

GW RESEARCH DAYS

— TUESDAY, MARCH 29, 2016

THE GEORGE WASHINGTON UNIVERSITY

WASHINGTON, DC



GW RESEARCH DAYS

2016

ANNUAL RESEARCH DAY

TUESDAY, MARCH 29, 2016

MARVIN CENTER

800 21ST STREET, NW, 3RD FLOOR

- 8:30-10:00 a.m.** **Registration and Posters Setup** (*Grand and Continental Ballrooms*)
- 10:00 a.m.-1:00 p.m.** **Poster Presentations and Judging** (*Grand and Continental Ballrooms*)
- 1:00-2:30 p.m.** **Poster Removal** (*Grand and Continental Ballrooms*)

RESEARCH DAYS 2016 WEBSITE

ONLINE - [HTTP://RESEARCH.GWU.EDU/RESEARCH-DAYS-2016](http://RESEARCH.GWU.EDU/RESEARCH-DAYS-2016)

- 5:00-5:15 p.m.** **Poster Winners and Nashman Research Awardees Announced Online**



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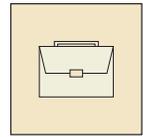
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SCHOOL OF BUSINESS

Barbie's Steps to Women Empowerment

Barbie, an iconic doll launched in 1959, has played a significant role in representing the various perceptions of females in society. Despite its popularity, there have been rising controversies against Mattel, maker of Barbie, which have included Barbie's disproportional body size (providing an unrealistic, too-thin body image), as well as the materialistic tendencies surrounding items under the Barbie brand. Additionally, various slogans such as "Math class is tough," "Don't Eat," and "Will we ever have enough clothes?" have been printed on Barbie-related products that encourage a negative perception of female.

In recent years, Mattel has spent significant effort in restoring Barbie's image through a new revised line of Barbie dolls celebrating female empowerment and promoting the beauty of women by introducing Barbie dolls in a variety of different body sizes and races. Research on the Barbie dolls' changing image over the past 50 years appears to document changes in society, especially in regard to the perception of women. An analysis of the newly designed Barbie product line and Mattel's marketing strategies is utilized to better understand Barbie's reflection of the ever-changing social acceptance in regard to women's empowerment.

STATUS

Student - Undergraduate

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BUSINESS



SCHOOL OF BUSINESS

Farm to Table Food Systems: Policy and Consumer Effects on Success and Sustainability

In this paper we analyze the success and sustainability of farm to table systems through different contexts to determine whether or not such systems are actually sustainable. According to certain research, what is thought as being a successful and sustainable system, is in fact not, due to one size fits all policy, mass marketing to the consumer, and scale-able differences. We also analyze two case studies from two different farm to table restaurants - one successful and one unsuccessful - in two similar locations, to determine what type of aggregate, sourcing and supply chain, and consumer issues beget success and failure. This fits into spheres of relevance ranging from the overall scenario, the implications of current food/public policy, and systems thinking and methodology.

STATUS

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CREATIVE ARTS



COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Rite of Spring Riots: Creation of and Reactions to Dance Performances of Stravinsky's Le Sacre du Printemps in 1913 and 2013

Contemporary choreographers are always looking for new ways to engage audiences. This engagement can range from having the audiences leave thinking about a certain subject, or be emotionally affected in some way. The Ballet Russe's premiere of Le Sacre du Printemps, composed by Igor Stravinsky and choreographed by Vaslav Nijinsky, angered its audience to the point where they left hastily, threw items onstage, and rioted in the streets. Ever since that day in 1913, some choreographers have been attempting to confront the piece of music and its history.

Through research conducted in Berlin and London, prominent choreographers and producers were interviewed in order to understand their attachment to Sacre and how they use it. Choreographers from these two cities were prominent figures in producing new works in 2013, celebrating the centennial anniversary of the ballet's debut. In addition, archival research was done to gain a better understanding. Marketing materials and literature were also analyzed to gain a better understanding of how these works have become such a sensation. These interviews and additional research point to cultural differences in how people regard Sacre and the dance performances using that score. These differences also reflected how all of these performances were funded, especially since so many were choreographed in 2013. The findings conclude that choreographers either choose to confront the history, attempting to gain a similar reaction, or simply use the iconic music for their own, different purpose.

STATUS

Student - Undergraduate

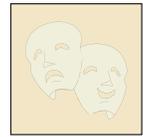
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CREATIVE ARTS



CORCORAN SCHOOL OF THE ARTS & DESIGN

Ancient Alien Protectors

Ancient Alien Protectors is an exhibition that tells the story of the wonders and benefits of horseshoe crabs. What are they and why should anyone care about them? Researching the topic revealed that more often than not an inhabitant of the Western Shore or any of the landlocked geographical locations in the United States has limited knowledge about horseshoe crabs. Their kind has inhabited our Earth for over 475 million years. They have outlasted over ninety-nine percent of all the species that ever swam or walked on the planet but are now in peril due to human activity. They have been harvested for farmers to make fertilizer for crops, chopped up as bait for fishermen, and captured and bled by biomedical companies. Their copper-based blue blood is used to produce a life-saving product that is hypersensitive to bacteria. The injectable drugs and medical devices that come in contact with our blood must be tested for the presence of toxins, horseshoe crabs have now become an invaluable commodity to modern medicine.

Horseshoe crab eggs are a food source for many crustaceans and fishes. Their eggs are an integral part of the diet of many shorebirds, allowing them to refuel and gain weight before continuing their journey northward to the Arctic. Disappearance of the horseshoe crab from the waters of the Atlantic Ocean would be a critical blow to the life-sustaining connection between members of local ecosystems.

The goal of this research is to create an exhibition that sparks an awareness about how we are an intrinsic part of the natural world. The exhibition is designed so that visitors will have an opportunity to enter a museum located in the Delaware Bay region, the natural setting where the largest population of horseshoe crabs are born, grow to maturity, and reproduce. Visitors can immerse themselves in an environment that will stimulate their senses as well as their mind and leave inspired to engage in the conservation and protection of this resilient species. The proposed site will also house a research facility collocated with the museum to foster cooperation and knowledge sharing among scientists. A partnership between the conservation and medical communities would strengthen the commitment to finding better ways to strategically manage and preserve this precious living resource.

STATUS

Student - Graduate

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CREATIVE ARTS



CORCORAN SCHOOL OF THE ARTS & DESIGN

Beyond the Pupuseria: creating and inviting exhibition about Salvadoran immigrants and the pursuit of home in Mt. Pleasant, Washington, D.C.

BEYOND THE PUPUSERIA: CREATING AND INVITING EXHIBITION ABOUT SALVADORAN IMMIGRANTS AND THE PURSUIT OF HOME IN MT. PLEASANT, WASHINGTON, D.C. is an exhibition proposal and feasibility study regarding exhibition design that uses available resources in the Salvadoran immigrant community of Mt. Pleasant. The exhibition's goal is to enable long-lasting relationships—re-establishing and fostering dialogue between communities.

The exhibit looks at Salvadoran culture; the communities' stories of migration, displacement, and the pursuit of home. It is intended for young adults living in the DC metropolitan area. The target audience is culturally and politically active at local, national, and international levels. They are a key component in extending the reach of the exhibit.

The exhibit presents narratives in two of Mt. Pleasant's Salvadoran eateries (Pupuserias) and one of its pocket parks. The pocket park is a neighborhood hub, actively used by many diverse communities. The accessibility and existing interchange between communities makes the park an integral part of the overall exhibit design.

By partnering with small Salvadoran businesses in the community, the exhibit not only offers authentic perspectives on the major narratives, it invites genuine connection between communities. Salvadoran residents are at home at these establishments; their stories will be shared on their terms and in their spaces. Relatively few non-Salvadorans visit these spaces; this creates opportunity for connections at a different level than what may currently happen.

The exhibit uses graphic applications, audio recordings, written testimonies, personal images, and communal imagery. The exhibit incorporates these elements into the establishments' existing design, which is focused on retail. Design integrates fully into this setting. For example, some graphic applications highlight products, connecting them to narratives of local families and larger history. Graphic applications and audio recordings are incorporated in an intuitive and accessible manner, based on studies of consumer behavior. This design integration promotes the message of the exhibition while boosting business of venues and bringing attention to the neighborhood.

The exhibit seeks to be a model of communication that partners with the subject community, presenting narratives in places that the community "owns". The exhibit utilizes readily accessible resources and uses design elements that engage different levels of learning and interpretation. It seeks to fulfill the purpose of being a creative model for the study, enriching and developing communities at a cultural level, and it seeks to highlight the plethora of available resources to do so, which speaks to its own feasibility.

STATUS

Student - Graduate

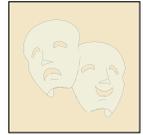
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CREATIVE ARTS



CORCORAN SCHOOL OF THE ARTS & DESIGN

“Mālama I ka Hale” A case study on community development as examined through an exhibition on vernacular architecture in Hawaii

Mālama is the Hawaiian word for to take care of, preserve and keep.

Vernacular meets the needs of the society.

This abstract is a case study on how through the care and preservation of the Hawaiian home, you can care for the community.

The Waianae community is troubled. It has economic and education issues with the state’s highest rates of teen pregnancy, school suspensions, incidents of substance abuse, and juvenile arrests. In addition, the poverty level is over 20% with few employment opportunities that in turn has led to a large homeless population.

This research examines the historical and cultural significance of Hawaii’s vernacular architecture and its close relationship to the community. It explores how the use of an exhibition on architecture can develop an ongoing relationship between the project and the local community to address the unique challenges of Waianae.

The result of the research is an exhibition proposal outlining a scalable project that is not just another building, but a representation of a nation and its people. It creates a platform for knowledge and cultural exchange, and provides a venue of education and enrichment exploring Hawaiian history through its architecture. It will set the stage to open discussions to issues that reach beyond the barriers of culture and expertise.

This exhibition also provides an opportunity for architects to share their technical knowledge and building skills with the local community. They gain an appreciation and understanding of the cultural significance and value that might otherwise be overlooked by architects and planning professionals. The project then becomes more than just building structures; it addresses real issues to create housing that matters.

STATUS

Student - Graduate

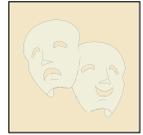
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CREATIVE ARTS



CORCORAN SCHOOL OF THE ARTS & DESIGN

Care Where You Give: Effective Altruism—A proposal for an exhibition on effective altruism in Penn Station, New York City

This proposal is for an exhibition on effective altruism in Penn Station, New York City. Effective altruism is the philosophy that a person should do the most good one can, often through donating primarily money or time to causes that are the best at getting aid to the people who need the most help. The goal of this exhibition is to spur visitors to examine the organizations to who they donate, and possibly change their donation habits based on this evaluation. This exhibition will be a takeover guerilla social movement campaign called Care Where You Give and will utilize unconventional graphics throughout the station, a variety of social media platforms, and built structures in the main concourse to convey the message and goal of effective altruism to all audience members. While this exhibition will be designed to be accessible for all visitors, the focus audience group is young professionals in their twenties and thirties. Multi-lingual opportunities and accessibility to convey the message of effective altruism is vital to this exhibition. The main content structures of the exhibition will focus on some key charities that have proven to be highly effective in helping people in the United States and around the world. The exhibition will give the visitors the tools within the exhibition to engage with future opportunities to donate resources to a cause that resonates with them. At the end of the day, when visitors leave Penn Station they should stop and think before the next time they donate, and care where they give.

STATUS

Student - Graduate

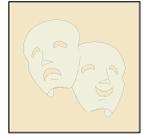
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CREATIVE ARTS



CORCORAN SCHOOL OF THE ARTS & DESIGN

The Considerate Consumer: What's love got to do with it?

The Considerate Consumer: What's love got to do with it? is an exhibition design proposal about creating a more thoughtful and fulfilling consumer culture through an exhibition about personal and cultural object value.

This exhibition proposal aims to show how an exhibition can create more considerate and mindful consumers, which in turn can contribute to a more satisfied and thoughtful consumer culture. Through an exhibition topic that takes a unique approach of considering how different types of love and value for everyday objects can affect our choices as consumers, this exhibition will create relevant connections to the topic on a personal, cultural, and global level. The target audience for this exhibition is active consumers with an interest in sustainability, object production, or being a conscientious consumer. Set at the Museum of Contemporary Art in Los Angeles, at their gallery located at the Pacific Design Center, this exhibition is a multi-faced approach to the idea that love for an object can have a major impact. The design of this exhibition is intended to create the optimal environment to allow for self-discovery of the topic in a comfortable and safe space, with a feeling of a calm and relaxed environment.

STATUS

Student - Graduate

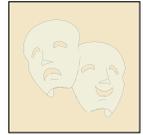
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CREATIVE ARTS



COLUMBIAN COLLEGE OF ARTS AND SCIENCES

#No Filter: The Wade Guyton Phenomenon

Every work of art can be bought and sold according to the most recent buyer's acceptable price. Wade Guyton, a 43-year-old contemporary artist, knowingly expresses his grievances with the stratification of the art market that forces many artists into financial distress. In May 2014, on the verge of the Christie's Auction House "If I Live I'll See You Tuesday" evening sale, Guyton took to Instagram to ruffle the feathers of the art world in a post one could say was heard around the art world. His Instagram attack reveals income disparities within the art world, in which uninformed, secondary art sales call all the shots; artists struggle to market, compete, and sustain themselves; and the fight to control the art market becomes a losing battle for the artist, the market's indispensable supplier and foundation. Though successful in outlining this systematic structural problem, Guyton's post did little to affect the auction's outcome, illuminating the disconnect between Guyton's artistic process and his feverish market. This project reveals that the two moving parts, his process and his market, do not progress at the same pace, nor does one directly influence the other. Guyton's secondary art market sales and soaring prices have little impact on his artistic practice or rate of production, and, likewise, his multiples do little to offset enormous final prices. Guyton's attempted interference with his market via the heated Instagram attack on Christie's serves as the link between these two factors defining his career, providing an intriguing singular phenomenon where, on the one hand, there is the artist's interactive physical process, and on the other hand, a market that refuses to cooperate with or be manipulated by any singular entity, whether that be Guyton's current production and/or critical discourse. In conclusion, Guyton's Instagram post allows viewers to reflect and recognize how these dual tracks originated, developed, and result in an anomaly of the twenty-first-century art world, where an artist has lost majority control of his market sales.

STATUS

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CREATIVE ARTS



COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Entrepreneurship in the Arts

This capstone project poses the question- "How can entrepreneurship create a future for classical music; artists and audience?" There will be an evaluation of the current state of performing arts and the relationship between audiences and classical music. Institutional orchestral and operatic performances have become an art form that exists through the subsidization of donors. In order to attract new audiences, these large and established institutions must undergo significant organizational change. It is possible that some institutions could change enough to adapt to the demands of a modern audience, but it is unlikely that all performing arts institutions will change enough to remain viable. Due to the fact that it is unlikely for the majority of institutions to change their culture drastically enough, I propose that the most effective way to move forward is for new performing arts organizations to be created. To get a better idea of how these new organizations would be formulated, I refer to the Social Entrepreneurship Model by Mort & Weerawardena (2006). Successful new arts ventures would address the need for segmentation, targeting, and positioning of music in order to capture unsaturated markets. My project will include an original set of propositions for structure and execution of new arts organizations, which essentially aim to present traditional music in a non-traditional way. Additionally, I will present my findings from the "pilot" chamber music concerts that I have arranged this semester in the community (e.g., music students performing at St. Mary's Court, Textile Museum, and the GW Hospital).

STATUS

Student - Undergraduate

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GRADUATE SCHOOL OF EDUCATION AND HUMAN DEVELOPMENT

National Language Issues related to Refugee Integration: Education, Employment Opportunities and Personal and Cultural Identity

Since the beginning of the Syrian conflict in 2011, millions of Syrians have migrated under the status of refugee to escape persecution. With a growing number of Syrians attempting to gain asylum in Europe, we questioned how their experiences might be affected by the languages policies of their host countries. Thus, our aim was to investigate the dynamics surrounding national languages and refugee integration in a new context, with a specific focus on education and employment opportunities, as well as the construction and maintenance of personal and cultural identity. We sought to answer the following questions: 1) How do national language policies affect refugees with respect to education and economic opportunity? and 2) How do refugees negotiate their cultural and personal identity within the national language of their new social context? Using a basic interpretive qualitative study, we examined the experiences of five Middle Eastern refugees living in Norway and the United States through 30-40 minute semi-structured interviews. We open-coded the transcribed data and categorized the responses into five categories: biographical, educational, policy, language and identity, which revealed three themes. Furthermore, the study showed that youth (educated in the host country) experiences were quite different from adults' (entered host country during their professional career) experiences. With respect to our first question, youth were given the opportunity to simultaneously learn the language and curriculum content through schooling, which provided them with better prospects for economic advancement—though the quality and process of immersion varies across schools. On the other hand, as a result of policies relating to education and visa/refugee status, adults experience challenges in the transferability of their academic records, often taking menial jobs to support their families. Our second research question revealed that youth do not have a concrete anchor to their home culture, resulting in a split identity between their home and host country. In order to feel fully integrated within the new community, youth feel they must possess a native-speaker level of fluency, whereas adults contend that simply being understood is enough for social advancement. Finally, as adults have stronger linguistic ties to their mother tongue, they are better able to maintain their cultural identity. In sum, language, both mother tongue and new national language, is a means by which refugees conserve ties with their home culture while claiming cultural belonging to their new context.

STATUS

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Out of the Classroom and into the Heart: An exploration of the motivation behind ESL teachers of Latino/a ELLs

The purpose of this study is to explore the experiences that have motivated and inspired successful ESL teachers to become persons who can effectively guide Latin American English Language Learners (ELLs) toward academic success. In the United States, approximately 75% of ELLs speak Spanish, and many of these students are represented statistically in the Latin American and ELL achievement gaps. Current research suggests that despite the achievement gaps, ESL teachers who demonstrate cultural and linguistic competence can effectively foster positive outcomes for Latin American ELLs in United States schools (ASHA, 2015; Cloud, et al., 2000; Koppelman, 2014; The Annie E. Casey Foundation, 2004). Interestingly, research also suggests that simply teaching according to culturally and linguistically competent practices isn't enough. Rather, ESL teachers need to possess a system of beliefs that foster success for all students (Pang & Kamil, 2004; Walqui, 2000; Marx & Saaverda, 2014; Chan, 2006). To further explore teacher ideology, the researcher conducted qualitative interviews with successful ESL teachers in the greater Washington, D.C., area. Principals recommended ESL teachers to be interviewed based on their effective practice of linguistically and culturally competent teaching, and each interview covered the following topics: (a) background in teaching, (b) past and current experience teaching Spanish-speaking ELLs, (c) experience with culture in the ESL classroom, and (d) current and future teaching opportunities. The patterns among the teachers' past and current experiences explores an untapped component of what led them to adopt culturally and linguistically competent ideologies. The research consequently provides a deeper exploration of the factors that may contribute to their successful teaching of Latin American ELLs.

STATUS

Student - Undergraduate

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EDUCATION



GRADUATE SCHOOL OF EDUCATION AND HUMAN DEVELOPMENT

The Relationship Between Science Classroom Facility Conditions and Ninth Grade Students' Attitudes Toward Science

Over half of the school facilities in America are in poor condition. Unsatisfactory school facilities have a negative impact on teaching and learning. The purpose of this correlational study was to identify the relationship between high school science teachers' perceptions of the school science environment (instructional equipment, demonstration equipment, and physical facilities) and ninth grade students' attitudes about science through their expressed enjoyment of science, importance of time spent on science, and boredom with science. A sample of 11,523 cases was extracted, after a process of data mining, from a databank of over 24,000 nationally representative ninth graders located throughout the United States. The instrument used to survey these students was part of the High School Longitudinal Study (HSLs:2009). The research design was multiple linear regression. The results showed a significant relationship between the science classroom conditions and students' attitudes. Demonstration equipment and physical facilities were the best predictors of effects on students' attitudes. Conclusion based on this study and recommendations for future research are made.

STATUS

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EDUCATION



GRADUATE SCHOOL OF EDUCATION AND HUMAN DEVELOPMENT

Translating Mind-Brain-Education Research For Early Childhood Practitioners

Mind brain education (MBE) is a relatively new field integrating theories and findings from cognitive neuroscience, psychology, and education. It provides a framework that facilitates the interpretation and translation of these findings in an effort to improve education through interdisciplinary collaboration. Synthesis of findings across these disciplines has allowed researchers to begin to suggest MBE evidence-supported ways to optimize social-emotional development and academic achievement in early childhood. The purpose of this poster is to discuss the neural correlates of important behavioral, social, and emotional markers in children at-risk or with disabilities and examine how researchers can translate findings on relationships, toxic stress, and neurodiversity for early childhood practitioners.

STATUS

Student - Graduate

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EDUCATION



GRADUATE SCHOOL OF EDUCATION AND HUMAN DEVELOPMENT

Designing the 21st Century Learning Environment

K-12 education is currently undergoing revitalization, and the proliferation of emerging teaching and learning models is pushing the boundaries of traditional conceptualizations of the classroom. Parents, teachers, administrators, and researchers are increasingly concerned with this question: What does the 21st century classroom look like? While many students still are stuck in rows of hard seats that face a board and a teacher, there are new classroom models that integrate time-tested, effective practices in pedagogy with new trends in education research. We are now reevaluating how we should conceive the physical classroom and beyond.

Classrooms have long been a place for direct instruction, project-based learning, dialogue, and other teaching techniques; however, new research has centered on the educational value of maker-space, mindfulness, the role of nature in learning, classroom flexibility and comfort, accommodation of individualized learning styles, and many other aspects of the learning process.

How can we embrace new research on promoting effective teaching and learning within the learning environment? Imagine a classroom that offers students opportunities to discuss English literature and philosophy over coffee and tea, or promote meditation and relaxation with yoga mats and ambient music, or foster a student's appreciation of nature with peace lilies and great views of the outdoors, or positively affect a student's sleep cycle with circadian lighting throughout the day.

Our presentation will explore the latest contributions revealed by education research and how we can better promote the cognitive, physical, and emotional development of our students. Participants in this workshop will learn about the newest research trends and how these approaches can affect learning environments.

STATUS

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EDUCATION



GRADUATE SCHOOL OF EDUCATION AND HUMAN DEVELOPMENT

“Let There Be Light!”: Effects of Teaching about Religion on the Religious Tolerance of Middle School Students

Since 9/11, the repercussions of religious intolerance have reached center stage, highlighted by religious hate crime statistics, governmental policies (e.g., The Patriot Act), and documented cases of increased anxiety. Religious illiteracy is also a common phenomenon across the American landscape. Conceptual arguments hold that knowledge of other religions and development of religious tolerance can promote intercultural discourse and understanding, critical elements of a proper civic education. However, there exists a practical gap between the growing religious intolerance in the United States and the educational measures taken to resolve the issue. A case study of a Core Knowledge Foundation school that begins teaching about religion in first grade will be utilized. Surveys to measure religious literacy and tolerance, observations of the unit, and interviews with the students and teachers will be employed to examine the effects of teaching about religion on the religious tolerance of sixth grade public school students.

KEYWORDS:

religious tolerance, religious literacy, Core Knowledge, middle school, civic education

STATUS

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EDUCATION



COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Exploring the relationship of the arts and conation in undergraduate students

Conation is a construct that has received relatively little attention in educational research despite its intimate relationship with motivation and volition. Some theorists believe, like cognition and emotion, the development of conation can be studied and supported to enhance learning. Substantive research is available on how the arts can support cognitive and emotional development in educational contexts, however no studies examine the possible benefit the arts can provide to a student's conative ability. This study uses qualitative interviews conducted with undergraduate seniors from a variety of majors. The goal of this study is to explore the conative capacity of these students and identify if intensive involvement in the arts corresponds with a discernible conative capacity. This will be achieved using thematic coding to determine if and what pattern comes about when investigating a student's conative ability in relation to the arts. If a stable pattern of conative processes emerges, the findings of this study may highlight the importance of studying conative capacities of students. The findings may also potentially contribute to research on how the arts can be harnessed to intentionally support student development in educational contexts.

STATUS

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EDUCATION



COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Building Support for Elementary Students Experiencing Homelessness

When a student has to worry about a basic essential such as a bed to sleep in, other aspects of life such as schooling may not seem as significant. This ties in with the most foundational level in Maslow's Hierarchy of Needs, physiological needs like food, clothing, and shelter. In order for a person to be satisfied, these needs must be met first (Simons, Irwin, & Drinnien, 1987). External stressors about home life have the ability to put children at a major disadvantage in their academic careers. Psychosocial effects stem from these outside influences and sometimes interfere with behavioral development in students (Zima, 1999). According to a 1999 study, over half of pre-school children living in homeless shelters have at least one developmental delay, 28%-32% of school-aged children experience behavior problems, while some have depressive symptoms (Zima, 1999). This research study is focused on the academic achievement of homeless and low-income elementary school students in Washington, DC, and specifically how the teacher, who often offers one of the first consistent interventions in a child's life, provides support to these students to help them be more successful. For the purposes of this study, ten teachers throughout the DC Public Schools were interviewed about their experiences working with students facing homelessness. Questions posed to teachers were separated into three categories: (1) teacher's experience working with homeless and low-income students, (2) academic achievement of students of homeless and low-income backgrounds, and (3) the school's intervention methods and implementation when working with these students. Current literature suggests that in addition to escalation in developmental and psychosocial delays in students who are experiencing homelessness, familial problems negatively impact a student's development. This study has the potential to uncover some best practices that could inform schools and communities who serve children who are homeless.

STATUS

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EDUCATION



COLUMBIAN COLLEGE OF ARTS AND SCIENCES

The Power of Parent Engagement

Throughout many low-income urban communities, children are not receiving equitable opportunities for education. The educational disparity between children in low-income communities and high-income communities is referred to as the achievement gap. The research shows that high levels of parent engagement are one factor that could close the achievement gap between children in low-income urban communities and their more affluent peers. However, many schools are struggling to utilize parent engagement in a way that considers barriers and the needs of specific communities. In order to explore current methods of parent engagement in low-income urban elementary schools, this study uses qualitative interviews of school coordinators and program coordinators within low-income elementary schools and early education programs in Washington, DC. The semi-structured qualitative interviews focused on current methods of and barriers to parent engagement. The researcher transcribed each recording verbatim and coded each transcript for central themes and ideas. The results will be presented and discussed along with implications for research and practice. The discussion of this study can translate into attainable parent engagement practices for other low-income urban communities to utilize. By exploring parent engagement within low-income urban elementary schools, new insight may provide opportunities for learning and growth for all children.

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Enhanced Estimation of Land Surface Moisture and Heat Fluxes by Coupling Water and Energy Balance Models

The land surface is a key component of climate system. It controls the partitioning of available energy at the surface between sensible and latent heat, and partitioning of available water between evaporation and runoff. Determination of energy and water exchange between the land surface and atmosphere is the primary objective of land surface models in many fields such as hydrology, climatology and meteorology. The Water and energy cycles are intrinsically coupled through the moisture flux from the surface to the atmosphere. This mass flux (evapotranspiration) represents a heat exchange as latent heat flux, coupling water and energy balance equation. Among the numerous techniques developed to make quantitative estimates of surface, data assimilation (DA) techniques (e.g., variational data assimilation (VDA)), have gained substantial success in recent years. In this study, we apply the VDA technique to retrieve the key unknown parameters of the land surface by assimilating land surface state variables (i.e., soil temperature and soil moisture). The surface energy balance (SEB) is coupled with surface water balance (SWB) through evapotranspiration flux. This coupling makes SEB and SWB to operate in a consistent and dynamic way and provide means to more accurate prediction of the closure relation between water balance and energy balance equations, unknown parameters and flux components of both equations. Small root mean squared error between observed and estimated θ from VDA estimates in comparison with those of SWB estimates (using common combinations of $EF-\theta$ and $Q-\theta$ relationships) reveals the importance of using VDA-proposed $EF-\theta$ and $Q-\theta$ relationships in land surface model. The retrieved values of land surface fluxes (i.e., Sensible (H), Latent(LE), Ground, and net radiation (R_n)) are in good agreement with observations in terms of both magnitude and day-to-day dynamics. This indicates that VDA is able to use the information in LST dynamics to partition available energy among the turbulent heat fluxes.

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CRED: Cloud Right-sizing to Meet Execution Deadlines and Data Locality

As demands for cloud-based data processing continue to grow, cloud providers seek effective techniques that deliver value to the business without violating Service Level Agreements (SLAs). Cloud right-sizing has emerged as a very promising technique for making cloud services more cost-effective. In this paper, we present CRED, a novel framework for cloud right-sizing with execution deadlines and data locality constraints. CRED jointly optimizes data placement and task scheduling in data centers with the aim of minimizing the number of nodes needed while meeting users SLA requirements. We formulate CRED as an integer optimization problem and present a heuristic algorithm with provable performance guarantee to solve the optimization. Competitive ratios of the proposed algorithm are quantified in closed form for arbitrary task parameters and cloud configurations. Simulation results show that our proposed algorithm significantly outperforms existing heuristics such as first-fit by reducing up to 44% of required active servers, and achieves nearly-optimal performance in terms of cloud-right sizing.

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Ultrasound-activated microbubbles for cartilage tissue engineering in 3D printed scaffolds

Gas-filled microbubbles encapsulated with lipids and other surfactants are highly responsive to ultrasound, which has led to their effective role as ultrasound contrast agents (UCA). In this study, for the first time, we used lipid-coated microbubbles (MB) prepared in-house in order to better harness the beneficial effects of ultrasound stimulation on proliferation and chondrogenic differentiation of human mesenchymal stem cells (MSCs) within a novel 3D printed poly (ethylene glycol) diacrylate (PEG-DA) hydrogel scaffolds. A significant increase in cell number ($p < 0.001$) was observed with low intensity pulsed ultrasound (LIPUS) treatment in the presence of 0.5 % (v/v) MB after 1, 3 and 5 days of culture. MSC proliferation enhanced up to 40% after 5 days of culture in presence of MB and LIPUS while this value was only 18% when excited with LIPUS alone. We investigated the effects of acoustic parameters such as excitation intensity, frequency and pulse repetition period on MSC proliferation rate. Our 3-week chondrogenic differentiation results demonstrated that combining LIPUS with MB significantly enhanced both Glycosaminoglycan (GAG) and type II collagen production. Therefore, integrating LIPUS and MB appears to be a promising strategy for enhanced MSC growth and chondrogenic differentiation.

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Geometric Average Based Fast Converging Proportional Fair Scheduling for Multi-user Downlink Transmission

In the OFDMA based wireless technology, User Equipments (UEs) provide the feedback on the quantized channel quality indicator (CQI) for the eNB to select which UEs to be scheduled and which modulation and coding schemes (MCSs) to be used. To reduce the large overhead, each UE typically sends only the average CQI measured over all subcarriers. However, our preliminary study shows that this can cause a significant loss of the system performance especially in the low SNR regions when the well-known BestCQI and Proportional Fair Scheduling (PFS) algorithms are used. These algorithms have tendency to assign multiple subcarriers to a single UE. When only one MCS is applied to all data transmitted over multiple subcarriers with possibly very different CQIs, the received signal cannot be correctly demodulated by UE. Motivated by this observation, we propose yet another scheduling algorithm similar to PFS but developed based on geometric average throughput. We prove that the geometric average throughput converges to the solution of an ordinary differential equation, a similar result shown in the convergence of arithmetic average based PFS. Extensive simulation results show that our proposed scheduling achieves significant improvements over BestCQI and PFS with faster convergence rates.

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Water vapor concentration measurement with TDLAS during VHTR steam ingress

Very-high-temperature reactors (VHTR) are a type of next generation nuclear reactor that utilize a graphite-moderated, helium-cooled design that has the ability to provide outlet temperatures in excess of 700°C. Safety and structural integrity concerns have led to extensive accident condition investigations. Steam generator heat-exchange tube rupture accidents (SGTR) can lead to increased reactor core steam density, which can cause chemical corrosion of graphite structural supports and fuel elements. It is important to be able to computationally model the propagation of steam throughout the nuclear reactor core, but more experimental data is needed to validate such CFD codes. The primary objective of this project is to instrument a 1/8th scaled experimental VHTR, designed by The Ohio State University, with tunable diode laser absorption spectroscopy (TDLAS) equipment to map how water vapor propagates through the test facility's lower plenum rod configuration via concentration changes.

TDLAS is a non-intrusive, non-perturbative line-of-sight diagnostic technique that can be used to measure steam concentration, temperature, and pressure. A laser beam propagates through a gas and is attenuated if the laser wavelength matches absorption transitions of the gas species. The Beer-Lambert law of absorbance can be used to recover this information. Four wavelength ranges were selected based on H₂O absorption simulation outputs from an in-house MATLAB code developed to mine the HITRAN molecular absorption database to find the best transitions for the VHTR environment (P = 0-35 psi, T = 200-700°C, [H₂O] = ~0.01-0.9, x = 8.8 cm). Distributed feedback lasers (DFB) were utilized in this experiment due to their ability to be rapidly scanned (5kHz+) over small wavelength ranges (~0.25 nm) by modulating current. A three-chamber heated pressure vessel was constructed to verify our selected transitions and to gain more experience with the technique before moving to VHTR testing. Preliminary testing at low temperature (<100C) in a non-sealed environment has provided promising results with a ratiometry between absorption peaks yielding a percent error of 5.5% for temperature and ballpark estimates of concentration at ~50% error. Currently, instrumentation rods with high temperature fiber optics for taking measurements in the VHTR test facility are being designed and the data analysis code is under further refinement for improved measurement accuracy.

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Three-dimensional separation over a wall-mounted obstacle in pulsatile flow

Wall-mounted obstacles are prevalent in nature and engineering applications in a variety of freestream flow conditions. Despite their prevalence, the study of wall-mounted obstacles has been restricted to steady (constant velocity) freestream flow. In biological and geophysical flows, pulsatile flow is much more common, yet the effect of pulsatile freestream flow on the wake of a wall-mounted obstacle has yet to be extensively studied. This study aims to characterize the complex physics produced in this unsteady, separated flow. Experiments were performed in a low-speed wind tunnel with a set of rotating vanes which produce the pulsatile inflow waveform. Results from instantaneous and phase-averaged particle image velocimetry taken about a hemispherical obstacle in pulsatile flow will be presented and compared. A mechanism based on self-induced vortex propagation, analogous to that in vortex rings, will be proposed to explain the observed fluid structure dynamics. A prediction of the propagation velocity based on the Saffman equation for vortex rings in a viscous fluid will be compared to the experimentally measured propagation velocity. The effects and contribution of the surrounding pulsatile boundary layer on the observed physics will be explored.

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Development of a Parallel 3D High-order Navier-Stokes Solver for Studying Secondary Flow Structures in a Curved Artery Model

In computational fluid dynamics, unstructured high-order methods, i.e. those considered 3rd order and above, are useful for the study of unsteady vortex dominated viscous flows in complex geometries. These methods can provide high accuracy for similar cost as low-order methods. Furthermore, solution acceleration can be achieved with p-refinement and p-multigrid methods. However, high-order methods are less robust and more complicated to implement than low-order methods, especially when treating irregular geometries. With the development of high-order unstructured methods comes the need to achieve faster convergence, especially for solving large-scale problems using parallel computers. This demand motivates the development of time stepping techniques for which the Courant-Friedrichs-Lewy (CFL) condition is less restrictive, which is hardly the case when explicit (e.g. multi-stage Runge-Kutta) schemes are combined with high-order methods. We present the flux reconstruction (FR) method with an implicit lower-upper symmetric Gauss-Seidel (LU-SGS) time stepping scheme that overcomes the time step restriction associated with explicit schemes used for solving the unsteady incompressible Navier-Stokes equations. As computers become equipped with larger RAM, implicit time stepping schemes are seen as effective drivers to overcome this stiffness. With these implicit schemes much larger time steps can be taken in comparison to explicit schemes, delivering the potential to improve the rate of convergence significantly. Application of the discontinuous Galerkin method to the incompressible Navier-Stokes equations have been performed by various authors. However, methods that use a Poisson solver cannot be easily parallelized according to domain decomposition of the grid. One advantage of our work lies in the fact that the method is discontinuous and local; as a result, there is no global matrix to split within a parallel implementation. Furthermore, with the introduction of artificial compressibility, pressure and velocity are loosely coupled and the Navier-Stokes equations take on a mixed hyperbolic/parabolic mathematical nature. This loose coupling lends itself to parallel computing as both pressure and velocity are state variables in pseudo time. This work aims to bring a popular high-order method and time stepping technique for producing high-order accurate solutions for compressible flow to the incompressible flow regime. In this regard the current method is novel, especially if it can be applied to moving and deforming grids needed to solve problems involving fluid-structure interaction.

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Investment Risk Mitigation and Cost-Benefit Analysis of Energy Technology Deployments

This research seeks to develop a methodology for assessing the impact of component-level energy technology investments for the Department of Defense (DOD). We employ mean-variance portfolio theory to derive sets of optimal electricity generation technology mixes. This approach, used by financial investors, informs us that a portfolio of assets is a hedge against future volatility. The adoption of this theory implies the evaluation of the cost of fossil and renewable resources on the basis of their combined contribution rather than their stand-alone cost implications. The level of riskiness in the portfolio sets represent the degree of environmental regulations expectations, resource availability, technology performance, and cost parameters. This project will provide a decision support system that evaluates and ranks the benefit-cost of the technologies that compose the energy systems of the DOD at each state across the United States. The benefit-cost analysis is performed on the efficient frontier, which is drawn from all the optimal electricity generation portfolios that meet all the constraints and requirement of the power system. The outcomes provide a stronger empirical basis for decision makers to explore trade-off between long-term technology investment and near-term operational needs, and simultaneously shed light on the critical activities within the ecosystem of DOD's independent microgrid system. We found that stringent regulatory environments lead to more costly and riskier sets of optimal generation technology portfolios.

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Micro-propulsion at GWU: The road towards more power efficient CubeSat propulsion

I. INTRODUCTION

CubeSats are small satellites of standardized size, the smallest size corresponds to a cube with sides measuring 10 cm and a total mass of 1 kg. This is the standard size and is regarded as 1 U (one Unit). Larger satellites are possible by “stacking” units, leading to a 3 U or 6 U satellite. In recent years, CubeSats have become a useful research tool that have allowed universities [1], [2], [3], private companies, space agencies such as NASA [4] and ESA [5], and even small countries without a strong space presence to test their technologies in space [6].

Initiatives such as NASA’s CubeSat Launch Initiative (CSLI) encourage organizations to test technologies for reasons that are consistent with NASA’s Strategic Plan, such as educational purposes [7].

In recent years, the research has been focused on increasing the lifetime of CubeSat missions by equipping them with their own propulsion systems. CubeSats are usually launched into Low Earth Orbits (LEO), where their lifetime is usually less than two years. Only a handful of technologies are viable for this type of task [8], [9].

One of these technologies is the Vacuum Arc Thruster (VAT). Such a technology is currently being developed at The George Washington University at the Micro propulsion and Nanotechnology Laboratory (MpNL). This thruster has successfully been flown on BRICSat-P, a 3 U CubeSat designed by the US Naval Academy that was launched in May 2015 atop an Atlas V rocket.

II. THE THRUSTER

The μ CAT is a matured miniature thruster with flight legacy that has reached NASA’s technology readiness level 7 (TRL 7). This was reached due to its successful de-spinning of BRICSat P earlier this year.

Figure 1 shows a CAD model of the circuit board used for the aforementioned satellite. Two of these were mounted onto the satellite to de-spin/de-tumble it after it is released from the launch adapter.

The thruster works by producing a voltage spike between the cathode and the anode through a conducting layer over an insulator. This conducting layer causes breakdown that leads to the arc discharge. A magnetic coil connected in series with the cathode uses the discharge current to produce a magnetic field that enhances ionization. The vacuum arc discharges are known to release highly energetic ions and produce highly ionized plasmas [10]. The discharge produces a small force on the cathode, known as thrust. This effect was observed and measured as early as 1929 [11].

The current transfer during an arc discharge is split into approximately 10% and 90% for ions and electrons, respectively. Since the ions are responsible of producing the thrust, as the mass of the electrons is 4 orders of magnitude smaller than the former. Therefore, the thrust contribution by the electrons can be neglected. To increase the thrust, it is necessary to tap into the energy carried by the electrons. In this project, we addressed this issue. The next section will describe the methods used. The motivation of this research is to increase the efficiency of these propulsion systems in order to provide more thrust to the satellite while maintaining or lowering the power consumption, allowing for longer CubeSat lifetimes.



Figure 1. CAD Image of the circuit-board for BRICSat-P and two thruster heads (μ CAT), their respective insulated-gate bipolar transistor (IGBT) and their solenoid.

III. METHODS

Measurements of the discharge showed that the energy carried by the flux of electrons, as they travel to the anode, contribute to anode heating [12]. It was therefore envisioned to use this effect for additional thrust generation by changing the material. Substituting the current anode from stainless steel to an ablatable anode has two major effects. In our case, the anode was made from solder. First, it would contribute to anode cooling due to ablative cooling. Second, it provide additional evaporated material to the discharge.

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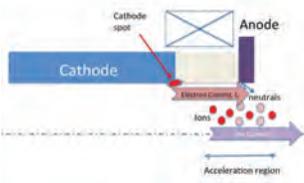


Figure 2. This image shows a simplified schematic of the new thruster configuration with ablatable anode. The light-red circles denote neutrals coming from the anode, increasing the overall mass-flow during the discharge.

The neutral vapor produced by the flux of electrons on the ablatable anode increases the mass flux emitted by the thruster and would contribute positively to thrust if the average particle velocity remains constant. Ideally, the geometric configuration of the anode provides a direct injection of neutral particles into the accelerating zone of the cathode region. Acceleration of the neutral particles would occur due to ion-neutral collisions.

Additionally, the electrons that are trapped in the magnetic field would ionize some of the neutrals released by the anode, producing a higher amount of ions.

The anode erosion was measured using a high-precision scale and scanning electron microscopy in order to observe the material changes produced by the flux of electrons. The tests were run for 17 hours for each anode at a pulse rate of 10 Hz. The background pressure was in the range of 2.2E-2 Torr. After each 17 hour test phase, the anodes were measured.

The thrust to power ratio for micro-cathode thrusters that accounts for significant anode ablation can be estimated with:

$$\frac{T}{P} = \frac{\dot{m} v_i}{e U_d} (1 + \alpha \sigma n L) \quad (1)$$

In this equation, T is the thrust, P is the power of the discharge, \dot{m} is the mass flow, v_i is the ion velocity, U_d is the discharge voltage, respectively. Furthermore, f is the ion current fraction, typically between 0.08 and 0.1 and e is the elementary charge. Also, α is the ratio between mass fluxes from anode to that of the cathode. In the previous equation σ is the collisional cross-section ($\sim 10^{19} \text{ m}^2$), n is the ion density ($\sim 10^{21} \text{ m}^{-3}$) and L is the length of the acceleration region (1 cm). If α is between 1 and 2, the thrust to power factor will be approximately 2 to 3.

IV. RESULTS

Preliminary measurements show a decrease in the mass of the ablatable anode as expected. The mass of the stainless steel anode increased during the experiments due to deposit of material from the discharge. Some of these residues contained carbon from the conductive layer and cathode material. The existing thruster has a TPR of approximately 20 $\mu\text{N/W}$ with an efficiency of up to 15%. It is expected that the new configuration with the ablatable anode can lead to an increase in thrust to power ratio of a factor of 3 compared to a stainless steel anode. We see that our estimations match our experimental data.

V. CHALLENGES

An ablatable anode, aside from bringing positive benefits to the production of thrust, adds complexity to the design. As the cathode is consumed by the discharges, it is spring-fed in such a way that, as long as there is cathode material available, it is always at the front and able to be used. If the anode is ablatable too, this means that there must be an anode-feed mechanism as well. We are currently looking into different cathode feed mechanisms in order to solve this question.

VI. CONCLUSION

The experiments performed for this project show that the introduction of evaporated metal from ablatable anode into the acceleration region of the

cathode increases the ion current to total current ratio by several percent points. This occurred without having to add extra power to the system. Therefore, the increase in thrust and efficiency comes from the energy that comes from the electron flux to the anode. Without an ablatable anode, this energy would have been lost as heat to the anode. This shows that this method of increasing the efficiency of the thruster is a viable and should be researched further. We expect an increase in thrust to power ratio of approximately a factor of 3 compared to a non-ablatable anode. This result is important because it means that the thrust can be increased without augmenting the power consumption, which is usually a major constraint onboard of CubeSats, as they have a very limited power budget.

