2022 FALL SYMPOSIUM ABSTRACT BOOK

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ARTIST STATEMENT
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Space: the final frontier. That's what American astronomer Nancy Roman believed throughout her time designing NASA's Hubble Space Telescope. At the time, it was indisputable how impactful this human innovation was. It gave scientists the ability to witness our universe up close without the impairment of Earth's atmosphere. Its ultra-violet vision capabilities have captured comets, planets, galaxies, black holes, and beyond. Even more notably, scientists have witnessed what the universe looked like 2.5 million years ago. Space exploration is the pinnacle of human innovation, advancement, and discovery- pushing the boundaries past what was ever thought to be possible. More importantly, understanding our universe is a road that leads towards a greater understanding of the true final frontier: the human brain. Proving to be one of the most enigmatic facets of science, the brain continues to baffle researchers. In particular, one unexplainable phenomenon exists: cosmic webs in the galaxy are morphologically similar to human neuronal networks. The meaning behind this is unknown, but what it suggests is that our existence is far more intertwined with our universe than we could ever imagine.

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Why Give at Work? Comparing the Motivations for Giving to a Workplace Fundraising Campaign in Higher Education across Three Profile Clusters of Givers

Authors: Maeve Barger, Mark Motsch, Jennifer Jones

Many nonprofit organizations solicit philanthropic donations to accomplish their mission. Examining donor habits and values can help these organizations target their communication to specific donor groups to encourage donor participation and ultimately to reach their mission-related goals. This targeted communication strategy is also possible for workplace fundraising campaigns, or federated campaigns, such as those frequently run by United Way. This qualitative study examines differences in donors' giving motivations and patterns in a workplace fundraising campaign at a large public university located in the southeastern United States. Semi-structured interviews were conducted with 45 participants, each from a different cluster of donors as identified by a factor analysis in a previous study (female faculty, male faculty, and a mix-gendered group of hourly employees; Jones, 2021). Interview questions inquired about motivations for giving, volunteering patterns, and changes in giving. Responses were collected and compared between clusters to identify variations in donor motivation and tendencies that might support marketing efforts. Several consistencies were observed across the clusters, such as a favorable perception of the ease of payroll deduction option offered by the campaign. Differences became apparent as well. For example, individuals from the mixed-gendered cluster of hourly employees tended to donate smaller amounts than the male faculty cluster but to causes closely aligned with their values. By understanding giving patterns and motivations such as these the charitable giving campaign can align its communications with donors' giving and involvement goals, furthering its ability to receive valuable funds.

Agricultural and Life Sciences

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College Students with Food Allergies and other Dietary Restrictions have Lower Adherence to a Mediterranean-Style Diet than those with Self-Selected Dietary Patterns Regardless of Food Security Status

Authors: Sean Tzoucalis, Vicki Freedman, May Alshahwan, Angelica Ahrens, Eric Triplett, Jen Doty, Liva LaMontagne, Anne Mathews

Adherence to a Mediterranean-style diet (MD) is associated with positive physical and mental health outcomes such as fewer symptoms of depression and anxiety. Few adults, particularly college students, report high adherence. Little is known about how dietary restrictions impact adherence to a MD and certain dietary restrictions may inhibit adherence to the MD. Food insecurity (FI), reliable access to quality nutritious food, is highly prevalent among college students and may further influence students' food choices.

To determine differences in adherence to MD and food security (FS) by diet type, such as vegan/vegetarianism, pescatarianism, paleo, aversion to dairy, gluten, and other allergens, among college students.

A cross-sectional survey of 1,134 first-year college students was conducted (fall 2021). Participants completed the USDA Adult Food Security Survey Module to assess food security status, the Reliability of the Mediterranean Diet Quality Index (KIDMED) brief FFQ for adherence to MD, and other questions regarding food patterns and demographics.

We categorized participants into three groups: those who have no dietary restrictions (0), those with food allergies or aversions to dairy/gluten (1), and those who have a chosen diet pattern (vegetarianism, veganism, etc.) (2). Group 2 had a significantly higher mean KIDMED score than students in groups 0 and 1 (4.01±0.26, 2.71±0.1, 3.02±0.25, $p< 0.001$, respectively). There was no significant difference in food security status by diet type.

First-year college students' food security status does not differ by diet type. Students with a self-selected dietary pattern (group 2) have relatively higher adherence to the MD than those on restrictive or no stated dietary pattern although all groups have low overall adherence to the MD. Interventions to improve diet quality may particularly benefit the improvement of mental health of college students.

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Genetic Variation in Nitrogen Content in Cowpea Seed Measured by Near-Infrared Spectroscopy and Wet Chemistry

Authors: Rebecca Arias, Habib Akinmade, Annmary Jubil Tharayil, Esteban Rios

Cowpea (Vigna unguiculata) is a drought-tolerant legume of economic importance in Africa, South America, and the southeastern United States. Functioning as a subsistence crop, cowpea seeds are a rich source of amino acids, carbohydrates, and protein. In the interest of breeding more nutritious cowpea cultivars, quick and cost-effective methods of nutrient analysis are key. The standard wet chemical method of nutrient analysis of grain is typically a time-consuming, destructive process, leading to the loss of valuable seed. Near-Infrared Spectroscopy (NIRS) is a nondestructive method of analysis that uses the reflectance of light from 700 to 2500 nanometers to determine the properties of a sample while retaining its' integrity. It is also a fast process, requiring very little time processing per sample. In this experiment, both whole and ground cowpea seeds were analyzed using NIRS equations and wet chemistry. We found that regardless of the equation used, it was necessary to grind cowpea seeds for accurate data. We also found that using the NIRS-Corn Silage Unfermented equation yielded values closer to the baseline wet chemistry than the NIRS-Legume/Hay equation. Analysis of 110 samples containing 55 accessions, 2 reps each, showed variance in crude protein content ranging from 19.69% to 39.19%, with 20 samples showing >30% crude protein content. This data will be used in the selection of cowpea accessions for breeding lines with higher crude protein content.
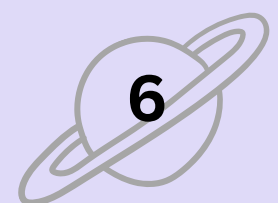
Self-Regulation as a Potential Mediator Between the Brightmind Meditation App and Psychological Well-Being

Authors: Nayha Kumbkarni, Tamar Deletis, Sarah Bottari, Liva LaMontagne, John Williamson, David Diehl

Introduction: Meditation and mindfulness-based apps have shown promise as effective interventions for reducing stress and improving overall psychological well-being among college students; however, the mechanisms by which these mindfulness apps achieve psychological benefits are not yet fully understood. The current pilot study aimed to explore potential mediators of these improvements. Methods: 39 college students were randomized into two groups: a mindfulness group, that was asked to use the Brightmind meditation app four times per week over a 4-week period, and an active control group that was asked to play a puzzle game (2048) for an equivalent amount of time. Both groups completed self-report measures of stress, positive/negative affect, and interoceptive awareness before and after the 4-week intervention. Correlations and t-tests were used to explore pre-post changes in these variables between the two groups. Results: Self-regulation, a facet of interoceptive awareness, showed greater improvements in the mindfulness group relative to the control group ($t[29.81] = -2.84$, $p < .01$, Cohen's $d = 0.93$). Improvements in self-regulation were positively correlated with number of mindfulness sessions completed ($rho = 0.47$, $p < 0.01$) and negatively correlated with perceived stress ($r = -0.31$, $p < 0.05$) and negative affect ($r = -0.32$, $p = 0.05$).

Discussion: Our findings show that a mobile app-based mindfulness intervention is associated with improvements in self-regulation, or the ability to regulate distress by attention to body sensations, relative to an active control. Moreover, these improvements are associated with indicators of improved well-being, including reduced perceived stress and negative affect. Thus, improving self-regulation may be one mechanism by which mindfulness apps achieve psychological benefits.

Smart Tools for Young Adults

Authors: Haleigh Morgan, Anita Blackmon, and Juan Donis

Many young adults may lack confidence in their future. They may struggle with a variety of things, from finances to mental health. Statistics show 70% of young adults are concerned about their finances and people aged 18-25 years had the highest prevalence of mental illnesses at 30.6% (Grabmier, 2015, and National Institute of Mental Health, 2022). Due to this, we think it is important to give young adults access to information that can help better their everyday lives. Our goals with our project was to make an effective and informative form of community resource development in order to provide young adults with research-based methods.

We created our Smart Tools for Young Adults as an attempt to better prepare teenagers and young adults with life skills. We focused specifically on educating Miami-Dade county residents on mindfulness, clarifying and expanding on Cryptocurrency, and to help incoming college students understand their financial aid options.

We started our project by conducting a needs assessment and choosing topics relevant to young adults; then, we collected and translated clinical research and created informative and creative flyers for each topic. We then distributed educational tools and surveyed recipients to collect outcome data. We found that the majority of people surveyed were satisfied with the education tools created. 100% of surveyors who answered agreed that they learned something about the topic from the infographics shared with them. Our study also shows that 89% of people who viewed the education tools plan on adopting one or more of the tips or strategies suggested.

Our research shows that we can find an engaging and scientific method to help build confidence in those entering adulthood.

EVE: Improved hydraulic conductivity and its impact in drought tolerance

Authors: Ribeiro, Cíntia & Conde, Daniel & Balmant, Kelly & Dervinis, Chris & Johnson, Matthew & McGrath, Aaron & Szewczyk, Paul & Unda, Faride & Finegan, Christina & Schmidt, Henry & Miles, Brianna & Drost, Derek & Novaes, Evandro & Peter, Gary & Burleigh, J. & Martin, Timothy & Mansfield, Shawn & Chang, Geoffrey & Kirst, Matias.

Enlarged Vessel Element (EVE), is a gene that was characterized as a determinant of vessel element formation by Ribeiro et al. (2020). Manipulation of vascular development alters the number and dimension of vessel elements, which in turn affects hydraulic conductance, potassium (K+) transport, vessel diameter, stem length and diameter. Each of these physiological factors contributes to crop yield and abiotic stress response. Expression of EVE positively correlates with vessel size and water conductance without compromising the integrity of xylem conduits. EVE has also been found to influence K+ transport in xylem cells. K+ is the cornerstone cation of the ionic effect which allows plants to maintain hydraulic conductance under water deficit conditions. To observe the role of EVE in drought tolerance in poplar trees, three test groups were developed: EVE overexpressing lines, CRISPR/Cas9 knockout lines, and unaltered wildtypes. These plants were challenged with water stress by gradually reducing the relative extractable water (REW) content to 20% over three weeks while the well-watered control groups maintained 85% REW for the five-week test period. The photosynthetic rates of the well-watered control group remained relatively constant, while the photosynthetic rate of the water-stressed wildtype and knock out groups dramatically declined. However, net photosynthesis of the water-stressed of the EVE overexpressing plants remained similar with the trees in the well-watered control group. Furthermore, the root and shoot biomasses of drought-stressed overexpressing lines were significantly higher than the EVE knockout lines and wildtypes. Increased EVE expression in trees as a mechanism to tolerate stress was further substantiated by qRT- PCR analysis of wildtype trees growing under well-watered and water stress conditions. Altogether, these results indicate that EVE may play a critical role in the drought response of the woody perennial poplar through regulation and transport of potassium content.

Effect of Iron on the Competition Between EIchhornia Crassipes and Pistia Stratiotes

Authors: Elizabeth Littler, Dr. Benjamin Sperry, Dr. Candice Prince

Aquatic invasive plants are a major problem in the state of Florida, with management costing $15- 20 million a year. Two of the most problematic plants are water hyacinth (Eichhornia crassipes) and water lettuce (Pistia stratiotes). These species create dense mats on the surface of water bodies which block sunlight from reaching organisms underneath, as well as prevent aeration and transportation. Our experiment evaluated competition between these two species, and the effect of iron on their interspecific competition. Plants were placed in 94.6-L mesocosms at 5 different ratios of water hyacinth to water lettuce plants (0:10, 3:7, 5:5, 7:3, 10:0). All mesocosms were fertilized with 10 g of MiracleGro, and half of them received an additional 2 g of chelated iron. There were four mesocosms per treatment. We recorded plant number after 2 and 4 weeks, and harvested final biomass at 4 weeks. The experiment was conducted twice (2021, and 2022). In both trials, the number of water lettuce plants was significantly affected by species ratio, as well as the interaction of species ratio and the presence of iron. In both trials, the ratio of hyacinth to lettuce also had a significant effect on the number of water hyacinth after 4 weeks, as well as the biomass of both water lettuce and hyacinth. However, in trial two, the biomass of water hyacinth was also significantly affected by the presence of iron. Data showed that the presence of water hyacinth had a negative impact on the numbers of water lettuce. Iron increased numbers of water lettuce but made smaller individuals, with the opposite being true for water hyacinth.

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IRES: The habitat and behaviorally mediated impacts of elephant presence in savanna communities

Authors: Janessa Keller, Amanda O'Brien, Cory McKinstry, Kayla Ehrlich, and Robert McCleery

Savannas, making up 20% of the world's land surface, are biomes with a co-dominant relationship between grasses and woody vegetation, (Scholes and Archer, 1997; Lehmann et al., 2014; McCleery et al., 2018). This codominance is maintained by disturbance. One major source of disturbance in Africa savannas is the elephant, an ecosystem engineers whose activity and feeding behavior alter the various communities throughout the system (Botes et al., 2006; Owen-Smith et al., 2019). However, we do not have a complete understand of how elephants alter communities. The prevailing thought has been the elephant disturb vegetation and this directly alters the animal communities that use them. In contrast to this habitat-mediated hypothesis there is also some evidence for a behavioral-mediate hypothesis where animals change there activity and distributions based on the presences of elephants alone. To better understand the ways elephants alter animal communities we conducted two experiments. First, we quantified large mammals' response to elephant playback to see if it altered their behavior. Second, we manipulated habitats to simulate elephants and simulated elephant presence via audio playbacks. For all of our treatments we quantified the response of large mammal, small mammal, and dung beetle communities. For our first experiment, we found that elephants caused large mammals to flee and increase vigilance, analogous to their response to large predators (i.e. leopard) . In our second experiments, we found that habitat and behavioral manipulations increased small mammal abundance and richness and decreased these measures for large mammals communities. We found no responses to these treatments for dung beetles. In total, our study suggests that understanding elephants' effect on animal community must consider behavioral-mediated as well as habitat-mediated responses.

Global Trade and Agricultural Production – The Evolution of the World's Top Agricultural Producers in the 21st Century

Authors: Julia Ulrich and Joao-Pedro Ferreira

In the beginning of the 21st Century, the world observed remarkable growth in production due to advancing technology and increasing trade. This economic growth impacted agricultural production across the world and affected distinct countries differently. Indeed, there were different growing patterns among the top ten agricultural producers, with some countries emerging as new global players and others keeping their position as world leaders. One common aspect among the major agricultural producers is that they all have become more dependent on external markets. To establish a detailed picture of the evolution of agriculture production, in the first part of this work, we analyze changes in agricultural output, productivity, and employment in the leading producers during the first fifteen years of the 21st Century and discuss their performance related to different macroeconomic variables. In the second part of this article, a multi-country input-output model is used to estimate the increase in international interdependencies at the country level. The results shed some light on two relevant conclusions. First, on the supply side, our estimations emphasize how agriculture production became more reliant on the imports of goods and services or on goods and services that incorporate a high level of imported inputs. Additionally, on the demand side, our results underline how the food production industry in these top ten countries became less dependent on domestic agricultural production and increasingly relied on agricultural goods produced abroad.

Association Between Informal Caregiving and Financial Toxicity Among Cancer Patients

Authors: Charles B. Drucker, Jude T. Flynn, Biswadeep Dhar, Ph.D. Skye O. Dougan, MPH and Michael S. Gutter, Ph.D.

Informal Caregiving (IC) describes the process by which individuals within a patient's social support network may undertake the role of a caregiver without formal compensation. Previous research has shown the impacts that IC can have on both the caregiver and care recipient, including economic stress. Such may be especially present for care recipients with chronic illnesses (e.g. cancer) who can be viewed as long-term consumers of healthcare resources. This paper seeks to capture the association between levels of financial toxicity (FT), a term developed to quantify the impact of high treatment costs on a patient's quality of life, and the following variables: presence of caregiving support, presence of some caregiver workplace adjustment, and duration and status of caregiver workplace adjustments. The outcome of interest, FT, was measured using the Comprehensive Score for Financial Toxicity (CoST). Survey data were collected from 259 cancer patients of an academic medical center in North/Central Florida in 2018. Notably, we observed lower CoST scores among patients whose caregivers made workplace adjustments compared to those whose caregivers did not make workplace adjustments ($p \approx 0$; CI: 4.7–12.6) and compared to those whose caregivers were not employed ($p = 0.0001$; CI: 3.5–12.5), with a family-wise confidence level of 95%. This indicates that patients who experienced greater FT were more likely to have caregivers who made workplace adjustments. Understanding these relationships may inform future interventions and policy reform designed to ameliorate the adverse financial effects concerning IC.

Agricultural and Life Sciences

The Effect of CRISPR-Cas Proteins Cas7 and Cas1b on the Virulence of Porphyromonas gingivalis ATCC 33277

Authors: Edison Tran, Muhammad Irfan, Ana Duran-Pinedo

The CRISPR (Clustered Regularly Interspaced Short Palindromic Repeat)-Cas system is a genomic arrangement, particularly associated with bacterial protection against foreign nucleic acids (plasmids, short DNA, phages, mobile elements). However, emerging evidence points to CRISPR-Cas being involved in bacterial virulence. Previously, it was reported that upregulation of all CRISPR-Cas genes in Porphyromonas gingivalis ATCC 33277 were observed in clinical samples of progressing periodontitis, an oral inflammatory disease induced by the coordinated action of a polymicrobial community. P. gingivalis is a bacteria strongly associated with periodontitis and harbors two types of CRISPR-Cas systems (Type III-C and Type I-C). In this study, we focused the attention to Cas1b and Cas7, two key genes present in Type I-C. In order to assess their effect, we constructed ΔCas1b and ΔCas7 and used Galleria mellonella larvae as an infection model because they harbor homologous human's genes coding proteins involved in the recognition of pathogens. Our results showed that, compared to the wild type strain, ΔCas7 displayed increased virulence. In contrast, ΔCas1b exhibited similar mortality rates compared to the wild type strain. Cas1b is involved in the initial step of foreign DNA recognition, and these findings suggest that Cas1b may be required to activate or stabilize the following CRISPR-Cas system. Interestingly, Cas7 showed a similar virulence effect to Cas3, a previously studied gene in P. gingivalis Type 1-C.

Light Transmittance Through Different Esthetic CAD-CAM Ceramics

Authors: L. Epstein*, R. Lencioni, M.G. Rocha, D. Oliveira.

Introduction: Dentists have been using light, normally blue light, to cure dental materials for years. However, the light transmittance through different ceramics can always result differently, which can have a profound effect on the longevity and durability of restorations.

Objectives: The aim of this study was to assess the difference in light transmittance through the Empress A2 and Emax A2 ceramic.

