences the behavior of the malignant cells - in particular, their responses to therapeutics. We have developed a “disease-on-a-chip” (DOC) system, in which breast tumors grow within a curved geometry, in the presence of non-neoplastic cells, like *in vivo*. DOC devices consist of micro-fabricated acrylic-based hemichannels coated with extra cellular matrix component that promotes the differentiation of non-neoplastic epithelial cells. Tiny tumor nodules are deposited on the DOC and rapidly anchor to the hemi-channel surface and grow. Morphological analysis of the tumor cell nucleus and anticancer drug treatment in the DOC as well as hydrogel and hanging drop systems showed that only nodules in the DOC have similar nuclear morphology as *in vivo* and that the DOC better illustrate the potential for efficacy of anticancer drugs compared to hanging drop and hydrogel systems.

L21.

Identification of a Novel Interaction Site of the Mu-Delta Opioid Receptor Heterodimers

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Mu opioids (MORs) remain highly effective for the treatment of pain, and would represent ideal analgesics if their side effects could be prevented. Evidence suggests that MORs can interact with delta opioid receptors (DORs) to form MOR-DOR heterodimers which may contribute to adverse effects of mu opioids. Our goal is to develop drugs that disrupt the heterodimers to lessen side effects of mu opioids. Yet, a lack of tools to investigate the role of MOR-DOR heterodimers is stifling our ability to target the heterodimers with drugs. To aid in the development of such tools, it is important to understand MOR-DOR interactions. We used a multipronged approach to investigate the stability of the heterodimers. We found five novel amino acids necessary for the heterodimer formation. These findings will move us closer to our goal to develop drugs that can be used with opioid analgesics to prevent adverse effects of mu opioids.

PHYSICAL SCIENCES

P1.

Optimal Number of Terrain-Based Clusters for Knowledge-Based Inference Digital Soil Mapping.

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Understanding soil spatial variability is crucial for sustainable land use. Digital soil mapping has become an alternative to conventional soil surveys due to lower costs and shorter time required for mapping. Soil mapping using the knowledge-based approach is an efficient and consistent way for predicting soil properties. Selection of the optimum number of clusters (ONCs) has a large effect on the final map. We used principle component analysis (PCA), analysis of variance (ANOVA), and histogram distribution to determine the ONCs. We then ran three different unsupervised classifications using the topographic wetness index (TWI) and topographic position index (TPI) as inputs, and either 3, 5, or 10 clusters as outputs. Chemical and physical data from 176 georeferenced point observations were then assigned to the appropriate cluster. All three of the statistical methods showed that 5 clusters best captures soil variation based on topographic differences within the study area

P2.

Testing k-monotonicity

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A Boolean k-monotone function defined over a finite poser domain D alternates between the values 0 and 1 at most k times on any ascending chain in D. Thus, k-monotone functions naturally generalize monotone functions. We initiate in this paper a systematic study of k-monotone functions in the framework of 'property testing.' We establish:

- K-monotone functions are difficult to test as compared to monotone functions over the hypercube domain
- Testing k-monotone functions over hypercube is easier than 'learning' them. Our tester has query complexity 2^{\sqrt d log d} which has no 'k' in exponent unlike the complexity of learning.
- A tolerant testing result over the hypergrid domain which makes progress on a problem from STOC 2014.

This work exploits testing by learning framework, uses novel applications of Fourier Analysis over Hypergrids and forges connections with distribution testing.

P3.

Radio Emission from Pulsar Transits in Disk of Sgr A*

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Radiatively inefficient accretion flow models have been shown to accurately account for the spectrum and luminosity observed from our Galactic Center in the X-ray regime down to mm wavelengths. However, observations at a few GHz cannot be explained by thermal electrons alone but require the presence of an additional non-thermal particle population. We propose a model for the origin of such a population in the accretion flow via means of a pulsar orbiting the supermassive black hole in our Galaxy. During the pulsar's transit through the accretion disk, relativistic pairs, accelerated at the shock front, are injected into the disk. The radio-emitting particles are long-lived and remain within the disk long after the pulsar's transit. Periodic transits through the disk result in regular injection episodes of non-thermal particles. We show a quasi-steady emission is established with luminosities in the 1-10 GHz range being comparable to the observed spectrum.

P4.

Hydroxyl radicals and cysteine disulfide derivatives (CySSR) – mechanism and reactivity studies

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Formation of disulfides involving cysteine amino acid residues is critical for proteins to maintain stable structures and execute bio-functions. These disulfide bonds readily undergo substitution by either radicals or nucleophiles. Even though several reaction pathways have been proposed to account for hydroxyl radical (OH•) attack to cysteine containing disulfides, details in mechanism remains unclear. In this study, mechanism of OH• reaction with cysteine disulfide derivatives (CySSR) is probed by modulating the electronic property of R group (electron withdrawing group (EWG) or electron donating group (EDG)) and monitoring change of their first generation reaction products. EWG, such as alkyl or aryl derivatized CySSR, was found to have a higher reactivity toward OH• as compared to R being EWGs (e.g. acetyl group). However, EWG directs OH• addition preferably to electron rich sulfur within the disulfide, leading to a dominant formation of Cy-SO• product. Theoretical calculations are utilized to aid mechanistic explorations.