VII. NEXT STEPS

In order to understand the changes that the ablatable anode brings to the discharge, it will be necessary to measure the produced thrust in order to corroborate the ion collector data to see if these new ions are also energetic enough to contribute positively to thrust. In order to perform these measurements, our team is currently working on the design of a torsional pendulum thrust balance. This system should be available to use by the end of the calendar year.

Also, further testing with different materials will be required in order to find out which anode material is most suitable for the task.

VIII. REFERENCES

- [1] C. Alexander, C. Roland, N. Ryan, M. Riki, and P.-S. Jordi, "CubeSat: The pico-satellite standard for research and education," in *IAAA SPACE 2008 Conference & Exposition*, ed: American Institute of Aeronautics and Astronautics, 2008.
- [2] E. H. Samudra, K. D. Christopher, K. Michael, and L. Tae, "Quad channel Micro-Cathode Arc Thruster Electric Propulsion subsystem for the Ballistic Reinforced Satellite (BRISat-P)," in *50th AIAA/ASME/SAE/ASEE Joint Propulsion Conference*, ed: American Institute of Aeronautics and Astronautics, 2014.
- [3] K. Schilling, "Design of pico-satellites for education in systems engineering," *Aerospace and Electronic Systems Magazine, IEEE*, vol. 21, pp. S_9-S_14, 2006.
- [4] C. D. Norton, M. Pasciuto, P. Pingree, S. Chien, and D. Rider, "Spaceborne flight validation of NASA ESTO technologies," in *IGARSS*, 2012, pp. 5650-5653.
- [5] R. Walker, P. Galeone, H. Page, A. Castro, F. Emma, N. Callens, et al., "ESA hands-on space education project activities for university students: Attracting and training the next generation of space engineers," in *Education Engineering (EDUCON)*, 2010 *IEEE*, 2010, pp. 1699-1708.
- [6] K. Woellert, P. Ehrenfreund, A. J. Ricco, and H. Hertzfeld, "Cubesats: Cost-effective science and technology platforms for emerging and developing nations," *Advances in Space Research*, vol. 47, pp. 663-684, 2011.
- [7] NASA Directorate. (Retrieved: October 25th, 2015). *The CubeSat Launch Initiative*, http://www.nasa.gov/directorates/heo/home/CubeSats_initiative.
- [8] W. Wright and P. Ferrer, "Electric micropropulsion systems," *Progress in Aerospace Sciences*, vol. 74, pp. 48-61, 2015.
- [9] J. Mueller, R. Hofer, and J. Ziemer, "Survey of propulsion technologies applicable to cubesats," 2010.
- [10] A. Anders and G. Yushkov, "Ion flux from vacuum arc cathode spots in the absence and presence of magnetic fields," *J. Appl. Phys.*, vol. 91, p. 4824, 2002.
- [11] R. Tanberg, "On the cathode of an arc drawn in vacuum," *Physical Review*, vol. 35, pp. 1080-1089, 1929.
- [12] K. Michael, Z. Taisen, S. Alexey, T. George, C. Dereck, L. Joseph, et al., "Electric propulsion for small satellites," *Plasma Physics and Controlled Fusion*, vol. 57, p. 014005, 2015.



SCHOOL OF ENGINEERING AND APPLIED SCIENCE

Magnetic Prussian blue nanoparticles as novel theranostic agent for cancer

BACKGROUND:

Theranostic nanoparticles simultaneously possess therapy and diagnostic capabilities. These nanoparticles offer the potential for more sensitive diagnoses and improved treatment results in human diseases, using a single platform. In the past, we synthesized Prussian blue nanoparticles that were independently used for imaging and therapy applications in the field of cancer. Inspired by the potential for improved outcomes using theranostic nanoparticles, we are now developing a single theranostic nanoparticle platform that integrates the imaging and therapy capabilities previously explored by us in cancer therapy.

OBJECTIVE:

The objective is to synthesize a composite theranostic nanoparticle that possessed both imaging and therapy capabilities. Specifically, to synthesize composite, core shell magnetic Prussian blue nanoparticles that function as MRI contrast agents in both T1 and T2 - weighted sequence and as photothermal therapy agent.

METHOD/DESIGN:

We synthesized a core-shell composite nanoparticle by growing Gadolinium Prussian blue (GdPB) nanoshell over a superparamagnetic iron oxide (Fe_3O_4) nanocore. The composite nanoparticles exhibit a high photo-thermal effect under irradiation of a near infrared laser due to strong absorption of PB nanoparticles. Additionally, gadolinium is an excellent MRI contrast agent in T1- weighted sequence and iron oxide acts as a MRI contrast agent in T2- weighted sequence. Hence capabilities of MRI targeting in both T1/ T2 - weighted sequence along with photo-thermal therapy are integrated into a single agent to allow efficient MRI guided targeted photo-thermal therapy.

RESULTS:

Preliminary testing using our novel magnetic Prussian blue nanoparticles demonstrated, nanoparticles as excellent MRI contrast agents in both T1/T2 weighted sequences.

Further, the nanoparticles were able to be photothermally heated hence proving that they can be used for ablative therapy for treating cancer cells. Ongoing studies are testing these theranostic capabilities in an animal tumor model (mouse neuroblastoma model) and prove the potential of our nanoparticles as theranostic agents.

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Effects of acoustic parameters on nanodroplet vaporization

Gas-filled microbubbles encapsulated with lipids and other surfactants are highly responsive to ultrasound, which has led to their effective role as ultrasound contrast agents (UCA). However, due to their micron size distribution and short lifespan, they cannot be used for extravascular interrogations. To overcome these limitations, phase shift nanodroplets are introduced. Due to their small size and high stability, these nanodroplets have the potential to be used for tumor imaging and drug delivery. These nanodroplets undergo a phase transition from liquid to highly echogenic gaseous state when activated by sufficient acoustic energy through a process termed acoustic droplet vaporization (ADV). In this study, we synthesised lipid-coated perfluoropentane (PFP) filled nanodroplets and lipid coated perfluorobutane (PFB) filled microbubbles via sonication and mechanical agitation methods, respectively. We investigated the ADV threshold of these nanodroplets as a function of acoustic parameters such as excitation pressure, frequency, pulse length, and pulse repetition period (PRP). Since nanodroplets offer more advantages than ordinary microbubbles, we compared the acoustic responses of vaporized nanodroplets with microbubbles at identical excitation parameters. Our results indicate that ADV threshold varies significantly with acoustic parameters studied here such as frequency and pulse repetition periods. Furthermore, above ADV threshold, droplets showed similar responses to microbubbles.

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3D bioprinting conductive nano scaffold with multi-walled carbon nanotubes for improved nerve generation

Neural defect resulted from various traumas and diseases, represents a critical clinical problem all over the world. Currently fully neural functional recovery is very difficult to achieve. Traditional surgical procedures such as nerve autograft may encourage and guide axonal regeneration between the ends of the severed axons and are effective for small nerve bundles with short gap distance. However, the repair of more complex defects with larger nerve gap remains problematic. In order to overcome these limitations, synthetic nerve scaffolds are being developed to mimic natural neural extracellular matrix that would encourage neuronal growth and axon elongation across the gap. Nerve scaffolds can be fabricated by various methods. Amongst them, 3D printing techniques have drawn great interest because they can prepare scaffolds with highly controlled spatial architecture and complexity to meet the customized requirements. The main objective of this study is to create an innovative nerve scaffold with a biomimetic nano to micro architecture by integrating advanced 3D printing technique and conductive multi walled carbon nanotubes (MWCNTs). MWCNTs are widely investigated in neural interfacing applications due to its unique physical, chemical and electrical properties. Unlike other conductive polymer materials, their electrical conductivity remains high over a long period of time under harsh condition. It is expected that MWCNT scaffolds may allow the electrical stimulation and promote excitability of neurons.

A series of mixture solutions of 0.01%, 0.025%, and 0.05% amine-functionalized MWCNTs and biocompatible poly (ethylene glycol) diacrylate (PEG-DA) hydrogel were successfully printed by our custom made stereolithography (SL) 3D bioprinter. SL printed scaffolds were designed as square pattern with small, medium, and large pores geometry (corresponding to 31%, 52%, 66% porosity) using computer aided design software. Neural stem cells (NSCs, ATCC) were further seeded onto prewetted scaffold and evaluated for adhesion and proliferation study. Our results shows that the MWCNTs were homogenously distributed inside the 3D printed scaffolds. 4-hour cell adhesion study showed the scaffolds with 52% porosity can significantly improve cell attachment compared to scaffolds with smaller pores. Then three more groups of scaffolds (52% porosity) with different concentration of MWCNTs were evaluated for proliferation study. Compared to any other groups, NSCs proliferate significantly on scaffolds with 0.01% MWCNTs after 5 day of culture. Through this study, amine-functionalized MWCNTs were effectively 3D bioprinted into a novel neural scaffold and greatly improved neural stem cell adhesion and proliferation, thus promising for future neural regeneration applications.

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SCHOOL OF ENGINEERING AND APPLIED SCIENCE

Major Research Instrument (MRI) for real-time high resolution large-scale dense 3D reconstruction

We presented a novel dense scene capture instrument designed to allow real-time scanning of surface geometry and color appearance information of large-scale 3D environments for both static and dynamic scenes. Using Vicon™ motion capture system, all sensors are registered to a common coordinate-frame, which allows fusing sensor data into a single volume and then export reconstructed dataset as triangular surface meshes or point cloud for rendering and other processing purposes.

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A Novel Approach to Measuring the Time-Impact of Oversight Activities on Engineering Work

I. INTRODUCTION AND RESEARCH MOTIVATION

Oversight activities are a necessary part of any government acquisition. Oversight is comprised of the tasks required for compliance with regulations, management procedures, and contracting terms and conditions. [1] These activities enable the government to understand and evaluate the product it is purchasing. While these activities can help to maintain a program's cost, schedule, and performance, they can also create a substantial burden upon the contractor's workforce - the core of the debate is whether this burden is necessary and appropriate or excessive. [2] For example, a report for a technical milestone in a procurement may require one or more presentations at different levels of the acquisition chain of command to follow all necessary steps of the acquisition process; but each presentation may also be followed up by multiple, sometimes extraneous, requests for additional information. Stories similar to the aforementioned example are widespread in the contractor community, spreading a belief that all of compliance-related time is burdensome - resulting in additional costs and increases in program schedule. [3] Instead of perpetuating this idea of oversight, we need an understanding of the extent to which these oversight activities impose a burden beyond what is necessary to monitor a program throughout its lifecycle.

In recent years, the appropriate level of oversight has been a frequent subject of debate, both in the media and Congress. On one hand, proponents of oversight argue that these activities are a necessary part of the process for a relatively inexpensive price. This view is represented by the following 2013 Aviation Week quote from then Brigadier General Roger Teague: "Mission assurance activities, such as tests and validation work, cost 2-5% of the total price of a rocket stack. This, he says, 'is cheap insurance' in contrast to the price of losing a satellite that could cost more than \$1 billion." [4] On the other hand, some see oversight as unnecessarily burdensome and costly, stating "There is suggestive evidence that the cost of government-driven mission assurance and current Federal Acquisition Regulations (FAR) increase costs by factors of 3-5 times, not just 20- 30%" [5] What is striking about these contrasting views is not just their drastically different estimates of the magnitude of oversight's impact, but rather the extent to which they focus on different kinds of impact. We contend that the heated oversight debate has made little forward progress because it has been based on opinions and experiences rather than empirically valid data.

We present an approach to measuring the time-impact of oversight activities on engineering work. We begin by discussing the methodological limitations of past attempts to measure oversight. We then describe the basis of our study approach. At the conclusion, we outline our plans for future work and suggest other areas where this tool might be beneficial in Systems Engineering research.

II. METHODOLOGICAL LIMITATIONS OF PREVIOUS WORK

Since the early 1990s, several studies have attempted to measure the impact of the Department of Defense's (DOD) regulation and statutory constraints on acquisition. [6]-[8] Each study looks at a specific part of the oversight process within a different community. Since each study measures a different aspect of oversight's impact, we cannot directly compare the findings from one study to another; rather, they together help to frame the discussion of oversight as it applies to each population. Previous estimates on the costs associated with compliance are based on data that compare the cost of military products to the cost of similar commercial products. Many times they use DOD data for the baseline product's cost and then base analyses off modeled projected cost savings. [9] Other assessments have used individuals' retrospective estimates for the amount of time spent complying with regulations.

The real impact of oversight is extremely difficult to measure for several reasons. Retrospective studies tend to overestimate strongly positive and strongly negative memories. [10] For example, when you ask contractor engineers about how much time they spend working on oversight related work, they will respond with a powerful anecdote about the time they wasted while having to comply with specific requests from the program office or DOD support contractor. He or she will estimate the impact as substantial - which it was in that week, but not over the full project. Second, many of the important impacts of oversight are indirect, making the breadth of a study hard to scope. Many of the impacts of oversight are related to the individuals and organizations involved with interpreting and enforcing the rules rather than the rules themselves. Third, studies based on real-time observation of activities have historically been considered too invasive.

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ENGINEERING



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III. EXPERIENCE SAMPLING METHOD APPROACH

Drawing on tools developed to study the daily activities of individuals, we adapted the non-invasive approach of the experience sampling method to study a 21st century engineering organization.[11] Instantaneous sampling provides a snapshot of the activities performed by an individual at the moment the subject receives a survey prompt. These samples take place over several months over random intervals, in order to generate a random sample of naturally occurring behaviors in the aggregate.[12] Using prompts from emails and text messages, today's web-based technology makes asking respondents to answer a quick question or two fairly non-invasive. Moreover, such short questions make it unlikely for any individual to systematically misrepresent the answer to a question like "what are you doing right now?"

The first step in conducting the non-invasive survey was to determine the categories of possible tasks completed by engineers. To determine this list of tasks, we used an inductive, time diary approach. This method asks individuals to report on the activities they performed over the previous work day in 15-minute increments, capturing a detailed description of their activities.[13] These diaries allow researchers to capture the rare and common activities each subject performed throughout their previous day.

We selected 16 respondents to participate in this initial process. They were chosen to span the major engineering activities across the selected organization. We chose two from each division to ensure that the activities we were hearing about were representative. Each of these respondents was asked to sit for a 30min-1hr interview held every two days over the course of two weeks. The cycle of every other day for 2 weeks was chosen to ensure that we had activities recorded for a full week of activities for each respondent. At the end of the two weeks of interviews, the researcher asked if there are any activities that have not been captured over the two weeks that are commonly performed activities. This helped to ensure that any cyclical activities (quarterly reports, audits, etc.) that might happen at other times in the business-year calendar that did not occur over the two weeks of interviews were captured in the full list of activities the individual performed.

The first step of the process yielded a comprehensive list of tasks completed by individuals in the organization. The next task was to synthesize these tasks into a list for the survey that could yield a response in 15-30 seconds that provided enough information to reconstruct the profile of oversight induced activities across the organization. We grouped and abstracted the tasks using an open coding approach until we had a list of 15 activities.[14] We stopped at this point because any additional abstraction would suppress important information about the work being performed. We then finalized the group task list with consultation from a group of individuals in the initial set as well as individuals in the host organization who work across all engineering disciplines.

The researchers developed a web-based survey tool to distribute the surveys and collect the data. During the survey collection period, each person participating was sent two prompts to respond to the survey per day. Each day, the survey distribution tool selected two random times for the individuals within each group to receive the survey. Each participant was sent two prompts during the day to respond to the survey at those randomly generated times.

We conducted the initial time diaries in November 2014 and then fielded the survey from May to November 2015. The initial e-mail request was sent from the desk of a senior vice president encouraging participation. Initially 400 employees signed up, spread across 7 departments. Over the 6 months that the survey was in the field, most participants continued to respond daily. Approximately 100 dropped off and there were two weeks where we had technical challenges. We are in the process of checking the drop-outs for

bias. We want to make sure that people are not dropping off from specific groups and that we have an accurate distribution of time samples across all times of the day. At the time of writing, the initial 6-month survey had just closed.

IV. CONCLUSIONS AND FUTURE WORK

We contend that this approach overcomes key limitations of past studies, in that it does not rely on fallible memories, it achieves minimal invasiveness for a real-time study and it enables a much broader sample, eliminating the need to define the scope of oversight impact up front. As analyze the data from our initial 6 month survey deployment, we expect to develop a) a more valid measure of the time-impact of oversight in one major government contractor and b) deep insights about the nature of the oversight impact.

V. REFERENCES

- [1] M. Peck and F. Scherer, *The Weapons Acquisition Process: An Economic Analysis*. Boston, Massachusetts: Harvard Graduate School of Business Administration, 1962.
- [2] R. Berrios, "Government Contracts and Contractor Behavior," *J. Bus. Ethics*, vol. 63, no. 2, pp. 119-130, Jan. 2006.
- [3] J. A. Drezner and United States, Eds., *Measuring the statutory and regulatory constraints on DoD acquisition: research design for an empirical study*. Santa Monica, CA: RAND Corporation, 2006.
- [4] A. Butler, "SpaceX, USAF Launch Talks Nearly Complete," *Aviation Week*, 10-Apr-2013.
- [5] S. Pace, *National Security Space Launch Programs*. Dirksen Senate Office Building 192, 2014.
- [6] Coopers and Lybrand, "The DoD Regulatory Cost Premium: A Quantitative Assessment," Dec. 1994.
- [7] J. A. Drezner, United States, and Department of Defense, *Measuring the statutory and regulatory constraints on Department of Defense acquisition: an empirical analysis*. Santa Monica, CA: RAND Corporation, 2007.
- [8] Government Accountability Office, "DOD Should Streamline Its Decision-Making Process for Weapon Systems to Reduce Inefficiencies," Government Accountability Office, Washington, D.C., GAO-15-192, Feb. 2015.
- [9] M. Lorell and J. C. Graser, "An Overview of Acquisition Reform Cost Savings Estimates," RAND Corporation, 2001.
- [10] M. M. Roy, N. J. S. Christenfeld, and C. R. M. McKenzie, "Underestimating the Duration of Future Events: Memory Incorrectly Used or Memory Bias?," *Psychol. Bull.*, vol. 131, no. 5, pp. 738-756, 2005.
- [11] J. M. Hektner, J. A. Schmidt, and M. Csikszentmihalyi, *Experience sampling method: measuring the quality of everyday life*. Thousand Oaks, Calif: Sage Publications, 2007.
- [12] M. Csikszentmihalyi and R. Larson, "Validity and Reliability of the Experience-Sampling Method," *J. Nerv. Ment. Dis.*, vol. 175, no. 9, pp. 526-536, 1987.
- [13] J. Ziker, "The Long, Lonely Job of Homo academicus," *The Blue Review*, 31-Mar-2014.
- [14] M. B. Miles, *Qualitative data analysis: a sourcebook of new methods*. Beverly Hills: Sage Publications, 1984.



SCHOOL OF ENGINEERING AND APPLIED SCIENCE

4D printed biomimetic nano smart bone scaffold

The gold standard method for repair of bone defect is utilizing an autologous bone graft, but the availability of autologous bone graft is limited and severe complications may generate in the graft harvesting. To replace autologous bone, great efforts have been made on grafting materials and fabricating techniques. In this study, we aim to 4D print nano smart biomimetic gradient bone scaffolds by a 3D printing guided approach to fill bone defects through shape memory effect. The term "4D print" refers to added shape transformation of printed construct on specific stimulation according to requirements to achieve minimally invasive surgeries and perfect end-to-end joint connection. The term "smart" originates from the shape memory behavior of the synthesized biocompatible polymers. To reach these goals, novel shape memory polymers with excellent biocompatibility and tunable shape changing effects are synthesized and cured with biomimetic nanocrystalline hydroxyapatite (nHA) in the presence of 3D printed sacrificing structures which are subsequently dissolved to create controllable and gradient porosity in the scaffolds. Morphology, thermal, mechanical and biocompatible properties as well as shape memory effect of the resultant porous scaffolds are characterized using varied techniques. Fourier transform infrared spectroscopy (FTIR) and gel content analysis confirm the formation of chemical cross-linking in obtained smart polymers which are synthesized by reacting polycaprolactone triol and plant oil with multi-isocyanates. Transmission electron microscopy (TEM) analysis shows that the nHA is 50-100nm in length and 20-30nm in width of grain sizes similar to natural human bone nHA. Compression testing indicates that the obtained polymers have close compression modulus to polycaprolactone which is widely utilized as bone scaffold material, and fully interpenetrating polymeric networks are formed in fully cross-linked polymer networks. Scanning electron microscope (SEM) analysis shows that the nHA is distributed evenly in the scaffold and micro pores are present in gradient from top to bottom of the scaffold, which mimics the non-uniformly distributed porosity in natural bone. Shape memory test results show that the 4D printed nanocomposite scaffolds display finely tunable recovery speed and exhibit greater than 90% shape fixing at -18 or 0 °C and full shape recovery at human body temperature. With polycaprolactone serving as a control, human bone marrow-derived mesenchymal stem cell shows significant higher proliferation and osteogenic differentiation. The current work will advance the future design and development of novel and functional bone healing nanocomposite scaffolds with advanced 4D printing technology and highly biocompatible smart biomaterials.

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SCHOOL OF ENGINEERING AND APPLIED SCIENCE

Formation of transient pores on the blood vessel wall using contrast agents

Ultrasound waves are pressure waves capable of transporting energy into the body as they are absorbed relatively little by tissues. Their non-invasive, safe and painless transmission through the skin makes them to be widely used in drug delivery and gene therapy application. Ultrasound in the presence of microbubbles facilitates the transportation of drugs. Microbubbles are injected to the bloodstream. The injected microbubbles are contrast agents as they were initially developed for enhancing the contrast of the image inside body. Contrast agents consist of a gas core encapsulated with a layer of protein, lipid, and phospholipid to prevent them against dissolution. Microbubbles can carry and transport drugs or genes on or within their encapsulation to the desired site within the body. Ultrasound wave excite the microbubbles to oscillate repeatedly or implode (collapse) resulting in the release of drug/gene into the desired tissue. In addition to the role of microbubbles as drug carrier, it is shown that they can help enhance drug delivery in the presence of ultrasound through a process called sonoporation. Currently this process is very difficult to observe and understand experimentally as it occurs very fast.

Therefore in this research we are studying the process of sonoporation numerically to better understand its mechanism. We are modelling the dynamic behavior of the microbubbles and the dynamic of the surrounding fluid in the presence of ultrasound. The encapsulation changes the rheology of the microbubble, and therefore we are also modelling the effect of encapsulation in our equations. We show that both oscillation and collapse of microbubbles generates shear stress on the vessel wall. The shear stress temporarily ruptures the cell membrane on the vessel wall and therefore increases the pores size on the membrane. This will help the drug and large molecules to easily and efficiently pass through the membrane to reach the unhealthy tissue.

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Evolution of vortical structures in a curved artery model with viscoelastic blood-analog fluid under pulsatile inflow conditions

Investigations of secondary flow morphologies in curved pipes have been of interest for many years. Curvature-related vortical structures that produce secondary flows appear in cross-sectional planes of curved pipes and vessels. Such secondary flow vortical structures which alter energy transport have the potential to affect shear stresses in the flow and near-wall regions, and hence impact hemodynamics, drug delivery, concentration of various blood-borne particles and platelet activation in human vascular system. Moreover, blood is a complex material, composed of plasma, blood-borne particulates e.g. red blood cells (RBCs), leukocytes, and is a non-Newtonian, viscoelastic fluid. Therefore, the investigations of vortical structures associated with non-Newtonian fluid flow in curved pipes are expected to provide realistic insights into pathophysiological cardiovascular flows in curved arteries.

Most of the previous investigations of secondary flow structures were limited to 1) assumption of blood with Newtonian working fluid, 2) steady inflow condition rather than pulsatile flow and 3) cross-sectional planes at specified angles in the curved artery test-section. However, the current study is directed towards capturing secondary flow structures in several cross-sectional planes as well as axial planes in a curved pipe under physiological pulsatile inflow condition, obtained from carotid artery flow rate. A non-Newtonian, viscoelastic working fluid having characteristics similar to blood with 40% hematocrit was prepared and used as a blood-analog fluid. A non-invasive method named Particle Image Velocimetry (PIV) is used to obtain velocity field with high resolution. The results revealed that due to separation of flow from inner wall vortical structures exist along the primary flow direction in the curved artery model between $\sim 5^\circ$ - 40° angular locations. These structures differ the mean flow toward the inner wall and cause a low wall shear stress region followed by high wall shear stress region which can cause or accelerate cardiovascular diseases. These vortices also differ from the Dean-, Lyne- and Wall-type (D-L-W) vortices in secondary flow and seems to be the source of downstream secondary flow vortices (D-L-W) around 40° location.

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DNS of Air Entrainment at Air-Water Interface of a Temporally Developing Boundary Layer

I. INTRODUCTION

The entrainment of air at the free-surface of a turbulent boundary layer remains a poorly understood problem. This flow, typically found at the side of surface vessels, is characterized by highly turbulent bubbly region close to the surface and two-phase mixing. This is different from the wake behind a surface vessel where breaking waves are responsible for air entrainment. On the side of such a vessel a Spatially Developing Boundary Layer (SDBL) forms and interacts with the surface. Interaction of turbulence with the surface against the restoring effects of surface tension and gravity deforms the surface and may result in air entrainment. Understanding the entrainment mechanism is especially important to military applications where the bursting bubbles contribute to the acoustic signature of the vessel. Furthermore, the existing entrainment models are still in their early stages and rely simple models and assumptions.¹ As such, identifying conditions under which entrainment occurs and the details of the process are the main focus of this study. A SDBL can be simulated by a Temporally Developing Boundary Layer (TDBL)—where turbulent boundary layer develops over a moving plate. Different streamwise locations of SDBL correspond to TDBL at different points in time. This is the approach in the present numerical study. Important dimensionless numbers are: 1) Reynolds number ($Re=U l/\nu$)—a measure of inertial forces against viscous forces; 2) Froude number ($Fr=U/\sqrt{gl}$)—a measure of inertial forces against gravity; and 3) Weber number ($We=(\rho U^2 l)/\sigma$)—a measure of inertial forces against surface tension. Here U is the characteristic velocity (belt speed in present study), l is the characteristic length scale (either momentum thickness θ , boundary layer thickness δ or local scales), g is the gravitational constant and ρ , ν , σ are density, kinematic viscosity and surface tension of water. Our intension is to identify the local scales (e.g. velocity and length scales) of entrainment and constitute the relative importance of gravity and surface tension with regards to their restoring effects. Knowledge of these scales and the details of the process will pave the way for improving upon existing entrainment models and conception of new ones.

II. METHODS AND COMPUTATIONAL SETUP

We utilize a conservative solver, where the interface is sharply defined using a level-set formulation. The solver also benefits from Adaptive Mesh Refinement (AMR) which allows us to locally refine the computational grid to achieve better accuracy without heavily increasing computational cost. The solver uses central differencing for discretization in space and two-step Adams-Basforth discretization in time. Fractional step method is used for time marching. We define the Cartesian (XYZ) domain in such way that X is the streamwise direction, the moving plate is located at $Z=0$ and gravity is imposed in (-Y) direction. Initial water level is set to $Y=-0.5$. We use periodic boundary condition in streamwise direction to simulate an infinitely long plate; convective outflow condition for the boundary opposite the moving plate and slip wall for the two remaining boundaries. The domain is made up of about 28 million nodes at its coarsest. Velocity of the moving plate was set to unity.

To achieve a fully turbulent boundary layer, we initialize the flow using a Log-Law mean flow in the streamwise direction and impose the velocity fluctuation field of a Couette flow solution onto it in order to enforce transition to turbulence.

III. RESULTS AND DISCUSSION

Based on preliminary results of Washuta et al. (not published), the boundary layer thickness at the onset of entrainment is very consistent and is around 3 cm. This gives a value of

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$A=(We_g)/(Fr_g^2)=122.6$ which we hypothesis is the critical ratio (c) for entrainment, based on integral scales.

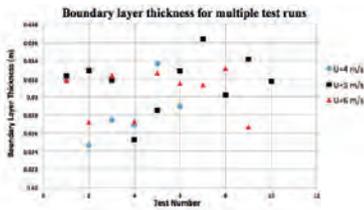


Fig 1. Preliminary experimental results (Courtesy of Washuta et al.–UMD)

Table 1 lists 5 different test cases and their specifications. For cases a-c, Froude number is constant while Weber number is changed. No entrainment took place even though for the latter two cases A was set to four times and eight times the critical value c respectively. For cases d and e, Froude number was not kept constant and we observed that the nature of surfaces disturbances had changed from ripples to larger grooves and waves. We conclude that the flow is mainly gravity driven and surface tension does not have a significant restoring effect.

TABLE I. COMPUTATIONAL TEST CASES

Test Case	Fr_g	A	Surface disturbance
a	1	c	Ripples
b	1	4c	Ripples
c	1	8c	Ripples
d	10	1.6c	Grooves
e	20	c	Grooves

Turning our attention to local scales, we define Weber number based on bubble diameter $We_d=(\rho U^2 d)/\sigma$. To be able to resolve the larger bubbles, grid spacing should be in the order of average diameter. This grid would then be able to resolve bubbles of a few stencil points across. Preliminary results indicate a bubble size range of $1 < d < 10$ mm. Taking the average diameter (d_{ave}) to be 5 mm, we set the Weber number to $We_d=(\rho U^2 \Delta x)/\sigma=(\rho U^2 d_{ave})/\sigma$ and set the Froude number according to the critical ratio. In this case, we observe entrainment. The blue iso-surface represents the interface. To visualize the regions of the flow where rotation dominates shear, we use Q-criterion. The coloring of rotation-dominated regions represents contours of vorticity in the spanwise direction.

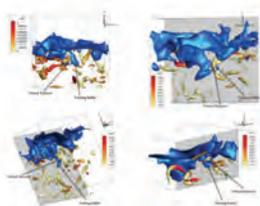


Fig 2. Incidents of bubble formation

It appears that the common trend in bubble generation is formation of a finger-shaped structure. The part of the finger that attaches it to the surface becomes narrower (forming a “neck”) as the solution advances, until the point that it pinches off and

a bubble is released into the viscous fluid. For all instances of entrainment, we observed a highly vortical structure close to the neck prior to pinch-off. Local Froude and Weber numbers associated with these vertical structures are of interest. We divide the vertical structures that sit beneath the surface into two categories. Those that are mostly oriented perpendicular to the surface and ones that are mostly parallel to it. The entrainment mechanism is different for the two types of vortices. Vertical structures induce a solid-body-rotation-like movement and the surface assumes a conically shaped trough. Horizontally oriented structures induce groove-shaped disturbances on the surface. This latter process is similar to studies of Song et al.² In order to establish the local scales we first identify the centerline of the vortex using minimum local pressure. Next we consider planes perpendicular to the centerline at different locations and compute the vorticity vector out of the plane (corrected vorticity). Corrected vorticity is at its maximum at the centerline and fades out as we move outwards. Taking a cut-off of $\omega=0.3$ we consider the radial size of the vortex to be represented by the circle with its center at the centerline and the value for correct vorticity equal to 0.3 at its edge.

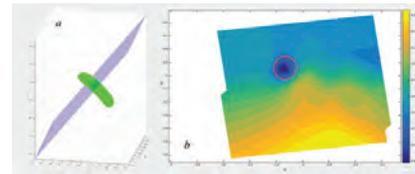


Fig 3. Vortex analysis

The area enclosed by this circle is used to determine circulation. We take an average of circulation and circle radii on different planes to establish local scales. Local Weber and Froude numbers are defined as $We=(\rho r^2)/\sigma R$ and $Fr=r/(\sqrt{gR^3})$. Figure 4 show the Fr-We plot for 5 vortices resulting in entrainment and 5 vortices that only induce disturbances. It is evident that entraining vortices have a local Froude number larger than 25 whereas non-entraining vortices all have Froude numbers lower than this value. We continue to increase our sample size to achieve better statistical accuracy and better our understanding of the local scales.

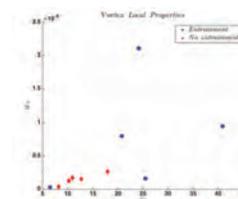


Fig 4. Vortex local properties

IV. REFERENCES

- 1 A. M. Castro, J. Li, M. Hyman, “Turbulent and Cavity Free Surface Bubble Entrainment with Application to Ship Hydrodynamics,” 30th Symposium on Naval Hydrodynamics, Hobart, Tasmania, Australia, 2-7 November 2014.
- 2 M. Song, L. P. Bernal, G. Tryggvason, “Head-on collision of a large vortex ring with a free surface,” *Physics of Fluids A* 4, 1457 (1992); doi: 10.1063/1.858420



SCHOOL OF ENGINEERING AND APPLIED SCIENCE

Three Dimensional Printing of Gradient Scaffolds to Bridge the Gap Between Bone and Cartilage for Osteochondral Defect Repair

I. INTRODUCTION

Osteoarthritis (OA) is a degenerative joint disease with symptomatic joint pain and dysfunction. In 2005, 47.8 million Americans were diagnosed with OA; this number is expected to grow to 67 million by 2030.¹ This condition adversely affects patient quality of life and indirectly impacts economic productivity through reduced contribution to the workforce and increased disability compensation. Pathologically, joint degeneration is caused by gradual loss of cartilaginous tissue at the joint surface. Existing minimally invasive methods of treatment or mitigation of disease progression exist, but in most severe cases, all treatments eventually lead to total joint arthroplasty.

Tissue engineering holds great promise for developing methods of repairing damaged tissue. For joint repair, cells can be harvested from the patient, seeded and grown upon a three dimensional (3D) scaffold in vitro, and transplanted back into the patient after desired cellular differentiation. The challenge with such scaffolds at joint surfaces is the diverse nature of bone and cartilage extracellular composition and mechanical properties, specifically at the osteochondral interface. Therefore, the objective of this study is to create a novel 3D printed osteochondral scaffold with biomimetic gradient architecture for improved osteochondral integration and regeneration.

This research uniquely hypothesizes that a gradient 3D scaffold, where pore distribution varies over the scaffold thickness, will have the ability to meet the needs of the bone and cartilage regions, as well as, the osteochondral interface. Successful gradient differentiation of human bone marrow mesenchymal stem cells (MSCs) over the thickness of the scaffold would indicate an ability of this implant to promote osteochondral repair in vivo. Analysis of mechanical properties will highlight contribution of pore distribution to scaffold strength and elasticity.

II. EXPERIMENTAL METHODS AND RESULTS

A Fused Deposition Modeling based 3D printer was used to fabricate a series of High Impact Polystyrene (HIPS) scaffold molds. Total samples included two models with isotropic pore distribution and two with anisotropic distribution, Figure 1. A poly(ethylene glycol):poly(ethylene glycol)-diacrylate (PEG/PEG-DA) hydrogel solution was filled into each mold and cured under ultraviolet light until firm. For differentiation studies a 60 wt% quantity of nanohydroxyapatite was integrated into scaffolds to help encourage osteogenesis. Heated sonication in Dilimonene assisted in leeching the HIPS out of the hydrogel leaving a porous, channeled scaffold of PEG/PEG-DA.

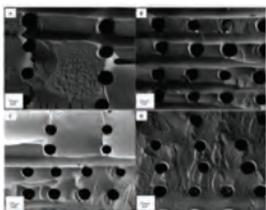


Figure 1. Scanning Electron Microscope (SEM) images of 3D printed scaffolds. Images highlight differences in pore distribution and uniformity. (A) Homogeneous low pore density; (B) Homogeneous high pore density; (C) Biphasic; (D) Triphasic.

MSC adhesion and proliferation was executed by seeding MSCs into scaffolds, culturing for specified time intervals, and evaluating results using a spectrophotometer. Differentiation was executed by seeding MSCs in a similar manner over time periods of one, two, and three weeks. After each time interval, cells were lysed and digested by freezing and lyophilizing

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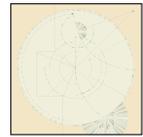
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scaffolds, then placing in a papain solution for 20 hours at 60 °C before evaluation.

Mechanical testing results illustrate a greater peak stress for triphasic samples and improved elasticity for samples with low pore density, as illustrated in Figure 2. Amongst sample groups with similar pore density, (biphasic, triphasic, and homogeneous high density) the triphasic sample maintained the greatest Young's modulus and peak stress.

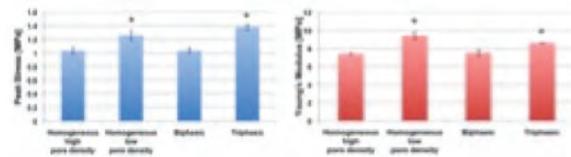


Figure 2. Mechanical testing on PEG/PEG-DA scaffold; data are average \pm StdEM, n=5; * p <0.05 when compared to all other samples.

Stem cell performance improved amongst the biphasic and triphasic samples with the biphasic sample significantly outperforming all other samples. Biphasic and triphasic scaffolds were further evaluated for hMSC proliferation over 1, 3, and 5 days. Both scaffolds significantly outperformed the control after 5 days, Figure 3. The increase in cell number supports the ability of cells to grow upon and within the porous, multiphase PEG scaffold. Cell viability and attachment was further assessed using confocal microscopy. Figure 4 illustrates good cell attachment, spreading and growth over 1, 3, and 5 day culture.

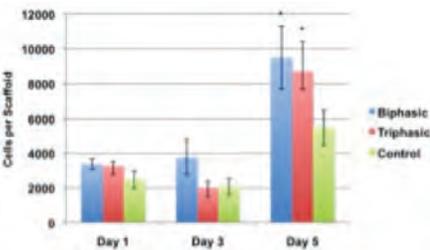


Figure 3. Cell proliferation on PEG/PEG-DA scaffold; data are average \pm StdEM, n=9; * p <0.05 when compared to all other samples. Figure 4. Cell proliferation, illustrating biocompatibility, on PEG/PEG-DA scaffolds; day 1 (left), day 3 (center), and day 5 (right).



Figure 4. Cell proliferation, illustrating biocompatibility, on PEG/PEG-DA scaffolds; day 1 (left), day 3 (center), and day 5 (right).

Seeded scaffolds were evaluated for GAG, total collagen, extracellular calcium, and collagen type I and type II synthesis after 1, 2, and 3 weeks of culture. GAG is an important early-stage marker for hMSC chondrogenic differentiation, Figure 5. Total

Collagen synthesis, illustrated in Figure 5, is a late-stage marker of extracellular matrix formation, and also serves as an indicator of scaffold viability. Extracellular calcium, on the other hand, is an important marker for late-stage osteogenic differentiation. For extracellular calcium evaluation the contribution of calcium due to incorporated nHA was accounted for and all data was normalized to remove these effects, Figure 5. Lastly, types I and II collagen were analyzed for additional osteogenic and chondrogenic feedback. Type I collagen, Figure 5, is one of the critical extracellular matrix proteins found in subchondral bone.

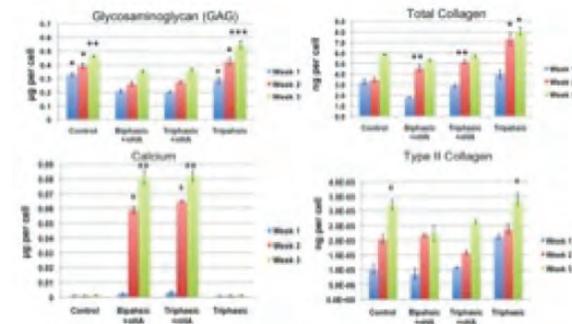


Figure 5. All data are average \pm StdEM, n=5. For GAG data * and ** p <0.05 when compared to other samples for week 2 and 3 respectively; * p <0.05 when compared to all other samples. Total collagen data * p <0.05 when compared to all other samples and ** p <0.05 when compared to the control. Calcium data * and ** p <0.05 when compared to other samples for week 2 and 3 respectively. Type II collagen data * p <0.05 when compared to all other samples.**

III. CONCLUSIONS

The results presented here illustrate improved biological and mechanical performance on porous 3D printed scaffolds with anisotropic pore distribution when compared to homogeneous/isotropic and non-porous scaffolds. Novel aspects of the current study include a more in-depth evaluation of pore distribution as a method of improving mechanical performance and inclusion of osteogenic growth factors within a hydrogel to encourage hMSC function. In addition, the use of chondrogenic media in an effort to produce a 3D bioactive scaffold for osteochondral tissue repair and regeneration was evaluated. Controlled manipulation of the FDM 3D bioprinter and investment casting processes facilitate a broad range of physical, mechanical, and chemical property manipulation which can be harnessed and implemented for enhanced scaffold performance towards a myriad of applications.

IV. ACKNOWLEDGEMENT

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V. REFERENCES

- Buckwalter, J.A. and J.A. Martin, *Osteoarthritis*. Adv Drug Deliv Rev, 2006. **58**(2): p. 150-67.

ENGINEERING



SCHOOL OF ENGINEERING AND APPLIED SCIENCE

Synthesis and Characterization of Copper and Silver Nanoparticle Inks for Printed Devices

Copper nanoparticles have recently gathered significant attention because of their unique properties and potential applications in industry. One such application is in conductive inks for printed electronics. Here, copper nanoparticles are synthesized and dispersed into an organic carrier liquid to form an inkjet ink. The fluid characteristics and microstructure of nanoparticles are then compared with a commercially available silver nanoparticle ink. Although critical fluid properties are adjusted into an optimum range, the homemade ink was not suitable for printing due to excessive nozzle plate wetting whereas the commercial ink prints relatively easily.

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Seismic Analysis of a Nuclear Fuel Assembly: Experimental and Numerical Simulations

Catastrophic failure of Fukushima nuclear power plant due to the Tohoku Earthquake and Tsunami in 2011 and the subsequent release of substantial amounts of radioactive materials led to global re-evaluation of the design methodologies and operation of nuclear power plants. Development of validated analysis methods that can be used to predict the seismic response of nuclear power plants is an important step toward preventing future catastrophic events. A key objective of this research is to design a representative scaled model of nuclear fuel assemblies that can be used to generate a set of high fidelity experimental data for validation of current and future designs of earthquake resistant nuclear power plants.

For this purpose, a scaled nuclear fuel assembly along with its support structure has been designed and analyzed under seismic loading conditions at the Earthquake Engineering and Structures Laboratory at VSTC, and a large number of seismic experiments have been performed on the experimental model. The experimental design was assisted by a series of three-dimensional finite element analyses that considered various details of the complex structural system.

All analytical results including predominant period, maximum displacements, and maximum accelerations of the system were compared to the responses obtained from the experiments. Comparison of analytical and experimental results has shown that the analytical model is able to capture the essential features of the response of power plant to seismic loading. In the poster, the comparisons of experimental results with results of a series of finite element simulations will be presented.

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Leveraging Knowledge and Learning to Help Engineer a Common Explanation of KM Using a Re-architecture Approach

PROBLEM STATEMENT:

For two decades, knowledge management (KM) academics and practitioners have written about the need for a common KM generalization.

OVERARCHING GOAL:

Discover a common explanation of KM.

APPROACH:

A mix of iteratively applied system engineering requirements identification and requirements definition, inference, theoretical sampling, requirement architecting, and theoretical saturation were used to identify, document, analyze, and organize concepts on knowledge, learning, KM competencies, and KM.

SOLUTION:

KM simply stated is accumulating and organizing knowledge (kennacy). Use and reasoning about knowledge (cognitacy) is also necessary, as is skill with representing, storing and communicating knowledge (mediumacy).

ORIGINALITY:

Six significant concepts were identified and are being explained: 1) Knowledge concept map. 2) Integrated organizational learning models perspective. 3) Eight ways to learn. 4) Educational competency guidelines. 5) The Unified Theory of Knowledge Management. 6) (KM) Practice management concept.

VALUE:

The research can result in improving primary and secondary education to better support the needs of the knowledge society. It adds a new way of thinking about KM: rife with mediums that represent, store, and communicate knowledge.

The knowledge concept map blends epistemological and practical views of knowledge. The integrated organizational models perspective presents a three level view of organizational learning techniques and approaches often merely categorized as learning at the organizational level; it also identifies eight ways organizations can learn at all three levels: individual, group, and organizational. Besides generalizing KM at the simplest level, the Unified Theory KM extends the idea of KM education and training needs before the graduate level. The theory leads the way to identifying practice management concept needs to help clarify KM uniqueness and perhaps widely improve discipline practice management by enabling a more complete view of the discipline's focus, knowledge artifacts, and purpose.

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CAPITAL Words: Algorithmic Generation of Reading and Spelling Exercises for Low-Literacy Users

According to the American Library Association, 14% of adults in the United States cannot “search, comprehend, and use continuous texts”. There is a significant opportunity for the development of technology to help improve literacy rates.