Methods: Emax and Empress ceramic blocks in shade A2 were cut and sectioned into six different thicknesses: 0.5mm, 1mm, 1.5mm, 2.0mm, 2.5mm, and 3mm (n=3). Next, the light transmittance was measured through the different ceramics using a spectrophotometer (Marc Light Collector, Blue Light Analytics). A dental curing light (Valo Cordless, Ultra Dent) that was pre-calibrated with 100 mW/cm2 was used. Lastly, data was analyzed using ANOVA and Tukey's Test.

Results: There was a difference between the blue light-transmittance in the Empress and Emax ceramic of size 0.5 mm and 2mm. The rest of the groups provided no statistical data to show a significant difference.

Conclusions: Within what has been seen in the study, it is seen that at thicker samples of both ceramics, the light transmittance values will be lower. It is also shown in the study that the Empress ceramic resulted in higher transmittance values compared to the Emax.

The effect of antidepressants, serotonin and norepinephrine reuptake inhibitor, on jawbone health: a bone histomorphometry study

Authors: Colton Yu, Jia Chang

Background:
Antidepressants are one of the most prescribed medicines to manage emotional disorders. Some studies have shown the negative effect of antidepressants to long bone health, especially for serotonin and norepinephrine reuptake inhibitors (SNRI). However, research on the effect of SNRIs on jawbone health is rare. Our previous retrospective clinical study found the adverse impact of SNRI antidepressants on dental implant health and on periodontal health. Taking SNRI medication was found associated with dental implant failure, while it was associated with better periodontal stability in periodontitis patients. Before starting the prospective clinical trial, an animal study exploring the effect of SNRIs on healthy jawbone is needed to better understand the biological mechanism beneath our findings.

Aims:
The major focus of the study is to determine the effects of one major class of antidepressants, serotonin and norepinephrine reuptake inhibitors (SNRIs), on jawbone structure by bone histomorphometry study.

Material and Methods:
C57BL/6 mice received SNRI i.p injection at 3-months-old. SNRIs was administrated @ 10mg/Kg, once a day for 2 weeks (IACUC study #201810400). By the end of administration, the mice were euthanized, and the jaw bones were collected for three-dimensional bone morphology with a Bruker Skyscan 1172 μCT (Kontich, Belgium). The bone histomorphometry analysis will be performed according to the guideline for assessment of bone microstructure in rodents using micro computed tomography. Cancellous volumetric (v) BMD and cortical tissue mineral density (TMD) were calculated after calibration with hydroxyapatite phantoms.

Results:
Looking at our data, we found SNRI injected mice showed a significant decrease in both bone mineral density (vBMD) and percent bone volume (BV/TV) when compared to the sham control group.

Conclusion:
Further study on mouse bone morphology and histomorphometry in these mice will help explore the impact of antidepressants on dentistry.

Empowering Latinx ESOL Paraprofessionals: Unveiling their Cultural Capital in US Secondary Schools

Authors: Dahlia Fabregat, Manuel Marichal, M.Ed, Dr. Erica McCray

he U.S. English Learner (EL) population, most of whom are Latinx, is increasing rapidly. Meanwhile, teachers remain mostly white and monolingual. The resulting cultural divide can lead to adverse outcomes for Latinx students. Culturally responsive curriculum and practices as well as ethnic match between teachers and students are among the strategies utilized to address the resulting cultural divide. Latinx EL paraprofessionals are educators that uniquely relate to and empower students through a variety of practices, including instruction, advocacy, testing, and translating. Guided by Community Cultural Wealth theory (Yosso, 2005) interviews were conducted with three Latinx Paraprofessionals regarding their lived experiences. The purpose of this study is to better understand the cultural capital (i.e., linguistic and cultural skills) that Latinx ESOL Paraprofessionals possess and how they employ it with Latinx EL students. Additionally, the study brings forth two research questions. The first research question (RQ1) was: What types of cultural capital are revealed by Latinx paraprofessionals who support ELs in secondary schools? The second research question (RQ2) was: In what ways do they describe their cultural capital shaping their work with ELs in secondary schools? By better understanding the lived experiences of Latinx EL paraprofessionals, school professionals can better unlock their potential to promote improved educational outcomes for Latinx EL students.
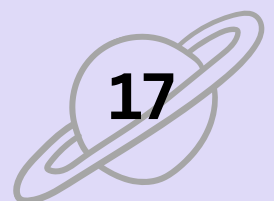
Impact of RAW 264.7 Macrophage Cells Response on Enzymatic Degradation in Silk Sponges for Biomedical Applications

Authors: An P. Nguyen, Henry M. Lutz, Whitney L Stoppel

Silk fibroin, from Bombyx mori silkworm cocoons, can be used to create sponge-like materials with a wide range of mechanical properties. Previous investigations show the potential for silk sponges to aid in tissue regeneration in vivo. Silk scaffolds with extracellular matrix (ECM) components encourage cell proliferation, migration, and infiltration. One advantage of silk fibroin-based sponges is their ability to be proteolytically degraded by macrophage-excreted enzymes. The products of this degradation are small peptides and amino acids. In this work, we aim to understand how macrophages, a cell type that is part of the immune system, interact with these materials and catalyzes their enzymatic degradation. To start these studies, I learned how to grow and culture RAW 264.7 cells. RAW 264.7 cells are macrophage-like cells that are used to evaluate immune responses and cell-material interactions in the laboratory. We can use small molecules to stimulate the cells' protein and cell surface receptor expression toward M1-like macrophages (inflammatory) or M2-like macrophages (anti-inflammatory). M1 and M2-like cells represent the extremes of the polarization spectrum of macrophages. M1-like cells show a decrease in cell proliferation rates and, in vivo, often causes tissue damage since this phenotype represents cells that clear pathogens. M2-like cells promote local cell proliferation and tissue repair in vivo. In this experiment, we culture RAW 264.7 cells and observe their growth at different cell seeding densities to help us choose appropriate seeding densities for our cell-material experiments. We investigated how the macrophage's polarization changed in response to different stimuli and I quantitatively analyzed the resulting fluorescence microscopy images using Cell Profiler®. My next steps include stimulating the macrophage-like cells and evaluating silk scaffold degradation caused by enzymes produced from these cells. I will examine the degradation of silk scaffolds in vitro to predict degradation timelines following implantation.

Engineering

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The Effects of Bioconjugation, Size, and Stiffness of Microgel Particles to Study Cancer Metastasis in a 3D Microenvironment

Authors: Griffin R. Golde, Julia M. Lavrador, Duy T. Nguyen, Alfonso Pepe, Lucca Trachsel, Diego I. Pedro, Gabriel J. Rosa, W. Gregory Sawyer

Cancer research has been limited by the ubiquitous 2D infrastructure of in vitro cell models. Although widely accepted as the method of choice for basic research, 2D cell models fail to recapitulate the complexities of the solid tumor environment in two drastic ways: by limiting growth to a monolayer and surrounding cells in a physically and chemically homogeneous environment. Conversely, in vivo cancer cells constantly evolve and grow in a three-dimensional, heterogeneous scaffold of extra-cellular matrix (ECM) proteins and cellular components, all of which pivotally influence tumor cells' proliferation, migration, immunosuppressive properties, and response to therapies. Using bioconjugated liquid-like-solid (LLS) microgels, we built a 3D ECM model that mimics in vivo conditions whilst permitting real-time, detailed imaging of migration and cellular interactions. The LLS stably supports cellular structures in 3D and the interstitial space allows permeation of media and treatment supply. The bioconjugation of ECM proteins on the LLS surface allows cell adhesion and migration, facilitating cell-ECM interactions and other natural cellular dynamics. Specifically, collagen1 conjugated LLS particles were used to characterize how interstitial space and microgel stiffness influenced cancer invasion. A fibronectin-collagen1 LLS was also created to demonstrate the ability to conjugate multiple ECM proteins onto the functionalized LLS and investigate the role of fibronectin on cell migration. The ability to visualize and trace tumor invasion in a tunable, 3D framework that closely mimics its natural environment will provide a preferable preclinical model for cancer therapeutics testing.

Engineering

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Solid-State Synthesis of Iron Fluoride Nanocomposites as Cathode Materials for Lithium Ion Batteries

Authors: Steph Meikle, Sicen Yu, Dr. Ping Liu

Iron fluorides are energy-dense cathode materials for lithium-ion batteries (LIBs). Iron fluoride mass production is hindered by fluorine sources, which are highly corrosive and dangerous. In this work, a simple and feasible solid-state reaction is reported to synthesize iron (II) fluoride (FeF2) by using polyvinylidene fluoride (PVDF) as a fluorine source and ferric oxide (Fe2O3) as an iron source. This method delivers carbon coated FeF2 nanocomposites with a particle size of less than 100 nm, characterized by scanning electron microscopy (SEM). As the ratio of PVDF:Fe2O3 increased from 1:1 to 3:1 wt. %, all Fe2O3 precursors were fully converted to FeF2, evaluated by X-ray diffraction (XRD). Ongoing work includes using polytetrafluoroethylene (PTFE) as a new fluorine source to synthesize carbon coated FeF2. The fast-charging performance and cycling stability of carbon-coated FeF2 electrodes, paired with lithium metal as a counter electrode in LIBs is intended to be investigated.
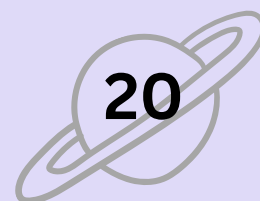
Modulation and Characterization of 3D-Printed Scaffold Geometry for Islet Transplantation

Authors: Justin Walsh, Taylor Lansberry, Robert Accolla, Jiapu Liang, Cherie Stabler

Type 1 diabetes is an autoimmune disorder where the patient's immune system destroys their insulin-secreting pancreatic islets leaving them unable to control their blood glucose levels. Clinical islet transplantation, a potential treatment option involves injecting donor islets into the liver. Unfortunately, with this method, there is a significant loss of islets due to mechanical stresses and inflammatory reactions. To address these issues, we previously engineered a macroporous polydimethylsiloxane (PDMS) scaffold using a salt-leaching method to distribute and retain the cells; however, there were inconsistencies in pore size, interconnectivity, and topography. We are currently using a 3D-printing technique to alleviate these issues to create a porous, 3D-printed PDMS scaffold (3DPSS) with more defined pore geometry. Using CAD modeling and 3D-printing, we modulated the width of the PDMS rungs in the xy plane, fabricating three unique 3DPSS prototypes with 150, 200, 300μm PDMS rung thickness. The rung thickness was significantly different among prototypes indicating successful modulation of rung thickness. The actual rung thickness was greater than the modeled rung thickness for each prototype, indicating expansion of the material during processing. Pore size in the 3DPSS prototypes was significantly less variable compared to the macroporous scaffold, demonstrating increased pore size consistency. The porosity of the 3DPSS was significantly lower than the macroporous scaffolds. Characterization of these geometric parameters in the 3DPSS will give us insight into how these parameters affect tissue integration in vivo in future experiments.

Characterization of Cyanobacteria Growth Utilizing the Products of Anaerobic Digestion

Authors: Ryan Ames, Nathan O'Neil, Dr. Ana Martin-Ryals

Regenerative space life support systems (SLSS) need to be developed to support long duration missions. Current SLSS require resupplies and do not recycle organic wastes, such as fecal and food waste. Anaerobic digestion (AD) is a popular method of treating biodegradable waste. Our goal is to use microalgae to convert the gaseous (biogas) and liquid (effluent) products of AD into a multi-use biomass. This would establish an integrated waste-to-bioproduct pipeline to improve nutrient recovery in SLSS. The objective of this series of experiments was to characterize the ability of Cyanothece sp. BG11 to grow in and acclimate to increasing levels of AD effluent (ADE). Two 14-day batch experiments were conducted in 10 mL glass cuvettes. The headspace of each cuvette consisted of 50% biogas (60% CO_2/40% CH_4) and 50% N_2. The 12 cuvettes were split into 4 conditions with 3 replicates each. The control condition contained only standard growth medium (Allen Medium minus nitrogen). In the experimental conditions of the first batch 12%, 14%, and 16% ADE was used as the growth media. The experimental conditions of the second batch were 16%, 18%, and 20% ADE. The replicate from the 16% ADE condition from the first batch that had the highest growth rate was used to seed every condition of the second batch. The growth rates of the second batch peaked faster and higher than that of the first batch due to acclimation. The percentage of ADE will continue to be increased in future experiments. Satisfactory growth at high percentages of ADE would show support for an integrated waste-to-bioproduct pipeline.
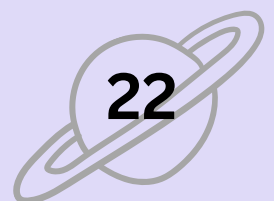
Examining the Thermostability of Silk Fibroin Micro- and Nano- Particles in vitro

Authors: Jostin Armada, Hannah Bagnis, Isabelle Gerzenshtein, Marisa O. Pacheco, Whitney L. Stoppel

Biopolymeric micro- and nano- particles made from naturally derived materials have been utilized for encapsulation and controlled release of bioactive molecules. Particles made from silk fibroin are useful due to the stabilization properties of the biopolymer and its degradation into small, soluble peptides and amino acids in vivo. This work aims to investigate the stability of silk fibroin particles to advance the potential for translation when used in the design of controlled delivery systems. We investigated the thermostability of particles stored at 23 and 37°C to evaluate the potential of silk particle formulations to bypass the need for strict cold-chain storage for at least a 5-week period. The particles used for these experiments are compared relative to a control batch stored at 4°C, which express hydrodynamic diameters of ~200-1000 nm. The silk fibroin is initially isolated from Bombyx mori cocoons, and the particles are formed by phase separation with polyvinyl alcohol (PVA), which is induced via probe sonication. In our group, previous work determined parameters that result in desired particle sizes. For our sonicating conditions, we utilized a sonication amplitude of 25% for 30 seconds prior to film casting and a sonication amplitude of 15% for 15 seconds after resuspension, using silk degummed for 60 minutes. Weekly samples were imaged via a Keyence BZ-X800 microscope in bright field to observe particle formation and confirm the absence of any bacterial contamination. Weekly samples were also analyzed via dynamic light scattering (DLS) to assess changes in average hydrodynamic particle diameter (Zavg) and particle size distribution (PDI). Additionally, scanning electron microscopy (SEM) was used to evaluate morphology and confirm physical size. No observable changes occurred in morphology, Zavg, or PDI values. Future work aims to explore the thermostability and utility of silk fibroin particles loaded with therapeutic agents and oxygen carriers.

Generation Z and E-Learning: COVID-19, Personality, and Technology Acceptance

Authors: Viktoria Marcus, Alaa Masrahi, Sanaz Motamedi

The COVID-19 pandemic has severely affected schools, with traditional in-person operation changing to remote online learning. The rapid, involuntary shift was met with resistance by Generation Z students. This study seeks to develop an e-learning technology acceptance model for Generation Z students, with a focus on the environment created by the COVID-19 pandemic. A theoretical framework based on the Technology Acceptance Model (TAM) was extended by 8 factors based on literature review and student input from a prior focus group study (Motamedi et. al., 2021). The survey has 3 parts: 1) background information, 2) personality traits, 3) acceptance model factors. 20 responses were collected and analyzed using Cronbach's alphas. The results found the reliability of items to measure the identified factors. The outcome of this study provides a baseline for future studies to validate the model. The framework provides understanding of Generation Z acceptance of e-learning.
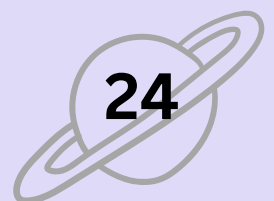
Mechanism of Light-triggered Carbon Dioxide Release by Photoacid

Authors: Stella Belony, Audrey Miles, Uvinduni Premadasa, Yingzhong Ma, Yi Liao,Vera Bocharova

Usage of amine-based materials has become increasingly popular for capturing CO_2 directly from the air and flue gases. However, this technology is relatively expensive due to high energy input needed to release chemosorbed CO_2 from amines. Also, amines are non-intrinsically safe for the environment as they decomposed during the repeating heating/cooling cycles. For these reasons, development of novel light-triggered molecules might reduce CO_2 capture cost and display innovative paths for capture and release of CO_2 due to their reversibility and efficiency. In this study, we sought to understand how light-stimulated novel photoacid (PA) triggers CO_2 release and tried to identify the optimum release conditions. We first tested the effects of PA and bicarbonate concentrations on CO_2 release and its kinetics. Then, we varied light wavelength exposure and duration to pinpoint optimal conditions for CO_2 production and release with photoacid. To characterize the system, we used ultraviolet-visible spectroscopy for wavelength-dependent light absorption of solutions. Broadband dielectric spectroscopy to examine conductivity of photoacid. Dynamic light scattering to evaluate the diffusion of photoacid and bicarbonate in solutions. A pH meter to monitor changes in the acidity and alkalinity of solutions upon irradiation, and other techniques to understand the mechanism of CO_2 release with photoacid. In our investigation, we demonstrated that light-induced changes conformations of photoacid and facilitates pH change of aqueous solution. The magnitude of pH change depends on the wavelength and intensity of irradiating light and concentration of photoacid. Our results indicated that photoacid aggregates are formed in aqueous solutions which ultimately affect the pH change. These aggregates could be reduced by adding bicarbonate. These findings allow us to better understand the fundamental and practical implications of the mechanism of CO_2 release with photoacids.
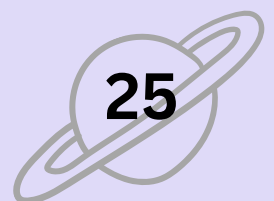
Open-source, High-throughput Computational Workflow on HiPerGator for the Uniaxial Deformation of Glassy Polymer Membranes

Authors: Brendan Wernisch, Mohammed Al Otmi, Janani Sampath

Industrially, polymer membranes are used in separation operations to split a chemical mixture into its components. Characteristic applications in this space include water desalination, hydrocarbon separations, and carbon capture. In high-pressure industrial separations, the membrane is deformed under external stresses, which can impact its suitability in target applications. Understanding the dynamics of a membrane under high pressure can allow the engineer to make informed decisions on how to better select and design membrane polymers for novel and existing applications.

In this work, we employ molecular dynamics simulations in an open-source workflow to build, deform, and analyze polymer membranes. To represent a breadth of amorphous, glassy structures typical in separation applications, we consider three chemistries that vary in their novelty and rigidity. These membranes are polystyrene (PS), polymethylpentene (PMP), and HAB-6FDA thermally rearranged polymer (TRP). With our workflow, we apply three strain rates uniaxially to PS, PMP, and TRP and construct a stress-strain curve, yielding insights into the mechanical robustness of these membranes. Computational techniques serve this work in two key ways: (1) visual snapshots throughout the deformation period provide qualitative structural insights on the atomic scale, capturing the three-dimensional morphology of a deforming membrane with intuitive visuals; (2) simulations yield detailed, quantitative results up to femtosecond intervals, providing the experimentalist a breadth of data with a single trial. By executing this workflow on HiPerGator, its high throughput nature is further enhanced; this protocol can serve to advance the rate of experimental discovery. Future work includes an investigation of how void spaces in the membrane evolve throughout the deformation period, which plays a key role in the efficacy of a separation process.