P5.

Water-mediated Aggregation of 2-butoxyethanol

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Water plays an important role in mediating hydrophobic interactions, and yet open questions remain regarding the magnitude, and even the sign, of water-mediated contributions to the potential of mean force between a pair of oily molecules dissolved in water. Here, the water-mediated interaction between 2-butoxyethanol (BE) molecules dissolved in water is quantified using Raman multivariate curve resolution (Raman-MCR), molecular dynamics (MD) simulations, and random mixing (RM) predictions.

Our results indicate that the number of contacts between BE molecules at concentrations between 0.2 M and 1 M exceeds RM predictions, but is less than some MD predictions. Moreover, the potential of mean force between BE molecules in water has a well depth that is shallower than the direct interaction between 1-ethoxybutane chains in the gas phase, and thus the water-mediated contribution to BE aggregation is repulsive, as it pulls BE molecules apart rather than pushing them together.

Post Doctoral Fellow Posters

LIFE, PHYSICAL AND ENGINEERING SCIENCES

PD-LPE 1.

Investigating the role of microenvironmental stress in breast cancer progression through transcriptional regulation mechanisms

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High content of reactive oxygen species in the microenvironment of triple negative breast cancer (TNBC) is conducive to oxidative stress (OS). Chromatin organizer, nuclear mitotic apparatus protein (NuMA) interacts with transcription factor lens epithelium-derived growth factor (LEDGF) and with chromatin protein, remodeling and splicing factor (RSF1) that are both up-regulated upon OS. **Our hypothesis is that OS influences NuMA-LEDGF-RSF1 interaction to promote breast cancer progression.** Using the HMT-3522 TNBC progression series (non-neoplastic S1 cells, preinvasive ductal carcinoma in-situ like S2 cells, invasive ductal carcinoma T4-2 cells) we show that expression of NuMA, LEDGF and RSF1 is significantly decreased in T4-2 cells compared to S1 and S2 cells. However, NuMA-LEDGF interaction under OS is decreased in S2 cells and increased in S1 cells, highlighting a different behavior in response to OS in phenotypically normal and cancerous tissues. These findings call for further investigation of NuMA-LEDGF-RSF1 interaction in controlling cell behavior under OS.

PD-LPE 2.

Fatigue crack growth model in high cycle fatigue

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Recently, total fatigue life approaches are proposed for linking short and long fatigue crack propagation in high cycle fatigue (HCF) regime. As for HCF life, cracks remain short for most of the fatigue life and long crack behaviors are not important. To estimate the fatigue crack growth in HCF regime, the UniGrow model is applied by simulating the stress-strain response in the elementary material volume adjacent to the crack tip. A systematic study is performed here to assess limitations of the UniGrow model to study mechanics aspects of short crack growth behavior in HCF. A modification of the model is proposed for the unification of short and long crack propagation to account for effects of stress ratio, stress amplitude, residual stress, and initial small crack size. The modified model predictions are in a good agreement with

experimental fatigue data sets of 2024-T3, 7075-T561 aluminum alloys and Ti-6Al-4V titanium alloys.

PD-LPE 3.

Unlocking the Chemical Diversity of Lamiaceae Through *de novo* Transcriptome Assembly and Chemical Profiling

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The Lamiaceae are a plant family of cultural and economic importance. Many species produce monoterpenoids, sesquiterpenoids, and iridoids, that contribute to their distinctive flavor and smell. Terpene synthases create diverse monoterpenoid and sesquiterpenoid products and thus are responsible for most of the diversity seen in the monoterpenoids and sesquiterpenoids. Because the Lamiaceae family in general are known for their terpenoid products, many of which lack biosynthetic information, a family wide survey of these pathways will provide the groundwork for understanding the biosynthesis of these important compounds. In this study transcriptomes and monoterpenoid, sesquiterpenoid, and iridoid profiles were generated for 48 species from the Lamiaceae family. This revealed the sesquiterpenoid bisabolene is found in oregano with no corresponding characterized bisabolene synthase but several promising candidate bisabolene synthases. As in the case of bisabolene the use of this dataset will provide a more complete picture of terpenoid metabolism in Lamiaceae

PD-LPE 4.