The goal of the CAPITAL project is to make high-quality learning resources accessible to users of all literacy levels. The project aims to automatically create exercises that will help users improve their reading skills.

CAPITAL Words is a mobile application designed to deliver and evaluate responses to exercises aimed at improving a novice reader’s phonemic awareness. Three types of exercises can be automatically generated:

Phoneme Swap is an exercise that takes a word and generates answer choices based on real words that differ from the base word by one phoneme. The student must either choose a correct spelling from a spoken word or choose a correct pronunciation for a word they read. For both exercises, two types of questions are generated—vowel and consonant questions. Vowel questions find all single-syllable words that differ only by the vowel phoneme. Consonant exercises swap commonly-confused letters [e.g., b/d/p, m/n, t/d].

Pick the Misspelling presents students with four words and their pronunciations. Students must hear each pronunciation and decide which word is misspelled. In order to ensure the questions were challenging, we developed an intelligent system of misspelling words.

Spell the Word is an exercise that shows students a word with one of its syllables replaced by blanks. Students hear the word spoken and must select letters from a given pool to spell the missing syllable correctly. When creating a question, we intelligently select a syllable to remove. We then choose appropriate distractor letters, considering possible homophones.

Truly effective algorithms would generate questions indistinguishable from human-created questions, which poses the question: Can people tell the difference between human-made and algorithm-generated exercises? In order to test this, a survey was sent out to sixteen participants asking them to decide if a computer or a human had generated the given question.

Results strongly suggest that our algorithms generate questions that are comparable to human-generated exercises. On average, participants did worse than chance in guessing if a human or the algorithm generated the question—43% accuracy for misspelled words and 36% for spell the word. This indicates that people were unable to clearly differentiate between the computer-generated exercises and those created by humans.

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Particle Size Distribution of Silicon Powder for Selective Laser Melting

Selective laser melting has not yet been widely used with powders made from semiconductor materials. In order to change this, the semiconductor powders must be shown to work in the process. This research addressed the effect of ball milling time on particle size distribution of boron-doped silicon powder. It was hypothesized that a longer ball milling time would cause the particles of the powder to become smaller and rounder due to increased collisions between the particles and the metal balls inside the ball mill.

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LENR Experiments Based on Co-Deposition of Palladium and Deuterium

Lattice Enabled (or Low Energy) Nuclear Reactions (LENR), which release MeV energies, can be triggered by chemical energies on the scale of eV. This has been shown in many experiments during the last quarter century. The experiments gave strong evidence of the occurrence of nuclear reactions under chemical conditions. Energy gains (thermal energy out divided by the input electrical energy) exceeding one thousand are possible. Gains as high as 800 have been reported, but not verified. There is solid evidence for gains up to 70.

The mechanisms that enable chemical triggering of nuclear reactions are not understood. Dozens of theories have been put forward, but none of them are adequately tested or widely accepted. We have set up a laboratory to do scientific experiments aimed at producing data to understand LENR mechanisms.

We are performing two types of experiments that have been shown to produce LENR: (a) loading Pd foils with deuterons (D) electrochemically, and (b) simultaneously electrodepositing Pd and D. This paper reports on the conduct and results of the second kind of experiment, commonly called co-deposition of Pd and D. Several chemistries and protocols have been employed to co-deposit Pd and D. We are employing the approach of Letts and Hagelstein, who modified an earlier method [1].

We can perform five types of spectroscopy during foil-loading and co-deposition experiments. Impedance Spectroscopy is used to determine the complex impedance of the electrochemical cells from frequencies near 1 Hz to 7 MHz. Optical reflectance spectroscopy in the 220 to 1100 nm range probes the energetics at the interface between the electrolyte and cathode in the cells. Acoustic Spectroscopy from 10 Hz to 10 kHz is employed to detect bursts of sound emitted by LENR. Radio-frequency spectroscopy from below 1 kHz to above 1 GHz is being used because a few experiments have shown correlations between RF emission and LENR. Finally, we will use a noise spectroscopy system good from 1 Hz to 100 kHz developed at GWU to look for signals accompanying the occurrence of LENR.

This paper will report on the status of our co-deposition experiments and the initial results obtained from them.

REFERENCES:

- [1] D. Letts and P. L. Hagelstein, "Modified Szpak Protocol for Excess Heat", *J. Condensed Matter Nuclear Science*, vol. 6, pp. 44-54 (2012)

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Electrospun Polyacrylonitrile (PAN) Nanofiber Supported Pd Catalysts for Contaminant Hydrogenation

Pd-based catalytic hydrogenation has emerged as a promising and sustainable technology for the removal of waterborne contaminants. Catalyst supports are indispensable because they prevent Pd nanoparticle aggregation and enhance catalyst recovery after use. Electrospun nanofibers act as a great catalyst support due to their large surface area, highly porous structure, and tunable physicochemical properties. Our previous study used a one-pot synthesis and fabricated Pd onelectrospun nanofiber catalysts with uniform Pd distribution, however the majority of Pd nanoparticles were embedded in the nanofibers and resulted in a low activity. The objective of this study is to tailor the properties of electrospun PAN nanofibers as the Pd catalyst support and load Pd nanoparticles exclusively on nanofiber surface via incipient wetness to improve catalytic activity for waterborne contaminant removal (e.g., nitrite, bromate, N-nitrosodimethylamine). Hydrolysis of electrospun PAN nanofibers by NaOH creates hydrophilic groups (e.g., carboxylic and hydroxyl groups) and the addition of MWCNTs treated by concentrated nitric acid (a-MWCNTs) into PAN nanofibers also introduces hydrophilic groups. Both strategies are expected to improve Pd²⁺ chelation, reduce Pd nanoparticle size, and improve catalytic activity. Our preliminary results showed that Pd on PAN/a-MWCNTs increased nitrite reduction kinetics up to 6.2 folds compared to its counterpart without a-MWCNT addition. The nanofiber diameter and porosity, surface functional groups, and Pd nanoparticle size will be evaluated.

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Fast Algorithm to Calculate Signed-distances between Convex Polyhedra

The field of robotics has expanded greatly over the last decade. Robots are used in a variety of areas, such as manufacturing products in assembly lines and exploring resources in the deep sea; however, most development and testing is done using real robots. This situation causes two major problems, the high costs of purchasing and maintaining a robot for programming development, and the lack of ability to do massive tests efficiently. To address these problems, people use physics simulations to test their code by simulating how robots will behave when running the code; however, current state of art software can only simulate contacts between rigid bodies that are represented by primitive shapes (boxes, prism, sphere, etc.). The main reason for this limitation is the difficulty of finding the signed distance between two complex geometries. The objective of this study is to figure out one computational efficient way to compute the signed distance between two complex geometries.

In physics simulation, the signed distance between two geometries are computed every step. For most of the cases, people use polyhedra to represent complex geometries. Computing the signed distance can be done quickly when the two polyhedra are separated, but it becomes difficult and time consuming when the two polyhedra are penetrating each other. Even considering only convex polyhedra, Minkowski-difference based algorithm still has time complexity of $O(mn)$ where m and n are the number of features (faces, edge and vertex) in each polyhedra. This implies the running time of the algorithm has a quadratic growth as the number of features of the two polyhedron increases. This is considered to be too slow for simulations, because the algorithm is going to take too long to run when the polyhedra are complex.

The study presents a faster algorithm for calculating the signed distance between two convex polyhedra with time complexity $O(m\log(m)+n\log(n))$ which means the running time growth with respect to the feature number is only linear. The study evaluates the performance of this algorithm by comparing running time of this algorithm calculating the signed distance between polyhedra with different complexity to that of the Minkowski-difference based algorithm. This algorithm allows contact simulations to be done with polyhedra, which can simulate more complex shapes than primitive ones and provides more accurate contact data than triangle meshes representation does; therefore, it allows people to perform much more complex task in a physics simulation.

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Achieving Sustainable Water Purification: Visible Light Responsive Graphitic Carbon Nitride for the Removal of Persistent Contaminants

Solar-energy-enabled photocatalysis is a sustainable technology to destruct persistent environmental pollutants. Graphitic carbon nitride ($g\text{-C}_3\text{N}_4$) has emerged as a novel polymeric photocatalyst because of its response to visible light and utilization of more renewable solar energy, facile synthesis from earth abundant materials, great thermal and chemical stability, and little to none-existent toxicity; however its application in environmental remediation is largely underexplored. Here, we developed supramolecule-based $g\text{-C}_3\text{N}_4$ from melamine, cyanuric acid, and barbituric acid with significantly improved surfaced area and charge separation compared to bulk $g\text{-C}_3\text{N}_4$ only from melamine. The photocatalytic reactivity was then evaluated in batch suspensions under visible light irradiation for the removal of a model contaminant (i.e., phenol) and emerging persistent contaminants (i.e., atrazine, carbamazepine, and sulfamethoxazole) across a variety of water qualities. The optimized $g\text{-C}_3\text{N}_4$ showed a reaction rate constant of 0.02 min^{-1} for phenol degradation in a model buffer system under Xenon lamp irradiation ($> 400\text{nm}$), which is 5.7 times higher than that of bulk $g\text{-C}_3\text{N}_4$ under the same experimental condition. Similarly, reactivity enhancement was also observed for the degradation of emerging pollutants. The chemistries of simulated natural water and partially treated water/wastewater had little to no inhibition on atrazine degradation kinetics compared to the model buffer system. Moreover, we performed atrazine degradation on $g\text{-C}_3\text{N}_4$ under light emitting diode (LED) irradiation to evaluate the feasibility of using artificial light sources for photocatalytic water treatment, and a comparable photocatalytic activity was achieved under LED irradiation and Xenon lamp irradiation ($> 400 \text{ nm}$). The increase of photocatalytic activity under irradiation at a shorter wavelength is in agreement with the optical absorption spectrum of $g\text{-C}_3\text{N}_4$. In summary, visible-light-responsive $g\text{-C}_3\text{N}_4$ holds great promise for the removal of waterborne persistent contaminants and the utilization of renewable solar energy, and its application will promote sustainable water treatment.

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Effects of three-times daily diet soda consumption for one week on the composition of the gut microbiome in healthy young adults

Epidemiologic studies report associations between artificial sweetener (ASW) consumption and metabolic abnormalities, yet well-designed human intervention studies in humans are limited. Given that ASW contain no or few calories, one potential mechanism through which ASW may influence metabolic risk is through altering the gut microbiota. As alterations in the gut microbiota are known to be implicated in the development of metabolic disease, the purpose of this study was to investigate the effects of one week of three times daily diet soda (with ASW) consumption on the gut microbiota in healthy college students. We hypothesized that participants randomized to consume diet soda would have lower microbial diversity following consumption of diet soda, while microbial composition in the control group would be similar before and after the intervention. Healthy adults (n=22) were asked to provide a stool sample at three study visits, each one week apart. After the first visit, participants were instructed to avoid all ASW-containing substances for seven days (week 0). A second fecal sample was then collected (day 7), and a third was collected after one week of three times daily diet soda or carbonated water consumption (day 14) to evaluate changes in gut microbiota. DNA and RNA were extracted and samples were run on a single lane of an Illumina HiSeq. Metagenomics was performed using PathoScope™ and CensuScope™ and compared against a knowledgebase of normal gut microbiome data. Changes in read counts over the three time points were then compared between the two study groups. Twenty participants underwent randomization (n=11 diet soda, n=9 carbonated water), eighteen of whom completed the two-week study. While data analysis is ongoing, our preliminary data (n=2) suggest that ASW may in fact reduce microbial diversity. We observed a relative increase in species within the Bacteroidetes phylum and relative decreases in other phyla analyzed (Actinobacteria, Verrucomicrobia, Proteobacteria, and Firmicutes) following diet soda exposure (n=1), but not following the carbonated water control (n=1). These preliminary data support our hypothesis that repeated ASW exposure may reduce the diversity of the gut microbiota and are consistent with findings of Suez et al., who also reported an increase in Bacteroidetes following saccharin exposure. However, a larger sample size and additional analyses are needed to confirm these findings. If ASW are found to adversely influence microbial diversity, this may have clinically relevant effects on metabolism, body weight, and health, which requires further study in humans.

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The Effect of Knocking Down the Gene *Choline Acetyltransferase* on Sperm Length in *Drosophila melanogaster*

Drosophila fruit flies offer a model system in which to study the genetics and evolution of complex traits because of their rapid generation time and extensive genetic resources. Sperm morphology in particular exhibits the widest range of variation within a lineage; with average sperm lengths per species ranging from 0.32 mm to 5.8 cm. Research in our lab has previously identified over 300 candidate genes that may influence sperm length in *Drosophila melanogaster*. The objective of this project was to study whether disrupting the function of one of these genes, *choline acetyltransferase*, had any effects on the sperm length of male flies. The *choline acetyltransferase* gene was knocked down in the testes using the GAL4-UAS RNAi knockdown system, which blocks the translation of the mRNA transcripts that code for the *choline acetyltransferase* protein. Sperm were then dissected from testes, stained, and measured using the ImageJ software. Control groups that did not experience the knock down gene were also used in order to compare with the experimental results. When all data were collected, they were analyzed using ANOVA in R.

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Characteristics of Intonation Patterns Produced by Pre-lingually Deafened Children with Cochlear Implants

Cochlear implants (CIs), although effective in restoring auditory sensation for deaf individuals, are lacking in fundamental frequency (F0 or pitch) and temporal fine structure information. Consequently, many aspects of speech *perception* are significantly compromised. It is reasonable then to suspect that with limited access to F0 and fine temporal structure of speech, the ability to *produce* intonation patterns by children with cochlear implants (CWCI) would be affected as well. Therefore, perceptual and acoustic analyses were conducted in order to examine production of intonation patterns by CWCI to signal question and statement contrasts. Seventeen children with cochlear implants participated in the study, ranging in age from 3;1 to 7;5 years. Statements and questions were elicited and digitally recorded during a role-play session with hand puppets. The elicitations were segmented, then randomly presented to a group of 10 normal hearing listeners who rated the intonation pattern of each utterance as ranging from falling to rising using a visual analog scale displayed on a computer screen. These represented the perceptual data and analysis. For the acoustic analysis, the final words of each utterance were segmented into syllables, and the beginning and end of each vocalic nucleus (defined as vowels plus sonorant consonants) was marked by examining both the waveform and spectrogram using Praat software Version 5.3.51 (Boersma and Weenink, 2013). Pitch measures (mean f0, min f0, max f0) of the segmented vocalic nuclei were extracted. The results from the listener judgments task revealed that CWCI could distinctively produce rising and falling intonation contrasts to signal a question or a statement. Preliminary acoustic analyses suggest a systematic relationship between intonation percepts and pitch changes between the final and penultimate syllables. Future directions and clinical implications for evaluation and intervention of prosody will be discussed.

REFERENCES

- Allen, G.D., & Arndorfer, P.M. (2000). Production of sentence-final intonation contours by hearing-impaired children. *Journal of Speech, Language, and Hearing Research*, 43, 441-455.
- Boersma, P., & Weenink, D. (2013). Praat: doing phonetics by computer [Computer program]. Version 5.3.51, retrieved 21 February 2013 from <http://www.praat.org/>.
- Chang, J.E., Bai, J.Y., & Zeng, F.G. (2006). Unintelligible low-frequency sound enhances simulated cochlear-implant speech recognition in noise. *IEEE Transactions on Biomedical Engineering*, 53, 2598-2601.
- Cullington, H.E., & Zeng, F.G. (2011). Comparison of bimodal and bilateral cochlear implant users on speech recognition with competing talker, music perception, affective prosody discrimination, and talker identification. *Ear and Hearing*, 32, 16-30.
- Fu, Q.J., Chinchilla, S., Nogaki, G., & Galvin, J.J. (2005). Voice gender identification by cochlear implant users: The role of spectral and temporal resolution. *Journal of the Acoustical Society of America*, 118, 1711-1718.
- Geurts, L., & Wouters, J. (2001). Coding of the fundamental frequency in continuous interleaved sampling processors for cochlear implants. *Journal of the Acoustical Society of America*, 109, 713-726.
- Nakata, T., Trehub, S.E., & Kanda, Y. (2012). Effect of cochlear implants on children's perception and production of speech prosody. *Journal of the Acoustical Society of America*, 131, 1307-1314.
- Patel, R., & Grigos, M.I. (2006). Acoustic characterization of the question-statement contrast in 4, 7 and 11 year-old children. *Speech Communication*, 48, 1308-1318.
- Peng, S.C., Tomblin, J.B., Cheung, H., Lin, Y.S., & Wang, L.S. (2004). Perception and production of mandarin tones in prelingually deaf children with cochlear implants. *Ear and Hearing*, 25, 251-264.
- Peng, S.C., Tomblin, J.B., Spencer, L.J., & Hurtig, R.R. (2007). Imitative production of rising speech intonation in pediatric cochlear implant recipients. *Journal of Speech, Language, and Hearing Research*, 50, 1210-1227.
- Peng, S.C., Tomblin, J.B., & Turner, C.W. (2008). Production and perception of speech intonation in pediatric cochlear implant recipients and individuals with normal hearing. *Ear and Hearing*, 29, 336-51.

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Characterizing the Gut Microbiota in Healthy Young Adults

OBJECTIVE/BACKGROUND:

Trillions of micro-organisms reside in the gastrointestinal tract, and play a critical role in the host's physiology. Recent evidence has demonstrated that these micro-organisms, referred to collectively as the gut microbiota, are intricately involved in the development of obesity, diabetes and other metabolic diseases. Factors including route of delivery (i.e. vaginal birth vs Caesarean), infant feeding practices (i.e. breastfeeding vs formula feeding), diet (e.g. vegetarian vs. low-fat, high fiber diet vs. Western diet), physical activity, medication use, and smoking influence the gut microbiota and contribute marked variability in microbial composition between individuals, yet little is known about what constitutes a "healthy" gut microbiome. Given the emerging importance of the gut microbiota in human health and disease, the objective of this study is to evaluate the associations between lifestyle factors, metabolic biomarkers, and gut microbiome composition, in order to determine whether one or more patterns of "healthy microbiome composition" exists. In addition, we aim to evaluate the intra-individual reproducibility of gut microbiome composition.

METHODS:

Young adults (18-35 years of age) participate in a study visit where they are instructed to collect a stool and urine sample, and complete a detailed diet history questionnaire, a validated physical activity questionnaire, a lifestyle habits questionnaire, a validated perceived stress questionnaire and validated sleep index. During the visit, participants also undergo anthropometric measurements including height, weight, and waist circumference, and provide a fasting blood sample to evaluate metabolic markers including blood glucose levels, lipid profiles, and inflammatory cytokines. Participants are then asked to record their diet, physical activity, and sleep patterns and are also asked to provide two additional stool samples, over a period of seven days following their study visit.

RESULTS:

Data collection is currently in progress. To date, we have screened 65 volunteers and have enrolled 11 participants (9 male, 2 female, mean age 22.09).

CONCLUSIONS:

In investigating the reproducibility of repeated measures of microbial composition and in determining what constitutes a 'healthy' microbiome, our study will provide important data, which will advance the human microbiome field. Findings of this study will enable us to develop rigorously-designed future studies aimed at elucidating the role of the human gut-microbiota in the prevention and treatment of metabolic disease.

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Genome Editing in Human Cancer Using CRISPR/Cas9 Technology

CBX (chromobox) proteins are sub-units of a large nuclear complex called Polycomb Repressive Complex 1 (PRC1). The CBX proteins are “readers” that bind specific epigenetic modifications and recruit additional proteins to interpret the genome.¹ CBX proteins are highly expressed during development and in stem cells. This complex is known to silence genes and is frequently deregulated in cancer.² CBX8 is overexpressed in pancreatic and breast cancers. Therefore, we generated genetically modified cell lines that harbor knockdown of CBX8 to address its role in those cancers.

This project utilized a new technology called CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats) to edit the genome by exploiting the Cas9 enzyme, originally derived from *Streptococcus pyogenes*. To target the gene of interest, it is necessary to design a short guide RNA (sgRNA) that specifically targets a sequence within that gene.³ This sgRNA is cloned into a plasmid DNA vector that contains the Cas9 enzyme to create a Cas9-sgRNA complex; the enzyme cleaves double stranded genomic DNA recognized by the sgRNA. The process causes a frame-shift resulting in a premature stop codon, or a nonsense transcript that will become targeted for degradation.³ We created multiple sgRNAs to target CBX8 and validated the efficiency on the protein level through Western blotting. Currently, we are performing experiments using breast and pancreatic cancer cell lines to test the effects of CBX8 knockdown on cell proliferation and RNA expression.

REFERENCES

- 1 Richly H, Aloia L, Di Croce L. Roles of the Polycomb group proteins in stem cells and cancer. *Cell Death & Disease*. 2011;2(9):e204-. doi:10.1038/cddis.2011.84.
- 2 Tzatsos A, Paskaleva P, Ferrari F, et al. KDM2B promotes pancreatic cancer via Polycomb-dependent and -independent transcriptional programs. *The Journal of Clinical Investigation*. 2013;123(2):727-739. doi:10.1172/JCI64535.
- 3 Ran FA, Hsu PD, Wright J, Agarwala V, Scott DA, Zhang F. Genome engineering using the CRISPR-Cas9 system. *Nature protocols*. 2013;8(11):2281-2308. doi:10.1038/nprot.2013.143.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Elucidating the mechanism of human amylin trafficking in the pancreatic β cells

Type 2 Diabetes Mellitus (T2DM) is a complex metabolic disorder characterized by progressive loss of pancreatic β -cells secretory functions, β -cells death, peripheral insulin resistance and resulting hyperglycemia. Studies showed that, β -cell derived toxic aggregates of pancreatic hormone amylin contribute significantly towards the development of T2DM. The human amylin (hA) is a 37 amino acid hormone, which shares similar biosynthesis mechanism like insulin and is co-secreted with insulin by the pancreatic β -cells upon glucose stimulation. However, the cellular processes that regulate hA mediated cytotoxicity is far from clear. It is known that during T2DM, impaired folding, dysregulated ER to Golgi traffic or increased ER exit of proinsulin contribute to the development of insulin deficiency. It has also been suggested that similar to proinsulin, dysregulated processing and trafficking of pro-amylin contributes significantly towards the β cell failure during T2DM. However, detailed cellular trafficking mechanism of hA is unknown and hence investigated in the current study. In order to achieve the goal, I used lenti virus mediated gene delivery approach and validated hA and rat amylin (rA) overexpression in two rat pancreatic β -cells lines (*RIN-m5f* and *INS 832/13*) as well as in human islet cells. In order to identify the cellular compartments involved in hA trafficking and turnover cytosolic, membrane/organelle and nuclear/cytoskeletal fractions were prepared from the pancreatic β -cells following overexpression of hA and rA. WB analyses revealed the accumulation of hA in cytosol and organelle-enriched (Golgi/ER) fraction of RIN, INS and human islets cells. Interestingly, hA was also frequently found in the nuclear/cytoskeletal fraction of the RIN and human islet cells but not in the INS cells. Co-localization studies using immunofluorescence confocal microscopy confirmed significant accumulation of hA in Golgi, as well as nuclear accumulation of hA in RIN and human islet cells. Accumulation of hA in Golgi region rather than ER resembles trafficking pattern of proinsulin and possibly indicates the rate limiting role of Golgi during hA trafficking. Nuclear accumulation of hA mirrors trafficking pattern of other amyloid proteins and implies possible role/s of nucleus in turnover of hA in pancreatic β cells. This study, as well as future studies focused on determining the hA trafficking under normal and hyperglycemic condition, will help us to understand the strategies by which β -cells distribute and/sequester hA to prevent its toxicity, and if and how this protective mechanism may be altered and/or impaired under stress conditions like diabetes. This knowledge is important for development of new treatments against hA toxicity and T2DM.

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Transgender Male Voice During the First Year of Testosterone

BACKGROUND:

While it is widely accepted that voice pitch will deepen for transgender men undergoing testosterone therapy, there is sparse prospective data on the effects of testosterone therapy on the voices of transgender men (females to males). Due to this paucity of knowledge, providers are unable to advise patients of the expected timing and extent of voice changes. This study investigated voice pitch, as measured objectively by fundamental frequency, in three-month intervals during the first year of testosterone therapy.

METHOD:

An ethnically diverse sample of seven transgender men naïve to testosterone therapy received two voice assessments at baseline and one assessment at 3, 6, 9 and 12 months while on intramuscular testosterone esters. A control group of two transgender women received the same voice assessments while on estradiol and spironolactone. None of the participants received voice therapy during the study.

RESULTS:

All seven transgender men experienced a significant decrease in mean fundamental frequency (MF0). All were within natal male MF0 range within 6 months of testosterone therapy and four continued to decrease MF0 after 6 months. The mean decrease in MF0 after 12 months of testosterone therapy was 7 semitones (49 Hz). For the six of seven participants demonstrating change, longitudinal voice data exhibited three patterns: MF0 change over 0-6 months only, MF0 change over 3-9 months only, and relatively slighter MF0 change over 0-12 months. The 0-3 month period was most heterogeneous with some participants showing no drop in pitch and others showing their greatest decline in pitch.

CONCLUSION:

Clinicians should advise transgender men that the majority of pitch lowering will occur within 6-9 months of starting testosterone therapy and that they may or may not experience pitch lowering within the first 3 months.

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Effects of diet soda consumption three-times daily for one week on diet composition in healthy young adults

OBJECTIVE/BACKGROUND

Non-nutritive sweeteners (NNS) are commonly used to sweeten foods and beverages without significantly contributing to calorie intake. However, epidemiological studies report associations between NNS consumption and obesity. Furthermore, rodent studies show that NNS may interfere with appetite regulation and weight gain, but it is unclear whether this applies to humans. Therefore, the objective of this study was to investigate the effects of repeated NNS exposure on calorie, total carbohydrate, and sugar intake in healthy individuals who do not habitually consume NNS. We hypothesized that calorie, total carbohydrate, and sugar intake would be higher among participants randomized to consume diet soda three times daily for one week than among those randomized to the carbonated water control group.

METHODS

Seventeen participants completed the two-week study. During the one-week run-in period (no intervention) and the one-week intervention period (randomized to consume diet soda with NNS or carbonated water, three times daily), participants self-reported their dietary intake using 7-day food diaries. Nutrient composition was obtained using the USDA SuperTracker or through the manufacturers' published nutrition facts, when available. Descriptive statistics were calculated for calorie, total carbohydrate, fiber, and sugar intake. Paired and unpaired t-tests were used to examine differences within subjects and across groups, respectively.

RESULTS

No differences in within-subject changes in calorie, total carbohydrate, or sugar intake were observed between the diet soda and carbonated water groups. Though the calories consumed and sugar intake were similar during the run-in and intervention periods in the diet soda group (n=10), we observed a non-statistically significant decrease in total carbohydrate intake (-22.4±43.2 g; p=0.14) and a statistically significant decrease in fiber intake (-2.7±3.5; p=0.03) in those randomized to diet soda. In contrast, calorie, total carbohydrate, sugar, and fiber intake were similar during the run-in and intervention periods in the control group (n=7).

CONCLUSIONS

Contrary to our hypothesis, there were no significant differences in calorie, total carbohydrate, or sugar intake among participants randomized to consume diet soda when compared to the carbonated water control. We did, however, observe a significant decrease in fiber intake in the diet soda group, a finding which requires further investigation. Additional larger and longer-term studies are required to substantiate our findings and to advance the understanding of whether NNS do in fact influence appetite and dietary intake, as has been suggested in rodent models.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

LabNIRS: A Spectroscopic Window to the Brain

In the summer of 2015, a study (by Nichole Cubbage) was conducted by making a test subject tap their right finger off and on for about 30 seconds. After only LabNIRS and MRI measurements were taken, a fusion software was used to merge the two kinds of images. We then later measured the same activity on EEG and compared the results. When one of the right fingers were moving, images recorded activity taking place in the left hemisphere of the brain. Oxygen in the cerebral blood increased in addition to the amount of electrical signals recorded by EEG.

LabNIRS contributes to significant areas of research in the studies of things like Alzheimer's disease, Schizophrenia, and stroke rehabilitation. The brain-function imaging system utilizes near-infrared light lasers to penetrate the cranium and measure oxygenated and deoxygenated hemoglobin in addition to the rate of change between the two within the brain.

LabNIRS has 80 fiber optic cables (40 pairs, 142 channels), each cable contains a near-infrared laser and photomultiplier which converts the light scattering and absorbing measurements into electrical signals. Prior to this version of an fNIRS system, spatial and temporal resolution were not as clear as most machines only used about 20 pairs of cables at the very most. More fiber optic cables and near-infrared lasers means reception of a denser, higher resolution image that captures even the faintest signals, thanks to the photomultiplier. Not only does LabNIRS have a higher quality imaging system, but it is also faster than many other systems that have come before it, specifically when it comes to measuring blood flow. LabNIRS is capable of recognizing things more efficiently in nearly every respect!

I would simply like to present the research I did this summer to inform the public about this kind of imaging. While I will share my personal experiments (brain measurements on musicians with sight-reading versus rehearsed music, etc). I also intend to inform attendees of how EEG, MRI, and LabNIRS can work together to truly be a window to the brain.

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Keratinocytes cultured from human chronic wound specimens demonstrate delayed wound closure and differences in apoptosis in an *in vitro* scratch assay

Wound healing is a critically important physiologic process which restores the normal epidermal barrier function of the skin after injury. Chronic wounds that have failed to heal affect approximately 6.5 million people in the US with a prevalence of 1% and costs estimated at \$25 billion per year. The purpose of this study was to utilize a keratinocyte scratch assay to investigate molecular mechanisms of human wound healing.

METHODS

This research was conducted through the Wound Etiology and Healing (WE-HEAL) Study as approved by the George Washington University Institutional Review Board (041408).

In vitro scratch assay was performed according to established methods. Human epidermal keratinocytes were cultured at 2×10^5 cells/well of a 6 well plate. Cells were allowed to reach ~80% confluence. A scratch was made with sterile 1ml pipette tip. Individual wells were photographed at 0 h, 24h, 48h, 72h, 96h using an inverted phase contrast microscope (Leica). Wound closure was determined as the decrease in percentage in gap width over the initial gap width at respective time-points.

Cell Viability Imaging was done using ready probes (Life technologies). Live cells stained with Nuc-Blue reagent were detected by a standard DAPI filter. Nuc-Green reagent stained nuclei of cells with compromised plasma membrane integrity, detectable by a green FITC/GFP filter. Images were taken in a fluorescence microscope (Nikon Eclipse TE300) and then merged to get a composite image of the ratio of live/dead cells after 96 hours.

RESULTS

In the keratinocyte scratch assay percent closure was significantly less in cultured keratinocytes from chronic wound specimens than from normal keratinocytes at all time points measured. At 24 hr. the difference in % closure was 19.66 ± 10.03 in normal compared to 8.83 ± 5.04 in chronic wound specimens ($p=0.0194$). Similarly, differences at 48, 72 and 96 hr. were 35.97 ± 11.16 vs. 19.86 ± 8.43 ($p=0.0063$); 51.94 ± 9.02 vs. 28.01 ± 10.86 ($p=0.0003$); and 72.81 ± 8.83 vs. 41.03 ± 7.94 ($p=0.0001$), respectively. Significant difference was only seen between normal and hidradenitis keratinocytes at the 96 hour time point (72.81 ± 8.83 vs. 61.65 ± 7.04 ; $p=0.0143$). Cell viability was significantly higher in keratinocytes from normal compared to chronic wound specimens at 96 hr. (% live cells: 86.15 ± 4.13 vs. 59.94 ± 11.68 ; $p=0.002$).

CONCLUSION

Using this keratinocyte scratch assay we were able to show that scratch closure in keratinocytes harvested from normal skin was faster than that seen in keratinocytes harvested from chronic wounds. This suggests that inherent biologic mechanisms at the level of the keratinocyte contribute to delayed wound healing *in vivo*.

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Flexible nanofiber-based nerve electrode to realize intimate contact and enhanced oxygen permeability

Polyimide(PI) based electrodes have been widely used as flexible biosensor and implantable device application, which can be micromachined in various designs suitable for implantation and have been shown to be biocompatible and stable over months of in-vivo implantation. However, the long-term efficacy of the polyimide based cuff electrodes tend to decrease due to nerve damage by low oxygen permeability and insufficient blood flow inside cuff electrode. For solving these problems, the newly developed polyimide nanofiber sheet electrode for peripheral nerve signal recording is introduced in the first time. The newly developed nerve electrode was fabricated by using electro-spinning, ink-jet printing, and electro-polymerization. For electro-spinning process, the PI nanofiber(NF) sheet was synthesized and electrospun using precursor of polyimide (PI), poly(amic acid)(PAA). Then, the AgNP on electrospun PI nanofiber sheet was patterned by using a conventional ink-jet printer. Finally, conductive polymer PEDOT was electro-polymerized on patterned AgNP. The fabricated PI nanofiber sheet electrode was characterized and checked its applicability by using electrochemical impedance spectroscopy, cyclic voltammetry, and acute in-vivo test in rat's sciatic nerve. As shown in results, the impedance and charge delivery density were improved by the patterned AgNP and deposited PEDOT. In addition, the evoked nerve signal via PEDOT/AgNP sheet electrode was much higher than that of AgNP. The newly developed PI nanofiber sheet electrode with PEDOT/AgNP has very simple fabrication process and easy applicability as nerve electrode due to high oxygen permeability of PI nanofiber, flexibility, and biocompatibility. Furthermore, PI sheet electrode with various electrode patterns via ink-jet printing is useful for nerve electrode as well as implantable devices applications.

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Scleroderma Wounds Exhibit Slower Healing than Wounds from Other Etiologies

INTRODUCTION

Scleroderma is an autoimmune disease characterized by inflammation, vasculopathy, and fibrosis of skin, vasculature and internal organs. Delayed wound healing is a known complication of scleroderma. The purpose of this study was to investigate whether chronic wounds in scleroderma patients heal more slowly than chronic wounds of other etiology.

METHODS

This research was conducted through the Wound Etiology and Healing Study (WE-HEAL Study). The WE-HEAL Study is a biospecimen and data repository approved by the George Washington University IRB (041408). Subjects gave written informed consent for collection of their data. Scleroderma cases with wounds (n=25) and age and sex matched control patients with chronic wounds from other etiologies (n=25) were selected for analysis. Baseline demographics, comorbidities, wound size, time to healing, and pain score were compared between the two groups. Scleroderma wounds were further analyzed based on scleroderma classification (localized vs. systemic; limited vs. diffuse). Statistical tests including T-test, Fisher's Exact and Chi Square were performed using GraphPad Prism 5.0.

RESULTS

While baseline total wound surface area (tWSA) was unchanged between the scleroderma and chronic wound groups, the tWSA at the last visit was significantly larger in the scleroderma group 24.80cm² 54.18 compared to the chronic wound group 0.18cm² 0.71 (p=0.028). Scleroderma wounds were significantly less likely to ultimately heal 52% compared to 84% (p=0.015). Pain scores tended to be higher in the subjects with scleroderma, but this did not reach statistical significance (4.08 ± 3.73 compared to 2.68 ± 2.90, p=0.145). Limited scleroderma wounds took longer to heal compared to wounds in patients with diffuse scleroderma suggesting the mechanisms of delayed wound healing in scleroderma may be more related to vasculopathy than ongoing inflammation.

CONCLUSION

Scleroderma patients exhibit delayed wound healing compared to patients with wounds from other etiologies. Scleroderma wounds are significantly less likely to ultimately heal than chronic wounds of other etiologies. There is an unmet need to further investigate the etiology of delayed wound healing in patients with scleroderma.

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NRF2-P62 contribute to resistance to carfilzomib in Multiple Myeloma cell models

Multiple Myeloma is a widely spread malignancy with drug resistance being a major cause of therapeutic failure. NRF2, a transcription factor widely used in antioxidant pathways, and SQSTM1/p62, a NRF2 regulator, are found to contribute to resistance to carfilzomib treatment in multiple myeloma. carfilzomib is a second-generation proteasome inhibitor that is administered to patients with multiple myeloma who have failed several previous treatment regimens, including treatment with bortezomib, a first generation proteasome inhibitor. Using in vitro cell models, we found NRF2 target genes to be activated in resistant cells. Elevated levels of the transcription factor NRF2 and the autophagy associated protein SQSTM1/p62 were found to be major contributors to this resistance and increased survival in the presence of carfilzomib. We have shown that the mechanism of NRF2 activation involves elevated levels of its regulators PERK and p62. The proteosomal inhibition caused by carfilzomib, causes an activation of PERK in the ER membrane. The PERK kinase directly phosphorylates NRF2 allowing it to activate. We also found that translation of NRF2 and p62 was more efficient in resistant cells. While NRF2 is translated using standard cap mediated initiation, p62 requires IRES mediation for it's increased elevation. This transition is regulated by PERK kinase when it phosphorylates eIF2a. NRF2 is known to activate antioxidant defense, fatty acid oxidation (FAO), and autophagy. In our resistant cells we found decreased levels of reactive oxygen species, as well as elevated levels of both autophagy and fatty acid oxidation. Previously, we have shown that elevated levels of P62 cause resistance in other cell lines, and it appears to be a common element that is worth targeting in future research and treatment options. Along with the target of p62, small molecule mediated inhibition of NRF2 and PERK as well as inhibition of autophagy, FAO and cys transporter restores sensitivity to carfilzomib.

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Effects of Essential Oil on Fear Memory and the Immune Response; A Potential Alternative Therapy for Post-Traumatic Stress Disorder (PTSD)

Stress and anxiety-related mental health disorders such as post-traumatic stress disorder (PTSD) are on the rise. Stress is known to modify the immune system and the balance of the autonomic nervous system. Despite the growing literature on immune system changes associated with direct stressors, the relationship between fear memory and the immune system has not been well characterized. Moreover, there are only two FDA-approved medications for PTSD. Orange essential plant oil (OEPO) has been previously found to have CNS depressant-like effects in mice. Therefore we examined the effects of OEPO on fear memory and immune cell activation in a mouse model of PTSD (Pavlovian Fear Conditioning). The treatment group (n=8) was administered 25% OEPO via olfactory exposure prior to and after fear conditioning. Mice exposed to 25% OEPO showed no difference in percent freezing during fear acquisition compared to controls. However, when tested for extinction retention 48 hours later the treatment group experienced a $17.21 \pm 1.58\%$ ($p < 0.01$) significant decrease in freezing behavior versus control ($3.67 \pm 2.13\%$), suggesting that OEPO affects extinction of fear memory in mice. This appears to be independent of a shift in immune cell activation as treatment and control mice showed similar levels of splenocyte derived naïve / effector lymphocytes and antigen presenting cells. Both groups however showed increased levels of naïve T cells CD62hiCD44lo $56.9(\pm 0.83)\%$ relative to non-fear conditioned mice $46.3(\pm 3.16)\%$ ($p < 0.01$). These data suggest that OEPO enhances extinction of fear memory while its effects on the immune system remain unclear.

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Development of non-invasive MR-guided high intensity focused ultra sound treatment for pediatric limb-length discrepancy

BACKGROUND:

Pediatric leg length discrepancy can cause a limp, lower back pain, scoliosis, poor posture, osteoarthritis of the hip and spine, and other conditions. Treatment of limb length discrepancy in children involves invasive techniques that require a lengthy recovery, protected weight bearing and the use of ionizing radiation for intraoperative guidance. The purpose of this study is to evaluate the utility of MR-guided high-intensity focused ultrasound (MR-HIFU) as a noninvasive treatment of limb length discrepancy - one that minimizes both surgical trauma and exposure to ionizing radiation.

METHODS:

Physis MR-HIFU ablation was tested using a tissue-mimicking phantom where the physis was represented by a slit between two pieces of ABS plastic kept 3 mm apart, suspended in agarose gel. MR thermometry was used to acquire the distribution of temperature in the phantom during sonications. Penetration of lethal heating into the physis was measured as the distance from periosteum at the edge of the physis to the farthest extent of lethal thermal dose (≥ 240 cumulative equivalent minutes at 43 °C [CEM43]). Feasibility of MR-HIFU epiphysiodesis was also tested in young pigs, an established preclinical, large animal model. Damage was assessed using X-ray imaging, and MR contrast-enhanced imaging. Penetration distance of lethal damage into the physis was quantified on 8- μ m sections stained with hematoxylin and eosin. Physeal growth was histologically evaluated using fluorescence imaging, following 2 calcein injections, 2 days apart, prior to sacrifice of the animals.

RESULTS:

In tissue-mimicking phantoms, in ex-vivo leg samples, as well as in vivo, maximum penetration of lethal thermal dose (≥ 240 CEM43) was approximately 1 cm into the physis. Preliminary examination of x-rays of targeted and control hindlimb tibia and femur revealed a maximum bone length difference of 8 mm between treated and untreated bones. Greatest damage to the physis was visible on treated tibias, with most extensive damage in the front of the bone, where the HIFU beam was positioned at a right angle with respect to the bone surface (in the physeal plane). Histologic evaluation revealed that 1 week after treatment, the targeted physis as well as bone surrounding it were denuded and demonstrated weak eosin binding compared to untreated areas. One week after MR-HIFU ablation, the treated physes of both femur and tibia were wider in the treated area, with an abrupt (1-5 cell layers deep) border region separating the apparently treated physis from physis with normal appearance (n=1). Ten weeks post treatment, both fusion across the physis as well as necrosis were observed, with bone growth continuing around the damaged physis (n=5). Additional analysis is ongoing to correlate both the spatial extent and severity of histologically-identified damage to growth delay and thermal exposure.

CONCLUSIONS:

This is the first time that MR-HIFU was used to non-invasively hinder bone growth with the potential to dramatically reduce the invasiveness and enhance outcome of limb length discrepancy treatments. If proven to be safe and effective, non-invasive MR-HIFU treatment of limb length discrepancy may become current clinical practice by providing a non-invasive alternative to surgical procedures.

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Sentence Stress Production in Children

The production of contrastive focus using stress in adults is the result of altering three main acoustic elements: amplitude, duration, and frequency (Meister et al, 2011). These cues can all be seen in a spectrogram of an utterance. In the spectrogram stress can be seen by an increase in amplitude or loudness, a longer duration of the utterance, and an increase in fundamental frequency or pitch. The primary purpose of this study is to answer two questions: 1. Do hearing children produce sentence stress to accurately convey contrastive focus? And 2. What are the acoustic cues that hearing children of different ages use to produce these stressed words? A group of hearing children between 4 and 8; 11 years of age completed a series of tasks comprising the Profiling Elements of Prosodic Systems - Children (PEPS-C) developed by Sue Peppé. The task of interest is known as the focus task, in which "animal soccer" is used to elicit stress on different words in an utterance. PRAAT (a spectral analysis program) was used to measure amplitude, duration, and fundamental frequency of the stressed and unstressed words to see if there are any differences in the production of stress verses unstressed. The results provide a clearer picture of how young children produce stress in sentences to reflect focus stress. This normative data will ultimately be used to contribute to the goal of understanding how children with reduced hearing who rely on cochlear implants are able to perceive and produce various aspects intonation.

REFERENCES

Meister, H., Landwehr, M., Pyschny, V., Wagner, P., & Walger, M. (n.d.). The Perception of Sentence Stress in Cochlear Implant Recipients. *Ear and Hearing*, 459-467. Retrieved February 23, 2015, from The Perception of Sentence Stress in Cochlear Implant Recipients

Peppé, S., & McCann, J. (2003). Assessing intonation and prosody in children with atypical language development: the PEPS-C test and the revised version... Special issue: selected papers from ICPLA 2002. *Clinical Linguistics & Phonetics*, 17(4/5), 345

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Nucleotide resolution allelic maps of breast cancer

Allele Specific Expression (ASE) is a genetic mechanism where one allele is expressed preferentially over the other in a diploid genome. ASE is most notably present in X-chromosome inactivation and in genomic imprinting, where genes are expressed in a parent-of-origin-specific manner due to epigenetic regulation. ASE is generally widespread throughout the genome and is known to play a significant role in a variety of pathogenic conditions and diseases, such as Prader-Willi syndrome, Angelman syndrome, some psychiatric diseases, diabetes, and cancer. Tools for assessing ASE are increasingly based on analysis of sequencing data. We have recently developed a tool, RNA2DNAalign, that is capable of identifying genome-scale allelic imbalances of different types including allele-specific expression in tumor-specific or tissue-independent settings. Using this tool, we have produced nucleotide-resolution allelic maps of breast tumors, and have compared the genome-wide allelic distribution between normal and tumor tissue. These comparative maps have revealed a number of novel observations, an example of which is the region-based across-genes clustering of allele-specific expression specific for tumor tissue. In addition, we have produced the first to our knowledge comprehensive catalog of allele-specific expression in breast. We aim to further expand the analysis towards the identification of novel breast- and breast-cancer-specific ASE, and to provide a pipeline for high resolution fine allele mapping studies.