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Quantifying functional diversity in Ovarian cancer

Authors: Syed Tahir, Adriana Del Pino Herrera, and Meghan C. Ferrall-Fairbanks

Intratumor heterogeneity refers to the differences between cells of a given tumor. This population-level variation allows tumors to evolve in response to selective pressures, ranging from chemotherapy to inflammatory responses. Quantifying this heterogeneity can provide insight into cancer cell population dynamics and how a tumor evolves over time. In turn, clinicians can potentially use metrics of heterogeneity as a biomarker for tumor progression and outcome, adding to their toolbox for precise, personalized treatment.

Our research focuses on a class of diversity indices from ecology known as functional diversity indices (FDI). Traditional diversity indices in ecology balance species abundance and dominance in an ecosystem to quantify an "effective number of species" present. These indices do not account for the relatedness of species in a population of interest. Functional diversity allows us to quantify varying levels of differences between species, in turn providing a more accurate description of the varied phylogenies of tumor populations.

We processed single-cell RNA sequencing data from ovarian cancer cell lines that were induced to evolve PARP Inhibitor resistance. We applied traditional and functional diversity indices to this population of 5091 cells as a test-of-concept for application to larger single-cell data. For the functional diversity index, we used the Leinster-Cobbold Index with 5 methods of quantifying differences between species, which we explore in our analysis.

Overall, our analysis provides a framework for using functional diversity indices to quantify heterogeneity from related populations, providing additional insight to traditional metrics of diversity. This will lend itself to further studies of cancer evolution.

System Study of Fuels from Carbon Dioxide Feedstocks Using Plasma Catalysis

Authors: Victoria Stevenson, Berkay Ekinci, Sean D. Knecht, Xiaoxing Wang, and Sven G. Bilén

Non-thermal plasma catalysis is an expanding research field with the potential to play an important role in sustainable carbon conversion due to its lower temperature and energy requirements. Without the need for external heat or pressure, non-thermal plasma (NTP) provides activation energy for chemical reactions via energetic electrons. When paired with a catalyst, these advantages can be leveraged for better process reactors. In the reactor, a high voltage electrode is inserted through a packed-bed dielectric barrier discharge chamber, which consists of a dielectric material packed with a catalyst. The reactor aims to reduce the need for conventional fossil fuel production while being powered by renewable energy sources and industrial-scale sources of CO_2. Important fuels such as methanol, ethanol, and propane can be produced via hydrogenation of CO_2, and these could become economically competitive with current sources while reducing emissions. When scaled up, the NTP reactors would be placed near industrial carbon feedstocks or utilize CO_2 from carbon capture and storage (CCS) processes to close the carbon cycle. However, the reactors are still of laboratory size, thus there is still much research to be done into the construction of reactors at an industrial scale. It is not feasible to move entirely away from carbon-based energy sources, and this reactor can help create a circular carbon economy. The transition to an economy sustained by renewable energy requires investment, and the purposeful implementation of innovative technologies, such as NTP reactors, are critical to achieving this.

Let's Get (Thermo)physical: Recovering & Modeling Data from NEOWISE's Asteroid Survey

Authors: Isabella Macias, Joahan Castañeda Jaimes, and Joseph Masiero

I present results from my work identifying previously undiscovered near-Earth asteroid (NEA) detections in the NEOWISE archive. Identifying the composition and orbital path of NEAs will provide a greater understanding of the origins of our solar system and improve our safeguards against these hazardous planetesimals. While a survey of threatening NEAs is currently underway under the NEOWISE mission, our manual search of unreported epochs of asteroids from the NEOWISE archive complements this program and enables us to construct a complete framework of the NEAs' characterizations. We recovered data from the NEOWISE mission's Infrared Science Archive (IRSA) database to be inputted into a Markov Chain Monte Carlo (MCMC) modeling code, which fits a triaxial ellipsoid model to constrain thermophysical properties such as diameter, thermal inertia, and albedo. We reported the observed epochs to the International Astronomical Union's Minor Planet Center's (MPC) database and built tools for locating missing epochs in NEOWISE's search for NEAs.

Analytical method development and data analysis strategies for mapping metabolic rewiring in sepsis using imaging mass spectrometry

Authors: Yu Tin Lin, Manal L. Zabalawi, Nicholas R. Ellin, Lane M. Smith, Peter W. Stacpoole, Charles E. McCall, and Boone M. Prentice

Sepsis causes 270,000 deaths and over $38 billion in hospital management costs each year in the United States, yet the understanding of its molecular mechanism remains unclear. The dysregulated immune response to infections during sepsis (i.e., shifts from immune resistance to tolerance) has been known to result in bioenergetic perturbations via the disrupted tricarboxylic acid (TCA) cycle. The onset of immune tolerance reduces pyruvate dehydrogenase complex (PDC) activation via increased pyruvate dehydrogenase kinase expression. This leads to itaconate-induced inhibition of succinate dehydrogenase by the upregulated itaconate synthesis pathway, which is a catabolic divergence of cis-aconitate anabolism. Treatment with the prototypic PDC activator dichloroacetate (DCA) has shown promise in decreasing levels of itaconate, potentially reversing metabolic rewiring during sepsis. Imaging mass spectrometry (IMS) is a powerful analytical tool to study the spatial metabolomics of sepsis, providing label-free detection of metabolites in tissue samples with high sensitivity. Herein, we have investigated metabolic rewiring and disease progression during sepsis and DCA treatment of septic tissues at different timepoints via matrix-assisted laser desorption/ionization (MALDI) IMS. Multivariate analysis of variance (MANOVA) is performed on regions of interest (ROIs) corresponding to the left ventricles, interventricular septum, and right ventricles to elucidate the association between metabolic rewiring and sepsis-induced cardiomyopathy. Further inspection of our IMS data based on ROIs revealed sepsis-induced spatiotemporal metabolic alterations, such as elevated itaconate. MANOVA was performed to investigate the metabolisms of pyruvate, TCA intermediates, amino acids, and fatty acids, and revealed the successful reversal of itaconate elevation by DCA treatment.

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Religion and Power in Haiti: an Evaluation of Syncretism in Catholicism and Haitian Vodou

Authors: Caroline Levine

This project explores the concept of Catholic syncretism in the religious practice of Haitian Vodou. Since the French colonial era of Haiti, there have been many visual indications of Catholicism in Haitian society and the practice of Vodou, such as in shrines and other religious imagery. Evidence of this syncretism can even be seen in the Haitian diaspora. For my research, I have studied the concept of syncretism in Haiti through scholarly resources and I have conducted fieldwork in New Orlean, Louisiana at a Voodoo botanica that contained many shrines dedicated to Haitian lwa. In my research, I examine the extent to which Catholic imagery permeates Haitian Vodou. This project will fill a research gap in the relationship between Catholicism and Haitian Vodou, exploring whether or not the two religions have truly been syncretized.

Detecting pH Changes Using a New Spectrophotometric System

Authors: Refat Roja and Julian David

Understanding CO_2 effects on marine organisms is important due to climate change and ocean acidification. We are interested in testing acute CO_2 effects on the growth of marine worm Capitella teleta, but this requires new techniques for CO_2 exposure and monitoring. My project addresses this through the development of a new spectrophotometric system, which measures absorbance ratio changes of a pH indicator dye in seawater (SW). The design parameters require a system that can monitor pH changes in a closed chamber while not itself affecting the exposure conditions. In preliminary experiments with a variety of pH indicators, I identified m-cresol purple (mCP) as the most sensitive to pH changes over the range needed for our studies. I then designed and constructed a spectrophotometric system that uses SW in the well of a multi-well plate instead of a cuvette, as would be in a typical spectrophotometer. This system uses a warm-white, diffused LED diode, a fiber optic sensor, and a sealed CO_2 chamber. For an exposure, 2 mL SW with 0.015 mg/mL mCP is placed in a well inside the chamber, which is then flushed sequentially with 419 ppm, 600 ppm, and 800 ppm CO_2 in air. The pH changes are determined based on the ratio of the peak absorbance (acidic and basic) wavelengths of mCP. The results showed stable absorbance ratio readings under 419 ppm CO_2 exposure (with open valves and flushing). Upon addition of 600 ppm CO_2, pH decreased and stabilized over a period of approximately 2 hours. Similar kinetics occurred with a subsequent change to 800 ppm CO_2. These results indicate that the new system is sufficiently sensitive to detect small pH changes in SW resulting from CO_2 exposure, though the calibration method needs improvement to increase the precision of the pH change detection.

Effect of Stress on Oxycodone Self-Administration, Extinction, and Reinstatement

Authors: Courtney S. Wilkinson, Siya Bhutani, Marek Schwendt, Lori A. Knackstedt

Opioid use disorder (OUD) affects over 2.7 million people in the United States and nearly 75% of drug overdose deaths in 2020 involved an opioid. Individuals with comorbid post-traumatic stress disorder (PTSD) and OUD suffer more severe outcomes than those with a single diagnosis. The present study investigates the long-term effect of stress on oxycodone self-administration, extinction, and cue-induced reinstatement. Thirty-six Sprague-Dawley rats (19 male, 17 female) were exposed to predator scent stress exposure in the form of the fox pheromone 2,5-dihydro-2,4,5-trimethylthiazoline (TMT) for 10 minutes. Exposure sessions were recorded and analyzed for freezing behavior as an indicator of fear. Seven days later, rats were tested for persistent anxiety-like behavior on the elevated plus maze (EPM) and acoustic startle response (ASR) task. One day after EPM+ASR testing, rats were surgically implanted with jugular catheters for IV oxycodone self-administration. After recovery, rats were permitted to self-administer oxycodone 3 hr/day 6 days/week for 12 days. For the first 6 days, rats earned infusions on a fixed ratio 1 (FR1) schedule of reinforcement, followed by an FR3 schedule for the next 6 days. Subsequently, rats underwent extinction training for 2hr/day for a minimum of 14 days followed by cue-primed reinstatement testing. Rats showing greater anxiety-like behavior after TMT exposure trended towards higher oxycodone intake. Mean startle predicted an exponential increase in oxycodone intake during self-administration and active lever presses during reinstatement for both groups. Stressed rats trended toward increased oxycodone self-administration and showed significantly greater response for the active lever during extinction. These results indicate that greater anxiety-like behavior increases oxycodone intake and reinstatement of oxycodone-seeking, and that stress exposure promotes continued drug-seeking during extinction.

Quantitative imaging and physics-driven modeling of liposome-mRNA nanoparticle assembly for RNA-based vaccines and immunotherapy

Authors: Alen Zacharia, Reagan McGinley, Michael Chung, Hector Mendez-Gomez, Elias Sayour, Juan Guan

Empirical trial-and-error optimization in nanoparticle engineering inevitably approaches plateau with modest improvement in treatment efficacy and diagnosis capabilities. Novel use of quantitative assays and measurements that provide mechanistic insights into the nanomaterial assembly process may point to alternative routes in areas currently under-developed in nanomedicine. Here, we used fluorescence microscopy to track nanomaterials assembly in a model RNA-liposome system, in real time, with high specificity, spatial resolution, and throughput. We showed that the assembly occurs in discrete steps after mixing of mRNA and cationic liposomes in aqueous solution. Following the initial mRNA adsorption, the mRNA-coated liposomes self-assemble into heterogeneous conglomerates spanning several orders of magnitude in size. Quantitative imaging reveals the assembly process is consistent with a Smoluchowski model with a constant Brownian diffusion kernel. These observations prompt fine-tuning of the assembly process by modulating the initial liposome concentration, which leads to changed nanoparticle size distribution and dramatically improved mRNA delivery efficiency. As this scrutinized RNA-liposome assembly is the basis of an ongoing FDA-approved clinical trial for cancer immunotherapy, this work reveals quantitative fluorescence imaging has enormous translational potential.

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Effects of Increased Carbon Dioxide and Amputation on Capitella teleta Growth

Authors: Raluca Velcu, Dr. David Julian

Aquatic animals, such as the polychaete Capitella teleta, are being exposed to higher levels of carbon dioxide (CO_2) due to changing climate conditions. Furthermore, like many other polychaetes, C. teleta can regenerate its posterior segments after an amputation. C. teleta is emerging as a model organism for studying marine invertebrates, and therefore understanding how stressors affect C. teleta is expected to help our general understanding of the effects of climate change on marine animals.

I studied two stressors: elevated CO_2 (600 ppm) and amputation. I tested three hypotheses: H1, exposure to 600 ppm CO_2 reduces the growth rate compared to normal CO_2 (416 ppm); H2, amputation reduces the growth rate; and H3, the combination of 600 ppm CO_2 and amputation produces a combined or synergistic effect on growth rate. I tested these hypotheses with a 2 × 2 experimental design: unamputated and amputated C. teleta exposed to 416 ppm and 600 ppm CO_2. All groups were maintained at the designated CO_2 condition at 18 C for 8 days after which we measured growth.

I found that elevated CO_2 alone does not significantly affect growth rate compared to normal CO_2 ($p= 0.113$) and that amputation does not significantly affect growth rate ($p= 0.458$), but that the combination of elevated CO_2 and amputation significantly reduced growth rate ($p= 0.042$). Therefore, H3 was supported while H1 and H2 were not supported. This suggests that elevated CO_2, such as is predicted to occur due to climate change, in combination with amputation will have a negative effect on polychaetes, and furthermore that we should consider the subtle effects of combined stressors when predicting the effects of climate change.

Russian Blues: Linguistic Recognition of Color Perception Induced by Bilingualism

Authors: Reinaldo Cabrera-Perez, Alina Neverodska, Eleonora Rossi

Learning and speaking two languages is a known example of continuous life experience that induces neuroplasticity. Neuroplasticity refers to the brain's unique ability to change its structure to adapt to its environment through repetitive actions. Over time, speakers' (i.e. bilinguals, L2 learners) brains continuously experience structural and functional changes with increased exposure to their L2. The present behavioral study takes a new approach to linguistic recognition of color induced by bilingualism. For example, English has the single word "blue" to encompass both light and dark blue colors, but Russian has separate basic color terms for light blue (goluboy) and dark blue (siniy). This means that individuals whose L1 is English and who learn Russian as an L2 may experience neural restructuring that affects the way they perceive colors. While there is extensive research on neuroplasticity in the brain of bilinguals, there is a gap in the literature in terms of how these changes can affect perception in the everyday life of bilinguals, such as in color perception tasks. The primary goal of this study is to investigate the degree to which knowledge of Russian coupled with English causes a change in color perception and a "temporary" conflict between the two languages. This study examines how learning and being immersed in an L2 environment that has different basic color terms influence the way we process colors in our native language and affects performance on a color perception test.

Early Behavioral and Neural Signatures of Novel Language Learning in Bilinguals

Authors: Melanie Gonzalez, Lisa Gonzalez, Megan Nakamura, Eleonora Rossi

The disciplines of cognitive neuroscience and psycholinguistics have long been fascinated by the bilingual experience. This study aims to further the literature on bilingualism that focuses on the neural signature differences between monolinguals and bilinguals during lexical processing. The purpose of this study is to determine whether behavioral and neural signatures can arise after a brief period of novel language learning. We are also interested in exploring the potential mediation effects of bilingualism in novel language learning. This study implements a mini-longitudinal design that consists of a pre-test, 10 days of novel language learning, and a post-test. A semantic categorization task is conducted during the pre-test and post-test, prompting the participant to evaluate the word's meaning in terms of animacy and relative size. Electroencephalography (EEG) proves to be a useful technique for quantifying the behavioral and neural signatures of novel language learning during the semantic categorization task. The N400 component of the event-related potential (ERP) is a negative deflection wave well-known for its connection to semantic processing. We expect the N400 to be significantly reduced in the post-test compared to the pre-test, supporting the claim that neural signs of novel language learning are present after a short language learning period. This study directly relates to the overarching topic of neuroplasticity in language which can be further researched through other neuroimaging techniques.

Hydrogen Bonded, Pi-Conjugated, Self-Assembly Capable Molecules for Organic Solar Cell Applications

Authors: Kern, Faith K; Pan, Cheng-Yen; Castellano, Ronald K.

Organic photovoltaics (OPVs) are becoming a notable and cost-effective source of electricity due to their potential improvements to environmental sustainability as well as electrical power. Currently, the bulk heterojunction (BHJ) design is widely used and features active layers formed by blending donor and acceptor organic materials together during processing. The morphology of the active layer depends on the interactions between materials but its consequences on efficiency are hard to predict and control. Well-designed molecular structure can help us derive structure-property relationships and control morphology in the active layer. Our previous studies have proven that self-assembling pi-conjugated donor materials with phthalhydrazide(PH) as hydrogen bonding units have the potential to enhance the efficiency of the OPV devices by improving the morphology. Thus, this research aims to improve upon this molecular design by developing a new donor-acceptor molecule with a centralized PH containing building block, which will afford an easier synthesis as well as improve pi-pi-interactions between target molecules, named QPH. Characterizing QPH with proton and carbon NMR and IR spectra confirms its structure and optimal geometry. Additionally, QPMe, an important comparator molecule to QPH, was designed and synthesized. Here the PH functional group on QPMe is blocked by methyl groups, so the hydrogen-bonding interactions are "turned off". Proton and carbon NMR, as well as IR, were employed to understand the differences between QPH and QPMe.

Site-Directed Mutagenesis of Oxalate Decarboxylase Isozymes Investigating the Role of an Active-Site Flexible Loop in Catalysis

Authors: Lucas Cathey, Michael MacNair, Alexander Angerhofer

Oxalate decarboxylase (OxDC) is a naturally occurring enzyme found in Bacillus subtilis. It is induced by low-pH stress, and has the function of breaking down the mono-anion of oxalic acid into carbon dioxide and formate. During the course of the reaction an acidic proton is removed from an oxygen atom and placed on a carbon atom, raising the pH. The enzyme possesses an isozyme, designated OxDD, which possesses a similar conformational structure and performs the same function, but does so with half the activity of OxDC under environmental conditions. Upon examination of the amino acid sequence of the two isozymes, an important difference was found in a flexible peptide loop which gates substrate access to the active site. A single polar asparagine residue in the center of the flexible loop in OxDC is replaced by a non-polar phenylalanine in the loop in OxDD. We hypothesize that the loop serves to keep the substrate and its intermediates bound in the active site during the course of catalysis and that the polarity of the residues in the loop modulate this effect. This project aims to elucidate the effect of this difference in the loop structure on enzyme activity and to find out whether it is responsible for the decrease in activity of OxDD compared to OxDC. We employed site-directed mutagenesis on both isozymes to alter the structure of their loops to resemble each other, creating an OxDC enzyme with an OxDD loop and an OxDD enzyme with an OxDC loop. Observation of the catalytic efficiency of the mutants through assay has provided evidence that the nonpolar loop structure decreases activity in OxDC, and that the polar loop increases activity in OxDD. Spin-trapping electron paramagnetic resonance experiments confirmed this through the detection of leakage of radical intermediates during catalysis.