Improving Biofuel Viability: Metabolic Engineering of Arabidopsis for Production of 2-Phenylethanol

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2-Phenylethanol (2-PE) is a naturally occurring volatile that has been suggested a potential biofuel if an efficient production platform can be found. Here we use the model species Arabidopsis thaliana to develop a metabolic engineering strategy to increase production of 2-PE in plant systems. Coordinated overexpression of the two enzymes required to convert phenylalanine to 2-PE resulted in moderate product accumulation. Modeling of the metabolic network suggested that competition by the lignin biosynthetic pathway was preventing further 2-PE accumulation, and that this could be relieved by either increasing phenylalanine availability or decreasing flux toward lignin. Both approaches were tested and found to improve product accumulation by greater than an order of magnitude. Further bottlenecks to accumulation will be identified by stable-isotope labeling in conjunction with metabolic flux analysis. The optimized

engineering strategy will be used to genetically modify biofuel feedstocks, with the goal of complementing lignocellulosic ethanol production.

PD-LPE 5.

A Preliminary Study on a Robot's Prediction of Human Intention

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A wise man is said to do the right thing at the right time. Thanks to the cognition, human beings are able to make reasonable judgments and take specific actions accordingly. However, nowadays even the most intelligent robot in the world is not satisfactory in its understanding of the context, not to mention its rudimentary ability to proceed according to its understanding. In fact, "When to do", "What to do", and "How to do" not only confuse philosophers, but also trouble designers of intelligent robots. In this preliminary research, we will investigate how a robot can perceive and learn from its surrounding environment, including movements of human participants. We will also demonstrate how the learned knowledge can make the robot more intelligent.

PD-LPE 6.

Profiling Diphenylurea Compounds As A New Antibiotic Class Targeting Bacterial Cell Wall Synthesis

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Bacterial resistance to antibiotics remains an imposing global public health challenge. Of the most serious pathogens, methicillin-resistant *Staphylococcus aureus* (MRSA), is problematic given strains have emerged that exhibit resistance to several antibiotic classes including β-lactams. New antibiotics composed of unique chemical scaffolds are needed to counter this public health challenge. The present study evaluates two compounds, bearing the diphenylurea scaffold, that inhibit growth of MRSA at concentrations as low as 4 μg/mL and are non-toxic to mammalian cells at concentrations up to 128 μg/mL. MRSA mutants exhibiting resistance to the compounds could not be isolated. Bacterial cytological profiling revealed the diphenylureas exert their antibacterial effect by targeting cell wall synthesis. A mice skin infection model determined both compounds decreased the burden of MRSA in wounds similar to the antibiotic fusidic acid. The present study lays the foundation for further investigation of diphenylurea compounds as a new class of antibacterial agents.

PD-LPE 7.

Biodegradable PEGylation Glycolipid-Like Nanocarrier for Efficient Systemic Gene Delivery

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In this study, we introduced a chitosan-based gene delivery system for *in vivo* pDNA delivery and gene transfection. We developed PEGylated chitosan-ss-stearylamine (PEG-CS-ss-SA) co-polymer as our gene delivery vector, which was mixed with pDNA at different N/P ratios to prepare PEG-CS-ss-SA/pDNA nano-complex. The nano-complex was approximately 150 nm in diameter and 20 mV in zeta potential. The nano-complex showed efficient gene transfection in cell based assay. Wild-type p53 was selected as the target gene. The nano-complex up-regulated p53 expression and induced apoptosis in tumor cells. *In vivo* studies showed that PEGylation extended half-life of the nano-complex. Light sheet microscopy provided us a 3D view of fusion gene expression in the tumor tissue after systemic injection of the nano-complex. Tumor sections further confirmed the induction of tumor cell apoptosis by the nano-complex.

SOCIAL AND BEHAVIORAL SCIENCES

PD-SBS 1.

Regional Variations in Noise Mitigation Policy Implementation at Large US Airports

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Noise pollution from aircraft in the vicinity of airports is problem that has been shown have negative impacts on the welfare of the surrounding environment including the nearby communities of humans and animals. The International Civil Aviation Organization has issued guidance on how to combat the issue of noise pollution through policy. This study evaluated the local airport policy implementation schemes at 132 Class B and Class C airports in the United States. A latent class analysis was used to determine variations in mitigation policies among six different airport clusters. Each cluster was likely to implement a different set of noise pollution mitigation strategies ranging from the implementation of only specific, Federal Aviation Administration approved, noise abatement procedures for aircraft to airports that closely monitor aircraft noise output through strategically placed noise-monitors while investing millions of dollars in the community through soundproofing homes and schools in noise-sensitive areas

PD-SBS 2.

Research on In-Vehicle's Interactive Interface Design and Safe Driving Behaviors

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The interface design of In-Vehicle information system (IVIS) is an important research topic in the area of driving behavior and safety. With eye tracker, electroencephalogram, vehicle data recorder and other equipment, the research collected qualitative and quantitative data about the drivers' driving load, situational awareness, driving intent and other cognitive indicators. Based on the analysis of these data, a user cognitive model was built and a usability evaluation method of vehicle information system was proposed. By using the evaluation method, the paper revealed drivers' behavior change criteria in the process of operating IVIS. These criteria laid the theory foundation for the development of driving detection system, which is used to help the driver drive safely and reduce the probability of traffic accidents. These criteria also provided a basis for the future development of unmanned technology.