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Characterization of microbial communities in schizophrenia and mood disorders

BACKGROUND

Mental and neurological disorders like mood disorders (MD) and schizophrenia constitute a worldwide health issue. Standard treatments often provide inadequate responses. Among factors involved in resistance to psychotropic drugs, microbiota has an underestimated influence on host behavior and in drug metabolism, as suggested by previous findings in humans, mainly based on inflammatory bowel disorders, which are associated with microbiota dysbiosis and are highly comorbid with psychiatric disorders. In this study we aim to characterize the gut microbiome of schizophrenia and MD patients.

METHODS

Gut microbiome from 30 individuals (8 controls, 7 MD patients, 15 schizophrenia patients) was surveyed with shotgun metagenomic sequencing. Exploratory and differential species abundance analyses were performed on read datasets.

RESULTS

Differential taxon abundance analysis revealed that samples did not differ at the phylum level; genera *Lactobacillus* (\log_2 fold change [LFC] = 8) and *Peptoclostridium* (LFC = 4) were more abundant in schizophrenia patients than in controls. In MD patients, genera *Lactobacillus* and *Bifidobacterium* were relatively more abundant (LFC > 2), while genera *Streptococcus* and *Enterococcus* showed a decreased abundance (LFC < -1). Differentially abundant taxa are involved in metabolism of key neurotransmitters (GABA, serotonin) and brain development at different levels.

Alpha-diversity measures showed a reduced species richness in schizophrenia and MD patients, further suggesting a link between the explored diseases and the microbial communities inhabiting the gut.

CONCLUSION

Our findings show that gut microbiota is different in schizophrenia and MD patients compared to controls, suggesting that microbiota profiling can constitute a valuable tool for the management and the treatment of psychiatric disorders. Further studies will focus on the metabolic features of microbial communities in different diagnoses.

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Using Concept Mapping to Understand Consumption and Perceptions of Low-Calorie Sweeteners

BACKGROUND:

The prevalence of low-calorie sweetener consumption has increased markedly in the United States. Currently, approximately 40% of adults and 25% of children report consuming foods or beverages with low-calorie sweeteners daily. Due to the obesity epidemic, there has been a strong public health emphasis on reducing sugar and it is therefore likely that the trend of increased low-calorie sweetener consumption will continue. However, despite widespread use, it is unclear whether low-calorie sweeteners are beneficial for weight management. Epidemiologic studies suggest low-calorie sweeteners may promote weight gain, yet human intervention studies show the replacement of added sugars with low-calorie sweeteners may promote weight loss, particularly when consumed in the context of behavioral weight loss and/or caloric restriction. Therefore, the purpose of this study is to use concept mapping to determine why, when, where, and with whom individuals consume foods and beverages containing low-calorie sweeteners. Understanding the determinants of low-calorie sweetener consumption will provide insight into the potential role of low-calorie sweeteners in promoting or preventing weight management and prevention of chronic disease.

METHODS:

Adults (planned n = 100), 18 to 35 years old, who regularly consume low-calorie sweeteners, (>1 per week) will be eligible to participate. Through the use of concept mapping, determinants of low-calorie sweetener use will be identified and the frequency and importance of these factors will be assessed. Participants will contribute their ideas through: (a) qualitative brainstorming, (b) sorting of ideas, and (c) rating each idea on its importance and frequency. Demographic and anthropometric information will also be collected.

RESULTS:

Data collection is currently in progress.

DISCUSSION:

Understanding the rationale behind low-calorie sweetener use and the contextual factors associated with their consumption will provide detailed information on how low-calorie sweeteners are used in 'real-life.' This will serve as the basis for designing subsequent randomized controlled trials to systematically investigate the health effects of low-calorie sweeteners in a manner that best represents consumption behaviors and will provide important information which may explain current discrepancies between findings from epidemiologic, rodent, and human intervention studies. Furthermore, our analysis will allow us to explore the extent to which patterns of low-calorie sweetener use differ based on demographic characteristics, including gender, race/ethnicity, and weight status. Understanding how low-calorie sweeteners are used is critical to elucidating their effects. This study will generate novel findings and will serve to advance the highly controversial and rapidly growing scientific study of low-calorie sweeteners.

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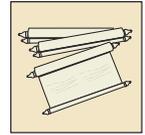
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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

(Dis)Loyal Leaders: Reinterpreting Plutarchan Romans in Two Modern Versions of *Antony and Cleopatra*

In William Shakespeare's Roman tragedy *Antony and Cleopatra*, Mark Antony and Octavian Caesar must choose between their personal ambitions and previous agreements. These decisions involve the ancient Roman value *fides* (loyalty, trustworthiness), which governed societal, personal, and familial relationships. The classical Greco-Roman biographer Plutarch's *Life of Antony* represents Antony and Octavian as frequently neglecting *fides*. Shakespeare's adaptation of Plutarch transforms these historical figures into compelling dramatic characters. Over 400 years later, Gregory Doran and Michael Boyd's two modern stagings reinterpret Antony, Octavian, and *fides* for the Royal Shakespeare Company's modern audiences. This analysis examines the productions' portrayals of the classical leaders and their struggles with *fides*. Although scholars have written about connections between Shakespeare and Plutarch, the reception of ancient historical figures, filtered through Shakespeare, into current culture deserves further investigation. Through textual research and the lens of classical reception studies, this project finds that Shakespeare's appropriation of Plutarch focuses attention on the internal motivations behind Antony and Octavian's *fides* (or lack thereof). Archival research and performance studies methods indicate that Doran's 2006 rendition of *Antony and Cleopatra* employs a Plutarchan vision, in which Antony breaks *fides* because he fails to control himself, Octavian because he wants to control others. On the other hand, Boyd's 2010 adaptation brings Shakespeare's Plutarchan play into the present day, portraying Antony and Octavian's Rome as a modern city so corrupt that it might not merit anyone's loyalty. Employing its multi-layered methodology, the exploration concludes that the different versions of Antony and Octavian across the centuries ask what drives, destroys, or deserves *fides*. The study suggests that the trans-temporal receptions of classical figures not only keep Antony and Octavian in the public consciousness, but also provoke consideration of the role (dis)loyalty can play in a leader's life and actions.

STATUS

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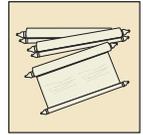
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Race Dynamics Between Student and Tutor: Exploring How Differing Race Identities Affect Tutor-Child Partnerships in Washington, DC's Educational Non-Profits

In 2013, 0.3% of Washington, DC's volunteers identified as black, while 34.5% of them identified as white. This study looks at the relationship specifically between volunteers and children and how the relationship between the two may or may not be hindered by their differing racial identities, especially in settings where the children are all children of color and the volunteers are predominantly white. Many studies explore relationships between predominantly white teachers and children of color in urban settings and reveal that when a teacher chooses to be color blind, it may detriment a child's vision of himself or herself and how he or she perceives their own chances of success. There is a gap, however, in the research done concerning racial dynamics in the Human Services sector, particularly in the relationship between white volunteers and black children. This study interviews alumni, staff, volunteers, and children from local DC educational nonprofits about their experience with racial identity and relationships in service. This qualitative study uses the experiences of the interviewees to further understand the race dynamic in the educational nonprofit sector.

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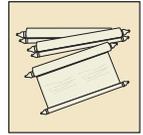
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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Atop the Aryan Akropolis: Nazi Appropriation of the Parthenon

On April 27, 1941, Nazi troops scaled the Athenian Acropolis and raised the German Swastika over the Parthenon. In an instant, the two thousand year-old, enduring symbol of Greece became German. While many historians have written about the military history of Nazi-occupied Athens, few have comprehensively studied the Parthenon, the city's most famous icon, during this period. This study therefore explores the events leading up to the raising of the Swastika over the Parthenon, the physical ramifications on the structure during the occupation, and the Greek and international community's response. Last, the project analyzes the Parthenon and its appropriation as a reflective text of Greek cultural and national identity during this period. Secondary literature addresses the build-up to the occupation and is supplemented by primary source documentation from the Bundesarchiv Berlin-Lichterfelde, one of Germany's federal archives. Evidence for the physical effects of the Nazi occupation has been gathered from the photographs collection of the Bundesarchiv, as well as from the William Bell Dinsmoor Papers of the Blegen Archives at the American School of Classical Studies at Athens (ASCSA). The Dinsmoor Papers, as well as the Spyridon Marinatos Papers of the Gennadius Library Archives at ASCSA, document the Greek and international community's response. Preliminary analysis indicates that whereas the Nazis sought to eradicate Jewish cultural identity almost entirely, they co-opted the Parthenon in an attempt to assimilate by force Greek culture into German culture. Additional effort is required, including translation of both primary and secondary source documents, in order to understand and analyze the Parthenon as a text of Greek cultural and national identity during the period of occupation. This research project brings together the disciplines of history, classical studies, and anthropology in a truly interdisciplinary fashion, and thus offers a new, exciting interpretation of the Parthenon in a specific context of its two thousand five hundred year history.

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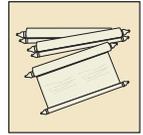
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The Points of Division and Union among Quakers in Contemporary America

Religions throughout history and across the globe experience developmental shifts and divides. The Society of Friends, also known as Quakers, is a religious group which came out of the English Reformation, based on progressive biblical reading and the belief that each individual is divinely inspired. It has since divided between the Friends who emphasize scripture and those who want to focus more on individual ministry. Academic research on modern Friends is limited and past writing tends to make sweeping historical judgments about Quakers, instead of studying their internal conflicts. Understanding the clashes between them, as well as Friends' relationships with non-Quaker Christianity, demonstrates fundamental information about how religions grow and address divisions.

I did background research about the Quaker development in America to understand the conflicts that have occurred since Quakers entered America along with the other pilgrims of the 17th century. I also researched as many contemporary Quaker organizations as possible. I visited three different Quaker communities in America to get an idea of how Quakers in different branches relate to one another. I attended worship groups and bible studies and interviewed around fifteen individuals to learn about various insider perspectives. I followed up by reading literature written by Quaker Meetings and modern, influential Friends.

The primary result I found was that Friends are deeply divided over fundamental theological differences about adhering to mainstream Christian values and scripture versus listening to continuous, new revelation and focusing on distinctly Quaker values (like the inner Light). I found that unity is really only possible between willing and middle-ground individuals who are interested in reviving Quaker values, as well as exploring Christian texts and messages. There are a large number of Quakers, but far from a majority, in each branch who are drawn to this middle ground and seek to incorporate elements from other Quaker branches into their own worship. This includes Evangelicals who wish to experience silent worship and Liberal Friends who want to reconnect with their Christian background or listen to a minister.

Among the "Liberal" (progressive) Friends, the relationship to Christianity has ebbed and flowed. Liberal Friends have strengthened their relationship to social service as a fundamental piece of their faith, which has effectively phased out Christian teachings for many. The variety of beliefs and the encouragement of diversity may discourage unity within the branch. Some Friends seek to revive Christian scriptures and wish to remain connected with more Christian Quakers (Orthodox or Evangelical Quakers), which conflicts with Liberals who disagree with these groups' conservative social views.

Realistically, these findings suggest that there is no easy way for Friends to reunite or overcome differences. My research has pointed out the difficulties in bridging century-old divides, but also demonstrated the ways in which willing Friends can and have already found common ground. It may simply be unnatural for a faith to remain together when core differences become overwhelmingly evident. However, with the right sensitivity, positive relationships and collaboration are still possible between willing members of these divided groups.

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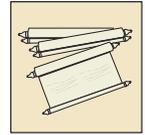
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Effects of European Colonialism on Gender in Native and Colonial North America (Working Title)

In studying North America, historians use colonialism as a central tenet for evaluating change over time in both colonist and Native lives. The focus on gender, however, has been limited; Native gender systems have been studied largely in a precolonial context, whereas European gender systems have often been regarded as independent of external influence and interaction with the many Native peoples whose land they occupied. This project is therefore an examination of both Native American and European gender systems and their change over the course of the colonial period, specifically in interaction with and reaction to one another. The chronology of this study bridges from the mid-1600s into the 1700s. Because of the broad focus of this analysis, the study is divided into three major areas of examination: Spanish territories, interacting with the Pueblo Indians, French territories, interacting largely with Iroquois-speaking tribes (such as the Wendat) and their collective Five Nations Iroquois enemies, and English territories, particularly in the northeast interacting with the Algonquian Narragansett and Wampanoag peoples. By examining primary colonial documents from the Pueblo revolts, the French's Jesuit missionaries, and English captivity and trade narratives, this study concludes that exchange of religion, warfare, and trade interactions were the most prominent ways in which European colonialism affected North American social systems of gender. This was done by Native people accommodating to Christian religious and marital practices, by Europeans stratifying their gendered roles and practices in reaction to the unfamiliar social systems of Indian country, and by both Native and European peoples shaping their lives around trade goods in the contentious market of early America. This study advocates for gender to be considered as one of the lasting legacies of colonialism in North America and encourages further studies of gendered reactions as a product of colonialism in American history.

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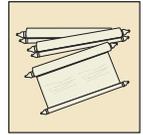
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Salem, 1692: Strategy and Social Networks

The history of the 1692 Salem Witch Trials fills dozens of history books, and theories about the causes of the witchcraft accusations span from the psychological to the political. Most of these theories face criticisms since many different motivations could have affected each accusation of witchcraft. My synthesis of these theories along with evidence provided by constructing a social network of the court documents, and analysis of strategic decisions by individuals, found through a careful reading the court records, truly tells the tale of the Salem Witch Trials. Several historians offer theories that developed the current understanding of the trials, but as yet do not give a complete explanation of how the trials occurred. Richard Latner's suggestion of multiple, simultaneous and consecutive witch hunts within the trials by geographic location, Paul Boyer and Stephen Nissenbaum's study of the Putnam family, Enders A. Robinson's Putnam conspiracy theory, and Mary Beth Norton's research on the influences of war on the Maine frontier explore many aspects of the witch hunt, but each of these theories lack certain evidence or look at a different aspect of the trials without exploring the heart of the issue. However, these theories together approach a comprehensive understanding, aided with my social network analysis. Now that new technology allows more in depth methods to study history, social network analysis combined with traditional textual analysis demonstrates the role of Thomas Putnam Jr. and his family in the accusations by revealing his calculated actions to achieve power.

When the Massachusetts Bay Colony decided to hold the trials, attorney Thomas Newton determined which cases to hear by strategically choosing eight suspects that were easiest to convict and presented the opportunity to allow more trials to follow. The social network analysis of two hundred related court documents for these eight suspects demonstrates the Putnam influence. Ann Putnam Jr., the daughter of Thomas Putnam Jr., claims the highest Eigenvector score, placing her mathematically as the most powerful person in a network of five hundred people. In a Puritan society, a twelve year old girl achieved such a paradoxically strong influence. The court records establish how the actions of the Putnam family manipulated the situation to strategically advance accusations against individuals with higher social statuses, which also expanded Putnam control in the hysteria. This control becomes evident in the timing of the accusations with the Putnam position in the social network.

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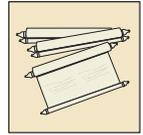
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Unmasking the Readymade: Multiplicity of Identity in Duchampian Modernism

If the modern artist is a crafter of ideas, Marcel Duchamp is a crafter of personas and a master of self-invention. At the first half of the twentieth century Duchamp and his contemporaries begin to explore and, eventually, break down the conventions of identity. One of the most pivotal moments in the creation of the Duchamp name is the "birth" of Duchamp's alter-ego, R(r)ose Sélavy. Rose functioned not only as his longest performance piece, but acted as a repository for some of his most daring works, acts and ideas. She became a paradigm of his most consistent theme, androgyny, and a platform for what Pierre Cabanne called, "the greatest sociocultural disturbance of the century." This research examines the ways in which Duchamp used modernism to project his authenticity as an artist through personas, portraiture and textual references. It analyzes the relationship between his essays on gender and identity and his visual art. Looking at the conceptual evolution of Duchamp's works, one can understand the ways in which his heritage has enriched the artistic arena. Modern art of today thus seems to be more a space of truth, authenticity and contemplation than a realm of beauty and contentment. Duchamp's art was ultimately crucial in facilitating the dialogue we use to talk about gender and individual identity today.

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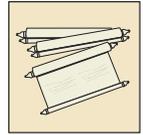
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Fighting Loneliness with Dignity: An Ethnographic Study into the Eating Habits of Elderly Female Home-Cooks

Our project focuses on the changing eating habits of three elderly female home cooks. Ethnographic interviews were conducted with three participants in order to gain a better understanding of how their food practices compare today to those that they had in the past. Our results show that they now have less of an involvement in food preparation, due to physical limitations and the effects of loneliness. In spite of this, all three women continue to maintain food traditions ingrained in them from earlier periods of their lives. This demonstrates the importance that food practices can have in one's life as well as the evolution of these practices over time.

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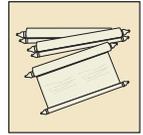
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The Many Fates of Medieval German Palmesels During and After the Reformation

The Palmesel, a nearly life-sized wood sculpture of Christ riding on a donkey, took part in a rich tradition of liturgical and para-liturgical processions and performances during the Middle Ages. While many medieval processional sculptures were used to celebrate a number of saints' days and religious feasts, the Palmesel was created to fulfill a specific purpose during Palm Sunday processions, when it was wheeled through the streets of medieval towns to celebrate Christ's entry into Jerusalem. Because few scholars have touched on the destruction that Palmesels underwent during the Reformation and on the subsequent transformation of their Catholic use, this aspect of Palmesel history warrants deeper study. This essay relies on the examination of existing Palmesels, and the physical evidence they present, to prompt discussion of their fates during and after the Reformation. Because most existing Palmesels come from southern Germany and were made between 1470 and 1520, most of the Palmesels examined here are German in origin and date within that time frame, though earlier and later examples are included. The Palmesels that are most useful in a discussion on the transformation of their use during and after the Reformation will have experienced some kind of intervention during that period. While the Reformation is often seen as an era replete with image destruction, existing Palmesels tell a more nuanced version of their history. Some have been partially destroyed; some Palmesels were put away and hidden, only to be found centuries later; some seem to have been kept on display, though disused, in Lutheran churches; and some were added to or changed, attesting to their continued use despite the controversy around them.

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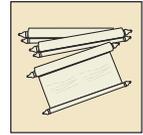
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Cognitive Phenomenal Intentionality

Over the past half-century, philosophers of mind have been primarily concerned with two projects: that of naturalizing intentionality, and that of naturalizing phenomenal consciousness. In philosophy, the project of naturalizing a target phenomenon p is the project of analyzing the concept we use to pick out p in such a way that physical, logical, and mathematical facts alone can determine whether or not something is a p . Roughly, a mental state is intentional in the relevant sense if and only if it refers to objects or properties in the world. For example, my thought that the cat is hungry is intentional inasmuch as it refers to my cat and the property of being hungry, in such a way that it is made true if and only if the cat is hungry. And, roughly, a mental state m is phenomenally conscious for a subject S if and only if there is something it is like for S to be in m . For example, there is something it is like to see the color red, and there is something it is like to taste a mango. So, some visual and gustatory mental states can be phenomenally conscious.

Today, there is widespread agreement among philosophers about how intentionality can be naturalized. While there is still disagreement about the details of the right theory, it is generally agreed that reference is a unique kind of causal relationship that obtains between mental states and their referents. The problem of naturalizing phenomenal consciousness, however, has proven more difficult, and there is not yet any widespread agreement about which theory is best equipped to solve it. Most researchers, however, are confident that questions about phenomenal consciousness are theoretically downstream from questions about intentionality, and that results in the study of phenomenal consciousness will not constrain theorizing about intentionality.

Recently, however, some researchers have proposed that the link between intentionality and phenomenal consciousness is closer than philosophical orthodoxy would have it. As the above treatment suggests, paradigmatic cases of intentional mental states are thoughts, and paradigmatic cases of phenomenally conscious states are perceptions. But these researchers propose that thoughts can also be phenomenally conscious, and that the phenomenally conscious properties of thoughts determine their intentional properties. My research examines some of the most influential arguments for this view, which I call 'Cognitive Phenomenal Intentionality'. My results are largely negative: even if cognitive mental states can be phenomenally conscious, I argue, there is no reason to think that their phenomenally conscious properties determine their intentional properties.

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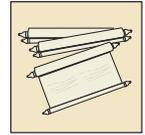
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ATG Digitalized: An Interactive Guide to the Bad Doings of Alexander the Great

Alexander the Great, to this day, is celebrated as one of the most impressive military strategists the world has ever seen. However, becoming the grand figure he is today also required the sterilization of evils he inflicted upon others. While we have the narratives of Alexander as a great warrior and leader, his battles are romanticized and the deaths of hundreds of thousands of people are dulled and lessened in importance. The purpose of this project is to illuminate the darkness within Alexander the Great, by providing a map that visually represents his every callous action. This map is twofold: it provides real, understandable data that the viewer can digest, while also being a complete, interactive experience, in which the viewer can filter through specific subject material, follow Alexander's journey in time-lapse, and associate his negative actions to raw data. The research put forward in mapping his route, with a specific focus on his negative actions, provides a fresh understanding of the impact that Alexander's destruction had on the people during the Hellenistic period. This map has come into fruition through use of five major marks of negative actions Alexander displayed throughout his expedition. These marks are conceptualized as subjects in every event: how many people he murdered, the amount of peoples he enslaved, if he plundered and stole from his enemy, whether he razed everything after conquering an area, and if there was any evidence of sexual violation (i.e., rape). These marks are meticulously collected and calculated using the five main ancient sources on Alexander, which are Arrian, Plutarch, Diodorus Siculus, Quintus Curtius Rufus, and Justin. However, in creating a map of a Hellenistic world that is more than two-thousand years in the past requires a distinct understanding of both ancient demography and geography. Thus this map will be a capstone of a three-year long interdisciplinary search for the negative impacts of Alexander the Great. This project offers the Classical and Historical community with a completely comprehensive, visually interactive, and statistically significant study of the route of Alexander, not as the Great, but as the Evil.

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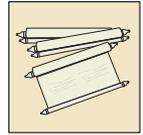
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Women v. Men: An analysis of collegiate sports media

In 1972, the US government passed Title IX prohibiting discrimination based on sex in any educational program or activity receiving federal financial aid, which dramatically increased the percentage of girls and women participating in sports. Despite this influx in the quantity of women in sports, statistics collected revealed that the quantity of coverage that women received on sports channels did not increase proportionately. In addition, the little coverage women received was very matter-of-fact compared with the exciting delivery of sports news that male athletes received (Cooky, Messner, & Musto, 2015). However, very little is known about the quantity and quality of coverage at the collegiate level, where the effects of Title IX are thought to carry the most weight. This research collected qualitative and quantitative data from the National Collegiate Athletic Association's (NCAA) online website, including the daily highlights and stories for both men's and women's Division I collegiate basketball. Findings from this analysis will be presented and discussed.

SOURCES

Cooky, C., Messner, M., & Musto, M. (2015). "It's Dude Time!": A Quarter Century of Excluding Women in Sports in Televised News and Highlight Shows." *Communication & Sport*, 27, 1-22.

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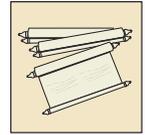
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HUMANITIES



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Social Justice Efforts in American Jewish Leadership: Exploring the Jewish Response to the Syrian Refugee Crisis

As a result of a devastating war, millions of Syrians have become uprooted victims of ongoing conflict and persecution. At least 7 million people are internally displaced, and over 4 million have fled the country, most escaping in mass numbers to neighboring countries with lack of safety or shelter (United Nations High Commissioner for Refugees [UNHCR], 2016). In the wake of this humanitarian crisis, like many others throughout history, American Jewish communities must decide if and how they will collectively make sense of the situation, respond, advocate, or even act. Little academic research has been able to identify the existence or impact of current practices for doing so. The purpose of this study is to explore if and how American Jewish leaders in synagogues, nonprofit organizations, and schools empower the Jewish community to respond or engage with an issue of social or global urgency. Specifically, this study looks at how leaders of Jewish communities are responding to the ongoing Syrian humanitarian crisis, in order to understand the strength, vitality, and outlook of Jewish leaders and their communities on urgent issues of social justice. This study utilized individual interviews, approximately 45 minutes in length, with five individuals that hold diverse leadership positions in various American Jewish communities. Each interview was recorded and then transcribed verbatim and coded to identify themes that crossed denominational, organizational, and ideological divides. The results of this study may suggest implications for future practices in effectively shaping a collective response to social injustice in a Jewish context, as well as provide topics for future research.

REFERENCES

United Nations High Commissioner for Refugees. (2016). Regional Operations Profile—Europe. Retrieved from <http://data.unhcr.org/syrianrefugees/regional.php>.

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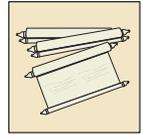
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Dialogic Connections: An Analysis of Groundwork Anacostia River, DC's Use of Facebook and Twitter

The recent development of social media websites makes it much easier for organizations to interact with the community they are trying to reach. Research has been done regarding the most effective types of social media for this task, as well as how those websites can be used best to benefit the organization. This essay analyzes the Facebook posts and tweets of Groundwork Anacostia River, DC (GWARDC) and uses frameworks laid out by Lovejoy and Saxton to determine whether or not GWARDC is creating dialogic connections with their audience. To do this, the Lovejoy and Saxton framework, originally designed to analyze tweets made by organizations, is applied to Facebook posts. I analyze Groundwork's use of Facebook and Twitter and determine that they are on the right track to forming dialogic connections with their audience, however their practices still need to be refined for dialogic connections to occur.

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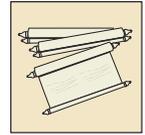
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The Effects of Eighteenth-Century English Literature on Crime Policy, Penal Policy, and the Justice System

London during the eighteenth century was filled with commotion. Transitioning monarchs, an uptick in literacy rates, a swelling industrial economy, and an exponentially rising crime rate were only a few of the issues eighteenth-century Britons were forced to negotiate. At the time, there were over 200 different crimes that could be punishable by capital punishment or public execution. It was also a time where newspapers, journals, broadsheets and thus text in general were expanding. After the Press Licensing Act of 1695 was thrown out, publications, journalists, and writers had much more freedom to publish and circulate their ideas. What we see in eighteenth-century London is a population wrought with intense income inequality, skyrocketing crime rates, and a blooming literacy rate. However, by the end of the eighteenth century, English penal policy, crime policy, and the structure of the justice system exhibit slow reform. Health and living conditions in prisons started to improve; the end of the century marked a change in capital punishment for petty offenses; and the balance of power in the courtroom gradually shifted towards the defendant with the allowance of defense attorneys.

This interdisciplinary study aims to discover how eighteenth-century English literature shaped and developed English crime policy, penal policy, and judicial reform. My research is concerned with how literature—taken broadly to mean fiction, narrative, and poetry—affected crime policy during one of the most intense periods for the development of crime and penal practices in the history of the Anglophone world. During my research, I analyzed several different novels, poems, series, and theoretical articles. I focused my lens on *Moll Flanders* (Daniel Defoe), *Tom Jones* and *Joseph Andrews* (Henry Fielding), *Caleb Williams* (William Godwin), *Bleak House* (Charles Dickens), *Industry and Idleness* (William Hogarth), *London* (Samuel Johnson), *The Victim of Prejudice* (Hays), and other small works. In addition, I read several different theorists opinions on the topic and completed archival analysis of different accounts in The British Library and The National Archives. This investigation reveals a robust and impassioned discourse between the literary and policy world to transform the standards of the justice system. Textual analysis revealed heavily coded language in the selected novels, which provided a discourse and avenue for policy changes. Several other details, including Fielding’s well-positioned influence on English politics, also demonstrate the literary world’s effect on public policy. The analysis gives us insight into how English literature affected an area of public policy and law.

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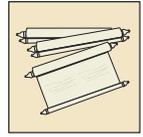
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HUMANITIES



ELLIOTT SCHOOL OF INTERNATIONAL AFFAIRS

Exploring the Role of Cities; An examination of Haussmann and Le Corbusier

Galvanized by the energy of the modernist movement, Charles-Édouard Jeanneret-Gris, better known as Le Corbusier, brought efficiency, mass planning and the automobile into city design. Le Corbusier's 1925 Plan Voisin called for a total redevelopment of Paris in the modernist style, with grid styled streets, towering concrete skyscrapers, and lush verdant gardens replacing the ancient city. Many Parisians were shocked by Le Corbusier's audacity. Previously the urban planner Georges-Eugène Haussmann, during his development of Paris and creation of the current beautiful city from the muddle of its medieval past, had defined the 19th century rules of planning through the use of homogenous street facades of classical design. Both designers used similar planning techniques and progressive goals in hopes of redeveloping Paris but produced plans with drastically different success. This study explores the changing aspects and values associated with architecture and urban design during the period of modernism. Along with examining the actual buildings and street mapping in Paris during the summer of 2015, additional research into modernist architecture incorporates museum exhibits, academic readings and an analysis of current urban design proposals. This research builds upon the debate in architecture between preservation and innovation and brings a number of new values for future architects to consider. These values, including pedestrian access, building on a personal scale, and integration of the old with the new, present a contrast between modernist and pre-modernist architecture.

STATUS

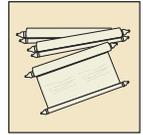
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Symbols of Soviet Power: The Soviet War Memorials of Berlin

Just after the allied victory in World War II, the Soviets built three memorials in Berlin dedicated to their victorious Red Army and their fallen in the final battle of the war. Previous research has focused primarily on the history of the structures. However, this project aims to discuss how the memorials have been used to accomplish political aims and how the narrative has changed since World War II. This project draws upon previous research published in German and English and a wealth of primary sources gathered through online newspaper archives, the Berlin State and Federal Archives, and interviews in Berlin.

During the Soviet occupation of eastern Germany, the Soviet memorials served as a physical statement of power and victory over Germany. They also served to re-educate the German people on the “correct narrative” of the war, featuring the heroic Red Army which “liberated” Europe. After the establishment of the German Democratic Republic in 1949, the memorials also became national symbols of the communist state used to create a constitutive story through mass ceremonies, including at times, the demonization of the West during the Cold War. In reunified Germany, average Germans pay scant attention to the memorials, although they continue to serve as objects of fascination for tourists and are still very important to the citizens of the former Soviet Union. This research examines how the memorials were used by both the Soviets and the East German communists to build support and legitimacy for their regimes in Germany and explores the relationship of the memorials to post-Soviet nationalism.

STATUS

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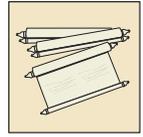
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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

“Domestic Tension”: The Symbiotic Relationship Between Art and Politics

Wafaa Bilal is a performance artist and Associate Arts Professor at New York University’s Tisch School of the Arts. In his 2007 piece “Domestic Tension”, Bilal allows distant viewers to shoot a paint-ball gun at him—anonously over the Internet—simulating a combat-like situation that allows the viewer to, literally, pull the trigger at a perceived “enemy.” Interestingly, the original name for this installation was, “Shoot An Iraqi”; however, the FLATFILE Gallery in Chicago, where the installation was located, censored his title because gallery owner Susan Aurinko thought that someone might take the title too literally as an invitation to shoot Bilal with a real gun. He renamed his installation “Domestic Tension.” On the very first day of the installation, the shooting began very early in the day with over a thousand shots fired in total, and that was just the first day out of a total of thirty days that the project would run.

The purpose of this research is to examine, using “Domestic Tension” as my primary example, the symbiotic relationship between politics and art. It is my contention that an artist like Bilal, who has been affected by, inspired by, and reacted to a set of political realities and further expresses his political perspective through his art, can have a significant influence on the general population by helping people to understand aspects of a particular political situation that they did not understand before they encountered the artist’s politically-inspired work. I will provide some background information on Bilal and provide a brief description of the journey that brought him from Iraq, through refugee camps in Kuwait and Saudi Arabia, and into the United States. I will also examine other political artwork that Bilal has created. I will examine documented reactions to the installation. I will attempt to demonstrate that politics have inspired artists, such as Bilal, to react by creating constructive executions such as “Domestic Tension” to create a dialog with the general population who participate in creating the art. According to Lucy Lippard in her article *Trojan Horses: Activist Art and Power* the “degree to which activist art is integrated with the artist’s beliefs is crucial to its effectiveness” (Lippard). Bilal has been able to infuse his beliefs about politics and war into his work to engage the public and, moreover, continue this conversation nine years later.

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Abortion in Brazil—Todo mundo faz.

This study analyzed the current actions of feminist movements, black women’s movements, and other advocacy groups that have a stake in the current debate for the legalization of abortion in Brazil. The purpose of the study was to assess the current political avenues available to marginalized groups who are disproportionately affected by the criminalization of abortion. It was built upon a comprehensive review of existing literature, which found very little information on the actions of feminist movements and black women’s movements in Northeast Brazil. The study was conducted over the course of four weeks in Salvador, Bahia. The methodology included interviews with four women affiliated with social movements, academic research organizations, and advocacy groups currently pushing for the legalization of abortion. Participant-observations were also conducted over the course of two days with the Marcha Mundial das Mulheres, an active feminist movement in Brazil. The study found that there is a lack of unity between feminist movements and other segments of civil society, which prevents the formation of a united front for the legalization of abortion. Alternatively, organized efforts by segments of society opposed to the legalization, specifically the Evangelical benches in legislative bodies, have gained strong momentum in recent years and are encroaching on existing sexual and reproductive rights. Furthermore, this study shed light on the issue of abortion as an instrument of oppression that perpetuates gender inequalities and institutional racism within a patriarchal society characterized by increasing religious fundamentalism.

KEY WORDS:

Abortion, legalization, gender-based violence, feminism, sexual and reproductive rights, institutional racism

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Provisioning Reintegration Services in Areas of Limited Statehood: The Cases of Uganda and the Democratic Republic of Congo

After years of violence by warring rebel groups in eastern and central Africa, the implementation of effective disarmament, demobilization, and reintegration programmes (DDR) are imperative for conflict resolution and post-war reconstruction efforts. Often overlooked as secondary to demobilization, reintegration refers to the long-term process that involves acceptance of ex-combatants back into their communities and regaining productive levels of engagement. This paper utilizes reintegration to highlight the difficulties of implementing long-term peacebuilding strategies and works within the limited statehood theoretical framework. Uganda and the Democratic Republic of Congo both have areas of limited statehood, regions where the state has limited capacity for governance and thus the provision of goods and services. This paper assesses the provisioning of reintegration services for ex-combatants in areas of limited statehood for the cases of Uganda and the Democratic Republic of Congo. Through interviews and reviewing existing literature, this research seeks to identify the key actors addressing reintegration in both countries and examine effectiveness. The objective of this research is to determine the most effective relationship between civil society and the state over reintegration within a conflict (DRC) and post-conflict setting (Uganda), as well as draw lessons that can be applied to other geographic contexts.

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Financial Decision-Making in Colombia: An Analysis of the Influence of Informality and Interdependence on Financial Stability

In the past two decades, the Colombian economy has experienced immense growth. While poverty rates have declined, income inequality has remained stagnant. While many factors are attributed for this phenomenon, high financial exclusion and literacy are identified as significant causes. Through extensive research and a survey of young adults in Colombia, the size of the informal sector, the rate of interdependence on family and friends, and lack of formal financial education are all identified as the most significant areas of vulnerability and potential for future programs targeting financial capability. This paper explores the influence of each factor while presenting recommendations for further research in order to promote further economic growth and political stability.

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Patriots or Xenophobes? The Relationship Between Ethnic Composition and Support for the National Front in France

The Paris terror attacks ignited a firestorm surrounding immigration. Lost in this debate has been the fact that the perpetrators in such events are often disaffected nationals, second generation immigrants. Instead of focusing on the institutional and social barriers that delay or obstruct immigrant integration, the current debate surrounding migration and terrorism is focused on controlling borders. Right wing parties, vocal opponents of immigration and staunch nationalists, have taken center stage in this debate, capitalizing on public fears and concern for national security. This public prominence, a recent phenomenon, deserves further investigation. Are the exclusionary attitudes, manifested in right wing anti-immigrant policy, evidence of a shift in opinions towards xenophobia, or do they represent efforts to preserve national identity in an age of globalization and increased immigration? Has the inevitability of migration empowered the far right? This paper seeks to identify the impact of demographic transition, due to immigration, on electoral support for right wing political parties. Using a dataset comprised of French population statistics and election results from legislative, European, and regional elections at the department level, we assess the National Front's vote share in light of fluctuations in the size of the largest minority groups. We find a negative impact on vote share for increases in the third largest minority group, but a positive impact on vote share when the fourth largest minority group increases. Thus, relative increases in ethnic homogeneity and changes in minority group hierarchies influence political support for the National Front. Left unchecked, we expect increased immigration to result in further shifting hierarchies, fear, exclusionary reactions, and social conflict. Therefore, these findings have implications for future public policy efforts to mitigate the barriers to immigrant integration. If political leaders can successfully ameliorate tensions between nationals and immigrants, there is the possibility of engaging homegrown terrorism at its roots.

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Tunisia's Young Islamists: Religious or Revolutionary Zealots?

Ennahda's many compromises during Tunisia's transition have prompted assessments that the party has alienated its base, especially by not taking more traditionally Islamist stances on issues like sharī'a. This paper draws on interviews with young Tunisian Islamists and assesses how they have responded to Ennahda's compromises. Although some young Islamists are disappointed that Ennahda did not pursue more hard-line Islamist stances, many actually share the leadership's progressive position on certain religious issues. Interestingly, young Islamists were far more angered by Ennahda's compromises on 'revolutionary' issues than they were by its compromises on 'religious' ones. This paper ultimately argues that Islam's role in Tunisian Islamism (although significant) should not be overstated, and that Ennahda and its constituents' other non-religious priorities, like identity and basic self-preservation (manifested as revolutionary zeal), are often of equal or greater importance.

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Understanding the Radicalization and Recruitment of Women

The academic narratives surrounding women’s involvement in terrorism are often framed as a binary— there is the narrative of the “violent woman” juxtaposed to the narrative of the “peacemaker.” The majority of current policy discussion assumes that women are inherently peaceful because of their traditional roles as mothers and caregivers. This role does put many women in a position to act as agents of prevention, but the academic and policy making communities do not consider that women may use this position to either encourage or perpetrate violence. The binary vision of women as terrorists and women as peacemakers gives no indication as to what issues and factors contribute to the radicalization of women, and whether or not those issues differ from those that aid in the radicalization of men.

This paper seeks to identify the specific narratives and tactics that extremist organizations use to target women as recruits. It seeks to understand what factors make women susceptible or averse to radicalization, and how those factors differ from those that are effective in recruiting men. The research team is undertaking an in-depth content analysis of recruiting materials from past extremist groups, specifically the Irish Republican Army and the Palestinian Liberation Organization, to identify cross cutting trends in tactics aimed at women. Integrating this content analysis with existing literature, and a funded research trip to Ireland, Patricia and Rebecca intend to understand the differing motivations and recruiting tactics leveraged against women, and to suggest better practices for countering the radicalization of women who are joining ISIL. Ultimately, this research will aid policymakers in identifying the best practices for countering violent extremism by integrating women into prevention projects and by further the body of research on the radicalization and recruitment of women.

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An Analysis on the Effectiveness of Multilateral Sanctions with a case study on Iran

In this research project I am going to address the use of economic sanctions by the United States (U.S.), the European Union (E.U.), and the United Nations (U.N.). I will first address these senders of sanctions separately and analyze the ways that each entity designates sanctions upon a target country and what the strengths and weaknesses of these programs are. I will next address each of these sender entities and the way that they all work together to create multilateral sanctions regimes. I will then take from the overview of these senders the essential criteria that are necessary for a sanctions program to be effective. I will then apply these criteria to the history of the sanctions program that targets Iran. I will use the example of Iran as a case study to showcase the criteria and if these multilateral sanctions were effective. I will look at the effect of sanctions on Iran overall as well as in specific instances. The effectiveness of the sanctions program will be evaluated by analyzing if the sending country's sanctions achieved their intended goal. The effectiveness specific to Iran will also be measured by the event of Iran coming to the negotiating table to complete the Joint Comprehensive Plan of Action (JCPOA). I will then briefly look forward to the way that the threat of multilateral sanctions will incentivize Iran in following through on its commitments to the JCPOA.

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Examining Germany's Healthcare Capacity and Waves of Migration from the Middle East since the 1970s

Germany, a powerhouse of European economic growth and a leader in health care access for the region, has dealt with several rounds of migration from the Middle East over the last fifty years. In light of Germany's unique history of migration and integration, this research sought to assess how well the German health system has accommodated migrants in the past, compared to the current refugee crisis. The research was conducted via an in-depth literature review using keywords, supplemented by key informant interviews. First, I examined Germany's healthcare system generally in order to understand its structure then searched for political actions on migration and healthcare since the 1970s to find similar factors and indicators that may affect migrant health and processing today. With this historical and structural perspective in mind, I found indicators for comparison like maternal health, disease incidence, and ER waiting times, among others. While this investigation is still ongoing, preliminary findings show negative outcomes in many key areas: maternal health outcomes are lower for current migrants than compared to native German women or previous migrant populations; there has been a resurgence of diseases that Germany had previously well controlled like TB; and waiting times for ERs have increased throughout the country compared to other waves of migration. There are still many signs Germany has the chance to improve and excel if the German government acts swiftly with a plan to unify its political federation and various state-funded hospitals. Once more evidence has been gathered more recommendations will come to light, but initial results point to specific recommendations like increasing maternal and child health services and resources, controlling for both emerging and reemerging diseases, and revamping ER intake systems to accommodate rapid influx.

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Developing Sanitation Infrastructure in the Time of Cholera

On January 12, 2010 a 7.0 magnitude earthquake struck Haiti killing between 100,000 and 220,000 people. The damage from the earthquake was extensive, further exacerbating the precarious construction of Haitian society. Months later, on October 12, the first case of what eventually became the largest cholera outbreak in the Western Hemisphere was reported in the Artibonite Valley in central Haiti. This second disaster further fractured the country, threatening the health of the population and inhibiting the post-disaster efforts. Cholera spread rapidly throughout the country because of the fragile sanitation system, exacerbated by the earthquake.

This research examines the development of sanitation systems in Haiti since the earthquake, looking at the different barriers to developing a full sanitation chain across the country. The research will also focus the coordination between the government and nonprofits to provide sanitation access and infrastructure to the Haitian population in the aftermath of the earthquake and the cholera epidemic.

Data was collected through semi-structured interviews with sanitation workers, government officials, and employees of nonprofits. The data was categorized by the researcher and coded to determine how each barrier identified fit into the sanitation chain. The findings will contribute to the literature on transitions from emergency response to long-term sanitation development. It will also serve to improve policy in Haiti, to improve coordination between the state and nonprofits, by increasing the capacity of DINEPA to formulate policy.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

International Humanitarian Law and the Protection of Human Rights: An Analysis of the Tunisian Constitution of 2014

On January 26, 2014, Tunisia's National Constituent Assembly promulgated the Tunisian Constitution of 2014. The Tunisian Constitution has been praised as one of the most progressive constitutions in the Middle East and North Africa region, due to its broad based commitment to the protection and promotion of human rights and its incorporation of international humanitarian law into the Tunisian legal framework. This study will examine the role international human rights instruments (international conventions and treaties) can play in the promotion of domestic human rights protections. Article 20 of the Tunisian Constitution incorporates international law into Tunisia's domestic legal framework making Tunisia an ideal case study through which to explore the effect international law can have on a country's ability to protect and promote domestic human rights. Data for the study was gathered through interviews conducted in Tunisia with Tunisian civil society organizations, legal scholars, judges, members of the Tunisian Truth and Dignity Commission, and the President of the Tunisian High Commission for Fundamental Freedoms and Human Rights. Data was also gathered from the analysis of the jurisprudence of the Tunisian Interim Commission for the Constitutional Review of Draft Laws and that of the Central and Eastern European Constitutional Courts post-1989. Since Tunisia is still in the process of establishing the primary institutions that will be responsible for protecting human rights, specifically the Tunisian Constitutional Court, the Human Rights Commission, and components of the Truth and Dignity Commission, this analysis is largely speculative. However, analysis of the collected data indicates that the Tunisian institutions responsible for protecting human rights will have the capacity to utilize international humanitarian law in their daily operations. This is suggested by the use of international human rights norms in the jurisprudence of the Interim Commission for the Constitutional Review of Draft Laws. The most influential factor of the capacity of the Tunisian Constitutional Court and Human Rights Commission to employ international law in their routine operations will depend on the character of the individuals appointed to each institution. This research offers an introduction into the ways international humanitarian law can be incorporated into a country's domestic legal framework to protect human rights and invites further research that would explore the effects of international law on Tunisia's ability to protect its human rights guarantees.