Chemical Synthesis of a Novel Pentamethylcyclopentadienyl Titanium Ketimide Complex

Authors: Kevin A. Stewart, Jacob J. Lessard, Alex Cantor, Jared I. Bowman, Brent S. Sumerlin*

Plastic waste generated by consumers across the world continues to increase, posing large environmental and health concerns. Most modern recycling methods have proven to be inadequate solutions as they oftentimes produce plastics of lesser quality and toxic wastes as by-products. As such, there is much scientific interest in finding pathways to recycle plastic waste to generate plastics of equal or better quality, higher value products, or monomer feedstocks. The research described here focuses on the upcycling of polyolefins using repurposed Group IV polymerization catalysts, with previous results depicting the chain scission of cis-1,4-polybutadiene is readily feasible. A particular family of cyclopentadienyl-titanium complexes, [CpTi(N=PR3)Cl2] (Cp = -C5H5, -C5(Me)5, (C5H4(C6F5)); R = -alkyl), are pre-catalysts that readily perform olefin polymerization upon activation; however, little research has been investigated that tests the microscopic reverse (i.e depolymerization properties) of these Group IV pre-catalysts. In this project, a novel pentamethylcyclopentadienyl-titanium complex with a unique ketimide (C=NRR1) group is synthesized for potential upcycling of polyolefins based on homogeneous and heterogeneous catalysis.

Polyimine Vitrimers and Linear Polymers from a Highly Aromatic Bio-Based Scaffold

Authors: Kevin A. Stewart, Jacob J. Lessard, Alex Cantor, Jared I. Bowman, Brent S. Sumerlin*

Bio-based vitrimers represent a promising class of thermosetting polymer materials, matching the recyclability of dynamic covalent networks with the renewability of non-fossil fuel feedstocks. Vanillin, a low-cost compound sourced from lignin, enables facile construction of polyimine networks marked by rapid exchange and sensitivity to acid-catalyzed hydrolysis. Furthermore, the aromatic structure makes it a promising candidate for the design of highly aromatic networks capable of high-performance thermal and dimensional stability. Here, we report on the fabrication of polyimine networks with particularly high aromatic content from a novel trifunctional vanillin monomer, prepared
from the nucleophilic aromatic substitution of perfluoropyridine (PFP) on a multi-gram scale (>20 grams) in high-yield (86%). The trifunctional aromatic scaffold was then crosslinked with various diamines to demonstrate tunable thermomechanical properties, viscoelastic behavior and thermal stability, with degradation temperatures up to approximately 340 °C and excellent char yields up to 68% at 650 °C (N2). Moreover, the vitrimers displayed rapid chemical recyclability following acidic hydrolysis at mild temperatures. Finally, a difunctional vanillin monomer was synthesized in similar fashion and step-growth polymerizations to yield a linear polymer system was demonstrated. Our findings indicate that vitrimers with tunable properties and high-performance thermomechanical behavior can be easily constructed from vanillin and electrophilic aromatic scaffolds.

COVID-19 Transition Challenges Perceived by College Students Enrolled in the Coordinated General Psychology Program

Authors: Agustina Salomon, Anna Thodhori, Amber Hatch, Shreya Gadikota, Feihong Wang

College students encountered various transition challenges during the COVID-19 pandemic that varied depending on race (Reyes-Portillo et.al, 2022), gender (Lei et.al, 2022), and location (Lee et.al, 2021). Few studies have explored the specific variations relating to college students' abilities to excel academically within these demographic categories. This study aimed to expand the literature regarding the COVID-19 transition challenges perceived by college students and whether they differed across gender, race, and geographic location.

We conducted thematic and secondary data analyses on transition challenges reported by 186 students enrolled in five general psychology sections at the University of Florida. Participants consented and responded to an open-ended survey item on perceived COVID-19 transition challenges. Verbatim responses were coded with an average inter-coder agreement of 88%.

Thematic analysis yielded 12 major transition challenges: Time management, motivation, course delivery quality, reduced/lack of interaction, online testing-related, focus issues, family interruption, resource accessibility, COVID-related, transition online-related, and difficulty learning online. Some students reported no difficulties or an appreciation for online learning. White people reported greater appreciation for online learning ($M=0.080$, $SD=0.267$, $p=0.002$) and fewer COVID-related issues ($M=0.300$, $SD=0.232$, $p=0.018$) when compared to other races/ethnicities. Students residing in Florida had greater focus issues ($M=0.220$, $SD=0.414$, $p=0.005$) and appreciation for online learning ($M=0.060$, $SD=0.241$, $p=0.002$) yet fewer COVID-related issues ($M=0.050$, $SD=0.2444$, $p=0.020$) than students outside of Florida. Impacts across gender were not significant.

Our findings extend the literature that collegiates face significantly different transition challenges depending on race and location. Higher educational institutions should recognize the various COVID-19 challenges on students and provide appropriate support.

The Effects of Bilingual Experience on Executive Function and Episodic Memory Across the Lifespan

Authors: Armaan Kalkat, Jason Rothman, Vincent DeLuca, Toms Voits, and Eleonora Rossi

In the last 10 years, researchers have highlighted that one potentially protective factor that promotes healthy aging is bilingualism. By now, a large number of studies have shown that bilingualism can even delay the onset of Alzheimer's dementia symptoms and also have broader effects on non-pathological cognitive aging (Bialystok et al., 2012). This is generally believed to be due to the experience of bilinguals, who have been demonstrated to engage a number of cognitive factors (such as cognitive control) to enable successful language processing in multiple languages. In turn, while executive control networks are often negatively impacted during aging, bilinguals' constant engagement with those cognitive and neural substrates seems to be the basis of the observed protective effects. The aims of this project are to investigate the effects of bilingualism as a continuum of experiences rather than a dichotomous variable (as most previous research has done) and test understudied age groups such as those aged 35 to 55 to determine whether any effects can be observed in the earliest instances of cognitive aging. The research is being conducted in northern Norway, which has a very high level of functional bilingualism in the general community. EEG methodology was used to measure executive functioning and episodic memory performance using a battery of cognitive tasks, and a demographic interview was used to collect data on language use as well as other important factors in cognitive aging such as exercise, diet, social network characteristics, education, and occupation. It was predicted that daily use of multiple languages would be associated with better executive functioning and memory performance in the older adults. Data collection and preliminary analyses are ongoing.

Monitoring the spatial metabolism of glucose in pancreatic tissues using imaging mass spectrometry

Authors: Katherine Gegoutchadze; Julia R. Bonney; Anna C. Rushin; Matthew E. Merritt; Boone M. Prentice

Diabetes, a disease characterized by the body's inability to produce or utilize insulin to regulate blood glucose levels, is a significant public health concern, resulting in 1.5 million deaths worldwide in 2019. The pancreas is an important organ involved in insulin homeostasis, consisting of endocrine cells that contain islets, which are comprised of many cell types (e.g., alpha and beta cells). Beta cells produce insulin, which signals the liver to store glucose, whereas alpha cells produce glucagon, a hormone that signals the liver to release stored glucose, which then raises blood sugar levels. Additionally, the pancreas contains exocrine cells, which synthesize and secrete digestive enzymes. Despite a significant amount of research into type 1 diabetes, much remains unknown about the metabolic pathways responsible for disease pathophysiology. Part of the challenge surrounding this research lies in the difficulty of studying small tissue structures (i.e., islets) with high molecular specificity. Mass spectrometry (MS) is a powerful, label-free analytical technique that can directly detect metabolites from biological tissues. Specifically, matrix-assisted laser desorption/ionization (MALDI) imaging mass spectrometry (IMS) uses MS as an imaging tool to map the distribution and abundance of chemical compounds in tissues. In this work, we have employed a mouse model of pancreatic tissue slices leveraging heavy labeled glucose to track spatial metabolism in mouse pancreatic tissue using imaging mass spectrometry. In particular, we are interested in studying metabolic processes such as glycolysis and the tricarboxylic acid (TCA) cycle that are used to produce cellular energy. Our preliminary data demonstrated the detection of ^{13}C-labeled glucose and pyruvate using IMS, which we will ultimately use to investigate glucose metabolism and its role in diabetes disease progression.

Low-dimensional Material Microscopy and Heterostructure Fabrication

Authors: Junhao Zhang, Alexey Chernikov, and Xiao-Xiao Zhang

To understand the behavior and interactions of many-particle systems in low-dimensional materials, we constructed a microscopy setup consisting of pulsed and continuous lasers, second harmonic generation, spectrometers, and CCD and streak cameras. A liquid helium cooling system was also set up for low temperature (<5K) measurements. Localized strain was induced on 2D transition metal dichalcogenides with the use of diamond substrates, and the strain was mapped by measuring peak exciton resonant wavelengths. A novel organic-inorganic layered perovskite crystal was exfoliated with various methods, and heterostructures were fabricated for AFM, WL measurements, and exciton diffusion/transport measurements.

A Comparative Study on the Treatment of Migrant Workers in Lebanon and the United Arab Emirates Through the Kafala System Since 1970

Authors: Sana Motorwala

The kafala system is a sponsorship system hosted by various countries, specifically those in the Middle East. This system has often been described as 'modern-day slavery' by various human rights organizations, including Amnesty International and Human Rights Watch. Through this program, migrant workers find jobs in a destination country and are under the responsibility of their employer, known as kafeel. This results in a one-sided dependency of the migrant worker on the kafeel, who essentially holds control over the migrant worker. The U.A.E. and Lebanon are both countries that have a defined kafala system, in which there are widespread abuses against guest workers. Some examples of abuses seen in both countries include the revocation of passports and denied access to healthcare. This study argues that the treatment of guest workers and the legislation passed concerning their welfare in Lebanon and the U.A.E. are influenced by factors such as the historical background of each country and their respective economic structure. These countries both have vastly different economies, with the U.A.E. representative of a post-industrial economy and Lebanon having a stagnating economy. The methodology used is a historical comparative approach that examines the kafala system in the U.A.E. and Lebanon. They will be evaluated based on the economic structure and the legislation passed concerning the welfare of migrant workers. The study will also delve into the historical development of each country and its relation to guest workers. Examining the kafala system in the U.A.E. and Lebanon is important because it emphasizes the plight of migrant workers in two contrasting case studies. The inhumane treatment of these workers often goes ignored and their severity is improperly represented. Therefore, this study sheds light on the widespread and pervasive problem of the kafala system.

Imaging Mass Spectrometry of Sulfur-Containing Metabolites in a Mouse Model of Systemic Staphylococcus Aureus Infection

Authors: Journie Hector, Justin M. Ellenburg, Joshua Lensmire, Paige Kies, Neal D. Hammer, Boone M. Prentice

Bacterial pathogens metabolize transition metals and other essential nutrients from their host in order to meet nutritional needs. With Sulfur being an essential macronutrient for both bacteria and host, its abundance allows the proliferation of pathogens, resulting in harmful parasitic relationships. Staphylococcus aureus has been implicated in the utilization of organosulfur metabolites like glutathione (GSH), however, direct evidence of sulfur-containing metabolites is lacking. Studies usually focus on identifying metabolite pathways and the roles that various enzymes play in sulfur metabolism and pathogen proliferation. However, studies in vivo or in situ of the proliferation of pathogens by metals such as sulfur have yet to be published. Matrix-assisted laser desorption/ionization (MALDI) imaging mass spectrometry (IMS) allows for the label-free mapping of a variety of metabolites within pathogen-infected tissues, providing evidence of in situ sulfur metabolization. Thin sections of epithelial tissue were prepared from mice that were systemically infected with Staphylococcus aureus for analysis by IMS. Our preliminary data from S. aureus-infected mouse kidneys shows localization of GSH to infectious foci (i.e., tissue abscesses) and localization of oxidized homocysteine non-abscessed regions of infected tissues.

Applying the Strep-tag II System to Oxalate Decarboxylase Protein Purification

Authors: Alyssa Cheong, Kyle Bisson, Alexander Angerhofer

Oxalate Decarboxylase (OxDc) from the soil bacteria Bacillus subtilis is a pH stress-induced enzyme which catalyzes the conversion of the monoanion of oxalic acid into formate and CO_2 in the presence of dioxygen and manganese. Previous overexpression and purification of functional OxDc protein have relied upon using a His-tag mutation at the C-terminal end, which is the addition of a six-histidine long tag to the protein chain. The protein is then purified using a nickel-NTA resin column, which binds the His-tagged protein while letting untagged protein escape. The His-tagged protein is then eluted from the column using a buffer with a high imidazole concentration. While this technique allows for effective purifications, the presence of imidazole has the side effect of stripping metals from solution and from proteins. Wild type OxDc Mn incorporation per monomer is high with approximately 1.93 compared to the theoretical value of 2 Mn per subunit. However, site directed mutations of the protein such as W96F show much lower Mn incorporation (0.55 per monomer for W96F). An alternative purification method was explored in this work which utilizes the Strep-tag II technology. In this protocol the Strep-tag II, consisting of the eight amino-acid sequence TRP-SER-HIS-PRO-GLN-PHE-GLU-LYS is fused at the end of the protein. After overexpression in E. coli the protein is bound to an affinity column containing Strep-Tactin. The elution step uses biotin instead of imidazole. As a result, we expect that the protein does not experience metal-leaching during purification and that the Mn incorporation per monomer will be increased. In addition to adding the Strep-tag II to WT OxDc, a C383A mutation was used to improve protein solubility and prevent aggregation. It was also expressed with the Strep-tag II in place.

Code-Switching in Bilinguals

Authors: Guadalupe Diaz, Rodrigo Medina, and Souad Kheder

Code-switching, the alternation between different languages within a single sentence or conversation is common amongst bilinguals. The control Process Model (Green & Wei, 2014) hypothesizes that varied language contexts, such as types of code-switching (insertional or dense), involve different engagement of cognitive control. Prior research has reported a conflict facilitation effect on the non-verbal Flanker trials after reading written code-switched compared to unilingual sentences (Adler et al., 2020). We aim to examine whether conflict resolution in a non-verbal task is affected by the type of code-switching. To test this, the experiment alternates pre-recorded code-switched and unilingual sentences with Flanker trials. Participants will be Spanish-English bilinguals in the US who learned Spanish from birth and English before the age of 12. Participants will listen to three blocks of language contexts: insertional and dense Spanish-English code-switching, or Spanish only. After each sentence type, participants perform Flanker trials (congruent [>>>>>] or incongruent [>><>>]) to which they respond by pressing a button to indicate the direction of the middle arrow. We will collect reaction times and accuracy on the flanker responses, as well as ERP P3 and N2 components. Statistical analysis will be performed to compare the adaptation effect between the three language contexts. This study will help us determine whether varied bilingual speech involves various types of control processes, how these control processes transfer to domain general cognitive control, and how they adapt to different conflicting situations within the same individual.

Rethinking Reentry Through an Abolitionist Framework

Authors: Jasmyne Nelson, and Bonnie Ernst

The United States has the highest incarceration rate in the world, 2.3 million people are confined to institutions and 95% of these people are released back into society, making mass incarceration and the reentry process significant. Scholars have begun to call for abolition, but the discussion around abolition has been centered on prisons and policing. What's missing is the discussion of reentry; how can abolition be used to radically rethink reentry? The purpose of this study is to examine reentry policies, practices, and experiences to determine how abolitionist work can newly shape reentry and be a means of carceral devolution.

Spatial analysis of kratom alkaloids in rat brain tissue using imaging mass spectrometry and computational image fusion

Authors: Angel S. Santos, Zhongling Liang, Abhisheak Sharma, Christopher R. McCurdy, Boone M. Prentice

Natural products of kratom (Mitragyna speciosa) have been widely used as an alternative treatment for opioid physical dependence and addiction. The analgesic property of the plant arises from its alkaloid components such as mitragynine. Studying the neurodistribution of this compound is critical to understand the pharmaceutical properties of kratom. Herein, we have used matrix-assisted laser desorption/ionization (MALDI) imaging mass spectrometry (IMS), a label-free molecular imaging modality, to analyze the spatial distribution and abundance of mitragynine in a dosed brain tissue extracted from a Sprague Dawley rat. In order to increase the spatial resolution of the IMS imaging modality, we have employed a computational image fusion approach. This approach builds a cross modality mathematical model between a low resolution, high molecular information image (i.e., IMS) and a high resolution, low molecular information image (i.e., brightfield optical microscopy of the tissue stained by hematoxylin and eosin [H&E]) to upsample the IMS image to the microscopy image. A multivariable regression model based on partial least squares (PLS) was used to find the mathematical relationship between the features of the brightfield image and the intensity values from the IMS image. The model is then used to predict the high resolution IMS images of mitragynine. This computational procedure was done with MATLAB, using the functions rgb2lab, rgb2hsv, pca, nnmf, rangefilt and entropyfilt for a 176-feature extraction on the H&E image. 5, 10, 20, 25, 30 and 50 components for PLS regression were tested using plsregress function. The quality of the calculated image was mainly evaluated based on the residual image acquired by subtracting the original IMS image from the calculated image. The lower and more random the residual values are across the tissue implies a more accurate calculation. PLS regression with 25 components produced the image with the best residual image.

Liberal Arts and Sciences

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Diagnosing Lymphedema in Breast Cancer: Bioimpedance vs. Arm Measurements

Authors: Christina Klassen and Julie Bradley

Background: Arm lymphedema following breast cancer treatment is an ongoing problem. Bioimpedance testing is an emerging technology that may detect lymphedema earlier than traditional methods such as arm circumference measurement. In this study, we compare traditional arm measurement to bioimpedance measurement.

Methods: Patients with breast cancer treated with surgery and radiotherapy (RT) were identified from a prospective registry from 2012-2021. Patients with both bioimpedance and arm circumference measurements at ≥ 3 time points were included. All arm measurements were obtained using circumferential tape measurements at 12cm distal and proximal to the olecranon process bilaterally. A > 2cm difference in arm circumference of left vs. right was defined as clinical lymphedema. Bioimpedance measurements were taken on a SOZO® machine and assessed using the Lymphedema Index (L-Dex) score (defined as ≤ 6.49 normal range, 6.5-9.99 cautionary; ≥ 10 abnormal). Abnormal was classified as lymphedema. Patient and treatment characteristics were extracted from the medical record.

Results: 94 patients were identified, with ages ranging from 24-81. 61% had sentinel node biopsy alone, 16% axillary node dissection and 9% both. The number of lymph nodes removed ranged from 1-26. 50% of patients had chemotherapy with a taxane. 59% were treated with proton and 41% with photon RT, respectively. 39 patients (41%) were identified with arm lymphedema by one or both methods. 20 patients had lymphedema according to arm circumference measurements alone, 13 by L-Dex alone, and 6 by both arm measurements and L-Dex. If cautionary L-Dex measurements were considered abnormal, then 5 of the 20 patients with abnormal arm measurements would have lymphedema diagnosed by both tools, leaving 15 still diagnosed only by arm measurements.

Conclusion: These data suggest that combined use of traditional arm and bioimpedance measurements are optimal to identify lymphedema in patients with breast cancer.