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Impact of Sanitation on Girls' Education in Urban Poor India

Pubescent girls in India disproportionately drop out of school, particularly around puberty, which some have attributed to the lack of school sanitation facilities for menstruating girls. While the sanitation sector is gaining increased recognition in policy and research, its inherent inter-linkage with educational attainment and impact on pubescent girls remains an under-researched subject. This paper examines how lack of access to adequate sanitation facilities affects educational attendance and performance of pubescent girls in urban poor India by demonstrating the relationship between pubescent girls' health and sanitation in their communities using comparative and baseline data from non-governmental organizations in India that focus on water and sanitation, as well as those that concentrate on girls' education, along with World Bank and Water and Sanitation and Hygiene (WASH) reports. In an effort to better comprehend the current reality of sanitation management and its daily impact on pubescent girls in India and identify gaps in research, policy and intervention, a review was conducted on the existing literature regarding menstrual beliefs, practices, and behaviors and the interface of sanitation systems in urban and peri-urban environments. Three main aspects of importance emerged from this research, namely the need for facilities to enable privacy for girls in schools; to consider that menstrual-related activity restriction may hinder girls' use of sanitary systems; and to adapt as needed the design of disposal mechanism for used materials given cultural taboos around menstrual waste. The overarching finding from the literature review and data analysis was that where sanitation facilities are sorely lacking, pubescent girls face many deprivations in education and that this inadequacy can be a structural pathway for cyclical gender based disempowerment. Sanitation system modifications could serve to raise the standards of sanitation systems in India and empower girls to actively and comfortably attend school.

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Avoiding Invasion: a multi-level analysis of factors responsible for the 1989 American invasion of Panama

In 1989, the Bush administration decided to launch a full-scale invasion of Panama, called Operation Just Cause, with the claim that Panama under the control of military dictator Manuel Noriega represented a threat to American national security. American foreign policy towards Panama had changed drastically since 1985, when the Reagan administration and Noriega's government were close partners. The central question of this study is to explore why U.S. foreign policy towards Panama was sometimes more and sometimes less cooperative between January 1, 1985 and December 30, 1989. This study chronologically breaks down system-level, state-level, and individual-level actors from the United States perspective and explores which of these independent variables caused the shift in U.S. foreign policy that resulted in an invasion. This process required the consultation of primary sources and peer-reviewed secondary sources, the plotting of independent variables (the levels of analysis) and dependent variables (policy) against a continuum of cooperation, as well as the adjustment and application of decision-making cognition theories. The motivation for this research is to better understand how presidential administrations can better avoid policy outcomes that lead to invasions and similar forms of violations of sovereignty, specifically because of the high casualty and economic costs associated with invasion and subsequent reconstruction efforts. By analyzing the events in a chronological order and applying various cognition theories at each level, this study finds that a complex array of state level issues, including the politics of congressional election cycles, were the major variables that resulted in the policy shift. By providing an explanation of different levels of analysis and their relation to invasion policies, this study hopes to make Congress and future presidential administrations more capable of avoiding the outcomes of invasions and their associated costs.

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The U.S. Mediator: From Northern Ireland to Israel

The Clinton Administration of the United States played a significant role in the negotiations of two defining peace processes of the 1990's: Northern Ireland and Israel- Palestine. Despite heavy U.S. involvement in both negotiations, Northern Ireland is continually designated as a success in the field of conflict resolution while Israel and Palestine failed to reach a final agreement, eventually collapsing into another decade of violence. Despite the individual complexities in the histories of each conflict, both are categorized as ethno-sectarian intrastate conflicts, with religious identity and acts of terrorism acting as defining factors in each. These conflicting conclusions beg the question of why the United States was able to successfully broker peace in one situation and failed exceedingly in the other. Rather than attribute the differing outcomes of negotiations to internal differences, this research examines whether the U.S. relationship with the actors at hand, and their strategic interests in the regions, played a hand in the negotiations' outcomes. The data collection process utilized previous arguments on the topic, newspaper accounts chronicling the negotiations, governmental documents, the statements and interviews of key actors throughout the processes, and the expertise of several professionals and academics in the field. While the internal differences between the conflicts contributed to the outcomes, the complexity of U.S. relations with the actors and its strategic interests in the area had a more detrimental impact on Israeli-Palestinian peace negotiations than the Northern Ireland negotiations. While the United States could act as a neutral third-party negotiator in Northern Ireland, its close, strategic relationship with Israel and complex interests in the Middle Eastern region as a whole, prevented the U.S. from acting as effectively in Israeli-Palestinian peace negotiations. Ultimately, this research might aid future policy-makers working to achieve Middle East peace, learning from past mistakes in approaches to the Israeli-Palestinian conflict, and what can be learned from Northern Ireland in the field of conflict resolution.

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Between the Capitalist Economy and the Solidarity Economy: Coopain-Cabana, a Quinoa Cooperative

The recent discovery of quinoa as a “superfood” has led to a rapidly increasing demand for this product, which can only be grown organically in the Andes. This demand has led to conflicting reports regarding the effect that global demand has had upon the lives of Andean quinoa farmers. This study investigates the quinoa cooperative, Coopain-Cabana, including its effects on its members and its values. The study’s primary questions deal with the topic of the solidarity economy, its effects of the cooperative, its values, and connections to traditional Andean values. It is based upon two weeks of fieldwork in the town of Cabana, Puno, Peru, a town dominated by quinoa agriculture. Primarily semi-structured interviews, participant observation, and many informal conversations with the people of Cabana, particularly the members and leaders of the cooperative were used to collect information. The cooperative was founded in 2010 to export organic quinoa to other nations. Since the start of the cooperative, the price of the town’s quinoa has increased and the cooperative is able to offer farmers a more just and stable price for their products. Now, farmers have more access to money and can improve their lives through the purchase of goods such as more modern kitchens, motorcycles, and better education for their children. This study concludes that the cooperative has improved the lives of the quinoa farmers and that it is also a true example of a solidarity economy due to its effects on the farmers, its goals, and the elimination of intermediaries. Now, the quinoa farmers have more power and control over the prices of the quinoa and are not abused by intermediaries who do not offer fair prices. Furthermore, the study analyzes the values of the cooperative and concludes that their success is due to the incorporation of traditional Andean values and the inclusion of capitalist values.

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Computed Electronic Structure of Polyaromatic Hydrocarbon Agglomerates

Soot formation is a complex and not fully understood process. In a flame a multi-step process occurs (1) incompletely combusted gaseous hydrocarbons quickly form polyaromatic hydrocarbon molecules (PAH), (2) PAH molecules form into turbostratic stacks, (3) the clustering of these stacks of PAH form spherical primary particles and (4) primary particles aggregate into larger soot fractal structures—all in a matter of a few milliseconds.

Studies of soot formation benefit research aimed at improving the efficiency of internal combustion engines or mitigating soot formation in industrial settings, but also atmospheric and biological studies. Atmospheric soot is a wide-spread pollutant with adverse health effects as well as effects on global warming. Better understanding soot formation will help us better understand the effects of soot in atmospheric chemistry and the biological effects of PAHs.

This work builds on two branches of research in our group to further elucidate a key point in the soot formation process, the agglomeration of PAH molecules into stacks and clusters: *in situ* studies of the optical band gap of soot formation and computational calculations of the bandgap of individual PAH molecules. In this new work Kohn-Sham HOMO-LUMO gaps, analogous to optical band gaps, are reported for a series of monomers, stacks, and clusters of six high-symmetry PAHs generated by DFT calculations with a 6-31G* basis set and B3YLP exchange-correlation functional using the computational chemistry package NWChem. A previously published atom-pair minimization algorithm was used to optimize the geometries of the PAH stacks and clusters.

HOMO-LUMO gaps decrease with an increase in monomer size. The HOMO-LUMO gap of homogeneous stacks and clusters is substantially lowered due to the agglomeration effects with the formation of dimers and the formation of clusters (two stacks) being the most dominant contributions. Heteromolecular particulates had HOMO-LUMO gaps that were strongly influenced by the larger molecular component in the system. The HOMO-LUMO gaps of homogeneous clusters approached a maximum agglomeration effect due to the localization of electronic interactions among adjacent stacks. Comparison of the computational results presented in this work with our group's previously published, experimentally determined optical band gaps (OBG) suggests that clusters with this OBG are comprised of modest molecular size PAH molecules, with a mass in the range 300-600 Da.

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Enzyme Kinetics: Interactions of Methanol with Catalase

Peroxisomes are membrane-bound organelles, which contain enzymes that produce hydrogen peroxide (H_2O_2) as a result of oxidation of substrates such as fatty acids, amino acids and polyamines. Catalase (CAT) in peroxisomes consume H_2O_2 and produce H_2O and O_2 . As a result, unlike mitochondria in peroxisomes oxidations are not designed to be energy conserving. Consuming H_2O_2 by peroxisomes is important as it's one of the reactive oxygen species (ROS) and can produce deleterious effects. Even though reactive oxygen species are used in cell signaling, they cause an oxidative stress, which damage cell components, such as proteins and DNA. This research intends to focus on how H_2O_2 consumption is influenced by alcohols such as methanol (CH_3OH) and ethanol (C_2H_5OH). Primarily human exposure occurs through consumption of alcoholic beverages, fruit juices, use of cosmetics, deicing fluids, and even varnish. During consumption of alcoholic drinks a little amount of methanol is ingested in combination with ethanol. The two alcohols are competitive substrates for H_2O_2 in the CAT reactions and, as a result, influence H_2O_2 levels.

When methanol interacts with H_2O_2 and CAT formaldehyde (CH_2O) and water are produced. Both methanol and formaldehyde are toxic and further damage cell components. It's hypothesized that methanol interactions with CAT will decrease hydrogen peroxide consumption. As a result, H_2O_2 will stay longer in the system and cause additional damage. As methanol is often consumed in a combination with ethanol, we simulated a model system with both alcohols. The model also includes a Glucose Oxidase (GOx), which serves a replacement for oxidation enzymes in peroxisomes. With two alcohols in the system even greater H_2O_2 levels were observed. Additionally, an experiment including formaldehyde interactions with CAT has been conducted.

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Scaffold Assembly Based on the Analysis of Non-uniform Gene Orders and Genomic Repeats

Advances in the DNA sequencing technology over the past decades have increased the volume of raw sequenced genomic data available for further assembly and analysis. While there exist many software tools for assembly of sequenced genomic material, they often experience difficulties in constructing complete chromosomes. Uneven coverage (particularly severe in single-cell sequencing) and presence of long similar subsequences (repeats) in genomes are among the major obstacles for existing genome assemblers. They therefore often are able to reliably reconstruct only long subsequences of the genome (inter-spaced with low-coverage regions and repeats), called scaffolds.

We present a method for assembly of annotated scaffolds (i.e., reconstruction of their order along genome chromosomes), which is based on the analysis of non-uniform gene orders, phylogeny and genomic repeats across multiple genomes. Our method takes as input several related genomes (some or even all of which may be fragmented) and performs simultaneous co-assembly of all fragmented genomes. The method relies on the evolutionary model, which includes genome rearrangements as well as gene insertions and deletions. Optional additional guidance for presented scaffolding method can be obtained from the information about DNA repeats from the genome assembler, as such information allows our method to reduce search space and provide more accurate results. We also integrate our method with MGRA2 ancestral genome reconstruction software, which analysis techniques increases quality of and assembly, produced by our method.

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Characterizing Candidate Genes for Giant Sperm in *Drosophila melanogaster*

Reproductive traits are important in ensuring fitness, and they tend to evolve rapidly. Sperm, in particular, is the most variable cell type in the animal kingdom. Although much is known about the genetics of spermatogenesis as a general process, little is known about the genetics of variation in sperm length and seminal receptacle (SR) length, a female sperm storage organ. Sperm length is important in sperm competition in *Drosophila* and can contribute to reproductive isolation. Moreover, sperm length coevolves with the SR length, resulting in male-female coevolution across the *Drosophila* lineage. The Manier lab previously investigated the genetic basis of sperm length in *D. melanogaster* and found 300 protein coding genes that may be involved in sperm length. A subset of these genes, *crossveinless c* and *tenectin*, were assessed using mutant lines. *Crossveinless c* is important for open tracheal system development, and *tenectin* is important for embryonic hindgut morphogenesis and epithelial tube morphogenesis. Each mutant line was crossed with the original stock flies to prepare a proper control. Males' seminal vesicles in testes and females' SRs were dissected. Sperm from dissected seminal vesicles and SR's were imaged and measured, and a statistical t-test was used to compare the mutant lines to appropriate wild type flies. Results found that there was no change in sperm length in both mutant lines. However, longer SR's were observed in *crossveinless c*. This means that mutant flies that lack proper function of *crossveinless c* have SR's that are longer than the control wild type flies. Thus, this gene plays a role in negatively regulating SR length. Future studies will investigate the roles of these genes during spermatogenesis using developmental, cellular, and molecular methods.

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Searching the Universe for Radio Transients with LOFAR

While most of the Universe changes on timescales of millions to billions of years, there are cosmological objects that change on human timescales, from years down to a small fraction of a second. These sources are called transients, and some of them give off radio waves: radio transients. Finding low-frequency radio transients can help further the understanding of astrophysics in the most extreme conditions, because transients are typically produced by some of the most physically extreme objects known, including exploding massive stars (supernovae, gamma-ray bursts) and the supermassive black holes in the centers of galaxies (active galactic nuclei), to name a few. There are still many unknowns about the landscape of radio transients as only a limited number have been observed. With the development of the Low-Frequency Array (LOFAR) in Europe, an array of approximately 7000 radio antennae across Europe, there is a prevalent amount of data at resolutions and sensitivities not seen previously at low radio frequencies. The Multi-frequency Snapshot Sky Survey (MSSS) is the first survey of the entire northern sky with LOFAR. It is set up in such a way, with two 7-minute observations and 4 hours in between them, that it is suited to search for transients and variable sources at timescales of hours and minutes. Here we present a transient search in a subset of MSSS, dubbed the MSSS Verification Field, paving the way for a search of the entire survey. We convert the calibrated data into images, and then process these images in the LOFAR Transients Pipeline (TraP), which has been developed to identify transients and variable sources. Following the processing done in the TraP, we apply machine learning techniques to the dataset to help identify sources requiring further investigation. Upon completion of the entire survey, it will establish a baseline for how active the radio sky is.

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Estimation of the True Evolutionary Distance under the Fragile Breakage Model

BACKGROUND:

The ability to estimate evolutionary distance between extant genomes plays a crucial role in many phylogenomic studies. Such distance is often measured as the number of genome rearrangements (such as reversals, translocations, fusions, and fissions) between genomes. This measure is traditionally based on the parsimony assumption, implying that the evolutionary distance between two genomes can be approximated as the rearrangement distance equal to the minimal number of genome rearrangements required to transform one genome into the other. However, in reality the parsimony assumption may not always hold, emphasizing the need for estimation that does not rely on the (minimal) rearrangement distance. The evolutionary distance that accounts for the actual (rather than the minimal) number of genome rearrangements between two genomes is often referred to as the true evolutionary distance.

METHODS AND RESULTS:

We employ the Double-Cut-and-Join (DCJ) model, which mimics genome rearrangements as DCJ operations, breaking a genome at two positions and gluing the resulting fragments in a new order. To estimate the true evolutionary distance between two genomes on the same set of blocks, we view the evolution between them as a discrete Markov process that transforms one genome into the other with a sequence of DCJs occurring independently.

We simulated the Markov model with 1000 fragile regions and up to 1500 DCJs and computed the relative error for our estimator, which happens to be below 10% in 95% of observations.

We further analyzed a set of five yeast genomes: *A. gossypii*, *K. lactis*, *K. thermotolerans*, *S. kluyveri*, and *Z. rouxii* represented as sequences of the same 710 synteny blocks. For each pair of genomes, we independently estimated the true evolutionary distance between them. The results demonstrate that some but not all pairs of yeast genomes fall under the parsimony assumption.

CONCLUSIONS:

Based on the Markov model, we developed an estimator for the true evolutionary distance between given genomes, which does not rely on the number of fragile regions in these genomes. We further established conditions under which the genomes resulted from the Markov process satisfy the parsimony assumption. Our estimator shows high accuracy even when the parsimony assumption does not hold.

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Chemical Characterization of anthelmintic activity in extracts of the bitter melon *Momordica charantia* using the hookworm *A. ceylanicum* and *C. elegans*

The Center for Disease Control and Prevention (CDC) estimates that hookworm currently infects 576-740 million people worldwide. Infection may cause anemia and protein deficiency, causing gastrointestinal health problems generally and retarded growth and cognitive development in children. The bitter melon *Momordica charantia* is widely grown in areas where hookworm is endemic, and has been used as a traditional medicine for parasitic infections and other disease in developing countries. Previously, aqueous extracts of *M. charantia* (MCE) have been shown to inhibit feeding of infective hookworm larvae (L3) and to kill adult hookworm in vitro. Identification of the biologically active component(s), could lead to development a new drug to treat hookworm and other helminth infections. To identify the active component(s) from complex botanical material such as MCE, a solvent system that effectively separates the active component(s) from the rest of the plant material is required. Extracted fractions are then tested in an in vitro adult mortality assay for activity against hookworms. The adult mortality assay requires recovery of adult hookworms from animals, and is therefore costly in terms of time, labor, and materials. Therefore, an effective separation system and a less expensive assay for testing MCE fractions would greatly accelerate fractionation and identification of the anthelmintic activity. My results suggest that there is more than one active component in MCE and that the active component has an affinity for polar solvents. I have also developed a mortality assay using the free-living model nematode *C. elegans* as an initial screen of fraction activity. This allows the initial steps in the fractionation process to be tested on much less expensive yet scientifically equivalent nematode species. Once a chemically pure compound is identified, its activity as an anthelmintic will be confirmed using hookworms. The determination of effective solvents and the characterization of the active component(s) will allow further chemical evaluation using high performance liquid chromatography, mass spectrometry, and nuclear magnetic resonance techniques to determine the chemical structure of the biologically active component(s). Using *C. elegans* with mutations in known pathways can be used to determine the mechanism of action of the active ingredient. Together, these results may lead to the development of a new anthelmintic for the treatment of hookworm.

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Palladium-LDHs: active and recyclable catalysts on decarbonylation of biomass-relevant substrates

Decarbonylation is a critical yet challenging reaction for conversion of biomass-derived materials, such as 5-hydroxymethylfurfural (HMF) and furfural. The development of low cost, active and long-lived heterogeneous catalysts for this reaction is thus highly desirable. Here we describe the development of a tunable heterogeneous catalytic platform consisting of Mg-Al-Pd layered double hydroxides (LDH). These catalysts can be electronically tuned by the incorporation of 0-10% compatible transition metals in the cationic LDH layers. Varying the quantity of Pd allows the selective incorporation of Pd only in the LDH cationic layers, or as multiatom Pd clusters on the LDH surface. The catalysts are fully characterized by XPS, Raman, PXRD, TEM, SEM, FTIR, TGA, ICP-MS, gas adsorption and microcalorimetry. The optimized catalytic system is highly active for decarbonylation of aliphatic and aromatic aldehydes, and in particular biomass-derived feedstocks HMF and furfural, even under neat conditions. The catalysts can also dehydrogenate the hydroxyl group of HMF, where tandem decarbonylation affords furan directly. The versatility of these catalysts potentially enables them to be used for additional tandem biomass-conversion reactions.

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Singular vs global solutions in generalized Hartree equation

A differential equation is a relation between a function and its derivatives. Differential equations form the language in which the basic laws of science are expressed. The science tells us how the system at hand changes “from one instant to the next.” The challenge addressed by the theory of differential equations is to take this short-term information and obtain information about long-term overall behavior. An evolution equation is a differential equation depending on a continuous time variable t . There are many questions which can be asked about evolution equations: the existence of particular types of solutions, such as equilibrium solutions, travelling waves, self-similar solutions; or a description of the solution dynamics such as an asymptotic behavior. We study the long time behavior of solutions in the nonlinear equations, where the nonlinearity is of nonlocal type and is expressed as a convolution. In these wave-type nonlinear equations there generally exists a competition between smoothing out the initial data (in terms of extra regularity and/or integrability) and focusing from nonlinearity that can cause some concentration or singularity. Our aim is to establish the threshold that gives the asymptotic behavior of solution: whether it blows-up in finite time, exists globally in time but behaves like a linear solution for large times (scatters), or exists globally in time but does not scatter.

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Reconstruction of ancestral genomes in presence of gene gain and loss

Since most dramatic genomic changes are caused by genome rearrangements as well as gene duplications and gain/loss events, it becomes crucial to understand their mechanisms and reconstruct ancestral genomes of the given genomes. This problem was shown to be NP-complete even in the “simplest” case of three genomes, thus calling for heuristic rather than exact algorithmic solutions. At the same time, a larger number of input genomes may actually simplify the problem in practice as it was earlier illustrated with MGRA, a state-of-the-art software tool for reconstruction of ancestral genomes of multiple genomes. One of the key obstacles for MGRA and other similar tools is presence of breakpoint reuses when the same breakpoint region is broken by several different genome rearrangements in the course of evolution. Furthermore, such tools are often limited to genomes composed of the same genes with each gene present in a single copy in every genome. This limitation makes these tools inapplicable for many biological datasets and degrades the resolution of ancestral reconstructions in diverse datasets. We address these deficiencies by extending the MGRA algorithm to genomes with unequal gene contents. The developed next-generation tool MGRA2 can handle gene gain/loss events and shares the ability of MGRA to reconstruct ancestral genomes uniquely in the case of limited breakpoint reuse. Furthermore, MGRA2 employs a number of novel heuristics to cope with higher breakpoint reuse and process datasets inaccessible for MGRA. In practical experiments, MGRA2 shows superior performance for simulated and real genomes as compared to other ancestral genome reconstruction tools.

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The Nature of Humans and Machines: Individual and Societal Impacts

The recent launch of the BRAIN Initiative, ongoing investment in “Big Science” and its “Grand Challenges”, and the dedication of the President’s Commission for the Study of Bioethical Issues all demonstrate the development of programs to address questions related to advances in artificial intelligence (AI) and neuroscience. The development of human-computer interfaces to augment human capabilities, introduction of technological products that replace the need for some human activities, and creation of machines that exhibit increasingly complex cognitive capabilities prompt questions about what it means to be “human” and how we, as humans, should regard these machines. The following presentation reports recent findings of ongoing research about the ways that discovery and innovation in this field will influence the human condition from three perspectives: technological, philosophical, and societal.

The key issues about the impact of relevant AI and neural technologies on humans are/were investigated by gathering data on state of the art technologies and applications, projections on likely advances and impacts in the 3-5 year horizon, and projections of impacts in the 10-year horizon. An important research vehicle includes the Association for the Advancement of Artificial Intelligence fall symposium, comprising multidisciplinary scholars and scientists addressing the impact of AI. Additionally, the HuMac Universe blogsite, developed under the guidance of Dr. Larry Medsker, engages scholars and student researchers about AI and its growing intersection in such areas within society.

The research yields data with positive possibilities, such as the potential for brain-mapping data for reverse-engineering neural networks, impacting the economy by furthering a more highly skilled workforce, and developing philosophical, theological, and legal definitions of humans vs. nonhumans, in light of neuro-and AI-technology. This project fosters discourse among AI researchers, scientists, humanities scholars, and policy makers through identification of related growth of AI with a focus on the cognitive capability of machines and their impact on people and societies socially, ethically, and scientifically.

We posit that such dialogue should not be confined to the academic sphere and that discussion of this sort is equally important for informing the public, media, and policy-makers, leading to an enlightened and empowered citizenry that will be prepared and responsive to near-term and future issues related to the nature of humans and machines.

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Investigating MID1 mechanism of function as a ubiquitin E3 Ligase in targeting and regulating cancer causing proteins

Tripartite motif (TRIM) proteins have the characteristic RING, B-box and Coiled-coil domain at their N-terminus. TRIM proteins are important for many cellular processes, including combating certain viral infections, including HIV-1.

TRIM proteins consist of either one copy of B-box domain (B-box2) or two copies (B-box1 and B-box2). These domains are known to function as ubiquitin E3 ligases, which serve to target proteins for cellular degradation and recycling. The MID1, which is important for proper midline development during embryogenesis, consists of both types of B-box domains. MID1 is a novel E3 ligase with three consecutive E3 ligase domains (RING-Bbox1-Bbox2) and without the B-box domains, the E3 ligase activity is significantly reduced. My project focuses on understanding the role of each B-box domains. I have created different RING-Bbox1-Bbox2 constructs, in which in the separation of the RING and B-box1 domains are altered and the position of the B-box1 and B-box2 domains are switched. My next goals are to determine how these changes affect the E3 ligase activity of MID1.

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An Open-Path Tunable Diode Laser Sensor for Measurement of Greenhouse Gases at the Bonanza Creek Site near Fairbanks, Alaska

Permafrost makes up one-quarter of the Earth's terrestrial surface and, as global temperatures continue to increase, it is at risk of thawing. Thawing permafrost has the potential to release twice the amount of carbon than is currently in the atmosphere. A multi-year field campaign has begun in collaboration with the University of Alaska - Fairbanks, NASA Goddard Space Flight Center, and our group at George Washington University to study carbon feedbacks during a springtime thaw at the Bonanza Creek Long Term Ecological Research site near Fairbanks, Alaska.

Here we present initial results from our near-infrared open-path instrument for the detection of ambient concentrations of carbon dioxide (in subsequent field campaigns a second channel for methane detection will be added). The optics launch-box portion of the instrument couples a near-infrared distributed feedback laser operating near 1605 nm for carbon detection with a visible laser for alignment purposes. The outgoing beam is directed through a 3.2-mm hole in a parabolic mirror and the launch-box is oriented using a two axis, alt-azi telescope mount so that the beam will hit the retroreflector target at a set distance downfield. The beam then retraces the path back to the launch-box where the light is collected on the surface of the parabolic mirror and focused onto a multi-mode fiber for detection. Using a National Instruments data acquisition system we are able to collect 500 scans per second which allows for long-term data averaging and subsequently increases the signal-to-noise ratio of our signal. The entire system has the ability to run on less than 40 W of power. In June 2015, the instrument was deployed to a thermokarst collapse scar bog in the Bonanza Creek Experimental Forest. With a 90 meter total pathlength we were able to resolve carbon dioxide absorption signals on the order of 0.5%.

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miR-141 Regulates CDC25a in Breast Cancer

BACKGROUND:

The most aggressive strains of breast cancer cells are found to be ER-/PR-/HER2-. miR-141, a member of the miR-200 family of miRNAs, has been identified for its role in breast cancer progression and has demonstrated differential expression in breast cancer cell lines. Moreover, our bioinformatics analysis suggests that miR-141 targets CDC25A, a known protein phosphatase that regulates the transition of cells from G1 to S phase. We therefore hypothesize that miR-141 binds to and regulates CDC25A gene, acting as a tumor suppressor miRNA.

METHODS:

qRT-PCR analysis was used to determine the expression of miR-141 in five breast cell lines, including MCF-7, T47D, MCF-10A, MDA-MB-231 and HS578T. After microdissection from breast cancer FFPE samples, we analyzed the expression of miR-141 during the progression of breast cancer, from normal, ADH, DCIS to IDC. Based on our target scan analysis, we selected ten probable targets for miR-141, including CDC25A. CDC25A expression was analyzed in two representative cell lines by qRT-PCR and Western blot, MCF-7 and MDA-MB-231 when transfected with control miR, miR-141 mimic, miR-141 inhibitor and inhibitor-mock. MTT assays were also used to explore cell viability following transfection of control miR and mimic in these same cell lines. A luciferase assay is underway to determine the binding specificity of miR-141 to CDC25A.

RESULTS:

Expression of miR-141 was found to be hardly detectable in MDA-MB-231 and HS578T relative to the other three cell lines. In patient samples, miR-141 expression was downregulated in IDC compared to early stage in 40% of the cases, and upregulated in 47%, with no clear change observed in 13% (n=15). qRT-PCR detection for CDC25A expression was decreased in MCF-7 and MDA-MB-231 cells when miR-141 was overexpressed. Western Blot analysis exhibited lower expression of CDC25A in MDA-MB-231 cells transfected with miR-141 mimic compared to those transfected with mock or inhibitor. The MTT assay revealed decreased cell proliferation in both MCF-7 and MDA-MB-231 when transfected by miR-141 mimic.

CONCLUSIONS:

Overall, these data suggest that miR-141 targets CDC25A, regulating its expression. Therefore, miR-141 may provide a novel approach for decreasing cell proliferation and halting tumor growth in breast cancer.

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Bumblebee Specialization Study and Gene Expression of the foraging Analogue in *Bombus impatiens*

Polyethism, the behavioral specialization of individual workers, is a key reason for the ecological success achieved by eusocial insects—those that live in cooperative colonies with queens and workers (Goulson. 2012). Just as we are trained as doctors, carpenters, or fishermen, eusocial insects, like honeybees (*Apis mellifera*) divide their tasks to specific members of the colony in order to maximize resources and allocate energy efficiently. For example, honeybees have many behavioral castes, including in-nest nurse workers that care for the developing offspring, as well as out-of-nest foragers. Amongst these foragers, some specialize on gathering pollen, while others specialize on gathering nectar. Honeybees get nutritional value in protein from pollen and get essential carbohydrates from gathering nectar (Page et al. 2007). Foraging behavior in honeybees has also been linked to a gene called foraging, but only by the difference in expression in age and category of bee (in-hive workers and foragers) (Ben-Shahar et al. 2003). Recent research has shown that despite their smaller (a few hundred as opposed to tens of thousands in *A. mellifera*) and simpler colonies, bumblebees (*Bombus impatiens*) have exhibited the same specialization behavior (Hagberry & Nieh. 2012; O'Donnell et al. 2000).

Bumblebees have an analogue to foraging, a cyclic GMP-related protein kinase— simply put, a signaling protein. It has yet to be annotated in NCBI for the commercially available North American bumblebee (Common Eastern Bumblebee, *B. impatiens*), which will be the subject of my study, but its sequence alignment is 99% identical to that of the European bumblebee, *B. terrestris*, as well as 97% identical to the Japanese species *B. ignitus*, which are both annotated correctly (Tobback et al. 2010; Kodaira et al. 2009). Due to this strong similarity, as well as the similarity between *Apis* and *B. terrestris* foraging sequence, we can assume that these are the same gene. This gene influences foraging behavior in a general sense, but has yet to be studied in the context relating to specialization. Furthermore, little to no research has been done on this bee here in the U.S., despite the fact that they are commercially available. They are mostly used for agricultural purposes and pollination of crops as opposed to being part of genetic research. The research I have done for my Honors Thesis will be presented and its aim was to study foraging gene expression levels in generalists (bees that visit both feeders with no apparent preference), as well as pollen and nectar specialists to understand how gene expression changes are related to foraging preferences. Essentially, the study will quantify expression differences between generalists, pollen specialists, and nectar specialists. This would be a novel result, and either a negative or positive outcome would be relevant to research using foraging specialization to understand the evolution of gene networks and social behavior (Page et al. 2012; Rehan et al. 2005).

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Determination of theoretical uncertainties to get $\gamma n \rightarrow \pi^- p$ data from photon-deuteron measurements.

The radioactive decay width of neutral baryons may be extracted from negatively charged and neutral pions photo-produced off the bound neutron, requiring model-dependent nuclear final state interaction (FSI) corrections. The cross section for the $\gamma n \rightarrow \pi^- p$ reaction will be extracted from recent CLAS and MAX-lab measurements (at energies between 400 - 2500 MeV and 146 - 166 MeV, respectively) for the $\gamma d \rightarrow \pi^- p p$ reaction, accounting for Fermi-motion effects in the Impulse Approximation (IA) as well as nucleon-nucleon and pion-nucleon-FSI effects beyond the IA. To test the GW-ITEP FSI code for $\gamma n \rightarrow \pi^- p$ in a reliable way and obtain information on the systematics of the extraction of the elementary $\gamma n \rightarrow \pi^- p$ reaction cross sections beyond the IA for $\gamma d \rightarrow \pi^- p p$, three key factors were chosen and analyzed: (i) The sensitivity to the number of steps of integration for numerical calculations of the five-fold integrals in the determination of FSI amplitudes; (ii) The sensitivity to the alternative deuteron-wave functions; (iii) The sensitivity to the experimental kinematic cut-off of the detected protons (the experimental information is uncertain). Preliminary estimations show that the contribution of all three factors to the overall systematics is less than 4%.

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Ecological Determinants of Antipredator Defense Behaviors in the Silver-Spotted Skipper

The larvae of *Epargyreus clarus*, the Silver-Spotted Skipper, is an insect that can be found on a wide variety of legume (*Fabaceae*) species, which offer a range of nutritional benefits that affect the growth and development of *E. clarus* caterpillars. The choice of host plant affects developmental path, overall vigor, and differential mortality from a range of invertebrate predators. This experiment tested the influence of instar and host plant on defensive responses exhibited by *E. clarus* caterpillars. Three host plants were used: soy (*Glycine max*), wisteria (*Wisteria sinensis*), and kudzu (*Pueraria montana*). Responses included immobility, movement away from the stimulus, movement towards the stimulus, biting, and regurgitation. Regurgitation volumes were also recorded across instars and host plants. Using both controlled procedures and predator arena trials, larvae inhabiting a range of instars and host plants were tested for differential responses to perceived threats.

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Smartphone app development in Neuroscience to accelerate learning and prepare students for exams in courses BiSC2220 and BiSC2320

A challenge facing science educators today is to identify and evaluate relevant platforms for engaging and interacting with a modern classroom while ensuring the quality of education is preserved. The smartphone is perfectly suited to support the open-access world of teaching and learning. By providing science education to students through smartphones, educators can effectively engage the students of a modern classroom by tapping into their digital lifestyle. This idea underlies the motivation and goal of the software presented here. We have developed a smartphone application called NeuroFacts that is associated with GWU Neuroscience courses: BiSC2220 Developmental Neurobiology and BiSC2320 Neural Circuits and Behavior. This app is available for free download from the iTunes app store by students, and will test their knowledge of modern neuroscience while preparing students for final exams. NeuroFacts contains concise details about neurobiology that can be searched by term or randomly examined. Favorite facts can be saved and quizzes for each course can be taken to test student's knowledge of key points and concepts. We are currently soliciting feedback on the app from students to help design future versions.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

The Application of Non-Dispersive IR Sensors to Detect the Variability of Local Carbon Dioxide Concentrations in Urban Environments

According to the EPA, carbon dioxide (CO₂) accounts for 82% of all greenhouse gas (GHG) emissions from anthropogenic sources. CO₂ contributes to increased global temperatures and contributes to many environmental consequences of climate change that negatively impact our health. In urban spaces, an observed trend is the development of CO₂ domes, characterized by a layer of higher CO₂ concentrations that are due to local emissions. In 2014, World Bank recorded the United States urban population at 81%. With the majority of Americans residing in urban spaces it is necessary to further quantify the variability of the local CO₂ concentrations spatially and temporally. To achieve maximum coverage and resolution, multiple ground-based measurements are necessary. With the use of low-cost sensors developed in our laboratory (referred to as "PiOxides") we can record local variations in concentration with higher spatial resolution. Each PiOxide unit utilizes a Raspberry Pi microcontroller, a non-dispersive infrared (NDIR) sensor, and a combination pressure/temperature/humidity sensor for the detection of CO₂. The inclusion of pressure and temperature measurements increases the accuracy of the CO₂ measurement. Employing PiOxides in the DC metro area would allow us to observe emerging trends in urban GHG concentrations. The goal is to expand sensor distribution to provide the potential for integrative access to an urban greenhouse gas dataset and build a citywide sensor network.

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Eip74EF in sperm length in *D. melanogaster*

The fruit fly *Drosophila melanogaster* provides an excellent model for exploring the genetic basis of complex traits, because of its short generation time, large family sizes, extensive genetic tool kit, and ease of rearing. My research examines the genetic basis of sperm length in *D. melanogaster* to provide more insight into how genetics influences morphology. After mating, sperm are stored within the female reproductive tract in specialized sperm storage organs. When females mate with multiple males, sperm competition ensues, and longer sperm are better able to displace and resist displacement by shorter sperm within the sperm storage organs. The Manier Lab used genetic mapping to previously identify candidate genes that may be responsible for sperm length. My project characterizes the effect of one of these genes, *Eip74EF*, to help determine its role in sperm elongation. *Eip74EF* is a transcription factor involved in cell death and oogenesis (i.e. creation of ova or egg cells), but its role in spermatogenesis is currently unknown. We used RNA interference (RNAi) to selectively knock down gene expression in male testes. Testes of knockdown flies were then dissected and their sperm spread onto slides, fixed, and stained. We imaged the sperm using fluorescence microscopy and measured sperm length using ImageJ software. We found that *Eip74EF* knockdown males had shorter sperm than control males, suggesting that *Eip74EF* is involved in the positive regulation of sperm length. We saw no influence of *Eip74EF* on the length of sperm heads. Future work will sequence this gene in populations of *D. melanogaster* previously selected for long or short sperm to look for differences in alleles associated with sperm length. We will also examine these populations for differences in gene expression using qPCR.

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Strict Unimodality of q -polynomials of rooted trees

We classify rooted trees which have strictly unimodal q -polynomials (plucking polynomial). We also give criteria for a trapezoidal shape of a plucking polynomial. We generalize results of Pak and Panova on strict unimodality of q -binomial coefficients. We discuss which polynomials can be realized as plucking polynomials and whether or not different rooted trees can have the same plucking polynomial.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Characterization of the *Drosophila* immune response against the pathogen *Photorhabdus*

The common fruit fly *Drosophila melanogaster* is a very efficient model for studying host innate defense mechanisms against pathogenic microorganisms. Four main pathways, namely the Immune deficiency (Imd) pathway, the Toll pathway, the Janus kinase/Signal transducer and activator of transcription (JAK/STAT) pathway and the c-Jun N-terminal kinase (JNK) pathway participate in the regulation of innate immune signaling. Strains of *D. melanogaster* with loss-of-function mutations in certain components of each pathway are commercially available. *Photorhabdus* is a Gram-negative bacterium from the Enterobacteriaceae family, which is pathogenic to *D. melanogaster* flies and other insects. *Photorhabdus* has multiple different species including *Photorhabdus luminescens* and *Photorhabdus asymbiotica*. The goal of this study is to characterize the molecular and phenotypic response of *D. melanogaster* upon infection with the insect pathogenic bacterium *P. luminescens* in comparison to the opportunistic human pathogen *P. asymbiotica*. Injection of each pathogen into mutant flies for the immune molecules PGRP-SA (Toll), PGRP-LE (Imd), Hopscotch (JAK/STAT) and Wengen (JNK) showed that *PGRP-SA* mutant flies were significantly less susceptible to infection with *P. luminescens* while *PGRP-LE* mutants were significantly more susceptible to infection with *P. luminescens*, and that *PGRP-SA* and *Wengen* mutant flies were both less susceptible to infection with *P. asymbiotica*. These results suggest the importance of the Toll, Imd and JNK immune pathways against *Photorhabdus* infection. Further experiments are underway to determine the immune signaling regulation upon challenge with the pathogens as well as the bacterial persistence during the infection. The significance of this research is to improve our understanding of the complex interactions between hosts and pathogenic microbes. This would further our understanding of how the switch from insect pathogen to human pathogen is made, which is an important step towards developing novel means to prevent diseases.

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Identifying the functional consequences of Six1 mutations in ear development

Hearing loss is the most prevalent birth defect in developed countries, occurring in 1/500 newborns. Half of the cases are due to genetic causes. It is critical to diagnose congenital hearing loss because without intervention these children do not acquire language skills, and often additionally suffer from social isolation. Branchio-otic (BOS) and Branchio-oto-renal (BOR) are among the most common types of syndromic hearing loss. The two causative genes associated with BOS/BOR diagnosis are Six1 and Eya1.

This project examines the effect of known human mutations of Six1 on genes that are required for the formation of different domains in the embryonic ectoderm: *foxd3* and *zic2* in the neural crest, *sox2* in the neural plate, *sox11* in the cranial sensory placodes, and *K81* in the epidermis. The Moody laboratory has synthesized four mutant versions of Six1 with single amino acid changes (Y129C, V17E, R110W, W122R) that have been identified in human BOS/BOR patients. These humanized mutants were expressed in *Xenopus laevis* embryos, a model organism well suited for gene discovery in human congenital hearing loss. In comparison to wild-type Six1 expression, which induced and broadened the *sox11* placode domain, the Y129C, V17E, and R110W mutants repressed and broadened the placode. However, these three humanized mutants had no effect on the *foxd3*, *zic2*, or *K81* domains compared to wild-type Six1. The W122R mutant induced *sox11* in the neural plate domain and repressed the *K81* epidermal domain. However, the W122R mutant had no effect on the *foxd3* or *zic2* domains. These findings suggest that patients carrying the Y129C, V17E, and R110W mutations are likely to have inner ear defects, whereas those carrying the W122R mutant are likely to have external ear defects. Our research into the developmental consequences of human Six1 mutations will help explain the molecular mechanisms leading to the variable inner, middle and external ear malformations in children and will help researchers associate mutations to clinical phenotypes.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Annotation of *PlexB* on the dot chromosome of *Drosophila ficusphila*

The dot chromosome of *Drosophila* is of particular interest for genetic research due to its contradictory characteristics. The chromosome appears to be heterochromatic, which is densely packed genetic material that is not easily transcribed, but despite its appearance, the dot chromosome has high gene density and is transcriptionally active. Current research through the Genomics Education Partnership (GEP), as implemented by students in the BISC 2208 Genetics Laboratory course, has examined the evolutionary trends of the dot chromosome in a variety of *Drosophila* species, using *D. melanogaster* as a well-annotated reference genome. My project examined and annotated the gene *PlexB* on contig 1 of the dot chromosome for the species *Drosophila ficusphila*, through the use of a variety of gene annotation programs such as the UCSC Genome Browser, FlyBase, and NCBI Blast. *PlexB* was analyzed in comparison to RNAseq data and other gene model predictions and annotated based on protein coding exon coordinates. The high conservation of the *PlexB* gene across species suggests its importance as a housekeeping gene in cellular functioning, and therefore has been under selection to remain unchanged over evolutionary time.

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High-sensitivity Capillary Electrophoresis Nanoelectrospray Ionization Mass Spectrometry: Toward Single-cell Proteomic

With a remarkable peak capacity and compatibility with miniscule amounts of sample, capillary electrophoresis (CE) is attractive for proteomic measurements on volume/mass-limited specimens, such as small tissue biopsies and single cells. Although multiple interfaces have been developed to couple CE to microflow ($>1 \mu\text{L}/\text{min}$) electrospray ionization (ESI) for mass spectrometry (MS), fewer designs exist that utilize nanoflow ESI (nanoESI, $<350 \text{ nL}/\text{min}$) that leads trace-level measurements in proteomics. Here, we present a CE-nanoESI interface that is simple to construct and able to detect trace-level peptides and proteins in single cells by MS.

The CE-nanoESI source was constructed based on the broadly successful co-axial sheath-flow design. As the electrospray emitter, we selected a tapered-tip metal capillary made of stainless steel because our earlier studies showed that this emitter provided high stability in both the nano- and micro-flow regimes. A CE separation capillary ($20/90 \mu\text{m}$ ID/OD, 100 cm length) was fed through the tapered-tip emitter ($100/350 \mu\text{m}$ ID/OD) and set to protrude $\sim 15 \mu\text{m}$ beyond the emitter tip. This CE-nanoESI source was positioned $<400 \mu\text{m}$ from the sampling plate orifice of a time-of-flight mass spectrometer. Optical inspection and monitoring of the ion current confirmed that stable cone-jet spraying regime was maintained when 50% methanol (0.1% formic acid) was supplied through the emitter at 150-350 nL/min as sheath-flow, and 25 kV was applied across the capillary ends during CE separation.

Analytical performance metrics of CE-nanoESI-MS were encouraging for single-cell investigations. By measuring 1 nL of a mixture of peptide standards, reproducibility was established at 2% relative standard deviation (RSD) for migration time and $<10\%$ RSD for peak area. The lower limit of detection was $\sim 2 \text{ amol}$ for angiotensin II. In a digest of 2 pg standard bovine serum albumin, the protein was identified with 12.2% sequence coverage (Mascot), raising a potential for measuring proteins in single cells. At present, we are testing this platform to monitor protein expression between single embryonic cells at different stages of embryonic development. We anticipate that CE-nanoESI-MS is adoptable to quantitative and qualitative analysis of broad types of single cells.

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Strange from the start: Ontogeny of the filtering mechanism in Silver Carp

Highly invasive Asian carp are destroying ecosystems throughout the United States by outcompeting native species. With populations growing at an alarming rate, these fish have proven difficult to control. Their ability to thrive within eutrophic environments is due to their very efficient filter-feeding mechanism. Here we present data from an ontogenetic series of Silver Carp ranging in size from 15-400mm SL detailing how this unique filtering structure is built. Like many filter-feeding species, Silver carp possess an incredibly large epibranchial organ that occupies the majority of the dorsal buccal cavity. Branchial arches 1-4 have greatly modified gill rakers that span both the ceratobranchial ventrally and the epibranchial as it curves into the body of the epibranchial organ. From the earliest ontogenetic stage examined individual gill rakers show a modified shape as compared to the basal character state for Cypriniformes. As development proceeds the structure of these gill rakers becomes increasingly complex. By early juvenile stages secondary growth of bone stitches together the primary gill rakers, forming a screen-like mesh upon which future elaborations of the filtering structures are built. As development proceeds the original shape of the gill rakers is modified, regressing in width only later to become scaffolding for more complex filtering structures. Gill rakers involved in filtering undergo significant architectural changes during development, while those curling into the epibranchial organ remain largely unchanged from earlier ontogenetic stages. Comparisons with the Bighead carp, a congeneric, suggest that the basal cypriniform morphology is retained within Bigheads.

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The Role of Pro-Phenoloxidase Genes in the Innate Immune Response of *Drosophila* to parasitic nematode infection

The melanization pathway is an important part of the innate immune system in the model organism *Drosophila melanogaster*. The reaction has been demonstrated as a powerful tool against invading microbes and in wound healing. Melanin synthesis is controlled by the enzyme phenoloxidase. Prophenoloxidase (PPO), the inactive precursor of phenoloxidase, is encoded by three genes; *PPO1*, *PPO2* and *PPO3*. Despite the importance of this system in antimicrobial immunity, little is known about the specific roles of each gene in the immune response to nematode infection. The parasitic nematode *Steinernema carpocapse*, together with its mutualistic bacteria *Xenorhabdus nematophila*, is capable of infecting and killing insects. The nematodes devoid of their associated bacteria are viable while remaining infectious. This provides an elegant model for investigating the immune response mounted by *Drosophila* in response to the nematode-bacteria complex and in response to its mutualistic partner separately. I have initiated a study to investigate the activation of *PPO* genes upon infection of *Drosophila* larvae with *Steinernema* symbiotic nematodes (containing *Xenorhabdus* bacteria) and axenic worms (lacking their bacteria). Further, flies carrying mutations in one or more *PPO* genes will be infected with the two different types of nematodes to examine the contribution of each *PPO* gene in the overall immune response against the parasites. Such studies contribute to the identification and characterization of novel innate immune mechanisms that might also exist in vertebrate animals, including humans.

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Predicting Population Demographic Information Using Multiple Imagery-Derived Spatial Features in Accra, Ghana

High quality demographic data is imperative for the development of sustainable urban growth strategies. Frequently, demographic data is collected using a ten-year census; however, the high costs associated with a census have often precluded their application in the global south, where the potential negative effects of rapid urbanization are most pronounced. Additionally, the large gaps in time between censuses can make the effective use of such data challenging in places undergoing extremely rapid growth. This project examines the efficacy of using a multispectral Quickbird-2 high spatial resolution satellite image mosaic (obtained 2010) processed with a variety of spectral and spatial feature extraction algorithms to predict neighborhood demographic variables such as population density and housing quality for Ghana's capital city of Accra. Spatial feature extraction algorithms examine groups of pixels to identify patterns, structure, variability and texture within the imagery, while spectral features examine the radiometric intensities of image pixels. Zonal statistics were calculated at the neighborhood scale for each of the imagery-derived features and in order to reduce the dimensionality and to de-noise the data, the zonal statistics outputs were condensed via Principal Components Analysis (PCA). To increase automatization and standardization in the variable selection procedure, the factors output by the PCA were input into a recursive feature extraction algorithm (RFE). However, the RFE selected all input variables to predict for all demographic variables, possibly because dimensionality had already been greatly reduced by the PCA. Using the principal components as predictors, two machine learning regression models were constructed in R: a Random Forest (RF) regression and a Support Vector Machine (SVM) regression. Though the research is ongoing, preliminary comparisons with 2010 census data provided by the Ghana Statistical Service indicate that all of the models exhibited low Mean Absolute Prediction Errors for both demographic variables, ranging from 0.39% (SVM) to 1.03% (RF) for population density and 0.11% (RF) to 0.54% (SVM) for housing quality. However, they also exhibited high Root Mean Square Errors (RMSE). RMSE for population density ranged from 5138.45 (SVM) to 7185.97 (RF) and RMSE for housing quality ranged from 0.10 (SVM) to 0.16 (RF). This indicates a small number of large errors, which is potentially a result of the data reduction via PCA. Ongoing research is investigating additional methods for variable selection as well dimensionality reduction other than PCA to enhance the predictive capability of the models.

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The interactions between associativity and self-distributivity

Associative algebraic structures have been studied for a long time and has broad applications. More recently with motivation from knot theory, self-distributive algebraic structures have been developed and are being studied. Homology theories are often used to study different properties of algebraic structures. In this poster, we shall study the different homology theories for associative self-distributive algebraic structures.

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The role of calnexin in cholesterol transport impairment in HIV infection and Tangier disease

HIV-1 infection is associated with an increased risk of developing atherosclerosis. Studies have demonstrated that this results from impairment of cholesterol transporter ATP-Binding Cassette A1 (ABCA1). In normal cholesterol transport, ABCA1 mediates the efflux of cholesterol to lipid-poor apolipoproteins, which then form high-density lipoproteins (HDL). HDL is responsible for transporting cholesterol from body tissues to the liver, which removes it from the blood. Nonfunctioning ABCA1 results in a buildup of cholesterol within the cell and leads to the development of foam cells (fat laden macrophages). These cells accumulate to form plaques within arteries and lead to development of atherosclerosis. HIV protein Nef binds to the endoplasmic reticulum (ER) chaperone calnexin, a protein responsible for the folding and maturation of ABCA1, and disrupts the interaction between ABCA1 and calnexin. This results in ER retention of ABCA1, preventing it from reaching the plasma membrane, its primary functional site. Previously, confocal microscopic techniques were used to demonstrate ABCA1 retention in the ER in HIV-infected macrophages. Upon further investigation, it was found that this phenomenon is present in images of cells transfected with ABCA1 mutants, Q597R and R587W. These mutations are characteristic for Tangier disease, a genetic disorder that results in significantly reduced levels of HDL in blood. We hypothesized that these mutations were responsible for weakened interaction between calnexin and ABCA1, similar to the mechanism engaged by Nef in HIV-infected cells. However, our results demonstrated that ABCA1 mutants bind more strongly to calnexin than the wild type ABCA1. We therefore concluded that an optimal level of ABCA1-calnexin binding is necessary for normal cholesterol efflux; both increased and decreased affinity of ABCA1-calnexin binding retains ABCA1 in ER and affects cholesterol efflux. Current study focuses on testing whether Nef, by decreasing interaction between Q597R and R587W ABCA1 mutants with calnexin, can reverse retention of mutant ABCA1 in the ER and rescue cholesterol efflux. A positive result would suggest a possible new therapeutic approach for treating Tangier disease by Nef-mimicking peptides.

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Stability analysis in a trend depending price formation model

The Price Formation Model was first introduced by J.-M. Lasry and P.L. Lions in the paper of mean field games at 2007, which describes the evolution of prices in the market. The problem was solved completely by M. d. M. Gonzalez and M. P. Gualdani with a symmetric initial condition at 2009. Luis A. Caffarelli, Peter A. Markowich, Marie-Therese Wolfram have proven the local and global existence and uniqueness with Neumann condition in 2011.

According to the conclusion proven in above mentioned literatures, the markets always stabilize. This is not the case in real life. We are interested in analyzing a modification of the model. This modification brings destabilization. We study the correlation between the stability of the model and the magnitude of a free parameter. Since the extra term can be treated as the source term, we can expect this term produces destabilization when the parameter is sufficient large.

Our model is non-linear equation; first we study the linearized model. Then we compute the eigenvalues and eigenfunctions. As the last step we plan to study the correlation between the non-linear model and linearized one. Both theoretical analysis and numerical simulation will be used in our study.

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Characterizing Gene *kayak* in Relation to *Drosophila melanogaster* Sperm

Spermatozoa are the most morphologically variable cell type in the animal kingdom and are key contributors to reproductive success and evolutionary fitness. In fruit flies of the genus *Drosophila*, sperm length can vary by two orders of magnitude, ranging from 0.3 mm in *D. persimilis* to 5.8 cm in *D. bifurca*, the longest sperm ever recorded. Sperm length in this group is advantageous in sperm competition, which occurs when females mate with multiple males, and their sperm compete for fertilizations within her reproductive tract. The Manier Lab is using *D. melanogaster* as a model to study the genetic basis of sperm length, and we have identified around 300 different candidate sperm length genes. My research focuses on the gene *kayak*, which is involved in embryo development, regulation of transcription, and signal transduction but has no known roles in spermatogenesis. We have knocked down this gene using RNA interference, which uses small interfering RNAs to inhibit translation of the *kayak* protein within male testes. We have dissected testes from knockdown males to obtain sperm, fixed and stained sperm samples on slides, and imaged entire sperm and visualized sperm heads under fluorescence microscopy. Both whole sperm and sperm heads were measured from these images using the software ImageJ, and we statistically analyzed the data to look for differences in sperm length and sperm head length in knockdown males compared with control males. We found that our knockdown males had longer sperm than the controls, suggesting that *kayak* plays a significant role in the negative regulation of sperm length, such that when it is disrupted, sperm are permitted to grow longer.

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Bottom-up Proteomics by Capillary Electrophoresis Mass Spectrometry

Mass spectrometry (MS) is the modern technology of choice for the analysis of proteins in complex biological specimens. In a bottom-up workflow, MS requires digestion of proteins to peptides followed by their separation by nano-liquid chromatography (nanoLC) before mass analysis. NanoLC achieves high performance metrics by measuring typically large volumes (100 μ L) of samples. To measure smaller sample amounts, such as single cells, we recently developed a capillary electrophoresis (CE) platform to enable the separation and ionization of peptides from nanoliters of samples. In this presentation, we overview the design and the analytical performance of CE- μ ESI-MS, ranging from high separation efficiency (\sim 300,000 theoretical plates) and trace-level detection sensitivity (\sim 75 amol lower limit of detection) to broad quantitative performance (at least 3-log-order concentration range). Additionally, we demonstrate how using this instrument, we are able to routinely identify \sim 200 different proteins from single embryonic cells in the 16-cell South African clawed frog (*Xenopus laevis*), which contain \sim 1,000-10,000-times less protein amounts than typically detectable by nanoLC-MS. Last, we highlight further analytical developments in sample preparation and analysis to increase the number of proteins that are identifiable in single embryonic cells and other volume/mass-limited specimens.

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Annotation of *Cadps-PA* on the dot chromosome of *Drosophila fucusphila*

The Genomic Education Partnership (GEP) is a collaboration between undergraduate institutions (including GW) and the McDonnell Genome Institute at Washington University in St. Louis that uses sequence improvement and annotation to shed light on the evolutionary history of the *Drosophila* dot chromosome. This tiny chromosome is unique because it is heterochromatic (tightly structured DNA), yet it has the same gene density and gene expression levels as euchromatin (loosely structured DNA). My project in the BISC 2208 Genetics Laboratory course annotated the A isoform of the *Cadps* gene on contig 55 of the dot chromosome of *D. fucusphila*. First, the gene and isoform (*Cadps-PA*) to be analyzed were identified using the UCSC Genome Browser. Next, the gene's position on contig 55 was verified using BLAST of both the *D. melanogaster* ortholog and contig 55 against the *D. melanogaster* genome. Next, BLASTx alignments of each exon against contig 55 were used to obtain preliminary coordinates of exon-intron splice sites. These putative splice sites were then verified or modified based on expected splice site sequences, gene predictions, BLASTx data from *D. melanogaster*, and RNAseq data of *D. fucusphila* using the Genome Browser. Finally, the resulting gene model of exon coordinates was confirmed using Gene Model Checker. I found that 91.8% of the amino acid sequence from the *D. fucusphila* *Cadps-PA* is identical to that of the *D. melanogaster* *Cadps-PA*, suggesting a high level of conservation between the two genes. These findings contribute to GEP's database of annotated dot chromosome genes of *D. fucusphila* and will help to elucidate patterns of genome evolution between *D. fucusphila* and *D. melanogaster*.

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Small-volume Proteomics for the Mouse Brain by CE- μ ESI High-resolution Mass Spectrometry

Microanalysis of the proteome in fine regions of the brain presents a powerful investigative opportunity to help illuminate the molecular basis of normal development and functioning of this critical organ. However, typical proteomic procedures by high-resolution mass spectrometry (HRMS), the measurement technology of choice for these molecules, require large, usually milligrams of proteins, necessitating averaging across multiple brain regions that obscures information on proteomic heterogeneity in the brain. In this presentation, we showcase custom-built HRMS platforms that accomplish high-sensitivity detection to determine protein expression in nanograms of proteins. We employ this technology to resolve proteomic heterogeneity in the mouse brain during normal development.

The cerebral cortex was isolated from adult mice (*Mus musculus*), and the tissue was lysed for bottom-up proteomic work up. The resulting peptides were sequenced by an in-house constructed capillary electrophoresis micro-electrospray ionization source coupled to HRMS. The analytical performance and protein coverage of this instrument was benchmarked against ultra-high performance liquid chromatography (UPLC), the proteomics industry standard.

A total of ~500 different proteins were identified in each ~20 ng of sample during a 60 min separation using CE-HRMS. Comparatively, UPLC-HRMS allowed the identification of ~750 proteins in ~250 ng of tissue digest over a 120 min separation gradient. The quantitative reproducibility was ~30% RSD for CE-HRMS and ~25% relative standard deviation (RSD) for UPLC-HRMS, and quantification spanned across a 4-log order dynamic range in concentration. More than 20 neuronal specific proteins were identified during the CE-HRMS measurements, with the majority involved in neuroprotection and cellular adhesion. The CE platform was sensitive enough to identify less abundant proteins implicated in cognitive function, spatial learning, synaptic plasticity, and signal transmission. Gene ontology annotation displayed a 30% overrepresentation of the observed proteins associated with glycolysis and the tricarboxylic acid cycle, suggesting higher metabolic activity needed for brain function. Besides demonstrating CE-HRMS technology for volume limited protein samples, this work provides protein expression data that can be used to complement existing information on gene transcription, helping the molecular understanding of normal brain development and functioning.

CE-HRMS provides reproducible and sensitive analysis of protein expression in the murine brain.

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Degree Profile of Hierarchical Lattice Network

We study the degree profile of random hierarchical lattice networks. At every step, each edge is either serialized (with probability p) or parallelized (with probability $1-p$). We establish an asymptotic Gaussian law for the number of nodes of outdegree 1, and show how to extend the derivations to encompass asymptotic limit laws for higher outdegrees. The asymptotic joint distribution of the number of nodes of outdegree 1 and 2 is shown to be bivariate normal. No phase transition with p is detected in these asymptotic laws.

For the limit laws, we use ideas from the contraction method. The recursive equations which we get involves coefficients and toll terms depending on the recursion variable and thus are not in the standard form of the contraction method. Yet, an adaptation of the contraction method goes through, showing that the method has promise for a wider range of random structures and algorithms.

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Synthesis of fosmidomycin analogs to target Dxr in *Mycobacterium tuberculosis* and *Plasmodium falciparum*

Antimicrobial resistance is an increasing threat that is present around the world. Resistant pathogens include *Mycobacterium tuberculosis* (Mtb), the cause of tuberculosis (TB), and *Plasmodium falciparum*, the cause of malaria. Drug resistant strains, combined with the burden for providing medication, have led to a need for new treatments. An appealing target for inhibitor design is the non-mevalonate pathway (NMP). This is the metabolic process used by these pathogens for the production of isoprenes, the building blocks of essential compounds for cellular function. Humans use an alternate pathway to make isoprenes, making the NMP of particular interest. Our focus is on the second enzyme of this pathway, 1-deoxy-D-xylulose-5-phosphate reductoisomerase (Dxr). The natural products fosmidomycin and its analogs, FR900098 and FR33289, inhibit Dxr. Our current research is on synthesizing and testing analogs of fosmidomycin against Mtb and *Plasmodium falciparum*. Specifically, β -hydroxy analogs as well as hydroxamic acid analogs with an α -substituent will be described.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Three-Dimensional Soot Thermometry Using a Commercial DSLR Camera and Focal Stacking Algorithms

Combustion processes produce approximately 80% of the energy consumed in the United States. Soot is a black carbon by-product of incomplete combustion, where a portion of the fuel carbon is converted into particulate matter. The electronic, physical, and chemical properties of soot lead to a range of negative effects for the climate, the environment, and human health. To lessen the gravity of these effects, the chemical and physical mechanisms of soot formation in combustion systems must be understood for the design of cleaner burning processes. An integral part of understanding the soot formation process in flame systems is a detailed knowledge of flame structure. In line-of-sight experimental techniques tomographic reconstructions are typically used to extract radially distributed flame structure data. Limitations to this approach include the loss of data fidelity and the increase in noise that appear during the data reconstruction. This study works to assess and demonstrate the abilities of a commercial Nikon D7200 camera to map three-dimensional (3D) soot luminosity in combustion systems without using a tomographic reconstruction technique. A series of images focused at different planes throughout the flame field are acquired to obtain soot luminosity data. Subsequently, focal stacking algorithms are used to construct a 3D map representative of luminosity data obtained from the stack of 2D images. The blackbody nature of the soot particulates provides a method for correlating the 3D luminosity, as measured by the calibrated spectral response of the camera's RGB filters, with temperature. This soot thermometry method will provide a 3D map of soot temperature without requiring a tomographic reconstruction method. The imaging methodology developed in this work will be expanded to additional diagnostics to provide more insight into flame structures including molecular and atomic species chemiluminescence.

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The Effects of Predation on Foraging Behavior in Bumblebees

Several studies have illustrated that predation affects bees' foraging. The presence of predators may cause bees to select lower quality resources if high quality foods are associated with a higher predation risk, or to decrease the amount of time spent foraging (Jones and Dornhaus 2011). Other studies have shown that certain species of bees will decrease foraging efficiency in areas where they have previously been exposed to predation by searching the area for evidence of predators before beginning to forage (Ings and Chittka 2008). This study aims to determine how predation risk alters foraging behavior in the bumblebee *Bombus impatiens*. We are introducing predation in order to analyze how it affects individual behaviors of bees who are attacked and bees who witness attacks. This study will also examine how foraging levels of the colony as a whole change once the threat of predators are introduced.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

High precision study for rho-meson resonance parameters

We study the meson's properties from two particles scattering point of view based on Lattice Quantum Chromodynamics(LQCD) method. The mesons are formed by two quarks or anti-quark which are governed by the strong interactions. The Quantum Chromodynamics(QCD) is the most popular theory which attempts to explain the strong interactions. Most of the meson have very short life time because they are formed from the scattering process of two or more stable meson such as pions. Lattice Quantum Chromodynamics is an approach to solve the QCD problems non-perturbatively by implementing the complicated simulations on large computer resources such as GW's Colonial One cluster. We can learn the QCD itself by comparing the simulation results with the natural data from the experiments. In our study, we present a high precision determination for rho-meson properties as it is in a two pions scattering channel.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Classification of High Dimensional Discrete Observations

Classification is a multivariate technique that is concerned with allocating new observations to two or more groups. A common method of classification, the normal theory linear discriminate function is not applicable to high dimensional data or for discrete multivariate distributions.

We use interpoint distances to measure the closeness of two samples, discuss their properties and use them to construct new rules for high dimensional discrete classification. We compare the proposed rules with the likelihood ratio test and data depths classifications for multivariate Bernoulli, multinomial, and multivariate Poisson distributions.

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Genome Structure via Crosslinking I: Method Development

Genome organization is of great interest in order to understand the molecular assemblies associated with the regulation of gene expression. Due to the size of the molecular scale the challenge of identifying the proximity of DNA segments to one another is difficult. With the use of a novel technique the DNA spatial organization can be reconstructed based on a proximity matrix. To approach this problem, the method named Genome-Wide Proximity Matrix via crosslinking (GWPMC) is proposed. Photo reactive probes, mono-psoralen and bis-psoralen, are used to crosslink nearby DNA segments. Unlike DNA to protein crosslinks, this new method will crosslink DNA to DNA to generate a map of the genome. With the use of imaging we will be able to detect the structural information after crosslinking. This presentation focuses on the steps in developing the method with double-stranded DNA in vitro. We have found bis-psoralen to be successful in generating interduplex crosslinks within the DNA structure. With this knowledge, we will use the GWPMC method with the photo reactive probe in other systems to determine genome packing and spatial organization.

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The Role of Golf Club Impact Conditions in Determining Spin Rate

With the introduction of Trackman technologies to the golfing industry, new ways of analyzing golf ball trajectories and swing paths have become available. The Trackman acts as a 3D Doppler Tracking Radar that generates microwave signals that interferes with the moving object (golf ball). Trackman is able to detect these reflected signals and compare the phase patterns of the waves to give an accurate portrayal of the golf ball trajectory. The software not only gives information about the golf ball like ball speed, vertical launch angle and spin rate, but also information about the golf club at impact like club head speed, angle of attack, and the loft of the club face at impact. One of the most important factors in golf is how the ball spins. This new data has shown that two people with the same club head speed can have a drastic difference in range of the golf ball. Trackman gives us the data to be able to interpret why this is. The process of what creates back spin will be explored based on the initial conditions of the club head at impact and which conditions are the most relevant. The main goal of the experiment will be to quantify how spin rate is derived and hopefully relate them to key data points from Trackman. Along the way the example of the two golfers with the same club head speeds will also be explored to describe where the loss of energy is occurring and how to fix it.

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Extrapolation of the $\rho(770)$ meson in masses and flavors

Lattice QCD calculations provide an ab-initio approach to the strong interaction and in particular to the scattering problem. Yet, those calculations are carried out at unphysical quark masses and sometimes with two instead of three flavors (for the light mass sector). A hadronic model is presented that allows to extrapolate lattice results to the physical point, formally equivalent to resonance chiral perturbation theory. The model is applied to lattice results by several groups, for the $\rho(770)$ quantum numbers. Phase shifts are extrapolated both in mass and flavor, allowing to study the role of the $K\bar{K}$ channel that has been overlooked in many analyses. For future development, this and related two-particle amplitudes will serve as building blocks of three-particle amplitudes beyond the isobar approximation, fulfilling three-body unitarity. Such amplitudes are needed for the analysis of upcoming lattice calculations, but also for experimental data from Jefferson lab in the search of hybrids and exotics.

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Network analysis reveals the recognition mechanism for complex formation of mannose-binding lectins

The specific carbohydrate binding of lectin makes the protein a powerful molecular tool for various applications including cancer cell detection due to its glycoprotein profile on the cell surface. Most biologically active lectins are dimeric. To understand the structure-function relation of lectin complex, it is essential to elucidate the short- and long-range driving forces behind the dimer formation. Here we report our molecular dynamics simulations and associated dynamical network analysis on a particular lectin, i.e., the mannose-binding lectin from garlic. Our results, further supported by sequence coevolution analysis, shed light on how different parts of the complex communicate with each other. We propose a general framework for deciphering the recognition mechanism underlying protein-protein interactions that may have potential applications in signaling pathways.

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Annotation of Thd1-PB on the dot chromosome of *Drosophila fucusphila*

The fourth or “dot” chromosome of *Drosophila melanogaster* has a number of unique characteristics that make it a unique model for the study of genome evolution. While chromosomes typically have either heterochromatic (permissive of gene expression) or euchromatic (repressive of gene expression) properties, the dot chromosome has some signatures of both. This unusual feature drives the Genomics Education Partnership’s (GEP) nationwide effort to understand the evolution of the dot chromosome across the *Drosophila* lineage with the assistance of undergraduate researchers. In the BISC 2208 Genetics Laboratory course at GW, we are annotating the dot chromosome of *D. fucusphila* to allow us to compare genomic patterns across the *Drosophila* lineage. In this project, I annotated an isoform of the gene *Thd1* of *D. fucusphila* using *Drosophila melanogaster* as a reference genome. Analysis using Flybase BLAST and the UCSC Genome Browser revealed moderate gene conservation between *D. fucusphila* and *D. melanogaster*, and an insertion event. As a consequence, the biological role of *Thd1* in *D. melanogaster*, namely mismatch repair, cannot be suggested for *Thd1* in *D. fucusphila* without further research. However, the protein in *D. fucusphila* may still be functional if the insertion is not in a critical region. The custom gene model created for Thd1-PB in this report provides a map and guide to future researchers who are probing its functionality and ultimately, it will help us explain the existence and the evolution of the dot chromosome.

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The Role of Halogen and Hydrogen Bonding Interactions in the Assembly of a Series of Uranyl Hybrid Materials

Inspired by previous work from our group which highlighted uranyl hybrid materials featuring para-substituted halogen benzoic acids,¹ a new family of four materials featuring meta-substituted halogen benzoic acid ligands and 3-Bromo-5-Iodobenzoic acid have been synthesized. These materials have been characterized via single crystal and powder X-ray diffraction and the structural systematics of these materials have been explored. Complex 1 is a molecular dimer that features pentagonal bipyramidal uranyl tectons bridged by a bidentate m-chlorobenzoic acid ligand. Compounds 2 and 3 are isomorphous uranyl 1D coordination polymers featuring the m-bromo- and m-iodo benzoic acid ligands where uranyl cations adopt the relatively uncommon square bipyramidal molecular geometry. Compound 4 is also a 1D coordination polymer yet the 1D chains are now assembled from uranyl dimers that are decorated by 3-bromo-5-iodobenzoic acid ligands on the periphery. This family of materials is highlighted by hydrogen bonding (1) or halogen bonding (2-4) interactions with the uranyl oxo atoms (Oxo-interactions), and the effects of these halogen bonding interactions have been probed via luminescence, Raman, and infrared spectroscopy. Initial results in both the luminescent and vibrational spectra suggest there is a relationship between the polarizability and number of halogen participating in halogen bonding interactions, and the observed luminescent and vibrational bathochromic shifts.

REFERENCES

- 1 N. P. Deifel and C. L. Cahill. Chem. Comm. 2011, 47, 6114-6116.

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Dissecting the role of NCX-6 in rhythmic motor behaviors in *C. elegans*

The exchanger protein NCX-6 belongs to the sodium calcium exchanger (NCX) family, a group of transporter proteins that regulate Ca^{2+} homeostasis and electrical capacitance by rapidly pumping calcium ions out of the cell. Expression of sodium calcium exchangers in *C. elegans* has been reported in diverse tissues and cell types, such as sensory neurons, interneurons, motor neurons, muscles cells and intestinal tissue, with even more diverse expression in mammals. Although the NCX family has been broadly studied, much is still unknown with regard to the specific function of NCX genes and proteins. In this characterization of NCX-6, we provide novel insight into the calcium dynamics moderated by $\text{Na}^+/\text{Ca}^{2+}$ exchangers, specifically NCX-6 and its role in rhythmic motor behaviors of the *C. elegans* intestine. Through a temporal expression pattern of *ncx-6*, we demonstrate that the gene is expressed in the intestine of the animal at all life stages. Defecation in *C. elegans*, the major intestinal process of the animal, is a highly stereotyped intrinsic rhythm that is regulated by calcium oscillations in the intestine. A comparison of the defecation motor program (DMP) in wildtype animals versus an *ncx-6* stop codon mutant reveal a significant defect in the expulsion step of this cycle when *ncx-6* was knocked down. Finally, visualization and analysis of Ca^{2+} oscillations in the intestine using the genetically encoded calcium indicator GCaMP indicate that NCX-6 does not play a role in regulating the amplitude or the periodicity of the intestinal calcium waves that have been linked to the DMP cycle in previous studies.

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Phenoloxidase Capacity of *Drosophila Chico* Mutant Flies in Response to Infection with the Insect Pathogen *Photorhabdus*

With only a single mutation in the insulin receptor substrate gene, *Chico* mutant *Drosophila* present a phenotype of enhanced longevity and a delay in the onset of age-associated traits as compared to wild type flies. Due to the correlative nature of ageing and immunity, a natural continuation of this work is to examine these flies with regard to the activity of fundamental immune mechanisms in response to infection. One of these mechanisms is the phenoloxidase pathway, which represents a junction of humoral and cellular effects. At fruition, this pathway is marked by a melanization response that aids coagulation and wound healing, as well as the production of reactive oxygen species that can have directly bactericidal effects in the *Drosophila* hemolymph. In order to measure the comparative activation of phenoloxidase in *Chico* and wild type flies, groups of these flies were first injected with pathogenic *Photorhabdus luminescens* bacteria, non-pathogenic *Escherichia coli* bacteria, or PBS as an aseptic wounding control. Melanization of the wound site was assessed visually, though in order to quantify the observed activity, hemolymph was isolated from groups of twenty flies, and an L-DOPA oxidation assay was performed in order to infer phenoloxidase activation levels from subsequent optical density measurements. Upon assessment, statistical analysis confirmed significant increases in *Chico* phenoloxidase activity across all treatments as compared to wild type controls ($p < 0.05$). Generally, these results implicate the insulin pathway in the regulation of the phenoloxidase component of the *Drosophila* immune system.

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Data Acquisition System for MUSE Experiment

Recent experiments show that measuring proton radius using two different techniques (muonic hydrogen level transition and electron scattering off the proton) provides contradictory results. The discrepancy between electronic and muonic measurements is of the order of 7σ (standard deviations). The Muon proton Scattering Experiment (MUSE) plans to resolve this discrepancy via a simultaneous measurement of electron-proton and muon-proton scattering.

The purpose of the present work is to develop a part of the Data Acquisition System (DAQ) for the MUSE experiment using FPGA-based TRB3 universal readout boards and PADIWA add on boards (developed at GSI, In Darmstadt, Germany). These will be read out using MIDAS, a general-purpose software package for event-based data acquisition.

The TRB3 boards offer many advantages, but need to be thoroughly investigated and understood before being used during the experiment. That is why, in addition, a set of slow control and monitoring packages (FPGA temperature monitor, PADIWA noise shape, automatic PADIWA threshold scan and threshold read out) was developed and tested for further use in the MUSE experiment. The obtained results are presented and discussed in the present work.

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Quantum Rectified Linear Unit for Quantum Neural Networks

Neural networks are machine learning algorithms that loosely draw their structure from the neuroscientific understanding of the human brain. They have applications to speech recognition, natural language processing, and self-driving cars. Efforts to develop neural network algorithms for quantum computers have mainly focused on developing a suitable quantum version of the artificial neuron, the basic unit of a neural network. The approach seen in recent literature involves translating classical models of neurons like the McCulloch-Pitts neuron or the sigmoid unit into the quantum world. These neural models, however, do not represent the current state-of-the-art in classical neural network research. The current gold-standard neuron for deep neural networks is the rectified linear unit (ReLU), which implements the activation function $g(x) = \max(0, x)$. ReLUs are considered the best choice neuron model because the activation function generates sparse representations and may be more biologically plausible than the sigmoid or McCulloch-Pitts model. For this research, I present a quantum algorithm with polynomial runtime for implementing a ReLU on a quantum computer. Although the runtime for this algorithm is far from fast by quantum computing's benchmarks, it represents a first step in translating the current standard neural unit in classical neural networks to the quantum realm. Additionally, a quantum ReLU may be useful for quantum neural networks because many quantum algorithms rely on sufficiently sparse matrices for their efficiency in preparing quantum states. This may introduce new approaches to developing training methods for quantum neural networks.

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Stability Studies of the MIDI B30.2 Domain for NMR Spectroscopy

Human MID1 is a microtubule-associated protein belonging to the tripartite motif (TRIM) family of proteins, and functions as an E3 ligase in the ubiquitination pathway, which tags proteins for degradation. Mutations in MID1 cause with X-linked Opitz BBB/G syndrome (XLOS), a developmental disorder characterized by malformation of the ventral midline such as cleft lip and/or palate, mental retardation, and organ complications. Mutations within the C-terminal half of MID1 cause MID1 to lose its association with the microtubules. My research focuses on the last domain of MID1, called the B30.2 domain. Using Nuclear Magnetic Resonance (NMR) spectroscopy we aim to solve the structure of the B30.2 domain so that we can characterize its function. Obtaining high concentrations of the B30.2 that is stable and soluble in aqueous solution is required for structural and functional studies. However, so far this is not feasible. My research project focuses on purifying and identifying conditions to keep the B30.2 domain soluble and stable for 2-3 weeks to acquire NMR data. Several combinations of buffers and detergents have been tested to create an ideal environment. Research regarding B30.2 stability is vital to determining its function and understand how Opitz Syndrome mutations affect its structure and function. I will present my current progress on this project.

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Biosensing on the Miniature Optical Fiber

We present a miniaturized plasmonic biosensor on the end of an optical fiber. Gold nanoparticles, which exhibit localized plasmon resonance, are employed to measure biomolecular interactions in real-time. This system allows for label-free detection of small proteins in low sensing volumes and can be used to spatially resolve molecular concentrations in cell cultures and tissue samples. Specific interactions are measured in a model two-protein system biotin/avidin, then two clinically relevant immunogenic systems, BSA/AntiBSA and Amylin/AntiAmylin.

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Mechanosensing for FLS2-activated Defense Against Bacteria in Plants

Flagellin is a key protein of the bacterial flagella. The newly discovered protein in plants that responds to flagellin, i.e., flagellin-sensitive 2 (FLS2), is ubiquitously expressed. FLS2 encodes a putative receptor kinase that recognizes an epitope flg22, the highly conserved fragment of flagellin, and triggers such downstream pathways as reactive oxygen species (ROS) for bacterial defense and plant immunity. Here we use both analytical and numerical methods to probe the elastic properties of FLS2 such as bending, twisting and stretching that underlie its sensing mechanism of flg22. Understanding this FLS2-activated defense may help design better vaccines for important crops and vegetables.

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Quantifying Translational Differences between Single Blastomeres in the 16-cell *Xenopus* Embryo by Mass Spectrometry

Characterization of the proteomic machinery underlying cell differentiation promises to elevate our understanding of the normal and impaired development of the vertebrate embryo. However, this requires specialized, highly sensitive tools, particularly based on mass spectrometry, to measure proteins in single cells. Here, we present how we designed and iteratively evaluated a single cell bottom-up workflow, including a custom-built capillary electrophoresis microelectrospray for the study of single embryonic cells (blastomeres) dissected from the 16-cell frog (*Xenopus*) embryo. We first evaluated each step of our analytical workflow to increase the number of identification. By iterative revision of sample preparation, data acquisition and processing we reached ~500 protein groups identified from single-cell amount. We then chose three distinct cells, D11, V11 and V21 which are precursors to the brain, skin and hindgut, respectively. Qualitative analysis allowed identifying ~1,700 proteins and revealed differences among the cells in correlation with their future fate. By implementing multiplex quantitation to the study of these cells, we quantified ~150 proteins. Quantification revealed significant differences ($p < 0.05$ and fold change ≥ 1.3) for 16 proteins between D11-V11, 47 protein between D11-V21, and 45 proteins between V11-V21 cells. These results highlighted translational differences along two important developmental axes: dorso-ventral and animal-vegetal, complementing earlier transcriptomics studies. Discovery proteomics on single cells opens exciting new possibilities to help better understand the basic molecular machinery underlying normal and diseased development.

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Presentations of Transversal Matroids: Uniform Matroids and Extensions

BACKGROUND:

Consider the task of filling a set of job openings from a collection of candidates. For each candidate, the only information given is which of the jobs they are qualified to hold. This is an example of a matching problem. A solution of the matching problem is a subset of the candidates that can precisely fill all the job openings.

The set of solutions to this matching problem form a geometric object called a matroid. The collection of candidates are the points of the matroid, and the solutions themselves are called the bases of the matroid.

This name is given in analogy with vector spaces, such as a line or plane. In essence, the bases of a vector space are distinct coordinate systems for the space. The size of a coordinate system is called the dimension of the space, and this works similarly for matroids from matching problems. The corresponding dimension for our example matching problem is the number of job openings.

Many distinct matching problems can give rise to the same matroid. These matching problems are called the presentations of the matroid. Many questions about these matroids can be answered by studying the set of presentations of the matroid. The set of presentations can be naturally ordered, and much information about the matroid is encoded in the structure of this ordering.

OBJECTIVE:

We present two topics onto which the relation between a matroid and its presentations sheds light. The first is a special class of matroids called uniform matroids. The second is the topic of matroid extensions, whereby a new point is added to the matroid.

RESULTS:

We show that there is a fundamental limit to the number of presentations that a uniform matroid can have. In fact, after a certain critical number of points, the set of presentations of a uniform matroid has a consistent form. We show that this critical number of points is precisely the height of the ordered set of presentations, which is dependent only on dimension.

We prove a lower bound on the number of extensions of a matroid achievable from a particular presentation. This bound is dependent only on the position (rank) of the presentation in the ordered set of presentations. Furthermore, we present examples to verify that this bound cannot be reduced in general.

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α - β Unsaturated and α 3,4-dichlorophenyl Fosmidomycin Analogues as Mycobacterium Tuberculosis Dxr Inhibitors

Mycobacterium tuberculosis (Mtb) is the world's second greatest killer due to a single infectious disease. In 2013 alone, there were 9 million new Mtb infections resulting in 1.5 million deaths, according to the World Health Organization (WHO). The Dowd research group investigates novel drug candidates to effectively and efficiently kill Mtb. 1-Deoxy-D-xylulose-5-phosphate reductoisomerase (Dxr), a key nonmevalonate pathway enzyme in bacteria isoprene intermediate synthesis, has emerged as a desirable target for inhibition—it is completely absent in humans and its inhibition causes Mtb cell death. By synthesizing analogues of Fosmidomycin and FR900098, two previously known Dxr inhibitors, the group aims to develop safe, potent antitubercular drug candidates. Two series, α - β unsaturated amides and ethers as well as α 3,4-dichlorophenyl substituted amides and ethers, are of particular interest.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Synthetic Variations of Hollow Carbon Nanospheres for Li-ion Battery Anodes

Graphite is the most widely used anode material in commercial Li-ion batteries. With a standard reduction potential of -2.9 V vs SHE and gravimetric capacity of 372 mAh/g (at LiC_6) it provides 2 to 3 times the energy density compared to aqueous battery chemistries. The challenge remains to charge graphite anodes at the very high rates required for applications such as electric vehicles while maintaining its capacity over thousands of cycles. Shortening the Li-ion diffusion distance in graphite crystallites allows one to increase the charging rate, however, small graphite particles have poor cycle life. We utilize hollow carbon nanospheres as an anode material that have orders of magnitude shorter diffusion distances than standard graphite. These HCNS are made up of concentric graphitic shells $\sim 50\text{ nm}$ in diameter that charge within minutes compared to hours for graphite. Unfortunately, the storage capacity for HCNS is lower than graphite ($\sim 220\text{ mAh/g}$ vs. $\sim 330\text{ mAh/g}$), which motivated us to investigate synthetic variation to improve HCNS.

Traditionally, we synthesize HCNS with a Ni metal catalyst embedded in cellulose. By simply changing to a Co catalyst the experimental capacity of HCNS was over 40% greater (310 mAh/g). Expanding upon this we now use a Fe catalyst as well reaching an experimental capacity that is also over 40% greater (320 mAh/g) than the Ni metal catalyst. The Li-ion cells prepared with HCNS from Co showed no capacity loss after 100 cycles with a long-term coulombic efficiency of 99.9%, both improvements over Ni synthesized HCNS performance. Additionally, the initial coulombic efficiency is 65%, an improvement of 35% compared to HCNS prepared from Ni. This new form of graphitic carbon is a very promising energy storage material that could provide batteries with faster charging rates and longer cycle life than standard graphite anodes.

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Developments for the A1 Neutron Detector: Production and Electronics

The A1 Collaboration of the Mainz Microtron in Germany uses electron scattering experiments to study many aspects of nuclear physics, particularly nuclear structure. One topic of interest to the A1 Collaboration is the study of the electric and magnetic form factors of nucleons. These form factors parametrize the response of each nucleon to an electromagnetic field, are related to the distribution of charge and magnetization in each nucleon, and are crucial to understanding the internal structures of nucleons. Proton form factors have been measured relatively precisely; however, neutron form factors are still dominated by error bars. The A1 Collaboration is in the process of building a neutron detector which will access the neutron electric form factor by measuring neutron polarization. The goal of this project was to conduct essential tests in preparation for the A1 neutron detector construction, including: testing a variety of wrapping methods for the scintillator bars of the detector, designing an efficient method for gluing elements of each individual scintillator bar, and conducting calibration tests on the electronics to be used in the detector system. The results of this project included the design of a light-tight wrapping mechanism for the scintillators, as well as the design of a platform for efficient detector construction. Testing of the electronics of the detector system yielded contradictory results, which will require further investigation as the neutron detector project proceeds.

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How Twitter Followers Consolidate and Tweet Content Changes as the Campaign for Presidency Continues

Every day, hundreds of thousands of Twitter users express their political opinions publicly online in geotagged tweets. Moreover, these users are interconnected, and followers of a particular well-known Twitter persona also tend to follow the same users. The purpose of this research is twofold: to trace how the Twitter followers of presidential candidates consolidate as the field itself consolidates, and to map unstructured political opinions into visualized relationships that reveal how Twitter followers of presidential candidates United States think about various political issues.

Through natural language processing of Twitter data, we will visualize in an interactive format (using D3.js) both issue topic, magnitude, and relative between the followers of different presidential candidates. We will also visualize the impact of the consolidation of the race for the presidency on Twitter followers. We will analyze how many followers of a candidate who dropped out of the race start following a different candidate still in the race, and map this relationship over time. This research is groundbreaking in its analysis and visualization of the virtual consolidation of presidential politics and subsequent political tweet content.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Direct Sample Analysis as a New Method of Identifying Writing Ink Compositions in Comparison to Conventional Analytical Methods

Direct sample analysis (DSA) coupled with time of flight mass spectrometry (TOF-MS) is an emerging technique for the analysis of substances in various disciplines such as food chemistry and drug detection. DSA utilizes an ion gun which can direct heated nitrogen gas molecules at solid, liquid, or gas analytes held in either mesh or glass capillary sample holders. The method is both rapid and simple because it requires very little sample preparation, eliminates the need for extractions, and provides data within seconds. Since DSA has not yet been applied to the forensic analysis of writing inks, the scope of this study is to utilize DSA in attempt to differentiate the components of various ink samples. The results of this method were compared with results obtained from liquid chromatography-high mass accuracy orbitrap mass spectrometry (LC-MS) and gas chromatography-mass spectrometry (GC-MS).

In this study, the sample collection consisted of 80 written ink entries in the form of single stroke lines on white paper. These samples included 20 black ballpoint inks, 20 black non-ballpoint inks, 20 blue ballpoint inks, and 20 blue non-ballpoint inks. For DSA analysis, a portion of each entry was cut and placed between two pieces of DSA mesh, analyzed directly on the paper by the instrument. LC-MS and GC-MS analyses required an additional extraction step with a formic acid/acetonitrile/water solution and methanol, respectively.