Comparing Rates of Insulin-containing Beta Cell Destruction Between Adult and Childhood-onset Type 1 Diabetes Patients

Authors: Anya Reddy, Clive Wasserfall

Islets of the pancreas are composed of several hormone-producing cell types. Two of the most common cell types are alpha and beta cells, which produce glucagon and insulin, respectively. Type 1 Diabetes (T1D) is an autoimmune disorder in which the patient's immune cells specifically destroy insulin-producing beta cells. We know that beta cells are destroyed over time and not synchronously; therefore, younger individuals appear to have a more rapid loss of beta cells. This project focuses on the hypothesis that younger individuals will have fewer insulin-containing islets than those with an older age of onset. To test this, we used images from pancreatic tissue that had been stained for insulin and glucagon.

Pancreatic tail images from patients with T1D and the control group were taken from the Network for Pancreatic Organ Donors (nPOD) Data Portal, then sorted into pairs matched by age (to within 1 year), gender, and ethnicity. Ten samples were then randomly chosen from each of the age categories, 0-10 years and 20-30 years. To match the diabetes duration, the maximum duration for both age groups was 8 years. We manually counted islets and stratified them by whether they contained insulin or not.

The average proportion of insulin-positive to total islets for the 0-10 year old diabetic group was 0.216. For the 20-30 year old diabetic group, the proportion was 0.244 for the diabetic group and 1 for the controls. A one-way ANOVA yielded a p value of 0.1. This preliminary study, while not significant, set a benchmark for us to test an automated image analysis program in the future, which will allow us to rapidly evaluate more images, thereby increasing the power to detect significant features of the T1D pancreas in these age groups. We believe this to be important in researching age-specific therapeutics.

Medicine

Glucocerebrosidase and leucine-rich repeat kinase 2 gene interaction and genotype characterization: a rodent model of Parkinson's disease

Authors: Sarah Brookman and Matthew Farrer

Parkinson's disorder (PD) is classified as a movement disorder and currently affects roughly 1.5 million people in the United States. PD is associated with malfunctions in the nigrostriatal dopamine circuit, causing neuronal death within the substantia nigra. A combination of both genetic and environmental factors is a leading theory in how PD develops. This study employs a rodent model to assess the relationship between two genes that are worldwide contributors of Parkinson's, leucine-rich repeat kinase 2 (LRRK2) and glucocerebrosidase (GBA). Differing results have been derived on the interaction between LRRK2 and GBA; however, human clinical studies have found that carriers with both the GBA and LRRK2 genes had a less severe clinical course than carries of GBA alone, but carriers of only LRRK2 (referred to in this study as GKI) had a less severe PD clinical presentation than both other groups. It was hypothesized that on measures of motor performance and working memory, LRRK2 G2019S knock-in (GKI) carriers would perform best, and GBA/GKI mutated lines would perform better than the GBA carriers alone. Anxiety was also measured to characterize the genotype. Thirty B6 transgenic mice (17 male, 13 female) between the ages of 11-14 months were employed for this study. Measures of motor performance, working memory, and anxiety included beam, rotarod, y-maze, elevated plus maze, and open field. This study found no significant difference between genotypes per sex in any paradigm, and further research needs to be conducted using a larger sample size.

Contribution of the Ventral Hippocampus to Risky Decision Making

Authors: Lily Cao, Mojdeh Faraji, Jennifer L. Bizon, Barry Setlow

In our study, we used optogenetic inhibition to determine how the ventral hippocampus is involved in temporally discrete stages of the risky decision-making process. Rats received an infusion of an AAV vector containing the gene for halorhodopsin bilaterally into the CA3 subregion of the ventral hippocampus. Rats were then trained in operant chambers on a behavioral task designed to assess risky decision making. In the task, rats were presented with a series of choices between two levers: a "safe" lever or a "risky" lever that was accompanied by varying probabilities of mild footshock. Once task performance was established, the rats underwent optic fiber implantation, which allows delivery of laser light into the brain to inhibit neural activity in the neurons in which the halorhodopsin gene is expressed. CA3 neurons were optogenetically inhibited during each stage of the task in separate sessions. Depending on the rat's choice on each trial, three outcomes were possible: delivery of the small, safe reward, delivery of the large reward without footshock (large, unpunished reward) and delivery of the large reward with footshock (large, punished reward). Inhibition of the ventral hippocampus during receipt of the large, punished reward caused a decrease in the choice of large, risky reward, whereas inhibition of ventral hippocampus during the other two outcomes did not alter choice preference. These results suggest that under normal conditions, hippocampal activity during receipt of the large, punished reward may be important for encoding information about the magnitude or frequency of punishment relative to the large reward, such that when this encoding is impaired, punishment becomes overvalued (and rats reduce preference for this option). More broadly, the results provide the first evidence to date for a causal role of temporally-discrete ventral hippocampus activity in cost-benefit decision making.

Medicine

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Variations in Human Gut Microbiotas Confer Phenotypes of Protection Against Clostridioides difficile Infection

Authors:Daniel Marquina, Tare Share, Jennifer Gollwitzer, Gurjit Sidhu, James Martin, Joan Whitlock, Eric Li, Gary Wang

Background: Gut dysbiosis renders hospitalized patients susceptible to Clostridioides difficile infection (CDI). However, susceptibility mechanisms are not fully understood. Fecal microbiota transplantation (FMT) is a treatment for recurrent CDI, yet variations in FMT success remain unexplained. We sampled 30 human stool donors to observe the interactions between a host's gut microbiota and CDI.

Methods: 30 human donors were screened for antibiotic use and gastrointestinal issues. A 10% fecal suspension for each donor was prepared, aliquoted, and stored at -80°C. 100 uL of aliquot was orally gavaged into germ-free C57BL/6 mice (n=2), and an identical 1 mL aliquot was processed for 16S rRNA sequencing. After colonization, the humanized mice and germ-free controls (GF, n=6) were challenged with CD strain VPI 10463. Mice were monitored and weighed periodically until the endpoint. Samples from the cecum were quantified for CD load and tested for CD toxin A/B.

Results: GF were moribund 36 hours after infection. Three phenotypes of susceptibility to CDI were observed in humanized mice. The resistant phenotype (n=9) exhibited no symptoms or significant weight loss and had no detectable toxin or CD load. The carrier phenotype (n=12) exhibited no symptoms or significant weight loss yet were CD toxin A/B positive and had CD cecal loads 10 to 100 fold lower than GF. The susceptible phenotype (n=4) exhibited symptoms of CDI and weight loss of 8-17% within 96 hours; they were toxin A/B positive and had CD loads comparable to GF. An indeterminate phenotype (n=5) presented variable outcomes from the same donor gavage, suggesting minor variations can affect susceptibility. Conclusion: Donor outcomes demonstrated the variations in CDI susceptibility. Further analysis of the stool samples may yield a model to predict the efficacy of a FMT sample before administration.

A Biophysical Study of AAV Genome Ejection

Authors: Keely Gliwa, Antonette Bennett, Austin Kansol, Joshua Hull, Courtnee Eddington, Paul Chipman, Hazel Levy, Mavis Agbandje-McKenna, Robert McKenna

Adeno-associated Virus (AAV) are the most widely studied viral vector for clinical gene therapy applications. Consequently, a significant amount of research has focused on understanding all aspects of the virus life cycle. An AAV infection is initiated by receptor/co-receptor binding, clathrin coated-mediated endocytosis, endo-lysosomal (pH 7.4 - 4.0) transport and escape to the cytoplasm, nuclear localization, and entry into the nucleus via the nuclear pore, where genome ejection occurs in the nucleus at pH 7.4. Genome ejection is therefore the final critical step for replicating and expressing the therapeutic gene. In this study, we present the development of a thermal assay to probe the DNA ejection process using two structurally diverse AAV serotypes, namely AAV2 and 5. Previously, differential scanning fluorometry studies determined the thermal melt temperatures (Tm) of AAV2 and 5 in PBS as 68 and 89°C, respectively. We have shown, using this thermal assay, that both AAV2 and 5 lose ~50% of their packaged genome at ~55°C, in PBS. This data is confirmed by cryo-EM micrographs of the virus at these temperatures. Examination of negative stain EMs reveal conformational changes in the AAV capsid at temperatures > 55°C , ~5°C, before the capsid Tm, when all the capsids are stain penetrated (empties) with 'strings' of exposed DNA exiting/ejecting from the capsid. This data would imply that the trigger for genome ejection is independent of the AAV serotype, but the rate required for all genomes to be released is dependent on the thermal stability of the capsid. These thermal assays can therefore be used to screen conditions experienced by the capsid throughout the viral life cycle. We can then measure those effects on genome ejection and ultimately assess how the rate of genome ejection affects the rate of therapeutic gene expression.

Investigating potential neuroprotective effects of running exercise in an Alzheimer's Disease (AD) Mouse Model

Authors: Eiko Alzamora, Sophia Moret, Jillian Murray, Jonah Juergensmeyer, Samantha Vilarino, Erin Kang, Allison Comite, Dr. Karina Alvina

Lifestyle interventions such as exercise can promote healthy aging and reduce the likelihood of neurodegenerative disease pathology. However, the mechanisms associated with these positive effects are not entirely understood. Therefore, we used a well-established AD mouse model (CRND8) and provided ad libitum access to a running wheel for 8 weeks, to investigate specific pathways associated with exercise. To measure the effect of voluntary running, we documented mouse body weight weekly and used Arduino devices to record the overall distance ran during an 8-week period. We used 6–7-month-old male AD transgenic (Tg) and non-transgenic (NTg, control) mice, divided into Sedentary (housed with a locked wheel) or Exercise (housed with a freely spinning wheel) groups. At the end, the memory function was tested using a NOR test. Mice were processed for brain tissue, organs, and blood collection for further studies. Our results show that the Tg mice ran more during the 8-week period than the other groups. Tg mice that exercised showed more rearing behaviors and less anxiety-like behavior compared to their sedentary counterparts. All organs measured were comparable in weight amongst all groups. The only difference was found in the adrenal glands which were smaller in NTg mice subjected to exercise compared to Tg mice. An ELISA test was conducted to detect the skeletal muscle derived Irisin in plasma, but no difference was found. The NOR test did not differentiate improvements in memory function between groups. These results indicate that 8-week voluntary running in AD mice cause an improvement in anxiety-like behaviors compared to sedentary mice. Our results support the idea that exercise can protect brain function in AD mice. However, we were not able to accurately evaluate memory function under these conditions. Future experiments will evaluate other memory tests and different experimental conditions.

The Role of snar-A Non-coding in Breast Cancer

Authors: Jessi Effinger-Morris, Tianqi Li, Mingyi Xie

Non-coding RNAs are RNAs that do not code for a protein but play important roles in gene regulation and cancer. The snaR (small NF90-associated RNA) family of non-coding RNAs are highly structured with conserved sequences. snaR-A is the most abundant of this family and has been shown to interact with the RNA binding protein NF90. snaR-A is upregulated in most immortalized cell lines, including cancer cells. The function of snaR-A is ambiguous, as well as the biological function of its interaction with NF90. We will study their interaction by generating conditional knockouts of the endogenous NF90 in both the MCF7 and MDA-MB-231 breast cancer cell lines. These cell lines will be used due to their differing levels of snaR-A expression. MCF7 has high expression of snaR-A, while MDA-MB-231 has relatively low expression of snaR-A. The goal of this study is to identify the role snaR-A and NF90 interactions may play in breast cancer. Previously published research indicates that snaR-A expression may be downregulated after the NF90 knockdown. Our preliminary data suggest that snaR-A knockdown inhibits cell proliferation. To probe this phenotype, we will be examining the NF90 knockout's effect on two cell lines that differentially express snaR-A. This project seeks to identify the role of NF90/snaR-A interactions in breast cancers and provide a better understanding of the pathological mechanisms.

Chronic oral administration of delta-9-tetrahydrocannabinol (THC) enhances working memory in aged but not young rats

Authors: Trinity Delancy, Isabella Mark, Sabrina Zequeira, Emely Gazarov, Alara A. Güvenli, Johleen Seedansingh, Alexandria Senetra, Abhisheak Sharma, Chris R. McCurdy, Barry Setlow, Jennifer L. Bizon

Cannabis is one of the most widely used drugs in the US, and individuals over the age of 65 are the fastest-growing demographic of users. As the number of older adults in the US is expected to reach 90 million by 2050, it is imperative to understand the potential cognitive impacts of cannabis use in this population. This is especially true given that cannabis use in young adults can impair cognition, and that many aged individuals already exhibit such deficits, particularly in forms of cognition supported by prefrontal cortex (PFC) and hippocampus. The effects of chronic oral administration of delta-9-tetrahydrocannabinol (THC; the major psychoactive component of cannabis) were evaluated on a delayed response task that assessed PFC-dependent working memory and a water maze task that assessed hippocampal-dependent spatial memory in young adult (5 months) and aged (23 months) Fischer 344xBrown Norway F1 hybrid rats of both sexes. Rats were trained on the delayed response task until reaching a stable baseline. In agreement with prior findings, aged rats were impaired compared to young adults, particularly at longer delays. Rats of both ages then consumed either plain gelatin or gelatin containing 1 mg/kg THC daily in their home cage. Drug was administered following daily behavioral testing to dissociate chronic from acute effects. Working memory was assessed after three weeks of daily consumption. No effects of THC were observed on working memory performance in young adult rats; however, aged rats consuming THC performed reliably better than aged rats consuming control gelatin. Rats were the trained on the water maze while continuing to consume gelatin following daily training. While aged rat performance on water maze was worse than young, no reliable effects of THC were observed at either age. These findings suggest that chronic THC does not impair, and may actually provide benefit to, cognition in older subjects.

Observing Aggregated Tau's Effect on Pre and Post Synapses

Authors: Alexis-Noelle Araune, A. Rei Favis, Dr. Paramita Chakrabarty

Alzheimer's Disease (AD) is a neurodegenerative disease with symptoms including a decline in memory and cognitive functions following progressive loss of neurons in select areas of the brain. Synaptophysin (SYP) encodes an integral membrane protein of pre-synaptic vesicles in brain cells. Postsynaptic Density Protein 95 (PSD95) is a postsynaptic marker. Tau is important for stabilization of microtubules. A synapse is the site of transmission of electric nerve impulses between two neurons. Accumulating evidence suggests that dysfunction and loss of synaptic connections may be an early event underlying AD progression. This study is looking at the aggregation of tau in relation to synapses. Phosphorylated tau has been shown to cause accumulation of insoluble tau leading to toxicity in synapses. It is suggested that even in the absence of tau tangles, mice overexpressing human tau display significant synaptic degeneration. This suggests that tau is the toxic species. Localization of tau at the synapse has been the focus of several recent reports that sought to determine whether the accumulation of tau will affect either pre-synaptic, post-synaptic, or both compartments. Cloning was conducted to transfer the transgenes into AAV vectors. A chicken β actin (CBA) promoter, known for providing high neural expression, was selected.
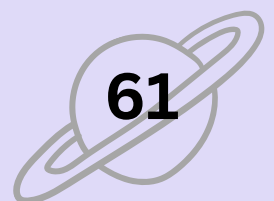
Mobile ECGs in Detection of Subclinical Atrial Fibrillation in High Risk Outpatient Populations

Authors: Victoria Vailoces, Danelle Antelo, Mansi Patel, Ajay Mittal, Mark Segal, MD, Zubin Agarwal MD

Smartphone-based Mobile ECG screening has the potential to provide a cost effective, preventive means of detecting atrial fibrillation (AF) in outpatient non-cardiology specialty clinics. This study aims to assess the KardiaMobile device in recording ECGs among high risk patient groups as a screening tool to detect AF and other cardiac arrhythmias. 1707 enrolled participants across 4 clinic sites (Nephrology, Sleep, Opthalmology, Urology) were surveyed and had a 30-second ECG recording using the KardiaMobile device. Participants, between ages 18-99, that agree to partake in the study are given a consent form and questionnaire that aims to reveal any risk factors for cardiovascular disease. Their ECGs are taken by the KardiaMobile ECG device. If patients are found to have newly diagnosed AF, the physician will be notified, and a 12-lead ECG or standard ECG equivalent will be ordered. Furthermore, to assess the feasibility of incorporating a mobile ECG in outpatient clinics there will be a means to measure the time associated with collecting this data within clinic flow. As of October 17th, 2022, 1707 of 3930 participants have been enrolled. Of the data collected thus far, the KardiaMobile rhythm strip reported 232 abnormal readings which are pending analysis from a cardiologist. 63 readings were labeled as possible atrial fibrillation, 138 readings were labeled unclassified and 28 were unreadable. Additionally, 27.7% of participants reported a history of being diagnosed with hypertension; 7.5% reported having heart stents; 18.9% reported having a history of congestive heart failure, heart attack, and coronary artery disease; and 8.8% previous AF diagnosis. While the data collection is currently in its initial steps and has yet to amass more statistically significant data, the preliminary data shows promise regarding the feasibility of using KardiaMobile ECGs for the prevention, treatment and diagnosis of cardiological disease in vulnerable outpatient populations.

Mnemonic Similarity Task in Touchscreen Operant Platforms in Aging

Authors: Bianca V. Para, Aleyna M. Ross, Carly N. Logan, Sara N. Buke

The Mnemonic Similarity Task (MST) was first developed by Stark (2011) and was designed to assess one's ability to discriminate a familiar target stimulus from a novel lure stimulus. The lure stimuli have variable degrees of similarity with the target. It has consistently been found that as lure similarity increases, the accuracy of discrimination decreases. This decline in accuracy as a function of target-lure overlap is evident through brain alterations found in older adults. This study has adopted the MST to an automated touchscreen chamber to address limitations of human error in behavioral paradigms designed previously. The use of these chambers allows more flexibility for the discrimination task, as well as more reliable behavioral methods to assess cognitive decline. The shaping and procedural training are designed to familiarize the rats with the touchscreen operant chambers and how to complete the trails. When the criterion is reached, the rats will then proceed to the mnemonic similarity task. During this phase, the rats will be pre-trained to discriminate between 2 images: the bulldog and the owl. During the pre-training phase, the rats must learn the screen position for each image, with the bulldog being on the left and the owl being on the right. Once the criterion is reached, the rats are then assessed on their mnemonic similarity performance. During the trials, the target images and lure images, which contain various degrees of similarity to the target image, are presented as a single trial. This behavioral task was developed to better understand the neurobiology of age-related cognitive decline.

Penis Morphology: Is it all about the hormones?