Analysis by DSA and LC-MS resulted in the identification of colorants as well as vehicles and additives while analysis by GC-MS only resulted in the identification of the non-colorant ingredients. Out of the three utilized methods, DSA provided the greatest number of identifications, indicating its sufficiency as a new method for the analysis of inks. However, no single method detected all the components of the ink formulations. For profiling purposes, it is therefore necessary to utilize more than one method, such as the combination of DSA, LC-MS, and GC-MS presented in this study.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Investigating Left-Right Asymmetry in Single Embryonic Cells Using Single-Cell CE-ESI-MS

Profiling the metabolome, the full suit of metabolites (<1500 Da) in embryonic cells, is crucial to understanding healthy or abnormal embryo development. Using our custom-built single-cell capillary electrophoresis mass spectrometry (CE-MS) platform, we recently found metabolic heterogeneity in single cells derived from the animal-vegetal and dorso-ventral axis of the 16-cell frog (*xenopus laevis*) embryo. This led us to now probe whether there is metabolic heterogeneity in the left-right embryonic axis. However, the metabolome being very dynamic, and diverse in chemical composition, makes the characterization challenging. This therefore calls for novel analytical strategies that are highly sensitive to diverse types of biomolecules, and compatible with the extremely small sample volumes afforded by single cells. To this end, we therefore enhanced the analytical sensitivity of our earlier approach to enable a broader coverage of the metabolome so as to qualitatively and quantitatively compare the metabolome of cells on the left to those on the right axis of the 8-cell embryo. The developed approach incorporates multiple solvents with complementary physicochemical properties. This enabled us to increase the number of metabolites to 55 from previous 40. Additionally, using multivariate and statistical analysis, we found 10 unique metabolites that are differentially abundant across the left-right axis and mapped them to central metabolic pathways. Apart from advancing single-cell analysis, and offering further insights to body patterning in the developing embryo, this methodology should be applicable to the investigation of different cell types.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Investigating the genotypic-phenotypic relationship between the gene small optic lobes (sol) and sperm length

Drosophila sperm range from 0.32 mm to 5,800 mm in length, making it a model organism for examining underlying mechanisms of spermatogenesis. Sperm length plays a major role in post-copulatory sexual selection and can cause rapid evolutionary diversification of reproductive traits and the formation of reproductive isolating barriers within species. Despite its significance, the underlying genetic mechanisms for sperm length variation are not well understood. Preliminary studies performed by the Manier Lab have identified 224 candidate genes involved in spermatogenesis through the use of restriction site associated DNA (RAD) markers to make a quantitative trait locus (QTL) map. This study investigated the effect of sol (small optic lobes) on sperm length in *D. melanogaster*. A GAL4/UAS system was used to perform an RNAi knockdown of sol in the testes during early spermatogenesis. Mature sperm from adult male *D. melanogaster* were then dissected from testes into a phosphate buffered saline (PBS), stained with DAPI, imaged, and measured. Data were analyzed to determine the effect of sol knockdown on sperm length. The sperm lengths of knockdown males were not significantly different from control sperm lengths. This result indicates that sol may not be involved in sperm length, but we also may not see an effect if a functionally redundant gene is taking over the role of sol in spermatogenesis. Alternatively, the sol knockdown may not have been fully effective. Future efforts will examine the effect of the knockdown on gene expression using qPCR and test a more effective knockdown driver. This information will be important to understanding the underlying genetic mechanisms of spermatogenesis, and will be useful for future studies of reproductive evolution.

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Multi-step small-molecular extraction for enhancing detectable coverage of the metabolome in single embryonic cells using CE-ESI-MS

Characterization of the metabolome (all metabolites) in embryonic cells fosters greater insights to growth and development. Since the metabolome is a downstream result of genomic, transcriptomic, and proteomic processes, it is a descriptor of a cell's phenotype. However, characterizing the metabolome is challenging when the sample is limited, its composition highly dynamic, and encompasses diverse types of molecules. Improved protocols are therefore necessary to enable collection of single blastomeres and permit efficient extraction of their metabolites for analysis by high-resolution mass spectrometry, the analytical method of choice for the label-free detection and quantitation of small molecules. Our goal was to develop a multi-step approach to overcome the problems that limit the detectability of the metabolome in single blastomeres. Single blastomeres were isolated by microdissection from 8-cell stage embryos of the *Xenopus laevis* (South African clawed frog), a powerful model for developmental studies. Different solvents were used to extract polar, moderately polar, and apolar portions of the single-cell metabolome. The extracts were then characterized using a custom-built single-cell capillary electrophoresis electrospray ionization mass spectrometer. This platform is able to separate, and detect metabolites with a lower limit of detection at <10 nM or 60 attomoles for various metabolites including neurotransmitters and amino acids. Statistical comparison of metabolite abundances revealed complementary performance using the multi-step extraction approach, effectively increasing the coverage of the single blastomere metabolome than what would be detectable using a conventional one-step extraction. A more comprehensive coverage of the metabolome allows us to gain a deeper understanding of biological processes underlying early normal embryonic development.

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Metabolomics by Microcapillary-Sampling CE-ESI-MS of Single Embryonic Cells in the Developing Frog (*Xenopus*) Embryo

Investigation of the embryonic single-cell metabolome provides direct molecular information on cell differentiation. Single-cell mass spectrometry is able to detect diverse types of metabolites in individual cells. Here, we develop an analytical approach that allows sampling of single cells in live embryos with minimal invasion during their developmental process to enable the characterization of their metabolome. Additionally, these small sample volumes (<5% of total cell volume) allow us to repeatedly sample the same blastomere and therefore, improve statistical confidence for data interpretation. In this study, we performed microcapillary sampling to extract cellular content from three blastomere types (V11, V12 and D12) in the 16-cell *Xenopus* embryo. Metabolites in the resulting extract were separated at 20 kV using a custom-built CE-ESI system (R.M. Onjiko et. al, PNAS 2015) and detected using a high resolution quadrupole-time-of-flight mass spectrometer (Impact HD Qq-TOF, Bruker). Our preliminary results indicate that microcapillary sampling improves the sensitivity of metabolite detection with complementary performance to our earlier approach using microdissection. Microcapillary sampling allowed us to detect ~130 different molecular features (unique m/z vs. migration time) in a single cell. Fifty-five of these molecular features were identified with high confidence as small molecules (metabolites) based on accurate mass measurements, tandem MS, and migration time comparison to standards. The separation power of the CE system was ~200,000 with a lower limit of detection at 60 amol for multiple small metabolites. The resulting metabolic data enabled the relative comparison of metabolic activities along cell lineages. With readily scalable dimensions, microcapillary sampling followed by CE-ESI-MS raises a potential for monitoring the metabolic activity of smaller cells and later stages of embryonic development.

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A Systematic Study of pH Driven Uranyl Hybrid Complexes with 4-Iodobenzoic Acid

Hybrid materials that are comprised of Uranium (VI) metal centers and organic ligands generate continued interest because of the diversity of structural chemistry. Beyond the structural cognizance, uranium-organic materials are significant in the context of the nuclear fuel cycle, particularly with respect to effects of long term waste storage on the environment. Our research investigates how the introduction of various functional groups onto organic ligands, specifically halogens (Cl, Br, I, F), can influence the coordination geometry of the uranyl cation, which in turn affects the resulting intramolecular and supramolecular interactions during crystallization. The current study has utilized uranyl nitrate and 4-iodobenzoic acid in varying concentrations and various initial pHs as a means to explore assembly and uranyl speciation. This led to the synthesis of three novel structures that have been characterized by X-ray diffraction. Compound 1 contains two monomeric building units bridged together by the carboxylate end of 4-iodobenzoic acid. Compound 2 is a tetramer which appears at a pH range of $6.8 < \text{pH} < 12$. Complex 3 is a chain decorated externally by a patterned motif of four 4-iodobenzoic acids and hydroxyl groups. Notably, the oligomerization which has occurred as a result of increasing pH also influenced the luminescence spectra, with a red shift occurring as a function of increased nuclearity.

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Enzyme Kinetics: Mitigating Oxidative Stress from Reactive Oxygen Species, Simulation of Peroxisomes by Enzyme Cross-Linking

Hydrogen peroxide (H_2O_2) is a reactive oxygen species (ROS) generated in mM concentrations during cellular respiration in peroxisomes and in the mitochondria for certain immunological and messenger functions. However, according to the mitochondrial theory of aging, H_2O_2 in excess can produce deleterious effects such as accelerated aging and cellular damage. Peroxisomes are membrane-enclosed organelles responsible for compartmentalizing ROS, namely H_2O_2 , produced by oxidases during normal metabolic processes, such as fatty acid catabolism. Peroxisomal oxidases are housed with catalase (CAT), which can consume the H_2O_2 as it is produced. Glucose oxidase (GOx) is an enzyme that produces H_2O_2 from glucose and serves as a good model for a peroxisomal oxidase. CAT consumes the H_2O_2 produced by oxidases (in this case GOx) and produces H_2O and O_2 . When these two enzymes are dispersed in solution together with excess glucose and oxygen, we observed an initial increase of H_2O_2 to about 800mM over 3 minutes, followed by nearly complete decomposition of H_2O_2 after 100 minutes. We then simulated a peroxisome by linking the two enzymes together using disuccinimidyl glutarate (DSG) to physically bring them closer together and generate multimers. The larger multimers are separated from the individual enzymes via size exclusion chromatography. We are testing the hypothesis that the multimers would limit H_2O_2 accumulation and accelerate H_2O_2 decomposition. With the cross-linked enzymes, H_2O_2 only accumulates to 600mM after 10 minutes and is fully decomposed after 50 minutes. Because the enzymes were cross-linked, the decreased distance the substrates traveled resulted in an increased reaction rate, as would occur within the peroxisomal compartment.

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Searching the Radio Sky for Transients with VLITE

With modern observatory systems peaking into the low-frequency radio spectrum of our cosmos, the field of astrophysics opened up a new window to search for new sources and phenomena. Collecting images outward into space at these frequencies grants astrophysicists wider fields of view than ever before, along with the ability to look back to times when the Universe was still very young. To study the most extreme phenomena of our universe, including supernovae, gamma-ray bursts, pulsars, and fast radio bursts, we must be able to detect and analyze single events from the busy system that is our cosmos. To achieve this, scientists have built the LOFAR Transients Pipeline (TraP). The TraP has been developed to sift through massive amounts of data, and locate possible transients and variable sources with the use of clever parametrization. The pipeline was built with the later intention to be used with telescopes or instruments besides LOFAR, including the recently commissioned low-frequency 10-antenna system employed on the Very Large Array, called the VLA Low Band Ionospheric and Transient Experiment (VLITE). This instrument will bring thousands of hours of radio frequency observing time each year, with a large instantaneous field of view, acting as new grounds for the TraP to explore. Since every new instrument is unique, it is important to tune the TraP parameters to ensure that transient and variable sources are indeed found, and spurious detections are minimized. Here we present initial results from a search for transients and variable sources in VLITE data at various timescales of one specific part of the sky, laying the ground for future systematic transient searches in all the VLITE data.

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HIV-1 Latency: Models, Techniques and Quantification

It's estimated that over 36 million individuals worldwide are infected with HIV-1, a virus with no cure. HIV-1 viral load may be reduced to undetectable levels in the plasma of infected patients by antiretroviral therapy (ART), but treatment interruption leads to viral rebound. The primary barrier to eradicating HIV-1 is the ability of the virus to establish latency in reservoirs within infected individuals, even those receiving ART. HIV-1 establishes latency early after infection by a variety of molecular mechanisms and it becomes transcriptionally inactive in CD4+ T central memory cells. Current HIV-1 eradication strategies rely on the use of latency reversal agents to reactivate the virus from latent reservoirs. These "shock and kill" strategies have shown some promise in vivo. One primary means of reactivation focuses on inhibiting histone deacetylases (HDACs) because of their role in the post-translational regulation of HIV-1. Because latently infected cells in vivo are rare, in vitro cell models provide unique mechanistic tools to better understand the establishment and maintenance of HIV-1 latency.

Here, we reviewed the literature and provide a comprehensive list of the current available models of HIV-1 latency and experimental approaches to quantify the reservoir. We depict the experimental tools, reagents and protocols necessary for the establishment of these models in the laboratory.

Model 1 - "ACH-2 cells". These cells are descendants of a human T-cell line infected with acute lymphoblastic leukemia, contain only one integrated copy of HIV-1, and provide an excellent model of early infection and latency due to the low amounts of RNA expressed before activation. Model 2 - "The Sharon Lewin model". This highly cited model relies on chemokine receptor binding to primary CD4 T-cells, which allows for infection with wild type HIV-1 and establishment of latency in physiological conditions. Model 3 - "The Eric Verdin model". This model also relies on leukemic immortalized T-cells known as Jurkat cells with single site integration of HIV-1 and have incorporated green fluorescence protein (GFP) so expression can be measured accurately by flow cytometry.

To measure the size of the inducible reservoir two main methods are currently accepted. Both the quantitative viral outgrowth assay (QVOA) and the Tat/rev Induced Limiting Dilution Assay (TILDA) are reliable approaches to accurately determine the frequency of latently infected cells with inducible provirus.

Latency models and novel quantification techniques are essential to advancing the field towards an HIV-1 cure.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

High Sensitivity Detection and Separation of High Explosives in Environmental Samples

This presentation will discuss a new technique to detect high explosives in environmental samples using micellar electrokinetic chromatography mass spectrometry (MEKC-MS).

Forensic chemists can use this rapid and highly sensitive method to separate and identify high explosives in contaminated sand, soil and water samples.

High explosives constitute the majority of modern military and industrial explosive applications. Because of their wide use, their environmental footprint is becoming an issue. Therefore identification of high explosives in soil and water is important. Currently, GC-MS and HPLC-MS are the preferred techniques for the analysis of explosives yet both have drawbacks. GC-MS is not suitable for the analysis of thermally labile compounds such as high explosives, while HPLC-MS lacks sensitivity due to low ionization efficiency of high explosives under negative ionization. Therefore a selective and sensitive method for the separation and detection of high explosives is desirable. In collaboration with the US Naval Academy, we developed a novel MEKC-MS technique for the detection of high explosives using a complexation reagent.

Analyses were performed using a sheathless CE (Beckman Coulter ProteomeLab™ PA 800) interfaced to a high resolution MS (Thermo Orbitrap Elite) using underivatized fused-silica capillaries (20µm I.D., ~100cm in length) with a porous tip. Electrospray voltage was 1.1kV and the mass spectrometer heated capillary was 150°C. Analyses were performed using a perfluorooctanoic acid (PFOA) ammonium salt as a background electrolyte. All samples were injected using pressure (1 psi for 4 s) and a separation voltage of 25 kV was used. Compounds were detected in negative ion mode as a complex with PFOA. Explosive samples from the US Army CBRNE Analytical & Remediation Activity Mobile Expeditionary Laboratory have been obtained, extracted and analyzed using our newly developed MEKC-MS method.

High explosives that formed complexes with PFOA included RDX, HMX, tetryl, and PETN. Also, amino-dinitrotoluene formed a complex with PFOA. Other nitroaromatics were detected as molecular ions. The five explosives which formed complexes with PFOA had detection limits in the high parts per billion range and linear calibration responses over two orders of magnitude. The technique was applied to the quantitative analysis of high explosives in sand samples.

Using PFOA as a background electrolyte, high explosives from contaminated sand samples could be separated and detected with high sensitivity.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

The role of *center divider (cdi)* effects on sperm head and tail length in *Drosophila melanogaster*

Postcopulatory sexual selection occurs when females mate with multiple males, resulting in competition between sperm from different males for fertilization. This postcopulatory sexual selection can drive the rapid evolution of both male sperm traits and female reproductive tract traits. In *Drosophila* fruit flies, sperm length is highly variable among even closely related species, is rapidly evolving, and includes the longest sperm known. Longer sperm have an advantage over shorter sperm from rival males during sperm competition, suggesting that postcopulatory sexual selection is driving the evolution of giant sperm. While much is known about their reproductive systems and the mechanics of spermatogenesis, almost nothing is known about the genetics that determine sperm length. Previous work in the Manier Lab identified *center divider (cdi)* as a candidate gene influencing sperm length. Preliminary work found that the female sperm storage organ, the seminal receptacle (SR) was longer in *cdi* knockouts, but sperm length was not affected. However, these studies were later found to lack an adequate control group. My study replicated this first experiment, and here I report my results of the effect of *cdi* on both sperm total length and sperm head length in *D. melanogaster*.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Tunable magnetic hydrotalcite catalytic supports: flow synthesis and characterization

We have optimized the synthesis of monodisperse magnetic core-shell particles, consisting of magnetite cores and hydrotalcite clay shells. These materials have a number of interesting potential applications, one of which is to immobilize single-site heterogeneous catalysts. Our group has used hydrotalcite supports previously for immobilization of such catalysts, but separation of the immobilized catalysts is hindered in the presence of other solids in the reaction. The materials reported herein will facilitate easy recovery. We have immobilized Pd, Ag and Ir catalysts on these supports for decarbonylation, transfer hydrogenation and acceptorless dehydrogenation reactions. The electronic effects of these supports on the immobilized catalysts are currently under investigation.

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Thioester-containing proteins regulate the immune response of *Drosophila melanogaster* against the pathogen *Photorhabdus*

The fruit fly, *Drosophila melanogaster* is an outstanding model to study the complexities of host-pathogen interactions and innate immune defense mechanisms. Thioester-containing Proteins (or TEPs) are conserved proteins among insects and mammals with potential antimicrobial activity, but their exact function in the immune system of the fly is not well understood. This study is based on an infection system that includes adult fruit flies and two different species of *Photorhabdus* bacteria, the insect pathogen *Photorhabdus luminescens* and the emerging human pathogen *Photorhabdus asymbiotica*. Here we characterize the function of TEPs in the immune response of *Drosophila* against infection by each *Photorhabdus* species. We infected *TEP2* loss-of-function mutants and their wild type controls with each pathogen and found that *TEP2* is significantly upregulated upon infection with *Photorhabdus* infection. Moreover, we saw significant differences in survival ability as well as pathogen burden between *TEP2* mutants compared to their wild type controls upon infection with each *Photorhabdus* species. Using *TEP* and immune mutant flies together with gene transcription assays, we found that certain immune signaling pathways control expression of *TEP2*. In turn, *TEP2* gene inactivation disrupts the induction of immune signaling in flies infected with the pathogens. Moreover, quantitative and qualitative assessment of the melanization reaction in *TEP2* mutants challenged with *Photorhabdus* revealed that loss of *TEP2* promotes melanization and phenoloxidase activity in the infected flies. These results suggest a potential function of *TEP* genes in the immune response of *Drosophila* against the pathogen *Photorhabdus*. Together, these findings generate novel insights into the immune role of *TEP* molecules as regulators and effectors of the *D. melanogaster* antibacterial immune response and provide a currently unknown layer of the innate immune system.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Studies of the Vestibular System in Congenital Disorders

In children with CHARGE syndrome and other related congenital disorders, vestibular parts of the inner ear are malformed, and the children experience delayed motor development and posture and balance problems throughout life. In these children, we hypothesize that improper sensory signals reach the vestibular nuclei, the first brain centers processing vestibular information, so that the nuclei develop abnormally. Exactly what happens to the vestibular nuclei is unknown and represents our long-term goal.

In our lab, we are testing a new animal model, the chick embryo, to understand what happens in the brains of children with CHARGE syndrome. Our lab and others find that rotating the developing ear, or "otocyst", 180 degrees in two day old chicks (E2) produces a large sac or an inner ear missing one or more semicircular canals (Hutson et al., 1999). To study how abnormal sensory inputs impact on brain development, we have selected a simple vestibular nucleus, the tangential nucleus, whose principal cells are distinctive (Peusner and Morest, 1977). The nucleus contains 300 principal cells. However, after otocyst rotation, the number of principal cells is decreased inconsistently, reflecting different inner ear pathologies. After hatching, the experimental chicks have problems with vestibular-mediated behaviors, including permanent head tilt, stumbling while walking, delay in standing from a supine position, and a tendency to close one or both eyes.

Our goal is to obtain a reproducible chick model so that we can generate predictable inner ear defects, like those found in CHARGE syndrome, and study the resulting brain abnormalities. We hypothesize that loss of the semicircular canals after rotation underlies the abnormal vestibular behaviors and decreased number of principal cells surviving in the tangential nucleus. We also propose that different inner ear pathologies result from instability of the rotated otocyst after cutting it free from surrounding tissue during rotation and/or not rotating the otocyst a full 180 degrees. We will address these issues by injecting fluorescent dye, Lucifer yellow, into the otocyst to improve visibility and confirm its position 24 hours after rotation when the wound has healed. We will check inner ear pathology in these embryos by injecting paint into the inner ear at E11, when ear structures are formed. With a protocol to standardize otocyst rotation so that defined inner ear pathologies are produced, we can then proceed to characterize the brain abnormalities secondary to anomalous vestibular inner ear development.

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Non-lethal exposure to widely used pesticides impairs important learning and memory functions in honeybees (*Apis mellifera*)

Our experiments and results demonstrate that sub-lethal dosages of imidacloprid (one of several wide-spread neonicotinoids) and glyphosate (an active ingredient of Roundup, one of the most common herbicides) negatively impact honeybee cognition and associative memory. These behavioral changes, induced by sublethal dosages of these pesticides, may be a significant contributor to the drastic world-wide decline of honeybees, dubbed colony collapse disorder (CCD), and may help further the understanding of this phenomenon. Both treatment and control honeybees were carefully selected and conditioned, using a series of proboscis extension reflex (PER) trials prior to exposing the treatment bees to oral sublethal dosages of pesticides and subsequent testing in a classic choice chamber. Classically conditioned honeybees, when fed sublethal dosages of imidacloprid or glyphosate at concentrations of 0.05% and 5% of the LD-50, respectively, performed significantly less accurate (compared to control bees), when testing their associative memory using this choice-chamber. Our results clearly demonstrate the negative effect of non-lethal dosages of pesticides on the associative behavior of honeybees. This in turn, implies the likelihood for a significantly reduced ability to properly and efficiently associate a variety of hive-important tasks with their associated cues. We hypothesize, and will further investigate, that a variety of cues (e.g. reading and remembering the encoded information of a waggle dance, correctly remembering nectar and pollen sources, or weakening of the hygienic behavior) may no longer stimulate honeybees to properly perform normally vital behaviors necessary for maintaining healthy honeybee hives.

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Numerical Study of Periodic Migration of Onedimensional Cell

In this proposed project, we apply the spectral methods to solve some time-dependent partial differential equations (PDEs). In particular, we adopt the spectral methods to study a physical model of cell migration. This model couples cell morphology and its polarity, and displays periodic migration, in which the cell crawls persistently in one direction before reversing periodically. As an initial attempt, we will only consider the one-dimensional (1d) case. By using the spectral methods on the numerical simulations, we explore the dependence of the period and amplitude of periodic migration on the model parameters, including the diffusion coefficient, time lag and other parameters in the kinetic term. Some elementary bifurcation analysis is performed to study this dependence theoretically.

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Hybrid Photonic Plasmonic Interconnects (HyPPI): A low Latency, Energy and Area Efficient On-chip Interconnects

As the on-chip process technology approaching the physical limit of silicon and the Moore's Law, which has guided the development of the electronics industry for over 50 years, keeps slowing down. Photonics and plasmonics on-chip interconnects have been proved as alternative options and been analyzed for the last few decades, in order to face the latency and energy challenges caused by the down-scaling of electronic devices. Although they seem to be effective solutions and have been widely applied in fiber optics and other long-range communications, the bulky diameter of the photonic devices and high Ohmic losses of the plasmonic devices are still the two main obstacles that preventing the optics system on-chip integration. This project proposed a novel hybrid interconnect technology (called "HyPPI") which combines photonics with plasmonics to overcome weaknesses from both sides, and contrasted it with other existing interconnect options such as electrical, photonic and plasmonic interconnects. The final result shows that the hybridization provides less than 10-10 sec/cm latency, 10-13 J/bit energy efficiency for data transmission, over 200 Gbps link throughput and cm-level chip-scale communication distance. Moreover, for other network metrics such as Bit Flow Density, Energy-Delay Product and Capability-to-Latency-Energy-Area Ratio (CLEAR), HyPPI generally shows 1~3 orders of magnitude higher performances. This novel hybridization technology can be applied in multiple fields, such as in chip processors, co-processors of laptops and other smart devices to consume much less energy and increase the battery life; in data centers to reduce the heat during operation and save the cooling energy; and in neuromorphic computing to mimic neuron activities and improve the performance.

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A Quantum Searching Algorithm

The problem of locating a specific piece of data in an unsorted array is similar to the problem of finding a needle in a haystack. Without resorting to sorting the array, a classical algorithm can do nothing except meticulously check each entry, one by one, until the desired one is found. In an array with n entries, then, the worst case scenario occurs when the algorithm has to check all n pieces of data in order to find the desired one. However, given a quantum computer, there is a much more efficient algorithm to solve this problem, which was presented by Lov Grover (1996). Grover's search algorithm harnesses the superposition principle of quantum physics to sort the data much more quickly, only requiring \sqrt{n} checks to search through n pieces of data. In addition to explaining how Grover's algorithm works, I will present an example in which I use the algorithm to sort a small set of data.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Investigating the structural effects of Opitz Syndrome causing mutation within the human MID-1 protein

MID-1 is a tripartite motif (TRIM) protein characterized by its RING, B-box, and Coiled coil domains. Loss of MID-1 function, due to mutations, is associated with the genetic disorder Opitz syndrome characterized by midline defects in the brain, heart, genitalia and facial structure (cleft lip and palate). MID-1 functions as an ubiquitin E3 ligase to regulating the cellular concentration of proteins that are important for cell-cell interaction and cell cycle progression, most notably protein phosphatase 2A(PP2A) and alpha4. The B-box1 domain is critical for targeting alpha4 for degradation and for the high efficiency of MID-1's ubiquitination activity. My project focuses on a mutation (P151L) in the B-box1 domain that causes Opitz syndrome. Residue 151 is a proline that is positioned at the end of an alpha helix. Therefore, it is important to understand how this mutation affects the B-box1 domain structure and function as an E3 ligase. Nuclear Magnetic Resonance (NMR) spectroscopy indicates that there are structural differences between the P151L mutant and the native B-box1 domain. However, the mutation does cause the protein to unfold compared to other mutations, indicating that MID-1 function may be altered. Autoubiquitination assays of the P151L mutant showed stronger activity compared with the wild type domain. This implies that a change in the alpha helix structure enhance E3 ligase activity. Further studies are needed to determine how this mutation will affect the targeting of alpha4 and PP2A.

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Hydrotalcite-Catalyzed Self-Coupling of Amines

Amines and imines are one of most common motifs in pharmaceutical drugs, but their traditional syntheses require the use of toxic precursors, such as alkyl halides and aldehydes. In an effort to develop economical methods for synthesis of imines and amines from more benign starting materials we employ low-cost heterogeneous catalysts. Here we report the development of a clay-based heterogeneous catalyst for the self-coupling of amines, a novel transformation. The optimized catalysts consist of impregnated palladium nanoparticles on iron-doped hydrotalcite clays. We find that microwave heating affords selectivity for imine products, while conventional heating produces both amines and imines. Interestingly, the elimination of solvent causes the formation of an azo product (functional motif of dyes). We are further exploring the mechanism of these unusual and industrially useful reactions.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Genome Structure via Crosslinking: Application to Bacteriophage

Bacteriophage genome, a complete set of DNA inside a virus that infects and replicates within a bacterium, folds back and forth many times into a supercoiled molecular assembly in its functional state. However, there exists very limited knowledge about its genome's spatial organization at the molecular level. Here we examine different models of its genome's spatial organization, and then propose a novel method to conclude to a certain model. The novel method includes a photo-crosslinking of bacteriophage DNA with bis-psoralen, a compound which intercalates between the DNAs, to identify those genomes that are in spatial proximity to each other, and to further reconstruct 3D genome spatial organization based on the proximity matrix. To this end, we will show some results of inter-duplex crosslinking of dsDNA using bis-psoralen, and then discuss the detailed method to get to the 3D spatial organization of bacteriophage genome.

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Fully-sampled phylogenies of squamates reveal evolutionary patterns in threat status

Many species are at risk from human-caused factors such as habitat loss and diseases. Collectively, extinction risk intensifies if species have low population densities and geographic range restricted to human-impacted areas. For most groups of organisms analyzed to date anthropogenic extinction risk does not affect lineages equally, however little is known about squamates (amphisbaenians, lizards, and snakes). Here we used a reference database containing 9,754 squamate species and compiled essentially all available DNA sequence data for extant squamates from GenBank. We had a total of 17 genes and in terms of sampling our data includes 5,415 species which represents 55% of the total currently recognized extant diversity of squamate, and 86.5% total currently recognized extant genera. Then, we estimate phylogenetic trees using Maximum Likelihood and Bayesian methods. We used tuatara as outgroup, so that the root node represents Lepidosauria, and the ingroup represents Squamata. For molecular dating we used a set of fossil calibrations, which for squamates is fairly well sampled. The tree estimated is overall highly similar to most previous estimates, in terms of both higher-level relationships, and the topology for smaller subclades. Across the tree 73% of the nodes are strongly supported, suggesting that this estimate provides a robust backbone for estimating species-level relationships. We used the Phylogenetic Assembly with Soft Taxonomic Inferences approach, which combines phylogenetic inference and taxonomic assignment to generate a posterior distribution of fully-sampled phylogenies. Overall, these analyses yield a distribution of 10,000 trees containing 9,754 squamate species. Using the fully-sampled phylogenies we then examined the coincidence of expert-based estimates of threat status for ~4,000 species assessed by the International Union for Conservation of Nature and phylogenetic diversity. First we asked, are threatened species more closely related than would be expected by chance, suggesting that, due to their traits or geographic distributions, certain lineages and their potentially yet unassessed species may be particularly prone to extinction? Second, are species at high risk of extinction particularly evolutionary distinct and thus represent a disproportionate amount of total evolutionary history? We found extinction-prone squamate species tend to concentrate in select portions of the tree. Both spatial co-occurrence of sister lineages in biodiverse regions, such as Madagascar and the Philippines, under particular threat, and shared ecological traits indicative of particular vulnerability seem to contribute to this pattern. However, there is no significant association between threat status and evolutionary distinctiveness, suggesting that for the species assessed near-future extinctions may not necessarily result in a disproportionate loss of evolutionary history.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

The stability of stationary solutions of a nonlocal bistable equation

In this work we study a nonlocal bistable equation which arises as the Euler-Lagrange equation of a nonlocal van der Waals type functional. We compare nonlocal interactions given by Green's functions of second-order and fourth-order differential equations and investigate stationary points with multiple discontinuous interfaces. In the second-order case, we show that the functional does not admit a stable stationary point of a finite number of discontinuities. In the fourth-order case, we show the functional may admit stable stationary points and further study the existence of minimizers in relation to the number of discontinuities.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

An investigation of the origin of charnockite and its role in the thermal evolution of a Precambrian mountain belt

It is understood that charnockites—granitic rocks that contain the mineral orthopyroxene—form as the result of an anhydrous processes. There is debate, however, as to whether those processes occur during direct crystallization from magma (igneous rocks) or as the result of previous minerals being dehydrated to pyroxene as the entire rock was metamorphosed. The literature on these rocks contains proposed mechanisms and examples for both. This project involves field work in Virginia’s Blue Ridge Mountains: one of the world’s highest concentrations of charnockitic rocks. Field observation of the overall textures of the rocks and microscopic observation of textures of specific pyroxene grains determine whether they are of igneous or metamorphic origin. Electron Probe Microanalysis (EMPA) targets grains of orthopyroxene, as well as the similar mineral clinopyroxene, to determine the crystallization temperature of the minerals and identify it as metamorphic or igneous. The abundance of these otherwise rare but economically important rocks in the Blue Ridge provides an opportunity to study a terrane containing both massive igneous plutons and metamorphic dehydration patches—negating the possibility that a single type of magma or single tectonic environment is responsible for their origin.

STATUS

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Annotation of the Ephrin gene on contig 29

The common fruit fly, *Drosophila melanogaster*, has been an important organism for geneticists. Because of its fully mapped genome, researchers are now looking at other species within the genus to study genome evolution. Of notable interest is the 'dot chromosome,' a small chromosome that is unique because of its dense, heterochromatic nature that also remains transcriptionally active. By comparing *D. melanogaster's* dot chromosome to the genome of *D. ficusphila*, we can observe what genes are conserved between the two species.

We annotated the Ephrin gene on contig 29 to provide a community resource for future evolutionary genomics research and to examine the degree of evolutionary conservation in this gene between *D. melanogaster* and *D. ficusphila*. We identified the exons on the *D. melanogaster* ortholog of Ephrin and confirmed the coordinates of the intron/exon boundaries. These coordinates comprised our new gene model, which was submitted online and verified.

The results showed a high degree of divergence between the two species. Roughly 71.4% of the submitted *D. ficusphila* sequence matched the Ephrin gene on *D. melanogaster*. The non-matching percentage can be attributed mostly to insertions and deletions on the gene.

This result is particularly interesting, given that the Ephrin gene is known to play a critical role in stem cell differentiation development of neural cells, processes that we would expect to be very similar across species.

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Isomorphisms of Infinite Directed Graphs Derived from Computable Functions

A central question in classical graph theory is to decide when two finite graphs are isomorphic. More generally, one of the main goals of computable structure theory is to classify mathematical structures up to *computable* isomorphism. Two computable structures \mathcal{A} and \mathcal{B} are *computably isomorphic* if there exists a computable bijection from \mathcal{A} to \mathcal{B} that preserves all of the functions and relations in the structure. Furthermore, we say that \mathcal{A} is *computably categorical* if every two computable copies of \mathcal{A} are computably isomorphic. All finite graphs are computably categorical; but characterizing classes of infinite graphs has been the subject of recent research.

In 2014, Cenzer, Harizanov, and Rempel studied computability-theoretic properties of injection structures, two-to-one structures, and $(2,0):1$ structures, all of which are defined by computable functions and can be interpreted as infinite directed graphs. We introduce the notion of a $(2,1):1$ structure, which consists of a countable set A together with a function $f : A \rightarrow A$ such that for every element x in A , f maps either exactly one or exactly two elements of A to x . Such structures can contain two general types of connected components: K -cycles, which consist of a directed cycle of k elements, each of which has attached an infinite (or empty) binary tree, and Z -chains, which consist of an infinite directed chain of elements, each of which has attached an infinite (or empty) binary tree.

We prove that the isomorphism problem for $(2,1):1$ structures is Π_4 in the arithmetical hierarchy, and that all such structures are Δ_4 -categorical in the Turing degree hierarchy. We provide conditions under which these structures are computably categorical, and construct examples of $(2,1):1$ structures with certain non-computable properties. We also present a connection to a long-standing unsolved problem in mathematics: the Collatz Conjecture.

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A computational method for solving exponential-polynomial Diophantine equations

This study proposes a novel computational method for solving some Diophantine equations of the form $KQ^n=f(m)$, where K and Q are fixed positive integers, and $f(m)$ is a second-degree polynomial with integer coefficients. The method presented in this study involves solving generalized Pell-Fermat equations and computing periodic zeros of the solution modulo some powers of Q . In particular, this method is tested on the equation $3^n=2m^2+1$ and shows that its only solutions are $(m,n)=(0,0)$, $(\pm 1,1)$, $(\pm 2,2)$, and $(\pm 11,5)$.

STATUS

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Seasonal Changes: A Differential Expression Analysis of the Fathead Minnow Transcriptome Acclimatized to Warm versus Cold Temperatures

Modern RNASeq technology provides a practical and accurate method for exploring the transcriptome and expressed proteins of non-model organisms. One such organism, the fathead minnow (*Pimephales promelas*), is a widely used toxicology model capable of surviving in a wide range of environmental conditions. However it is not know what changes in gene expression occur as the fish are acclimatized to the extremities of their range. Here we present a comparative transcriptome analysis of *P. promelas* at the extremities of its temperature tolerance. Differential expression results show a total of 75 transcripts with significantly higher expression in the warm acclimatized fish, and a total of 121 transcripts with significantly higher expression in the cold acclimatized fish. Giving us 196 transcripts which could be key in how the fish can adapt to environmental changes. However, many of these transcripts failed to be successfully annotated. Only 37 of the 75 warm transcripts and only 48 out of 121 cold transcripts were successfully annotated. Of these annotated transcripts, patterns that can be surmised include the up-regulation of transcripts coding for proteins involved in cell proliferation in warm acclimatized fish, indicating an increase in proliferation at higher temperatures. Transcripts coding for the mucin protein were significantly up-regulated in cold acclimatized fish, indicating that the mucus layer on the gills may be thickened at lower temperatures. Additionally, many proteins coding for viral protection mechanisms were up-regulated suggesting cold acclimatized fish were virally infected. Beyond these slight conclusions no patterns of functional enrichment in either warm or cold acclimatized fish emerged.

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SCHOOL OF ENGINEERING AND APPLIED SCIENCE

Interpreting strain-dependent interfacial rheological properties of lipid-coated microbubbles

It has been widely accepted that encapsulated microbubbles are capable of increasing the backscattered ultrasound and help in medical ultrasound imaging. This capability mainly depends on the compressibility of the inside gas. Although a free bubble is the best scatterer of ultrasound, it is unstable against dissolution in blood. Bubbles are encapsulated to overcome this limitation. Thus, to characterize the shell accurately is vital to the ultrasound imaging. However, nonlinear phenomena discovered in the lab recently—such as broadband attenuation of ultrasound measured at different excitation pressures being different—raises a serious theoretical concern, because the underlying assumption of linear and independent propagation of different frequency components nominally requires attenuation to be independent of excitation. The main purpose of this study is to investigate the validity of current attenuation theory for bubble measurement, as well as give an explanation that agrees our experimental data well. Here this issue is investigated by examining ultrasound attenuation through a monodisperse lipid-coated microbubble suspension measured at four different acoustic excitation amplitudes. We use the attenuation to determine interfacial rheological properties (surface tension, surface dilatational elasticity and surface dilatational viscosity) of the encapsulation according to three different models. A hierarchical approach of modeling has been developed in our lab, where a model is applied to one set of experimental data to obtain model parameters. We apply different interfacial models to the pressure dependent data to determine the values of interfacial dilatational elasticity and viscosity for the lipid coating as functions of pressure amplitude. Different models produce very similar values for the parameters. We investigate and establish the validity of the pressure dependent attenuation analysis and relate the pressure dependent properties to a strain-dependent properties showing that the interfacial dilatational viscosity and elasticity decreases with average areal strain. We provide a phenomenological relation for the strain dependence.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Identification and functional characterization of *Idgf* genes in the *Drosophila* immune response against nematode-bacteria complex

The immune response of insects against microbial infections is well studied, but our understanding of the molecular and mechanistic basis of insect anti-nematode immune defense remains incomplete. We have used the insect parasitic nematode *Steinernema carpocapsae*, which is found in mutualism with the bacteria *Xenorhabdus nematophila*, to study the *Drosophila* immune response against nematode infections. We have employed Illumina RNA-sequencing technology to determine the number and nature of genes that are differentially regulated in *Drosophila* larvae in response to infection by the nematodes. Bioinformatic analysis has identified certain genes in *Drosophila* that are known to function in immune signaling pathways, as well as genes that participate in wound healing, stress response, coagulation reaction, metabolic pathways and development. We have identified a family of genes called the Imaginal Disc Growth Factors (*Idgfs*) that could have a potential function against *Steinernema* infections. Infections with symbiotic or axenic (bacteria free) nematodes have revealed that inactivation of certain *Idgf* genes does not affect the survival ability of larvae compared to their wild-type controls. However, *Idgf3* mutant larvae exhibit resistance to infection by the mutualistic bacteria, *Xenorhabdus*. These results suggest that *Idgf* genes could function in the *Drosophila* innate immunity. Functional tests will reveal the specific activity of *Idgf* genes in the *Drosophila* innate immune response. These findings will help to identify novel genes and better understand the *Drosophila* anti-pathogen immune response.

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Behavior of solutions in the Nonlinear Klein-Gordon Equation

One of the variations of the nonlinear wave equation is the nonlinear Klein-Gordon equation with an extra linear term. A typical question studied in such nonlinear PDE is the existence of solutions and their behavior infinite or finite time. In this presentation we will consider the so called dichotomy between globally (in time) existing solutions vs solutions which exist only for finite time (i.e., form singularity or blow up). The case of the focusing cubic Nonlinear Klein-Gordon Equation in 3d is known when the energy is less than the ground state energy ($E(u_0; u_1) < E(Q)$). However, when one of the variations of the nonlinear wave equation is the nonlinear Klein-Gordon equation with an extra linear term. A typical question studied in such nonlinear PDE is the existence of solutions and their behavior in finite or infinite time. In this presentation we will consider the so called dichotomy between globally (in time) existing solutions vs solutions which exist only for finite time (i.e. form singularity or blow up).

The case of the focusing cubic Nonlinear Klein-Gordon Equation in 3d is known when the energy is less than the ground state energy ($E(u_0; u_1) < E(Q)$). However, when it is above the ground state energy, the question about solutions behavior is not yet understood well. Thus, the numerical simulations become vital. Numerical simulations show the blowup/global existence regions for some specific data. In the meanwhile, some interesting behaviors about the solution are also found. Similar results are obtained in different dimensions and nonlinearities.

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Torsion in rack and quandle homology and its applications to higher dimensional Knot Theory

Rack homology theory was introduced between 1990 and 1995 by Fenn, Rourke, and Sanderson, and in 1999, Carter, Jelsovsky, Kamada, Langford, and Saito modified it to quandle homology theory in order to obtain knot invariants for classical knots and knotted surfaces in a state-sum form called cocycle knot invariants. In 1993, Fenn, Rourke, and Sanderson introduced the rack space to define rack homotopy invariants and a modification to the quandle space and quandle homotopy invariants of classical links was introduced by Nosaka in 2011.

In analogy to the well-known result in reduced group homology of finite groups that the order of a group annihilates its homology, we prove that the torsion subgroup of rack and quandle homology of a finite quasigroup quandle is annihilated by its order. It was an open conjecture for over 15 years. We also introduce an m -almost quasigroup quandle as a generalization of a quasigroup quandle and study annihilation of torsion in its rack and quandle homology groups. Moreover, as a generalization of rack and quandle spaces, we define the Cayley-type graph and CW complex of distributive structures, and study a relation with homology theory of distributive structures.

The birth of higher-dimensional knot theory occurred in 1925, when Artin introduced the notion of spinning of a classical knot which is a method of making a knotted surface from a given classical knot. In 1965, Zeeman introduced the notion of twist spun knots and showed that (± 1) -twist spun knots are equivalent to trivial 2 -knots.

As an application of rack and quandle homology theory to higher dimensional Knot Theory, we first define a knotted 2 -dimensional foam which is a generalization of a knotted sphere and prove that a (± 1) -twist spin of a knotted trivalent graph may be knotted by using quandle colorings. We then construct some families of knotted graphs for which the (± 1) -twist spins are always unknotted. Second, we construct periodic surface links in 4 -dimensional space analogous to periodic classical links in 3 -dimensional space and introduce cocycle knot invariants using certain quandle extensions to color them and to compute cocycles.

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Green hydrogenation of Carbonyls, Olefins, and Imines: Iridium and Ruthenium-catalyzed Transfer Hydrogenation from Glycerol

Glycerol, an abundant byproduct of biodiesel formation, is a desirable hydrogen source for Transfer Hydrogenation (TH) through its redox coupled conversion from a waste stream to a value-added product, dihydroxyacetone. Furthermore, its use in excess eliminates the call for exogenous and often toxic solvents. While an ideal substrate, overcoming challenging thermodynamic barriers in glycerol require catalysts to elevate the reactivity and mediate TH. Homogeneous catalysts, consisting of organic ligands chelated to metal centers, provide ample opportunity for precise design through electronic and structural modifications in the ligand architecture. Herein, four water soluble, Iridium and Ruthenium homogeneous catalysts are reported with their reactivity towards Transfer Hydrogenation (TH) of various carbonyls, olefins, and imines using glycerol. With the preliminary studies of the catalysts completed, these catalysts can be supported on to tunable clays so that they may be reobtained and recycled in multiple reactions.

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hA induces ASK1 mediated pancreatic stress

Type II diabetes mellitus is characterized by the death of pancreatic β -cells and insufficient insulin production in response to elevated blood glucose levels. Previous research implicates the misfolding and aggregation of human amylin, a 37 amino acid peptide hormone, in the death of pancreatic β -cells. This study examines the previously unexplored role of apoptosis signal-regulating kinase (ASK1) in response to human amylin (hA) induced β -cells death. The first set of studies aimed at determining whether hA-induced cytotoxicity and c-JUN N-Terminal Kinase (JNK) activation were downstream of hA-induced ASK1 activation. In order to achieve this, pancreatic rat insuloma (RIN-m5F) β -cells were treated with an ASK1 specific inhibitor, NQD11, and then subsequently treated with hA, aggregation incapable rat amylin, hydrogen peroxide or thapsigargin. While H_2O_2 was used to induce oxidative stress, thapsigargin was employed to induce endoplasmic reticulum stress. Thus treated cells were then assessed for activation of ASK1 and another stress kinase JNK by western blot analysis using phospho specific ASK1 and JNK antibodies, respectively. Western blot analysis revealed that the inhibition of ASK1 activation only partially reduces JNK activation, suggesting that although ASK1 is an upstream signal to JNK, it is not the only cause of JNK activation. Furthermore, the cytotoxic effects of these treatments were determined by MTT metabolic assay. MTT studies revealed that co-treatment of stress inducers with NQD11 partially reversed the extent of stress in these cells. Taken together, these findings suggest that while the ASK1-JNK pathway indeed contributes to hA toxicity, it is not the only factor behind it. Current and future findings from this study will be critical in understanding the regulatory role of ASK 1 in human amylin induced cytotoxicity, which bears importance for understanding the biology of stress in pancreatic cells.