Authors: Brooke A. Armfield, Ryanne Mulligan, Alexandra Wiscovitch Bonilla, Yu Chen, and Martin J. Cohn

In mice, like humans, male and female external genitalia develop from a common progenitor structure in the embryo, the genital tubercle, but then undergo sexual differentiation to form a penis in males and a clitoris in females. Although sexual dimorphism of the external genitalia is believed to be controlled by gonadal sex hormones, males and females have different complements of sex chromosomes, and there is growing evidence that genes on sex chromosomes have direct, hormone-independent effects on sexual differentiation of reproductive and non-reproductive organ development. To decouple the effects of chromosomal vs hormonal differences on penis development, we used an innovative mouse model known as the four core genotypes (FCG) mouse. The FCG mouse was produced by translocating the male sex-determining gene, Sry, from the Y chromosome to an autosome, which allows sex chromosomes and gonadal sex to be manipulated independently in order to produce XX gonadal males with normal testes and XY gonadal females with normal ovaries in addition to XY males and XX females. We compared penis morphology in XY and XX gonadal males using nanoCT, which allowed comprehensive imaging of the internal and external morphology of XY male and XX male penises. We found no detectable differences in the gross morphology or tissue architecture of the penis between XY and XX males. We then used single-cell RNA sequencing and compared the clustering patterns of fully differentiated cells of XY and XX adult penises. We found that cellular composition of the penis is broadly similar between the two genotypes; however, a small number of cellular differences can be attributed to sex chromosomes. Our data reveal hormone-independent functions of sex-linked genes in penis development and add to the growing body of evidence that sexually dimorphic reproductive traits are regulated by both sex-linked genes and gonadal sex hormones.

Motor Benefit of Long-term unilateral VIM DBS in Essential Tremor

Authors: Kenai Gupte, Andrew Nordlund, Adolfo Ramirez-Zamora, Matthew R. Burns

Objective: Deep brain stimulation (DBS) of the ventral intermediate (VIM) nucleus of the thalamus significantly reduces tremor in patients with Essential Tremor (ET), but the extent of long-term tremor suppression remains unclear. We evaluated the long-term motor benefit of unilateral Vim DBS on ET patients based on change in Fahn–Tolosa–Marin Tremor Rating Scale scores of both ON and OFF stimulation at several timepoints from baseline to 9-year follow-up.

Methods: We retrospectively studied 45 patients with unilateral Vim DBS at the University of Florida Norman Fixel Institute from 01/2002–10/2016. We obtained total motor tremor scores as part of continuous long-time follow-up annually equal or longer than 3-years. Wilcoxon sign rank test was used to compare the contralateral TRS and total TRS motor between baseline and annually after DBS. Holm-Bonferroni method was used to adjusts p value for significance of multiple comparison.

Results: Contralateral tremor severity improved significantly after unilateral Vim DBS at each annual timepoint up to 9-years, compared to both baseline (post-DBS lead placement in the OFF state) and OFF condition at each timepoint. The overall improvement was 67.9±26.7% compared to baseline (p=0.000) and 55.8±28.6% improved vs. OFF condition (p=0.000) at 1-year follow-up; and 53.6±22.2% vs. baseline (p=0.002) and 55.3±15.5% improved vs. OFF at 7-years follow-up. At 9-years follow-up, contralateral TRS-ON improved 37.5±24.1% vs. baseline (p=0.043); 45.0±19.3% improved vs. OFF condition (p=0.043). Though the improvement decreased as disease progressed, the proportion of improvement of treated side was still 50% greater after 7-years.

Conclusion: Long term motor benefit of unilateral Vim DBS on contralateral tremor in ET patients remained significant at long term follow-up. The improvement decreased slowly, likely due to disease progression. The tremor habituation effect could be improved by programing in our cohort.

Preparation and Purification of Mitochondrial DNA Ligase III Alpha Base Excision Repair Protein

Authors: Tanay Parwal, Qun Tang, Melike Caglayan

DNA damage by oxidative stress has been implicated in the pathogenesis of several diseases. Oxidative stress is characterized by the overproduction of reactive oxygen species (ROS) in the mitochondria, and base excision repair (BER) serves as the major DNA repair mechanism utilized by cells to repair oxidative damage lesions. BER is a multi-step process and is finished by a DNA ligation by DNA ligase III alpha, which seals the nick. The LIG3 gene is crucial for the mitochondria, as mitochondrial DNA ligase III alpha (mtLIG3α) is the sole DNA ligase responsible for mitochondrial DNA (mtDNA) replication and repair. MtLIG3α joins DNA strand breaks during DNA replication, repair nicks, and contributes to genome integrity in the mitochondria through BER. The mutations (K537N, P609L, G964R, and C999Y) in mitochondrial LIG3 gene are exhibited in patients with decreased mtLIG3α protein and present with a variety of disorders including encephalopathy, immunodeficiency, and mitochondrial dysfunction. While mtLIG3α can identify oxidative damage in the genome, the ligation efficiency of the disease-associated mutations of mtLIG3α remain unclear. Through recombinant DNA disease-associated vectors, protein overexpression, and protein purification, this study aims to analyze the impact of the mutations on the function of mtLIG3α, and subsequent efficiency of BER of the mitochondrial genome. The results will contribute to the understanding of mismatch discrimination exhibited by mtLIG3α for repair of oxidative damage, as well as a greater understanding of its role in mitochondrial diseases.

Cannabinoid pharmacokinetics following exposure to cannabis smoke in young adult and aged mice

Authors: Bailey M. McCracken, Emely A. Gazarov, Sabrina Zequeira, Alexandria Senetra, John Howard, Abhisheak Sharma, Christopher R. McCurdy, Jada Lewis, Jennifer L. Bizon, Barry Setlow

We exposed mice of different strains and ages to acute cannabis smoke and evaluated the pharmacokinetics of Δ9THC (the primary psychoactive component of cannabis) and its two major metabolites in plasma and brain. To determine the time course of Δ9THC and its two major metabolites (11-OH-THC and 11-COOH-THC), young adult C57BL/6J mice (n = 72, half female) were exposed to smoke generated from burning 5 cannabis cigarettes sequentially over one hour. Trunk blood and brain were collected at 6 time points (10, 20, 40, 60, 120 & 240 min following smoke exposure). Plasma and brain homogenates were analyzed for Δ9THC and metabolites via mass spectrometry. To assess the effects of age and mouse strain on THC pharmacokinetics, male and female B6, FVB, SW, and 129 mice ranging from 4-24 months (n = 91) followed the same smoke regimen, with samples collected at 10 and 40 minutes following exposure. To determine the effect of dose on THC and its metabolites, mice were exposed to smoke from either 3 or 5 cannabis cigarettes, followed by sample collection 40 minutes post-smoke exposure. The time course study revealed that plasma Δ9THC concentrations peaked at 10 and 40 minutes for males and females, respectively, while brain Δ9THC concentrations peaked at 20 and 40 minutes for males and females, respectively. Females had significantly greater plasma 11-COOH-THC concentrations than males. There were no age or strain differences in plasma Δ9THC concentrations at 10 or 40 min; however, 129 mice had significantly higher brain Δ9THC concentrations than FVB mice. Additionally, a 3-cigarette dose produced significantly lower 11-COOH-THC plasma concentrations compared to a 5-cigarette dose. This effect was not evident in plasma or brain concentrations of Δ9THC and 11-OH-THC. These results provide a better understanding of THC pharmacokinetics in mice for future studies.

Influence of peripheral senolytic treatment on age-associated cognitive decline and synaptic function

Authors: Prem Patel, Vivekananda Budamagunta, Ashok Kumar, Asha Rani, Daohong Zhou, and Thomas Foster

Advancing age is a risk factor for a wide variety of diseases and disorders. Scientific advancements have uncovered several foundational causes and hallmarks of aging, which can be tackled to alter the pace of aging. Cellular senescence is the halting of the cell cycle, and is typically more prevalent in aged individuals. Despite being so widely studied, there are still avenues of aging and age-related conditions where the role of cellular senescence has not been defined. We hypothesized that the senescent cells accumulated in the peripheral tissues can impact cognitive function by virtue of the senescence-associated secretory phenotype (SASP) factors they generate, which can gain access to the blood and cross the blood brain barrier. SASP can lead to the clearance of these senescent cells, and improve function in the brain, but this clearance is decreased in aged individuals. We utilized a naturally aged rat model to test this hypothesis. The results obtained from the study indicates that the peripheral senescent cell accumulation is associated with the impairment in long-term memory retention, a phenomenon seen in aged individuals. The results cumulatively demonstrate that peripheral senescence clearance alone is sufficient to mitigate the age associated cognitive deficits.

Role of Compound KMT2C/DNMT3A Loss in the Development of Acute Myeloid Leukemia

Authors: James Leonard, Prabhjot Kaur, Olga Guryanova

Myelodysplastic syndromes (MDS) occur when there is an imbalance between the self-renewal of hematopoietic stem cells (HSCs), a process in which HSCs divide to maintain stem cells for life-long blood production, and differentiation, where HSCs specialize to form mature blood cells. This balance is maintained by specialized genes being turned on and off through a type of molecular switches called gene enhancers. MDS can be characterized by anemia, cytopenias (insufficient white or red blood cells, or platelets), and the inability to fight infections. Oftentimes, MDS can progress to acute myeloid leukemia (AML), an aggressive blood cancer. Prior research has revealed that mutations that disrupt either KMT2C or DNMT3A genes, both of which regulate gene enhancers, can lead to detrimental effects on blood production, reminiscent of MDS. The aim of this research is to observe how compound KMT2C/DNMT3A loss contributes to accelerated development of MDS and progression to AML. We predict that compound KMT2C/DNMT3A loss will lead to the retention of enhancers at HSC genes while limiting the activation of myeloid lineage genes, resulting in excessive self-renewal, preventing cells from maturing, leading to AML. Using colony-forming assays with serial replating, we will measure HSC self-renewal of bone marrow cells derived from genetically-engineered mice with single-gene or compound Kmt2c/Dnmt3a inactivation. Next, we will test their ability to differentiate into mature myeloid cells by analyzing surface markers by multi-color flow cytometry. Insights gained from these methods will be applied to the in vivo portion of the study where mice with compound Kmt2c/Dnmt3a loss will be used to understand the development of the disease in the context of a whole organism. This study will gain insight into the role of compound KMT2C/DNMT3A loss in the development of MDS and AML and provide clues to developing novel therapeutics.

Viral transduction of organelles as a toolkit to further our understanding of neurodegenerative diseases

Authors: A.Rei Favis, Alexis A. Araune, Malinda R. Gong, Brenda Moore, Daniel H. Ryu, Pedro E. Cruz, Cara L. Croft, Yona Levites, Todd E. Golde

Recombinant adeno-associated viruses (rAAV) are commonly used in gene therapies throughout the world, especially in the neuroscience field. As such, it would be a logical move to use rAAVs as a method to help investigate the mechanisms and pathways some diseases undergo in the cell. A common target of many neurodegenerative diseases are specialized subcellular units called organelles. The functionality of organelles range greatly and have been a widely researched component of many different diseases. Organotypic brain slice cultures (BSC) allow us to maintain an intact culture system of a mouse brain to image and observe changes in the CNS. Its use has significantly decreased the amount of animals needed and the costs to maintain them for long term experiments. Using the rAAVs ability to transduce CNS cells, we can target specific organelles with fluorescent proteins and observe their interactions, live, without the use of other substrates or polymers. Observing these interactions, especially in tandem with proteins of interest, could shed new light onto new targets for therapeutics and mechanisms.

Compensation or Competition: Striatal-Hippocampal Dynamics in Old Age

Authors: Shreya Mathur, Daniela Zambrano, Samantha M. Smith, Nicholas DiCola, Sarah Lovett, Anna Montelongo, Kimberly Nguyen, Caroline Davidson, Sara N. Burke

Understanding the neurobiology of age-related cognitive decline and the mechanisms underlying preserved cognition in old age is crucial for improving cognitive health in older adults. While the hippocampus (HPC) is vulnerable to age-related functional decline, the dorsal striatum (DS) has been hypothesized to be impervious to age-related impairments (Rogers 2012; Gardner et al. 2020a). A change from HPC to DS-dependent learning emerges during tasks involving spatial navigation (Barnes 1980; Pereira et al. 2015). Moreover, the inactivation of the DS in aged rodents contributes to the rescue of HPC-dependent spatial learning on a T-maze model (Gardner et al. 2020b). This has led to the hypothesis that the DS interference with HPC functions may contribute to age-related cognitive decline. However, the HPC and DS play other roles. To assess the hypothesis that inactivation of the DS can relieve age-related cognitive decline in other domains, we bilaterally inactivated the DS of young (n=8) and aged (n=7) rats during paired associates learning (PAL). Previously, we observed that PAL is susceptible to age-related cognitive decline in male rats and that aged animals are more prone to employ a DS-dependent response-based strategy (Smith, Zequeira, et al. 2022). PAL performance in young and old rats was not affected by the inactivation of the DS, however, the DS-dependent spatial navigation task (control) was altered. The higher 'cognitive load' required for PAL performance compared to spatial learning may explain the lack of the effect of the DS inactivation on the PAL task. Thus, current experiments are using in vivo electrophysiology recording from the HPC and DS during spatial learning to investigate why inactivation of the DS may improve aged animals' performance on HPC-dependent navigation tasks. Preliminary cross-spectral correlation plots highlighting interactions between HPC and DS local field potential oscillations during T-maze spatial learning will be presented.

Acute Effects of Cannabis on Cognition in Aging

Authors: Natalie Barber, Rachel Janke, Sabrina Zequeira, Emely A. Gazarov, Alara A. Güvenli, Erin C. Berthold, Marcelo Febo, Abhisheak Sharma, Christopher R. McCurdy, Jennifer L. Bizon, Barry Setlow

Older adults are the fastest-growing group of cannabis users in the United States. Cognitive functions supported by the prefrontal cortex (PFC) and hippocampus are impaired in aged relative to young subjects. These aspects of cognition are also impaired by acute administration of cannabis in young subjects; however, effects in aged subjects have been understudied. The goal of this study was to determine whether the cognitive effects of acute cannabis smoke exposure differ across age groups, using a rat model. Male and female young adult (6 mo.) and aged (24 mo.) Fischer 344 x Brown Norway F1 hybrid rats were tested on a PFC-dependent delayed response working memory task and a hippocampus-dependent trial-unique non-match to location (TUNL) task. A randomized, within-subjects design was used such that each rat was exposed to smoke from burning 0, 3, and 5 cannabis cigarettes immediately prior to test sessions in each task. In the delayed response task, initial data suggest that acute exposure to cannabis smoke enhanced accuracy in aged male rats, whereas cannabis smoke tended to impair performance in aged females. In the TUNL task, cannabis smoke had no effect in male or female rats of either age group. Together, these results suggest that the cognitive consequences of acute cannabis exposure differ as a function of age, and that these differences are moderated by both sex and the form of cognition evaluated.

Graph Expansion and Route Modulus

Authors: Luis Sordo Vieira, Igor Sokolov, Jason Cory Brunson

Every organism relies on complex biological processes to govern even the simplest of tasks. These processes transpire over a range of components which must effectively communicate. Intracellular signals are not always simple activations but may be co-dependent with other signals or inhibit rather than activate. Mathematical graph representations of these signal pathways are called signal transduction networks (STNs). We present a framework for analyzing pathways in STNs. We do this by first expanding an STN into a graph that preserves its synergistic and inhibitory attributes but eliminates computational ambiguity by introducing composite and complementary nodes. From this expanded graph, we compute minimal functional routes, analogues to shortest paths that take synergy and inhibition into account. Finally, we compute the graph modulus for these functional routes, a quantity parameterized by a norm that unifies many useful notions of richness and importance. We have implemented this process as two software packages under development. To illustrate the process, we analyze an STN representation of immune response to Bordetellae infection.

Optimizing Electroporation Conditions for siRNA Transfections in an *in vitro* DC Model

Authors: Varun Kanneganti, Anna DeVries, Hector Mendez-Gomez, Elias Sayour

With the COVID-19 pandemic, mRNA vaccines have seen a tremendous rise in usage, yet there are a growing number of studies showing their potential to be used as cancer immunotherapeutic vaccines. We have developed tumor specific mRNA encased in a well-characterized cationic lipid-nanoparticle (NP) as a systemic vaccine showing anti-tumor efficacy. We are still exploring the mechanistic pathways of the RNA-NP vaccine to better understand its anti-tumor response. We suspect that dendritic cells (DCs) are a key factor in the response as they are the link between the innate and adaptive immune systems. In testing the molecular mechanism of the RNA-NP vaccine, DCs are electroporated with siRNA to block signaling pathways in the immune response. Electroporation is generally a reliable tool for delivering nucleic acids to a variety of cells; however, the conditions for electroporation must be experimentally determined per cell line and nucleic molecule of interest to ensure high transfection efficiency and cell viability. This study presents data from optimizing conditions for electroporating eGFP siRNA in the primary DC line, JAWSII GFP where we assessed transfection efficiency by observing GFP knockdown and cell viability using live/dead marker in flow cytometry. The data shows that with optimal conditions there was significant GFP knockdown when compared to negative control siRNA 48 hours after transfection. This is significant because higher transfection efficiency leads to a better knockdown of the signaling pathways, which translates to more clear data on the molecular mechanism of the RNA-NP.

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Comparing Rates of Insulin-containing Beta Cell Destruction Between Adult and Childhood-onset Type 1 Diabetes Patients

Authors: Anya Reddy, Clive Wasserfall

Islets of the pancreas are composed of several hormone-producing cell types. Two of the most common cell types are alpha and beta cells, which produce glucagon and insulin, respectively. Type 1 Diabetes (T1D) is an autoimmune disorder in which the patient's immune cells specifically destroy insulin-producing beta cells. We know that beta cells are destroyed over time and not synchronously; therefore, younger individuals appear to have a more rapid loss of beta cells. This project focuses on the hypothesis that younger individuals will have fewer insulin-containing islets than those with an older age of onset. To test this, we used images from pancreatic tissue that had been stained for insulin and glucagon.

Pancreatic tail images from patients with T1D and the control group were taken from the Network for Pancreatic Organ Donors (nPOD) Data Portal, then sorted into pairs matched by age (to within 1 year), gender, and ethnicity. Ten samples were then randomly chosen from each of the age categories, 0-10 years and 20-30 years. To match the diabetes duration, the maximum duration for both age groups was 8 years. We manually counted islets and stratified them by whether they contained insulin or not.

The average proportion of insulin-positive to total islets for the 0-10 year old diabetic group was 0.216. For the 20-30 year old diabetic group, the proportion was 0.244 for the diabetic group and 1 for the controls. A one-way ANOVA yielded a p value of 0.1. This preliminary study, while not significant, set a benchmark for us to test an automated image analysis program in the future, which will allow us to rapidly evaluate more images, thereby increasing the power to detect significant features of the T1D pancreas in these age groups. We believe this to be important in researching age-specific therapeutics.

Localization of the LH receptor in mouse models using GeoMx Spatial Profiling

Authors: Sneha Suresh, Abigail Owens, Mackenzie Bolen, Gabriela P. Hery, Lloyd Wagner, Stefan Prokop, Gemma Casadesus

Steroid and gonadotropin dysregulation associated with menopause increases risk of Alzheimer's disease (AD) development in women. Recent research has identified the presence of the gonadotropin luteinizing hormone (LH) and its receptor (LHR) in the central nervous system. Importantly, central LHR activation has been shown to protect from ovariectomy-related cognitive and spine density loss in AD mouse models. Given the loss prevention capabilities encompassed by LHR and the lack of information regarding its localization within the brain, we have designed an exploratory study to localize the receptor spatially and by cell type in males, females, and ovariectomized females as a model of menopause. Utilizing new technology by Nanostring, the GeoMx Spatial Profiler allows us to visualize gene expression changes in specific regions of interest (ROI) and cells of interest (AOI). To this end, brain tissue from each of these groups is mounted and stained with morphology markers for microglia, astrocytes, and neurons. After staining, the areas of interest are identified, tagged using oligonucleotide-based barcodes, and sequenced for full transcriptome analysis. This project will guide future work by enabling us to identify gene expression changes in parallel with regional and cellular localization of this receptor and its hormone in a sex-dependent manner and in the context of reproductive senescence.

Clinical Course Comparison of Children with Acute Respiratory Failure Secondary to COVID-19 and Viral Infection compared to Viral Infection Alone

Authors: Ananya Mellacheruvu, Sara Rottink, Kristen Nethercott, C. Krystyn Linville, CPNP-AC

Introduction:
Viral illness is one of the most common reasons children less than 1-year of age are admitted to the hospital; however, at the onset of the COVID-19 pandemic the incidence transiently decreased. Bronchiolitis, which is commonly caused by respiratory syncytial virus (RSV), is the most common lower respiratory infection in children younger than two years. Bronchiolitis has been characterized with symptoms of coughing, wheezing, dehydration, and fever. There has been conflicting data with whether co-infection with COVID-19 in bronchiolitis is associated with more severe courses than a single infection.

Purpose:
This study aims to determine if patients admitted to the PICU with acute respiratory failure in the setting of viral illness have a different hospital course when having the additional diagnosis of COVID-19.

Methods:
A retrospective chart review is being conducted for patients admitted to the PICU with the use of ICD-10 codes encompassing viral illness associated with influenza, viral pneumonia, bronchiolitis, or acute lower respiratory infection compared with the additional diagnosis of COVID-19 from January 2020 to March 2022. Additional data being collected includes patient demographics, type of respiratory support the patient was on, and the severity of illness for the patient calculated using pSOFA scores.

Data analysis:
The main data being analyzed in this study are the length of stay, maximum level of respiratory support needed, whether there is a new respiratory baseline at discharge, and a comparison of the severity of parenchymal disease seen on chest X-rays. These will be compared between the two cohorts described above.

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Investigating the Mechanisms Underlying Digging and Burrowing in Mice

Authors: Anamaria Cotelo, Natalie L. Johnson, Daniel W. Wesson

Digging and burrowing are naturalistic rodent behaviors that can aid in their survival. For example, mice may dig or burrow in order to find food, bury foreign objects, or avoid predators. Additionally, mice will burrow filled tubes even when there's no functional need to do so. Knowing this, we sought to investigate the underlying mechanisms that drive these behaviors. We hypothesized that digging and burrowing are motivated behaviors that are reinforced by dopamine (DA) release in the ventral striatum (VS). To test this, we first used in vivo fiber photometry and the DA sensor GRADBA to measure DA release in the VS during digging bouts. We tested mice in a clean home cage with 5 centimeters of corncob bedding to promote digging. In doing so, we found a relationship between vigorous digging bouts and phasic DA release. To explore the differences between digging and burrowing, we additionally plan to record VS DA release while mice burrow. However, mainstream methods of evaluating tube burrowing are incompatible with the technical needs of in vivo fiber photometry. Therefore, ongoing work aims to validate alternative burrowing paradigms that are compatible with in vivo recording of DA dynamics. Future studies seek to investigate whether digging and burrowing are rewarding through the use of a conditioned place preference (CPP) paradigm.

Feasibility and Acceptability of Virtual Reality to Reduce Perceived Pain and Anxiety Among Patients within a Hospital System

Authors: Mansi Patel, Alyssa Higgins, Sofia Daza, Paige Nadler, Megha Srivastav, Tina Dinh, Mit Patel, Sarah McPherson, Subah Huq, Sedrick Osei Tutu, Keer Zhang, Ajay Mittal, Tung Wynn

At the oncology ward, lumbar puncture procedures and bone marrow biopsies are a recurrent procedure considered to be painful and anxiogenic. Pharmacologic pain management and/or topical anesthetic creams are used to relieve pain, but distraction-based methods can also modify the painful experience and discomfort associated with lumbar punctures/bone marrow biopsies. Recent studies support distraction as a useful method for reducing concern on the painful sensory input and as a result improve patients' experience. Virtual Reality (VR) is an emerging technology that provides an immersive user experience and has the capacity to distract patients from the negative or painful experience of procedures. Given the possible short-term and long term outcomes of poorly managed pain and suffering among oncology patients, healthcare professionals are challenged to improve patient well-being during medically essential procedures. The purpose of this pilot project is to assess the feasibility and acceptability of using VR as a distraction-based intervention for pain management compared to other nonpharmacologic interventions in the hospital setting, specifically in patients undergoing lumbar puncture procedures and bone marrow biopsies in the hospital.

Temporally-specific inhibition of ventral tegmental area dopamine neurons during decision making under risk of punishment

Authors: Joshua C. Diedrich, Wonn S. Pyon, Shelby L. Blaes, Caitlin A. Orsini, Katherine M Gonzalez, Jennifer L. Bizon, Barry Setlow

Decision making is a complex behavior that requires numerous brain regions working in tandem to achieve a desired outcome. A growing body of work suggests that the ventral tegmental area (VTA) and its dopaminergic output play critical roles in the decision-making process.

To explore the functional role of dopaminergic neurons in decision making under risk of punishment, male and female tyrosine hydroxylase(TH)-cre rats expressing halorhodopsin in dopaminergic neurons of the VTA were implanted with optic fibers to allow for the direct delivery of 560 nm laser light to the VTA. Rats were then trained on a risky decision-making task (RDT) in which they were tasked with choosing between a small, but "safe", reward lever that dispensed one food pellet or a large, but "risky", reward lever that dispensed two food pellets accompanied by a potential footshock (risk increasing in blocks of trials across each session: 0%, 25%, 75%,). Laser light was delivered to the VTA to inhibit dopaminergic neuron activity at one of five distinct time points during the RDT: prior to lever selection (deliberation), during delivery of the small reward, during delivery of the large reward (either with or without punishment), or between trials.

Preliminary findings indicate that inhibition of VTA dopamine neurons during delivery of the large, unpunished reward caused a reduction in selections of the large, risky lever . These findings are supported by the theory of reward prediction error signaling and suggest that optogenetic inhibition of dopamine activity during the large, unpunished outcome may be acting as an artificial negative reward prediction error signal, subsequently promoting a shift away from future selections of the large, risky lever.

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Synergistic Keto Diet Impact on Aging and Healthspan in Caenorhabditis elegans

Authors: Briana Robles, Laxmi Rathor, Sung Min Han

Aging is a lifelong process that ultimately alters the efficient function of our body. While it is inevitable, there are many supplements and activities that may alleviate the process. The Ketogenic Diet has been studied to extend lifespan, healthspan, and even provide neuroprotection. Additionally, L-Carnitine is a molecule known to use Beta Oxidation to transport fatty Acetyl-CoA chains to the mitochondria. It has been proven to improve energy, increase metabolism, and decrease cell death. L-Carnitine levels decrease with age, which may contribute to aging and a decline in mitochondrial function. The purpose of this study is to combine L-Carnitine with the Ketogenic Diet to understand if they have a synergistic effect of promoting longevity and aging-related health parameters using a live animal model such as the nematode C. elegans. First, we found a significant survival percentage in L-Carnitine-treated C. elegans. Moreover, the L-Carnitine condition improved many C. elegans health-related behaviors, like pharyngeal pumping and body movement. We found a significant increase in lifespan in C. elegans treated with a mixture of medium-chain triglycerides (MCT) oil and L-carnitine (M+C). Interestingly, M+C treatment reduced the pharyngeal pumping rate associated with feeding behavior, suggesting the complexity of aging and health regulation by M+C treatment. Currently, we are evaluating the effects of M+C treatment on healthspan, such as stress resistance and neuronal integrity during aging. We expect our results will improve our understanding of the overall physiological effects of the Ketogenic Diet on aging, neuroprotection, and overall health and strategy to improve its effects by combinational treating with L-Carnitine.

Liver Cell Culture Induces Foxp3+ Regulatory T Cells Ex Vivo

Authors: Daniel Min, Kevin Senior, Geoffrey D. Keeler, Cristina D. Gaddie, Brad E. Hoffman

Multiple Sclerosis (MS) is a demyelinating autoimmune disease that affects approximately 1 million people in the United States, including 5,000 children. While there is no cure available, the Hoffman Lab has previously developed an adeno-associated virus (AAV) gene immunotherapy that successfully prevents and reverses clinical disease in mice with the mouse model of MS. By causing the ectopic expression of myelin oligodendrocyte glycoprotein (MOG) in the liver, our therapy is able to induce MOG-specific regulatory T cells (Tregs) that restore immune tolerance and ameliorate disease. However, AAV has several potential adverse issues such as limited transgene size and immune responses against the viral capsid. To overcome these limitations, we are developing an autologous ex vivo hepatocyte gene transfer and implantation to promote ectopic expression of MOG in the liver. To demonstrate proof-of-concept that we can induce Tregs ex vivo, we obtained liver tissue from C57BL/6 mice that received AAV.MOG 14-days earlier. Tissue was disassociated into a single cell suspension and plated at different concentrations (125k, 250k, 500k, 1M, 2M, and 4M cells/mL). Naïve transgenic MOG-specific 2D2 T cells were co-cultured with the hepatocytes. Four days later, cells were processed and analyzed for expression of FoxP3, an intranuclear Treg marker. Using flow cytometry, we found that AAV.MOG-treated liver cell cultures were able to induce Foxp3+ regulatory T cells from 2D2 T cells, while cultures with untransduced liver cells did not. In addition, there was a positive relationship between the number of transduced liver cells and the number of induced Tregs. Ultimately, these results show that we are able to induce regulatory T cells ex vivo in a liver cell-dependent manner.

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Racial ethnic disparities in post-transplant outcomes for lung recipients

**Authors**: Abhinav Penmetcha, Omolola Suleiman, and Jason Brunson.

Lung transplantation is a thoracic procedure where a patient's lung is replaced with a donor's lung. As donor lungs are limited, an organizational system was implemented in 2005 in which waitlisted patients are prioritized by a score calculated from several aspects of the patient's health. This score is predictive of outcomes after transplant, along with other dimensions of health. However, as with other health outcomes, social determinants may also play a role. Of these determinants, the race/ethnicity of the patient is of particular interest.

Our goal in this literature review is to examine past research in order to identify determinants of post-transplant outcomes alongside race/ethnicity and construct a causal framework involving race/ethnicity, other social and health factors, and outcomes. We crafted a search strategy and screening method to compile relevant studies. We identified trends and contradictions among these studies that informed a preliminary pool of predictors, which we narrowed down through discussion. We derived a causal diagram that serves as the guide for an ongoing mediation and survival analysis.

Exogenous Ketone Body Therapy as a Treatment for Age-related Cognitive Decline

Authors: Fapianey Alexandre, John Thompson, Mackenzie Bolen, Tara Cooper, Argyle Bumanglag, Terrence Gatton, Elena Garcia, Maria Ramirez, Brittnie Pang, Jackie Lee, Bianca Parra, Sara Burke

A growing percentage of the population is over 65 and the cognitive health span of older adults has not kept pace with the increasing life expectancy. Recent research has established that inducing non-pathological nutritional ketosis through carbohydrate restriction is an effective method of improving cognitive function in older adults and other animals. Community dwelling populations, however, have difficulty maintaining a ketogenic diet. Thus, our study aims to test the effectiveness of exogenous ketones as dietary supplements for improving cognition. Young and aged male and female Fischer-344 brown Norway hybrid rats were given beta-hydroxybutyrate (BHB) and medium-chain triglyceride (MCT) oil supplement in their food and blood glucose and BHB levels were recorded at 0, 2, 2, and 24 hours postprandial after 1, 4 and 7 days of the supplement to assess age and sex effects on the bioavailability of BHB. The supplement lowered blood glucose and increased BHB in all groups and no significant age or sex effects were found. After this pilot study, the process was repeated, and spatial learning, memory, and visual discrimination (cognitive abilities often implicated in human aging) were assessed before and after via mnemonic description tasks.
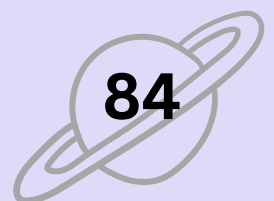
Membrane-Bound Double Stranded RNAs as a Potential Biomarker for Regenerative Therapy

Authors: Rachell Hawkes, Xiaoshu Pan, Mei He

Purpose: It is reported that 75% human genome is transcribed but not translated, therefore there are great amount of non-coding RNA we have little knowledge of and might be influential in the development of human diseases. A recent report identified a novel class of dsRNA-glycan conjugates on the living cell membrane, indicating they may play a role in cell signaling. However, little is known so far about the abundance of such surface-bound dsRNA in different cells and the cellular machinery on the maturation and presentation of dsRNA on the surface. By studying the expression level of membrane-bound dsRNA, sequence similarity analysis and the associated gene ontology analysis in progenitor cell lines like HEI-OC1, it is desirable to discover dsRNA-based pathways potentially related to cell regeneration and specialization to better understand signaling and regenerative therapy possibilities where dsRNA is found to be key regulator of the regeneration of follicle hair cells. Therefore, we examined dsRNA expression on progenitor cells, induced pluripotent stem cells, primary cancer cells, cancer cell lines with flow cytometry, obtained dsRNA from immunoprecipitation method from whole cells, plasma membrane, cytoplasm, and extracellular vesicles, and will complete gene oncology analysis to demonstrate the potential pathways dsRNA involved in in differentiable cells. So far, in this study, it was found that surface-bound dsRNA level is more prevalent in cell lines or primary cells that have differentiation capacity. Meanwhile it is found that dsRNAs from subcellular compartments were feasibly isolated by using hypotonic buffer, manual grinding and ultracentrifugation. More interestingly, extracellular vesicles were also found to carry dsRNA after the immunoprecipitation. With more sequencing data from the surface-bound dsRNA above, it is foreseen that we will be able to identify the abundance of dsRNA sequences from different subcellular and extracellular compartments and their possible functions in regenerative medicine.

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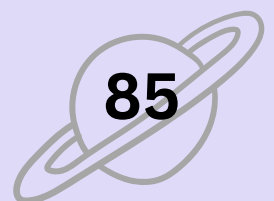
Examining How Attitudes Towards COVID-19 Policies Vary Among University Faculty

Authors: Rafael Garcia, Sarah McKune

It has been roughly two years since COVID-19 upended our lives. The dramatic shift was demarcated at various moments; perhaps none quite so significant as the March 11, 2020 decision by the NBA to cancel their season. This early, decisive action sent a shock through the whole country, foreshadowing much of the discourse that we have seen since. The social-political climate of this country has been activated by the pandemic, as people have different opinions about how society should respond. Our attitudes and actions have ranged from total lockdowns to the barring of vaccine mandates. It is no doubt that people have different viewpoints when it comes to all of the issues encompassed and embodied by COVID-19. The purpose of this study is to conduct an intersectional analysis of university faculty knowledge, attitudes, and behaviors surrounding COVID-19 and related policies. Different social variables, including gender, age, ethnicity, race, college of profession, religion, and political beliefs, will be examined to see how they relate to the perception of COVID-19 and related policy, which includes vaccine mandates/passports, lockdowns, etc. Previous studies have been conducted to see how age, gender, and ethnicity contribute to these outcomes; therefore, this study will primarily focus on the differences between colleges of profession and political attitudes. The other variables mentioned (e.g. knowledge about COVID-19, and age/gender/ethnicity) will be treated as confounding variables, as they too may vary systematically by college of profession. This study will be conducted through an anonymous online survey that would include basic demographic questions and questions related to COVID-19 policy. The goal of this study is to understand what populations on university campus are supportive of what policies, what underlying drivers of those outcomes are and where university leaders will need to target/focus efforts as new policies are introduced.

An investigation of interference between electromagnetic articulography and electroglottography

Authors: Jessica Goel, Ratri Wayland, Rahul Sengupta, Allen Shamsi, Karen Hegland, and Matthew Masapollo

The present study tested whether there is cross-interference between electromagnetic articulography (EMA) and electroglottography (EGG) during the acquisition of kinematic speech data. In experiments 1A and 1B, EMA sensors were calibrated with and without EGG electrodes present in the EMA field. In experiment 2, EMA was used to record lip, tongue, and jaw movements for one male speaker and one female speaker, with and without simultaneous EGG recording. Collectively, the results provide no evidence of signal artifacts in either direction, suggesting that EMA and EGG technology can be combined to reliably assess laryngeal and supralaryngeal motor coordination in speech.

Concurrent visualization and analysis of acoustic, fleshpoint motion, and electroglottography signals during speech production

Authors: Jessica Goel, Yoonjeong Lee, Ratri Wayland, and Matthew Masapollo

Over the years, technological advances have enabled speech researchers to directly track the skilled, sound-producing movements of the vocal tract, both intraoral and laryngeal articulators normally hidden from view (the tongue, velum, and glottis) and orofacial articulators directly visible on talkers' faces (the lips and jaw). Despite these advances, however, no single instrument is capable of concurrently recording movements of all the articulators, which has impeded progress in characterizing inter-articulator control and coordination. To explore how inter-articulator coordination subserves linguistic structure, tools that co-register and temporally align different signals from different recording devices are necessary. This tutorial introduces optimal methods for studying the temporal coordination between laryngeal, intraoral, and orofacial articulators by combining various signals from electromagnetic articulography (EMA), electroglottography (EGG), and audio recordings, and displaying the time-aligned signals in the same analysis space. The multimodal data is processed using a set of MATLAB-based functions, which co-register and display positional and velocity trajectories of the lips, tongue, and jaw in tandem with the EGG waveform, F0 trajectory, and acoustic waveform and spectrogram. The coordination of laryngeal and supralaryngeal speech movements can then be measured and analyzed.

Behavioral and Physiological Effects of PFAS Exposure on F3 Zebrafish Larvae

Authors: Dayita Banerjee, Gabrielle Gonzalez, Isabela Silva, Meguine Duvert, Alex Haimbaugh, Danielle Meyer, Chia-Chen Wu, Tracie Baker

Per- and polyfluoroalkyl substances (PFAS) are environmentally significant chemicals that are suspected to have effects on growth, development, reproduction, and neurobehavior. Colloquially known as "forever chemicals" because of their tendency to persist in blood and serum, PFAS are also easily able to cross into the placenta, potentially causing exposure to fetuses at critical periods of development. This phenomenon is examined generationally in larval zebrafish (Danio rerio), an NIH-validated model organism for human genomics. Zebrafish are an ideal developmental toxicology model because of their rapid development and high fecundity. The goal of this study is to determine the phenotypic and transcriptomic hereditary effects of PFAS exposure on the F3 generation of larval zebrafish by examining survival, behavioral, and abnormality endpoints. In previous studies, the F0 generation of larval zebrafish were directly exposed to PFOS, PFOA, and a mix of PFOS and PFOA at low, environmentally relevant concentrations of 0 ng/L, 7 ng/L, 70 ng/L, and 700 ng/L. A subset of these larvae were raised to adulthood and spawned through the F2 generation, producing the F3 larvae. These larvae were not further exposed to PFAS after the F0 generation, resulting in transgenerational effects observed in the F2 and F3 generations. Similar to the results of the F0-F2 generation, Day 0 survival rates were not altered in F3 PFAS-lineage larval fish. On Day 5, we evaluated larval behavior, screened for morphological abnormalities, and collected larval samples for downstream transcriptomic analysis. Larval behavioral patterns were affected differentially by each chemical. On a larger scale, these outcomes can inform legal limits for PFAS concentration in water, clothing, personal products, and other sources. The phenotypic and transcriptomic outcomes in zebrafish can also elucidate biomarkers of exposure in humans, such as changes in metabolites and/or signaling pathways.

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Auditory Feedback Control of Inter-articulator Speech Coordination

Authors: Grant Oberle, Kayleigh Burge, Abigail Lebedeker, Aleena Alex, Kiana Ferdowsiepour, Ana Rodriguez, Mahmoud Fakhouri, Nicholas Salazar, Melina Redondo, Jessica Goel, Susan Nittrouer, and Matthew Masapollo.

To determine the role of auditory feedback in the coordinated action of sets of speech articulators, the current research quantified changes in the temporal and spatiotemporal relations between jaw and tongue tip movements in response to noise masking. Normal-hearing talkers recorded /tV#Cat/ utterances using electromagnetic articulography, with alternative V (/ɑ/-/ɛ/) and C (/t/-/d/), across variation in rate (fast-slow) and stress (first syllable stressed-unstressed). Approximately 240 utterances were produced with auditory feedback and without auditory feedback (multi-talker babble noise was delivered over insert earphones). Visual feedback about talkers' loudness levels were provided during both conditions to counteract potential changes in speech intensity that would lead to a reduction in noise masking. Two articulatory kinematic measures were obtained: (1) timing of tongue-tip raising onset for medial C, relative to jaw opening-closing; (2) angle of tongue-tip raising onset, relative to the jaw phase plane. Results showed that any manipulation that shortened the jaw opening-closing cycle reduced both the relative timing and phase angle of tongue-tip movement onset, but both measures scaled more consistently with jaw opening-closing across contextual variation for utterances produced without noise masking. The effect of masking noise was greater for the phase angle measure. The details and implications of these findings are discussed in light of the task dynamics model of speech motor control.

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Force variability reduces with visual feedback magnification during a ramp task

Authors: Vahini Srikakulapu, Yoon Jin Choi, Basma Yacoubi, Evangelos A. Christou

We examined the effect of visual feedback on force variability during a continuous increase of force contraction (i.e., ramp).

Eight young adults (20.5±1.51; 4 female and 4 male) traced a ramp target with their ankle. Their non-dominant ankle was placed in a customized ankle device and measured isometric force of ankle dorsiflexion. There were two VF conditions: high gain (HG; visual gain= 5°) and low gain (LG; visual gain= 1°). The ramp target was 50% of their maximum force with rate of force development of 5% MVC/s. We high-pass filtered the force signal at 0.1Hz to remove the task frequency. We cleaned the trials that traced the ramp accurately and used 4 out of 6 trials to quantify the coefficient of variation (CV) of force for each VF condition. We then performed a wavelet analysis and quantified the sum of power from 0 to 4.5Hz for every 0.5Hz frequency bin.

The CV of force was significantly lower in HG compared with LG (t=-2.517, p=0.04). To determine the force oscillations that HG reduced, we examined the force oscillations for the two VF conditions from 0.5-4.5Hz (in bins of 0.5Hz). We found a significant interaction in power between VF condition and frequency (p<0.001). Power from 0.5-1.5Hz was greater in LG relative to HG. The reduction in force variability from LG to HG is significantly associated with a reduction in power from 0.5-1.5Hz (R2= 0.52, p<0.05).

Our findings provide evidence that young adults decreased force variability with magnification of VF during a ramp task. Young adults are able to perform visuomotor corrections and reduce force variability during a ramp task when the rate of force development is 5%MVC/s.

Up in the Air: Polyfluoroalkyl Phosphate Esters (PAPs) in Airborne Dust Captured by AC Filters

Authors:Timshina, Alina; Sobczak, William; Griffin, Emily; Lin, Ashley; Townsend, Timothy; Bowden, John

Per- and polyfluoroalkyl substances (PFAS) are ubiquitously present in our indoor living environments, which include homes, office spaces, and daycare facilities. Concentrations of PFAS in dust, a composite matrix that accumulates PFAS released indoors, can be used for estimating human exposure to indoor PFAS. Here, we investigated whether used air conditioning (AC) filters, ready-made samples otherwise intended as waste, could be exploited as a proxy for airborne dust in assessing PFAS burden in indoor environments. Used AC filters from campus facilities (n=19) and homes (n=11) were analyzed for 92 semi-volatile PFAS via targeted liquid chromatography – tandem mass spectrometry (LC-MS/MS). While 27 PFAS were detected (in at least one filter), the predominant species were polyfluorinated dialkylated phosphate esters (diPAPs), with ∑diPAPs ranging from 60.5 to 515 ng/g (median 102 ng/g) in facility filters and from 45.2 to 2650 ng/g (median 222 ng/g) in home filters. Further screening of a subset of the filters revealed the extensive presence of additional species of mono-, di-, and tri- PAPs. Considering the potential of PAPs to biodegrade into terminal species, assessing dust for such precursor PFAS warrants further investigation into both health concerns and its contribution as an unexplored waste stream in landfills.
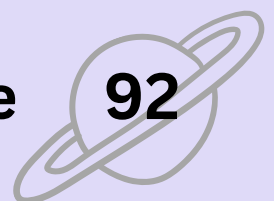
Developing an adverse outcome pathway for the alkylating antineoplastics: Effects of ifosfamide on molecular pathways related to cardiovascular function, neurotransmitter regulation, and immune responses in zebrafish (Danio rerio)

Authors: Cole D. English, Emma Ivantsova, Isaac Konig, Kira J. Kazi, Christopher L. Souders II, Christopher J. Martyniuk

Alkylating antineoplastics are employed in various chemotherapeutic treatments. With cancer prevalence increasing globally, exigency for increased administration of chemotherapeutic pharmaceuticals within a narrow therapeutic index expands, further necessitating a toxicological understanding of the agents. These chemicals enter the environment through hospital effluent and are detectable in surface waters. Ifosfamide is one such agent, yet few studies have assessed its threats to aquatic organisms. To address this gap, the three major objectives of this investigation concerning the zebrafish embryo and larvae model are as follows: (1) characterize the acute toxicological, teratogenic, and mutagenic potential of ifosfamide as manifested in morphological deformities, (2) determine if there exist acute behavioral and anxiogenic potential of the agent, and (3) assess changes in mRNA levels associated with oxidative stress via transcriptomics following acute environmentally-relevant ifosfamide exposure. Zebrafish larvae were exposed over seven days to ifosfamide at environmentally relevant concentrations, and morphological deformities such as pericardial edema, swim bladder abnormalities, axial malformations, and encephalic irregularities were assessed. Significant changes in deformities, morality rates, and reactive oxygen species induction were not observed at low exposure concentrations. However, the Visual Motor Response (VMR) assay revealed evidence for larval hyperactivity at low, environmental levels (0.1 µg/L). Non-mitochondrial respiration was depressed at 1000 µg/L and 2500 µ/L ifosfamide. Molecular mechanisms underlying responses to ifosfamide exposure will be discussed. Experimental conclusions will permit extension to the larger class of alkylating antineoplastics employing ifosfamide as a model to guide future investigations into the toxicological, teratogenic, and mutagenic potential of the drug class.
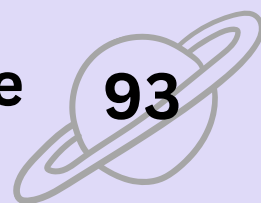
Reasons Affecting Extension Professionals' Decisions to Receive a COVID-19 Vaccine

Authors: Nina Miniet, Chuanhao Yang, Linda Liang

The Evaluation Program of the Southeastern Coastal Center for Agricultural Health and Safety led a collaborative effort to assess COVID-19's impacts on Extension professionals in Florida. An online questionnaire was distributed to Extension professionals using the Qualtrics platform, receiving a response rate of 48.8%. Data were collected from 450 extension professionals between 25-74 years in Florida, consisting mostly of County Agents and State Specialists. Analysis performed in SPSS using frequency distributions, Chi-square tests, and multinominal logistic regressions. The purpose of our study was to examine the major and minor reasons why Extension professionals did or did not intend to receive the COVID-19 vaccine and the influence of demographic attributes on their decision to receive the vaccine. While Extension professionals generally felt supported to face work-related challenges brought on by the pandemic, there were varying factors that influenced their intentions to receive the COVID-19 vaccine. Our results showed that age and trust are major factors influencing Extension professionals' intention to receive the COVID-19 vaccine. Other minor reasons included not being worried about getting sick; politics' role in developing the vaccine; and precaution towards COVID. We also found that individuals with higher education levels were more likely to say yes to COVID-19 vaccination.

Quantitative Analyses of Carapacial Bones of Fossil and Modern Samples of the Turtle Trachemys (Reptilia: Testudines: Emydidae)

Authors: Katelyn Palmer, Shion Newsom, and Richard Hulbert

Trachemys is a genus of freshwater turtle with a 7-million-year fossil record in Florida. Thousands of fossils of Trachemys have been collected at Montbrook, a new late Miocene locality in Levy County. This large sample allows statistical comparisons of individual bones of the shell with other samples of fossil and modern Trachemys. Thirteen measurements were taken with digital calipers on the nuchal bone. Using t-tests, Montbrook Trachemys adults are significantly smaller from those from an early Pliocene sample of Trachemys inflata from Polk County for 11 of 13 measurements (p values < 0.01). But, testing for differences in nuchal shape using Mann-Whitney U-tests for equal medians and Kolmogorov-Smirnov tests for equal distributions reveals no significant differences between 11 ratios of nuchal measurements from Trachemys inflata and Montbrook Trachemys. Significant differences in nuchal shape were present between Montbrook Trachemys and Trachemys scripta (both fossil and modern samples). This supports the assignment of the Montbrook sample to the extinct species Trachemys inflata. No significant differences were found in either nuchal size or shape between samples taken from different stratigraphic levels at the Montbrook site. The sixth and seventh neural bones of Trachemys are similar in both size and shape, and therefore difficult to distinguish solely by visual inspection. Linear discriminant analysis using eight measurements was able to correctly identify these bones from Montbrook with 94% accuracy. These results indicate that quantitative comparisons using standard univariate and multivariate statistics can be successfully applied to turtle shell bones if large samples (n>30) are available.

L'horloge de Flore: A Study from Oboes to Orchids

Authors: Turk Lisa and Odom Leslie

L'horloge de flore, or The Flower Clock, was composed by the French composer Jean Françaix in 1959. John de Lancie, a prominent American oboist, commissioned the piece and premiered it in 1961. L'horloge de flore has become a staple in 20th Century oboe repertoire and is comprised of seven movements originally written for solo oboe and orchestra. L'horloge de flore was inspired by Carl Linnaeus's flower clock. Linnaeus, a Swedish taxonomist who founded the modern system for nomenclature, created the flower clock, which is based on his observations of when flowers open and close at specific times of the day. Each movement of L'horloge de flore is named after one of the angiosperms on Linnaeus's flower clock. This paper examines the history of Linnaeus's flower clock, the history of this musical work, and analyzes each movement in respect to its musical characteristics and how well it represents the flower after which it is named. The flowers in this work that are analyzed in this paper include Cestrum nocturnum, Catananche caerulea, Selenicereus grandifloras, Jasminum malabaricum, Ipomoea alba, Pelargonium triste, and Silene noctiflora.

MISC

Surgical Management of Clinically Localized Urachal Carcinoma: Evaluating the Role of Lymphadenectomy as Standard of Care

Authors: Kyle Rose, Erica Roberts, Heather Huelster, Andrew Chang, Logan Zemp, Alice Yu, Michael Poch, Roger Li, Phillippe Spiess, Scott Gilbert, and Wade Sexton

Diverse practice patterns exist in the management of urachal carcinoma (UC). Case series involving this malignancy remain relatively small, precluding evidence-based revisions to clinical practice. Our aim was to utilize a large national dataset to better understand clinical and pathologic factors impacting oncologic outcomes and the role of lymphadenectomy.

The National Cancer Database (NCDB) was queried for patients with pure adenocarcinoma histology (8140, 8480, 8481, 8490) at expected UC locations (C67.1, C67.3, C67.7). Patients were excluded if there was metastatic disease (cN+M+), incomplete tumor staging or unavailable tumor size. The primary outcome was overall survival (OS) stratified by pathologic tumor and node characteristics. The secondary outcome was the presence of pathologically positive lymph node disease (pN+) based on primary tumor size. Survival data was estimated with Kaplan-Meier method, and evaluated using Log-rank test.

After screening, 629 patients were identified in the NCDB with cN0M0 UC. Median patient age was 59.0 years, and median tumor size was 4.0 cm. Surgical margins were positive in 61 of 516 (12%) patients who had complete margin status documented. Lymphadenectomy was performed at the time of surgery in 326 (52%) patients, of whom 66 (20%) had pN+ disease. Death occurred in 329 (52%) patients, with a median OS of 73 months (95% CI 67.8-79.4). The results of the OS analysis are shown in Table 1. Tumor size >5cm contributed to a lower OS (63 vs. 77.2 months, p=0.05). The incidence of pN+ cancer increased with primary tumor size (Table 2).

High rates of positive surgical margins and lymph node positive disease advocate for wide surgical excision and routine lymphadenectomy as standard of care in patients with UC. Despite excluding patients with cN+M+ UC, study limitations include the presence of surgeon selection bias for lymphadenectomy.

Moffitt Cancer Center 97

Phenological changes in seagrass-associated fishes in an altered climate: evidence that rising temperatures alters seasonality of fish migration patterns

Authors: Air Siegel, Adam Searles, Charles Martin

Fish migration into and out of seagrass beds is essential to fish lifecycles and to nutrient cycling. Changes in migration phenology would have massive impacts on fisheries and nutrient dynamics in Clearwater Harbor. In this study we analyzed changes in migration phenology of the five most abundant species in seagrass beds of over 50% coverage throughout Clearwater Harbor from 2009-2019. Trawl data (2009-2019) was provided by Clearwater Marine Aquarium's Sea Life Safari eco-tour boats in Clearwater Harbor, Florida. We tracked migration patterns through two metrics; date of 50% of cumulative yearly catch of each species (pigfish, pinfish, mojarra, planehead filefish, and silver perch), and yearly date of maximum catch. We then used local NOAA air and water temperature data to analyze impacts of climate change on fish migration. There was warming over the sampling period—linear regressions showed an average increase in air temperature of .245 degrees C per year, and an average increase in water temperature of .183 degrees C per year. There was also indication of changes in migration phenology for all five species, although interestingly the magnitude and direction of those changes differed between species. The extremity of our results may indicate that migration phenology in seagrass beds is more susceptible to climate change than are other migration patterns. Future research should aim to investigate whether these changes in migration phenology exist for other species, and in seagrass beds other than Charlotte Harbor. Additionally, if these changes are widespread, investigations should be done into impacts on nutrient cycling, health of seagrass beds, and fisheries management.

Phosphorylation of JNK, ERK 1/2, and p38 in a Mouse Model of Hypertrophic Cardiomyopathy Caused by MyBP-C Mutation

Authors: Christina Volpe, Sarah Powers, Suchita Pande, Robert Blanton, Gordon Huggins

Hypertrophic cardiomyopathy (HCM) is a genetic heart disease that causes heart muscle to thicken and result in contractile dysfunction, heart failure, and sudden death. Mutations in cardiac myosin binding protein C (MyBP-C) are a common cause of HCM that can, in some individuals, cause severe heart disease. A variant of the FHOD3 gene (FHOD3-V1151I) has been identified as a critical player in HCM patients when MyBP-C is also present. FHOD3 is essential to sarcomere formation within cardiomyocytes as demonstrated by FHOD3 knockout studies in mice. Currently, no pharmacological treatments are available for HCM patients. Our study hypothesized that JNK, ERK 1/2, and p38, kinases that have been identified in the context of cardiac hypertrophy, have functional roles in the expression of HCM caused by a MyBP-C mutation. We tested this hypothesis using two mouse models of cardiac hypertrophy and HCM. The genetic stress model consisted of mice containing the previously identified MyBP-C variant causing HCM. The pressure stress model consisted of mice with transverse aortic constriction induced pressure overload. In both models, we tested the expression of the kinases JNK, ERK 1/2, and p38. We used Western blots with antibodies designed to detect the kinases and phospho-kinases extracted from the hearts of mouse models in order to quantify protein amounts in varying genotypes. Results showed that phosphorylated JNK is decreased in the pressure overload condition as well as the genetic condition, phosphorylated ERK is unaffected in the pressure overload condition and increases in the genetic condition, and phosphorylated p38 is increased in the pressure overload condition and decreased in the genetic condition. Thus, we observed selective activation of kinases dependent on the source of hypertrophy. Understanding the expression of these kinases may be translational in the development of pharmacological treatments including kinase inhibitors for the treatment of HCM.

Tufts University Medical Center

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Bioconjugation Strategies to Target Polymeric Nanoparticles to Neutrophils

Authors: Jean-Pierre Pierantoni, Sophie Maiocchi, Edward Moreira Bahnson

Thrombosis in blood vessels can cause life-threatening conditions such as stroke and heart attack. Neutrophils are innate immune cells that interact with blood clot structures and can migrate into the clot core. The neutrophil-clot interaction can be exploited to deliver drugs to the clot core, a usually inaccessible area. Previous literature has characterized using Bovine Serum Albumin (BSA) to target neutrophils. BSA is a protein with a single accessible thiol group on its surface, and thiols are highly reactive with the chemical compound Maleimide. We propose utilizing Maleimide-Thiol Chemistry to create a nanoparticle (NP)-BSA conjugate for neutrophil uptake. These NPs are generated via Flash Nanoprecipitation (FNP) procedures which creates our uniform NP products specific for Neutrophil targeting. We have generated an NP-BSA model that is optimized for neutrophil uptake and can inform future studies for targeted thrombosis therapies.

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[60]Fullerene - Influence of its behavior in solution on diffusion rate through epithelial cells

Authors: Sara Sutton, Yuri Mackeyev, Sunil Krishnan

Due to the presence of 24 hydroxyl groups in C60-ser molecules, it has a uniquely high solubility in water, making it the most soluble [60]fullerene derivative. It has an intrinsic property of spontaneously forming labile aggregates when dissolved in water. To better understand its aggregation dynamics, here we performed a series of studies of C60-ser behavior in solutions at different temperatures (4-37 ˚C) and at four-order-of-magnitude concentrations range. This knowledge may help in utilizing the radioprotective properties of C60-ser more efficiently. We also hypothesize that its tissue absorption delay may be proportional to the aggregation degree due to enhanced permeability and retention (EPR) effect.

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