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Tcf1 and Lef1 establish CD8⁺ T cell identity *via* their intrinsic histone deacetylase activity

CD4⁺ and CD8⁺ T cells, the essential mediator in immune defense against foreign pathogens and transformed cells, are two distinct sub-lineages of T lymphocytes. However, it remains unknown how the CD4⁺ and CD8⁺ T cell dichotomy is established. This study examines the roles of high mobility group transcription factors Tcf1 and Lef1 for establishing CD8⁺ T cell identity. To determine if deficiency in Tcf1 and Lef1 perturbs CD8⁺ T cell integrity, RNA-Seq and ChIP-Seq analyses are performed for control and Tcf1/Lef1-deficient CD8⁺ T cells. The result reveals that Tcf1 and Lef1 are essential for repressing CD4⁺ lineage-associated genes including Cd4, Foxp3 and Rorc in CD8⁺ T cells. Loss of Tcf1 and Lef1 exhibits histone hyperacetylation, suggesting that Tcf1 and Lef1 are actively involved in restraining histone acetylation levels of CD8⁺ T cell genome. Mutating five conserved amino acids in the Tcf1 histone deacetylase (HDAC) domain diminishes the HDAC activity and the ability to suppress CD4⁺ lineage genes in CD8⁺ T cells, indicating Tcf1 has intrinsic HDAC activity. These findings reveal that Tcf1 can utilize heretofore-unappreciated intrinsic HDAC activity to guard CD8⁺ T cell identity by repressing lineage-inappropriate genes.

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Determining the proper storage conditions for Au nanoparticle optical fiber biosensors

Biosensors have the potential to be a powerful medical and diagnostic device as they can determine the presence and relative amount of a specific analyte. In order to successfully use a biosensor, the optimal chemistry of the surface must be determined to yield the finest sensitivity to detect the analyte. This requires many trials, therefore to streamline research, it would be ideal to prepare the optical fibers in large quantities and store them for long periods of time, rather than having to prepare a fiber before every experiment. However, the surface chemistry of the optical fibers is very delicate, therefore much precaution must be taken when transferring and storing these fibers. Various conditions were used for storage tests, such as a vacuum box, or in solution on a Teflon block in Phosphate Buffered Saline (PBS) or in 2-(*N*-morpholino) ethanesulfonic acid (MES), for different time periods ranging from 1 to 10 days. At the conclusion of the storage test period, the optical fiber was used to detect a standard analyte, Bovine Serum Albumin (BSA), to ensure that the optical fiber was still functional. The optical fiber has a well characterized activation pattern and BSA binding has also been fairly consistent for other experiments. Thus the success of the optical fibers was determined by comparing its activation and BSA binding patterns to fibers that were made and used on the same day. The optical fibers were most successful when stored in solution with minimal air exposure for short periods of time. However, fibers stored in air had mixed level of success, and some were even successful when stored for longer periods of time. Many of the fibers had non-characteristic activation and binding patterns when compared to fibers that were prepared and used on the same day. It is unclear if this can be considered typical for fibers that have been stored because not all of the abnormalities were consistent. Therefore more trials for each storage condition would need to be conducted to better understand the cause of these abnormalities.

STATUS

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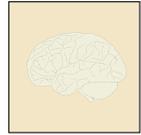
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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

The Normalization of College Drinking Behaviors

Heavy drinking is a common behavior among college students. The college social environment may be a contributor to the normalization of severe drinking problems on college campuses, which could influence perceptions of the severity of problematic drinking behaviors, as well as perceived need for treatment, social acceptance, and trait perceptions of individuals with alcohol use disorder (AUD) symptoms. The present study examined college students' perceptions of individuals whose drinking problems varied in severity and social context. A total of 114 undergraduate students read a case study describing a college student or a young working adult who either had a moderate or a marginal case of AUD, and then completed a survey on their reactions to the individual described in the case. It was hypothesized that participants would perceive drinking in the college context as more normal (as indicated by descriptive norms regarding typical male drinking patterns over a week), less severe, more attributable to external rather than internal causes, less likely to persist, and less stigmatizing (in terms of desired social distance and various trait perceptions) than drinking in the working young adult context.

Severity (moderate vs. mild) x context (college vs. noncollege) analyses of variance indicated that there were no significant context effects on descriptive norms, perceived severity, causal attributions, or perceived outcome/persistence of the described patterns of drinking. College drinkers were rated significantly less competent, likeable, and adjusted than working adult drinkers. Severity significantly impacted trait perceptions of adjustment and personal strength, as well as desired social distance and need for treatment, so that more severe drinking was more stigmatized and seen as needing treatment more than less severe drinking. The low severity drinker was also rated lower on perceived severity than the high severity drinker. Severity of the problem drinking and context did not interact. These results did not support our hypotheses. They suggest that participants perceived individuals with drinking problems in college more negatively than individuals out of college with the same pattern of drinking. This could have occurred because participants rated descriptive norms similarly for both contexts, or because college students may be more familiar with the damaging effects of heavy drinking in their peers. Working adults may also be seen as more competent, adjusted, strong, and likeable because of the perceived independence of being a working adult. These results also confirm other research suggesting that a more serious drinking problem is associated with more stigmatizing perceptions than a mild drinking problem.

STATUS

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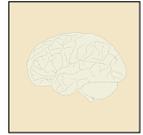
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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Hiring Decisions: Looking at Gender, Accent, and Race Effects in Technologically Mediated Interviews

The use of phone and online interviews allows organizations to interview people from afar, contributing to larger and more diverse pools for recruitment and selection. However, the addition of technology to the interview process can introduce new biases and call attention to cues or features not as salient in an in-person interview. This study analyzed data from an experimental study which randomly assigned participants to evaluate candidates of different race, accents and technological medium. Specifically, this study looked at both the quantitative ratings of the candidate, made by the participant, as well as the participant's open ended explanation for why they made those ratings. Based on current literature in the area, three main hypotheses were tested using both the quantitative and qualitative data. H1: The technological medium of an interview contributes to interview bias due to an increase in social bandwidth in video interviews, causing increased heuristic driven decision making. H2: This relationship is moderated by the interviewee's race and accent, where the salience of a non-white race and accent acts as an anchor to the evaluator and makes them more subject to heuristic driven decision making. H3: Based on gender differences in the manifestation of the Elaboration Likelihood Model, this relationship is also moderated by the gender of the evaluator, where women are less likely to use heuristics in decision making than men. All three hypotheses were partially supported. While there were no significant interactions that affected the overall quantitative decision, there were significant differences in how the participants justified their decision. These findings show that ultimately there are important differences in the way people make and explain decisions based on race, accent, and gender. The biases, however, may not be as obvious as previously thought and instead have subtler implications in the selection process.

STATUS

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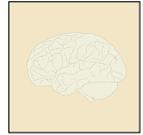
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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Parenting Interventions Differentially Impact Mother-Child and Father-Child Interactional Quality

BACKGROUND:

Approximately 2.5 million children in the U.S. have a parent in prison and 92% of incarcerated parents are fathers (King et al., 2015). Fathers may contribute uniquely to child outcomes by acting as catalysts for safe risk-taking and exploration (Paquette, 2004) and promoting language development (Tamis-LeMonda et al., 2015) differently than mothers do. Due to lower numbers of incarcerated mothers, evaluations of parenting interventions often do not compare mothers and fathers. This preliminary study evaluates mothers and fathers in the Baby Elmo Program, a structured visitation program for incarcerated teen parents.

METHODS:

25 teen parents (9 mothers) of children from 1 to 48 months were recruited from 5 juvenile detention centers in California. The intervention program included individual parent training sessions with a trained facilitator and visits with their children within the following few days. Post-visit, the facilitator and parent engaged in a reflective debrief.

CODING:

Video-recorded sessions were coded for child-directed speech. All phrases were counted and categorized as “business,” or “conversational.” Praise, labeling, and repetitive speech were measured as frequencies. Open-ended questions were counted as a proportion of conversational talk. The quality of parent-child interactions was scored using the IGDI-IPCI coding scheme (Baggett & Carta, 2002).

RESULTS:

Mothers’ and fathers’ measures of conversational talk did not significantly differ and remained fairly high across time (range 77-84%, SD range 9-19%). Mothers used more descriptive speech than fathers ($M_{\text{mother}} = 23\%$, $SD = 15\%$; $M_{\text{father}} = 14\%$, $SD = 16\%$) and fathers asked more open-ended questions than mothers ($M_{\text{mother}} = 11\%$, $SD = 7\%$; $M_{\text{father}} = 15\%$, $SD = 9\%$). IGDI-IPCI scores, reported on a 0 to 3 scale, showed that mothers made greater gains in maintaining and extending their child’s focus ($M_{\text{session1}} = .60$, $SD = .57$; $M_{\text{session4}} = 1.11$, $SD = .57$) than fathers ($M_{\text{session1}} = 1.09$, $SD = .72$; $M_{\text{session4}} = 1.19$, $SD = .97$) and fathers made greater gains in following the child’s lead ($M_{\text{session1}} = .44$, $SD = .47$, $M_{\text{session4}} = .74$, $SD = .52$) than mothers ($M_{\text{session1}} = .59$, $SD = .68$; $M_{\text{session4}} = .59$, $SD = .66$).

DISCUSSION:

The intervention delivers the same curriculum to mothers and fathers and while both sexes improve over time, they engage with their children in qualitatively different ways. In order to deliver a more specific and individualized service, some areas of focus may need to be weighted differently depending on the sex of the parent.

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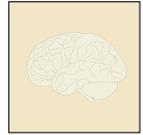
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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Supporting Embedded Public Workers: Avoiding the Discrepancy between Public Representations and Educational Realities

Over the course of the last few decades, there has been a powerful movement among colleges and universities advocating for the commitment to positive civic engagement with local and global communities. Most institutions of higher education have been supportive of this movement by recognizing that, so long as they are serving and interacting with their communities respectfully, faculty and students can play a critical role in social change. Additionally, from helping students comprehend how their majors can be used to improve society, to creating an educated and civic-minded electorate, the benefits for students of integrating public service into higher education are unquantifiable. However, while many universities have successfully inspired students to take on a civically engaged role in their communities, some of these universities have failed, as entire institutions, to recognize, understand, and embrace core engagement principles. If an institution is not embracing core engagement principles, then it is not supporting embedded public workers who seek to represent these principles in their daily service and interactions with community partners. One of such institutions is the George Washington University. To understand where the discrepancy lies between GW's public representations and educational realities, this research performed a textual analysis of GW-produced website content for one of GW's community engagement programs. A troubling small amount of indicators for core engagement principles were detected in GW's communications. However, this did not align with communications made by the community engagement program itself. This discrepancy may suggest that while certain professors, faculty members, and students in a university may be attempting to perform civic work that is modeled after basic engagement principles, their efforts may be obscured by the university's inability to portray this in its public communications. This is not only negative for an embedded-public-worker to be, but also for the university's community partners.

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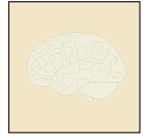
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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Sales Associate Personality And Consumer Purchasing Behavior in Fashion Retailers

Fast-fashion stores such as H&M, Zara, and Forever 21 have emerged in the past ten years as dominant players within the global fashion industry and have significantly impacted the luxury fashion business and consumer behavior models. With any new business model in the industry, there remains a difference between the interactions consumers have with sales associates in fast-fashion and those in luxury fashion. The proposed research further analyzes possible links between purchasing and personality traits (a la Goldberg's (1990, 1992, 1993) Big 5 model) and examines the interactions that consumers have with sales associates. Utilizing surveys from consumers, data will be analyzed to find the precise (sales associates') personality traits that can lead to consumer purchases. It is anticipated that sales associates who are more extraverted and conscientious will have a stronger need for social interactions and relationships and will be more present within luxury fashion retailers, thereby increasing the likelihood of a purchase. An understanding of these connections can help researchers, and fashion retailers, to better identify the nuances of personality, client-professional interactions, and purchasing behavior.

KEYWORDS:

Big 5 personality, consumer behavior, social interaction, fashion industry

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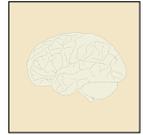
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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Impaired Vocalization in a Mouse Model of Rett Syndrome

MECP2 is a chromosome binding protein and regulator for brain development. Mutated MECP2 gene can be associated with language and motor deficits in patients who have Rett syndrome. Genetic deletion of the MECP2 gene in mice exhibits asymptotic behaviors during the first 6 weeks of postnatal development, but motor deficits and behavioral differences develop progressively and fatality occurs in these MECP2 conditional knockout mice soon after. However, it's unknown if the communication of these mice is also compromised. Such knowledge will be invaluable to validate the MECP2 knockout mouse as a potential model for Rett Syndrome, and to elucidate how MECP2 could contribute to language. Mice emit ultrasonic vocalizations (USVs) in different social scenarios such as mating, parenting, and fighting. Although such USVs vary from human language in many aspects, such as their involvement in learning, they do share some acoustic properties, carry important social meanings, and function as communication. In this study, we established a specific male-female social paradigm, to evaluate the USVs of MECP2 mice and wild type (WT) mice. We found null MECP2 had reduced vocalization (16.21 ± 7.38 syllables) in all social interactions but the vocalization by WT MECP2 is comparable to that of C57 mice (238.26 ± 40.46) as can be seen in spectrograms of their social interactions. To classify and compare the content of USVs, we analyzed the syllable types and found the ratio of down frequency sweep in null MECP2 mice is higher than both WT and C57. To examine the acoustic properties of USVs, we extracted parameters of the classified syllables, such as mean frequency, duration, and the relative spectral intensity above the noise floor from the frequency contour. Our data showed null MECP2 males vocalized at higher mean frequency, narrower frequency range, and shorter duration than WT and C57 mice (mean frequency: Null MECP2: 79.71 ± 0.99 kHz; WT: 75.20 ± 0.11 kHz; and C57: 74.30 ± 0.24 kHz; frequency range: 15.72 ± 0.77 kHz, 20.92 ± 0.18 kHz, and 23.00 ± 0.35 kHz; duration: 23.02 ± 1.54 ms, 59.96 ± 0.67 ms, 51.75 ± 0.87 ms, $p < 0.001$ for Null MECP2 vs. WT and vs. C57). Our results demonstrated a significant impairment of USVs of mice with MECP2 deletion. This may shed light on our understanding of MECP2's function in language deficits of Rett Syndrome.

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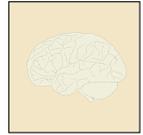
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Self-Compassion and Self-Esteem Buffer the Effects of Social Rejection on Negative Affect and Restrictive Eating

A significant health issue affecting college women is restrictive eating, which includes chronic restrained eating, extreme dieting, and monitoring caloric intake (Delinsky & Wilson, 2008; Eisenberg et al., 2011; Smith-Jackson & Reel, 2012). Social rejection is one social context that can negatively affect restrictive eating. Social rejection is a common yet painful experience, which occurs when an individual is deliberately excluded from a social interaction for social (rather than practical) reasons (Leary, 2001). Two ways of relating to the Self, including self-esteem and self-compassion, may buffer the effects of rejection on restrictive eating, though this relationship is understudied. Two studies examined the relationship between perceived social rejection, negative affect, and restrictive eating. Study 1 examined the cross-sectional relationships between social rejection, self-esteem, self-compassion, negative affect, and restrictive eating among a sample of college women. Results revealed that self-esteem and self-compassion were negatively correlated with rejection, negative affect, and restrictive eating ($p < .05$). In Study 2, a 7-day daily diary methodology was used to examine the association between social rejection and restrictive eating in a different sample of college women over time. Across seven days, self-reported rejection was associated with increased negative affect and higher instances of restrictive, maladaptive eating behaviors. However, this relationship was qualified by the women's self-attitudes prior to rejection: only participants with low self-esteem and low self-compassion exhibited a negative affective and behavioral reaction to rejection. Comparatively, among participants with high self-esteem and high self-compassion, the relationship between rejection and restrictive eating was not significant. This research is the first to explore how self-compassion and self-esteem influence the complex impact that social rejection can have on negative affect and restrictive eating. Social rejection is an experience that everyone can identify with. Rejection hurts, and inspires feelings of sadness, shame, anger, and often dislike of oneself; however, positive ways of relating to the Self, such as self-esteem and self-compassion, can buffer these effects of rejection and can result in a healthier response to one of life's most hurtful inevitabilities.

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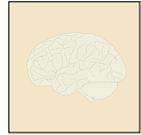
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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Continuous and extreme autistic trait ratings are associated with avoidance of alcoholic beverages

BACKGROUND:

Selective (i.e., 'picky') eating is common in autism spectrum disorder (ASD) with as many as 70% of individuals exhibiting this behavior. Prior reports suggest that although preference for particular foods and drinks is highly idiosyncratic, broader patterns emerge across children with ASD. For example, studies suggest that children with ASD have generally less varied diets, including eating fewer vegetables, salad, and fresh fruit, as well as less sweets and fizzy drinks (Emond et al., 2010; Pediatrics) than typically developing controls. The vast majority of studies to date have been conducted with children. While selective eating is persistent and extends into adulthood in ASD (Kuschner et al., 2015, Res Autism Spectr Disord) and it is more common than previously believed within the general population of adults, very little is known about specific food/drink preferences (including alcohol consumption) and their associations with ASD-like behaviors during this developmental window.

OBJECTIVES:

Examine food/drink preferences as a function of continuous and extreme autistic trait ratings within a large sample of adults.

Methods: A large group of 1,992 adults (1,445 females) completed online surveys including questions about how often they avoided various food/drink classes (e.g., fruits/vegetables, juices, alcoholic beverages, salty and sweet crunchy bread products, salty and sweet soft bread products, meats, and dairy products) on a scale of 1 (never) to 5 (always) as well as self-ratings of autistic traits utilizing the original 50-item Autism-Spectrum Quotient (AQ).

RESULTS:

Correlational analyses revealed that as self-ratings of autistic traits (using the AQ total score) increased the likelihood of trying alcoholic beverages decreased ($r=.14, p<.01$). Autistic social traits (from the Social Skills subscale) was the component of the AQ most strongly correlated with a general avoidance of alcoholic beverages ($r=.18, p<.01$). When submitted to regression analyses, autistic social traits predicted significant additional variance ($F=58.80, p<.001; \Delta R^2=.03$) above and beyond the influence of food neophobia and aversions to smells, each of which contributed its own significant variance ($ts>2.36, ps<.02$), to the likelihood of trying alcoholic beverages.

CONCLUSION:

This study provides further evidence linking ASD-like behavior with food/drink preferences, albeit among a relatively large population of adults. The food/drink that was most strongly related to subclinical ASD behavior was alcoholic beverages. This finding is perhaps unsurprising given prior research finding highly reduced rates of alcohol use and abuse among adolescents and adults with ASD (Fortuna et al., 2015, J Gen Intern Med; Mangerud et al., 2014, J Adolesc). Moreover, ASD-like social traits, in particular, were most strongly linked with avoidance of alcoholic beverages, and these influences were independent of generalized food neophobia and sensory aversions to smell, consistent with the notion of limited 'social drinking.'

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

A Critical Analysis of Hegemonic Masculinity in the 2016 Republican Party

INTRODUCTION:

This paper examines ways the practice of hegemonic masculinity, first identified by Raewyn Connell (1995), explain and shapes the positions taken by leading Republican Presidential candidates (“leading” here determined by October 1, 2015 poll numbers) Donald Trump, Ben Carson, Marco Rubio, Carly Fiorina and Jeb Bush.

METHODS:

The paper looks at candidates’ stances on three issues—gun control policy, abortion policy, and security policy. Gun control can be seen as an issue traditionally associated with hegemonic masculinity; the abortion debate is usually treated as a “gender issue”; security policy provides a way to look at how hegemonic masculinity shapes a less gendered issue. Hegemonic masculinity in these candidates is explored in terms of campaign strategy, image, and policy position as presented in each individual campaign. (websites, debates, etc.)The paper draws on the understanding of hegemonic masculinity developed by Angela Stroud (2012), Connell and Messerschmidt (2005), and Dan Cassino (2007). These works are used to articulate the form that hegemonic masculinity takes today in the United States: the authority for control of women and other less hegemonic men (Connell and Messerschmidt), the relationship of guns and the right to dominance (Stroud), the complex problem of achieving a Christian masculinity (Cassino).

RESULTS/CONCLUSIONS:

The opening defines hegemonic masculinity and introduces the candidates and policy issues. The body presents a content analysis of the candidates’ campaigns and how they are shaped by hegemonic masculinity, and draws conclusions that ultimately show the role that hegemonic masculinity plays in American politics and larger American society.

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Food waste in three DC public schools: Scope, causes and consequences

Food is the second largest category of waste sent to landfills for disposal in the US. Waste from institutional sources comprises a significant portion of this waste stream. The large amount of plate waste originating from supper in US public schools (funded by USDA) indicates inefficiency, unnecessary costs, and student dissatisfaction with meals. This study aims to quantify compostable waste (i.e. food and other organics), identify the primary causes, and propose changes that would improve materials management in DC public school cafeterias. Organic, recycling, and landfill waste produced by supper served in aftercare programs at three DC public elementary schools was weighed. During a single meal, on average, more than 1/2 pounds of edible food waste was generated per student, and a substantial amount of prepared food that had not been served was leftover. In the school that adopted a voluntary composting program, a lack of communication and commitment to proper sorting and disposal caused the program to be ineffectual. The problem of wasted food is well recognized by teachers and facilities workers alike, who feel restricted in their capacity to respond. There is much potential to reduce wasted food and increase the landfill diversion rate in DC elementary school cafeterias. Further studies are necessary to determine how to improve student meal consumption; how to promote sustainable waste management in cafeterias; and how to legally and effectively redistribute otherwise wasted food to populations in need in order to alleviate hunger in surrounding communities.

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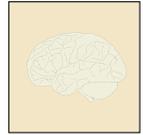
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ELLIOTT SCHOOL OF INTERNATIONAL AFFAIRS

Plenums, Protests, and the Politics of Democratization in Macedonia

Over the past few years growing disillusionment with the unending transition from socialism toward liberal democracy and neoliberal economics has sparked outrage by citizens across the former Yugoslavia. Street protests, burning buildings, angry crowds, and occupied universities have become the emblem of this frustration in the Balkans. Macedonia serves as a unique yet representative case of this post-socialist transition in the region and the broader landscape of Central and Eastern Europe. For Macedonia, 2015 marked a year of revolt. This research analyzes the impact of recent student protests and the formation of plenums, sparked by a proposed law which would limit student freedom and the autonomy of the university, on civil society's role in the consolidation of democracy in Macedonia. Furthermore, the research also discusses how the plenums and protests factor into the country's ongoing institutional and socio-political crisis which was incited following revelation of immense government wrongdoing. In particular, the research utilizes Juan Linz and Alfred Stepan's framework regarding democratic transition and consolidation, from their 1996 book *Problems of Democratic Transition and Consolidation: Southern Europe, South America, and Post-Communist Europe*, in order to situate the discussion. Within this framework and by incorporating qualitative and quantitative data from previous scholarly writings, international and national democracy indicators such as Freedom House and the Macedonian Center for International Cooperation, as well as interviews done in Skopje, Macedonia between December 2015 and January 2016 the research comes to an interesting conclusion. It finds that the plenums, as a component of civil society which includes social movements, are an effective method for citizens pursuing a concrete goal within the context of an illiberal democracy or captured state like Macedonia. However, beyond such specific goals and for ones which require broader political participation by citizens in a captured state they may be ineffective. Studying these forms of engagement in democratization and the political process, which have arisen alongside the authoritarian predispositions of elites across the region, is of crucial importance for academics and policymakers seeking to understand the role of the average citizen in these societies. Ultimately, the research is limited but serves as a stepping stone for further investigation into citizens and civil society's role in the democratization process of Macedonia and beyond.

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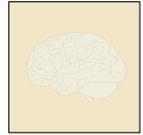
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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

The Modern Celebrity: How YouTube has Generated Successful Careers for Content Creators

Since its birth in 2005, YouTube has become the Internet hub for videos. According to statistics provided by YouTube, the website hosts nearly one-third of the world's population on their website on a daily basis (18 February 2016). Internationally, 300 million people every day are watching content on tutorials, viral trends, entertainment, lifestyle, and many other categories. While dominating the Internet, YouTube has unintentionally created a career-path that is globally accessible: the YouTuber. This study is designed to analyze YouTubers and their success. Research shows that roughly 20,000 YouTubers are a part of YouTube's Partners Program, a program allowing YouTubers to receive an income based on the traffic directed to their channel. Additionally, YouTubers have generated such high popularity that VidCon, a three day annual convention, has been created where YouTubers meet fans and participate on panels dedicated to key Internet topics. Data from the current study will be collected via surveys sent to two groups of subjects: individuals who watch YouTubers and YouTubers themselves. It is anticipated that as the originality of a YouTuber's content increases, the likelihood of his/her career becoming similar to that of a traditional celebrity increases. Additionally, YouTubers have the ability—through the creation of relatable material—to create an open audience connection, a strong and loyal audience following, and competitive industry ranking.

KEYWORDS:

YouTube, YouTuber, social media, creative content

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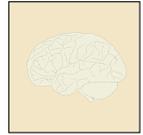
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SCHOOL OF MEDIA & PUBLIC AFFAIRS

Black, White, and Gray: How the News Framed the 2015 Baltimore Protests

To determine whether or not news covers civil unrest in a racialized way, and whether or not there are differences in that coverage across media outlets, the author compared local and national television and print news coverage of the spring 2015 Baltimore protests. This was measured using a content analysis of all stories about the protests found in *The New York Times*, *The Wall Street Journal*, *USA Today*, *The Baltimore Sun*, and evening news broadcasts from CBS, NBC, and WBAL-11, a local Baltimore station, published from April 18 to May 3, 2015. The author expected to find more sensationalized and less positive coverage of the protests in national news than in local news. The author also expected to find racialized coverage—or coverage that portrayed protestors, especially those who turned violent, as black, and law enforcement as white—across all media, though expected the visual nature of televised news to exacerbate this problem in comparison to newspapers. Finally, the author expected all news to rarely contextualize the protests within the broader American and Baltimore histories of police brutality and racial inequality, but expected print news to do so more often than television news.

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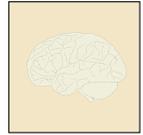
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Is Mike More Electable Than Ray, Jen, and Anita: An Analysis of Race and Gender Heuristics in Low-Information Elections

By conducting an experiment that randomly assigned respondents to evaluate one of five nearly identical fictitious candidates, I examined the impact of race and gender-based heuristics in low-information elections. Changing only the race or gender of a city council candidate impacted a respondent's perceptions of the individual's strengths and weaknesses. Specifically, the four candidates—Mike, Jen, Ray, and Anita—were evaluated differently in terms of their perceived characteristics and ability to successfully work on certain policy areas. While Anita and Jen were seen as more trustworthy and better able to improve K-12 education, Mike and Ray were perceived as more able to handle stressful situations and better suited to be in charge of the budget. In terms of race, Ray and Anita were evaluated as better equipped to ensure fairness in the community while Mike and Jen were seen as more prepared to lead and better able to reduce crime. Overall, I find that Mike is evaluated as being 25 percent more likely than Anita to make a good city council member.

KEYWORDS:

race and gender, heuristics, campaigns and elections

STATUS

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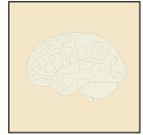
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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

How Sincere? An Analysis of Student Essays on Service.

Through my service-learning themed writing course, I volunteered with Life Pieces to Masterpieces, an art-oriented after-school program for African American boys from Wards 7 and 8 in DC. I documented my experiences and examined my own writing in retrospect. My curiosity in the relationship between how a student portrays his or her community partners and how the reader perceives the student prompted my research. The work here explores projected honesty in student reflective essays on service. Eileen Schell, in her book *Rural Literacies*, categorizes different types of rhetoric used to advocate for social causes. I have recontextualized this analysis into a scale, a Scale of Sincerity, that measures projected sincerity in these student reports. How do different phrases support or betray the writer in communicating the sincerity of a service experience? What kinds of relationships are implied through words students choose to write about their community partners? This Scale of Sincerity is applied to analyze 50 introductory reflections by my peers, and the discovery presents examples of rhetorical patterns that project a range of relationships. These illustrate how perspectives that suggest tragedy or mutual identification function to impact the reader's impression: How sincere?

"How Sincere?: A Rhetorical Analysis of Reflections on Service" is published in Volume 4 of the *Undergraduate Journal of Service-Learning and Community-Based Research*.

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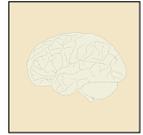
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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Prevalence and help-seeking behaviors among women at risk for postpartum OCD

Becoming a mother should be one of the happiest moments in a woman's life. Unfortunately, many women suffer from perinatal mood and anxiety disorders beginning in pregnancy through the first year postpartum. Most of the research has focused on postpartum mood disorders, particularly depression. More recently, research has started to focus on postpartum anxiety disorders - including postpartum obsessive-compulsive disorder (OCD). The prevalence of postpartum OCD is estimated to range from 1.7% to 9.0%, and postpartum women are approximately 1.5 to 2 times more vulnerable to suffer from OCD than the rest of the population. However, many women with postpartum OCD do not seek mental health treatment because of the stigma associated with having a mental illness. Additionally, expressing women's intrusive thoughts of harming their child may result in increased and unintended contacts with the legal system. These women may fear that if they discuss these thoughts with a health provider, they will be reported to Child Protective Services as they may be perceived to be at risk of harming their child. The purpose of this study is to examine the prevalence of postpartum OCD symptoms and women's help-seeking behaviors. We conducted an online survey posted in Postpartum Progress' blog, a non profit website that increases awareness of perinatal anxiety and mood disorders and provides a supportive forum for pregnant women and mothers. Two hundred and fifty one women completed the survey, which asked about common postpartum mood and anxiety experiences. Participants completed a demographic questionnaire including treatment history and current help-seeking behaviors, and the Postnatal Obsessive Compulsive Scale (POCS, Lord et al., 2011), a screening measure for OCD symptoms commonly experienced following the most recent pregnancy. Postpartum OCD risk was defined as a total POCS score >16, with higher scores indicating more risk (range of scores 0-40). The sample was fairly young (age: M = 30.85, SD = 4.69), predominantly White (86.8%), married (83.8%), and highly educated (93.4% with some college education or higher). The results from the POCS indicate that these women (n=205 with valid data) reported having moderate symptoms of OCD (M = 17.56, SD = 7.89). Among these women, 60.7% of women had were at "high risk" for postpartum OCD compared to 39.3% at "low risk". Compared to low risk women, high risk women were significantly more likely to report having a history of seeking psychological treatment (67.2% vs. 43.8%, $\chi^2 = 11.01, p < .01$) and significantly more likely receive current psychological treatment (51.2% vs. 33.8%, $\chi^2 = 6.02, p < .05$). These findings suggest that many women are suffering from significant symptoms of OCD, but we did not have a diagnostic interview for OCD. Nevertheless, these at risk women are more likely to have a history of seeking treatment and currently require treatment to deal with postpartum anxiety. Additional research should focus on the types of interventions to help prevent or treat postpartum OCD, thereby increasing attention to this under-recognized problem that affects women and their families.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Municipal Green Building: Development and Design Across the United States

The building sector became a target for climate change mitigation as awareness of human impacts on the environment grew. Consequently, green building was revitalized in the United States in the early 1990s. The advancement of green building since its reestablishment can be traced to the creation of building assessment systems. Previous research indicates that municipalities are key players in implementing these assessment systems through green building policies that regulate zoning and building permits. This study utilizes phone interviews and online survey data from 36 municipalities to analyze green building policy development in the United States. Specifically, it examines the actors involved in policymaking, sources of information used in policy development, and how gathered information is localized to meet the needs of the municipality. The study finds that cities are evaluating policies in other municipalities as models and that within this process municipalities prioritize the experiences of cities within their own region. A disconnect appears between the breadth and depth of information actually received and perceived by policymakers. This suggests a need for more thorough case studies and alternate information about green building policy options to promote climate change mitigation and larger sustainability efforts within American communities.

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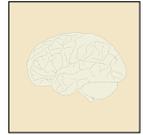
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ELLIOTT SCHOOL OF INTERNATIONAL AFFAIRS

Brazilian Religion and Daily Life in a Transnational Space: Perspectives from Anthropology

In this paper, I seek to explore the role of religion in the experiences of transnational Brazilian Spiritist migrants living outside of Washington DC. Studies of migrant religion generally focus on the role of the migrant church in creating networks and providing a common ethnic group for migrants. My work, however, shows that for Brazilians living outside Washington D.C., the social network provided by Spiritism is secondary. By situating the Brazilian Spiritists gathering at Maryland Spiritist Society in the context of a transnational religious space, we can see that Brazilian Spiritists in the U.S. view Spiritism as a frame for approaching their daily lives and their transnational existences. Using strategies from linguistic anthropology, I examine group constitution and the process of adjusting different epistemic worldviews as examples of how Spiritism provides a frame for approaching and understanding daily life as a Brazilian transnational migrant. In doing so, I contribute to a broader socio-cultural understanding of both religion and migration.

STATUS

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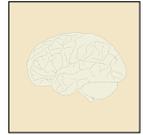
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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Welcome to ~~The O.C.~~ [Class Inequality], Bitch: America's Class Identity Problem as Seen in *The O.C.* and *One Tree Hill*

"Welcome to ~~The O.C.~~ [Class Inequality], Bitch: America's Class Identity Problem as Seen in *The O.C.* and *One Tree Hill*" observes the relationship between myths about class, and therefore class identity problems, in America and the representation of this in teen television dramas. Because both *The O.C.* and *One Tree Hill* fall under the teen genre they need to be widely marketable and therefore contain generic plot elements of the "everyday American" i.e. middle class. In both *The O.C.* and *One Tree Hill*, the main characters cling to the middle class identity, but when their lifestyles are examined it becomes evident that neither television series have protagonists that are truly middle class. There are also many cases of class inconsistencies and minimal discussions of class or of class issues in these shows; this also contributes to the class identity problem. One key question that this paper explores is why do these characters want to identify as middle class? This question of course leads to a wider subject of class identity in America and why so many Americans identify as middle class regardless of their actual income. This paper does not suggest that these teen dramas are directly influencing Americans in their class identity formation, but rather that these shows are in conversation with the class-related myths. Although there is some emerging scholarship on teen television there is very little available currently on recent teen television, post 2000; this paper is therefore an intervention into an existing field which rarely focuses on recent, popular teen television series. Through close readings of two popular teen television series of the 2000s this paper works to illuminate the class identity problem that is so abundant in America in both the real and fictional world.

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A (Visual) Tale of Two Cities: How the Protests in Ferguson and Baltimore were Portrayed in Broadcast News

I conducted an analysis of traditional and cable news programming in order to determine how these outlets visually portrayed the recent protests in Baltimore and Ferguson. Using a coding scheme developed from the fields of American Politics and Film Studies, the methodology was developed, primarily, to analyze images of immoral protest activity, like looting or overt violence, and images of violent police activity, such as the use of military surplus equipment in the dispersal of otherwise peaceful protests. Ultimately, the data will show whether or not protesters or police were portrayed more favorably in their interactions with one another. Preliminary data show that law enforcement was often portrayed as overly violent in response to the protests, with a heavy emphasis on the “militarization” of the police; however, this appears to be more so the case in Ferguson. Overall, the broadcast portrayals of these protests, depending on which frames were adopted in their presentation, could have reinforced dangerous stereotypes at certain times in their coverage; these stereotypes, however infrequent, can still pose a detriment in the opinion formation process of the viewing audience.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Acoustic Contributions to the Perception of Female Speech

INTRODUCTION:

The social mindset towards the gay/lesbian/bisexual/transgender (GLBT) community has evolved rapidly in recent years, providing researchers with an opportunity to better understand the influence of social-level change on linguistic variation and perception. Elements of human variation such as age and sex influence voice production, but the contribution of sexual orientation remains unclear. Research has provided evidence that listeners can predict females' sexual orientation at above chance levels, but the source of this phenomenon is unclear. This study systematically examines if and how fundamental frequency (acoustic correlate to pitch) and first and second formants (acoustic correlates to resonance) may affect listeners' auditory perception of a woman's gender performance and sexual orientation.

METHOD:

Twenty-three females and 22 males, aged 18-71 years old participated as listeners. A primary speaker and four foil speakers read two sentences. In addition to the original reading, listeners heard the sample digitally altered into five conditions:

1. F0 lowered across whole sentence
2. F1/F2 lowered across whole sentence
3. F0, F1/F2 lowered across whole sentence
4. F1/F2 lowered for vowels only
5. F0 lowered, F1/F2 lowered for vowels only

Listeners rated the speaker's gender performance and sexual orientation. They also reported their own sexual orientation, gender identification, and their interaction with GLBT community, as well as their awareness of lesbian speech stereotypes.

RESULTS:

None of the presumed acoustic correlates of lesbian speech altered listeners' perception of speaker's sexuality. However, some did alter perception of gender performance; conditions in which F0 was lowered were found to be more masculine than the unaltered condition and than the conditions in which only F1/F2 were lowered. Furthermore, listeners' self-rated sexuality, and exposure to the LGBT community affected ratings of both sexuality and gender performance. Listeners' sex only influenced auditory perception of gender performance.

CONCLUSION:

Auditory perception of gender performance was influenced by lowering F0 but not F1/F2. However, auditory perception of sexual orientation was not influenced by altering F0 nor by altering F1/F2. This may indicate a not yet evolved stereotype, the lack of a salient lesbian speech style, or possibly that the acoustic correlates of lesbian speech function in more complex acoustic combinations than what was tested here. Lastly, listener demographics in relation to their own sex, sexuality, and GLBT exposure should be considered when measuring auditory perception of gender performance in the future.

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An exploration of the developing factors of self-esteem in adolescent females

The purpose of this study is to explore the self-esteem of adolescent females. A 2008 study by the American Association of University Women found that girls rated their self-esteem significantly lower than boys did, and this gap increased as children moved towards adolescence (Corbett, Hill & St. Rose, 2008). While there is a great deal of existing research that compares the self-esteem of males to females, there has been little research exploring how factors such as friends, family, and peers impact the growth and development of confidence. In order to explore the contributing influences of self-esteem among adolescent girls in urban areas, a qualitative study was done in which individual interviews were held with a group of up to fifteen girls ranging in age from 11-13 years. This interview consisted of the discussion of their answers to an assessment comprised of an assessment in which the girls were asked to write down 20 statements about themselves, and the Rosenberg Self-Esteem Scale that they filled out prior to their experience in an after school experiential learning program. By going over the answers they chose and discussing their choice of words on the assessment, the research will provide a deeper understanding of the positive and negative factors that play a part in the development of self-esteem.

STATUS

Student - Undergraduate

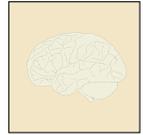
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Defaming the American Government & Imparting Urgency to the Black Panther Movement: A Rhetorical Analysis of the Writings of Huey P. Newton

The incidence of police brutality against African Americans in the United States has historically spurred significant national discourse and continues to do so today. The Black Panther Party, cofounded by Huey P. Newton, formed its identity in vehement opposition to the American government and its police forces. As expressions of this iconic figure of the greater Black Nationalist movement of the mid-twentieth century, Newton's anti-establishment rhetoric is an important indicator of the social reality of the time. In this essay, I analyze two pieces of Newton's rhetoric: his 1967 "Executive Mandate No. 1" and his 1970 letter "To the National Liberation Front of South Vietnam". Through this rhetorical analysis, I find that, in order to sustain an explicitly malicious image of the American government, both in domestic and world affairs, and to impart urgency to the Black Panther Party's opposition, Newton's rhetoric sought [a] to *align* ostensibly separate spheres of U.S. government agency, effectively essentializing the mission of the United States as the oppression of people of color, and [b] to establish *solidarity* with the people of the developing world, who Newton dubs victims of American imperialism, and contextualize the Black Panther movement on a global scale.

STATUS

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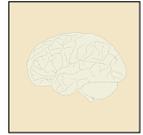
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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Influencers of Public Opinion on Mandatory Minimum Sentencing

Drawing on past research about framing and media representation of minorities, this research looks at whether providing people with information about racial and economic disparities in mandatory minimum sentencing for crack and powder cocaine yields changes in attitude about mandatory minimums. I use an experiment to test my hypotheses. I expect that people will be more supportive of changing mandatory minimum laws when given information about economic rather than racial disparities.

To test this, I will provide information framing mandatory minimums slightly differently to five groups. One control group will receive no information about mandatory minimum sentencing, one group will receive information about mandatory minimums without reference to crack or powder cocaine, one group will get information about discrepancies in mandatory minimums for crack and powder cocaine, and two groups will get that basic information about crack and powder cocaine differences, as well as facts about racial and economic disparities, respectively. Each group will then be asked to fill out a survey about their feelings on mandatory minimum sentencing. They'll be asked questions such as whether they think mandatory minimums are just and fair, whether they should be legal, and whether they are effective.

A pre-test of this data was conducted in December of 2015, and in the coming month I'll collect 900 survey responses and analyze those, as well. The completed version of this experiment will be defended as an honors thesis for political communication in the School of Media and Public Affairs.

STATUS

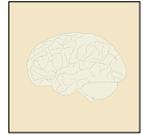
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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Factors Associated with the Quantity and Quality of Distance Communication Between Deployed Parents and Their Children

Previous research has found that deployments have negative effects on the wellbeing of children (Ackard, et al., 2006; Houston, et al., 2009; Mustillo, MacDermid-Wadsworth & Lester, 2015). Distance communication between deployed parents and their children may moderate these effects; however, it is not known what affects the quantity and quality of such communication. We analyzed the communication between children and deployed parents based on survey data provided by deployed (n=101) and at-home parents/caregivers (n=267). We found that perceived barriers to communication are associated with fewer communications between deployed parents and their children. Intimacy between the deployed parents and the caregivers were associated with warmth in deployed parent-child communications. These findings are consistent with a family systems perspective, suggesting there are indirect links between the parental relationship and the parent-child distance communications during deployment. In addition, communications between the deployed parents and their children were of better quality when children were younger and more well-adjusted. Our findings about predictors of the quantity and quality of communication can lead to interventions to improve communication between parents and children, and lead to better adjustment of military children.

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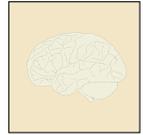
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Water Allocation in the Colorado River Basin: Problems and Prospects

The Colorado River Compact and its subsequent revisions and additions which comprise the Law of the River, form one of the most complex and well-established institutions supporting the allocation and distribution of water in the world. However, climate change is expected to dramatically impact the Colorado River Basin (CRB) with greater variability in the cycles of wet and dry periods and higher temperatures leading to consistently reduced river flow and therefore water supply for communities, agriculture, businesses and environmental flows. The objective of this study was to explore the current problems facing the CRB and examine how climate change will exacerbate these problems in relation to three broad categories, institutions, infrastructure and incentives. Data was gathered through an examination of current literature on climate change predictions in the CRB. An analysis of primary documents related to existing infrastructure and institutional structures was conducted in addition to a study of urban and rural communities relationship with the CRB. Results determined that the system was currently capable of handling and absorbing the expected changes in the near future however long-term changes in the climate will require aggressive adaptation. It is recognized that making the adaptations will be challenging, research has showed strong institutions, such as those established in the Law of the River serve as a key base from which to build reforms. Suggested reforms in the three categories include basin wide conservation goals, further increasing the reuse of water, and a tiered pricing system for urban communities. This research clearly showed the institutions and infrastructure in place in the CRB is well established and able to adapt to the coming changes, providing a strong introduction to a well functioning water management system that further research could examine if or how the system could be adapted to countries with less developed water management systems.

STATUS

Student - Undergraduate

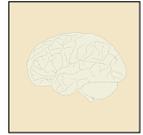
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A Disappearing Generation: An Ethnographic Analysis of Youth in the John Wesley AME Zion Church

Through participant observation and interviews with the John Wesley AME Zion Church in Washington, DC, and its members I examine the question of why generations of Black Americans born after the 1960s seem to be attending church at a lower rate than their parents and grandparents. I explore whether it is a matter of a progressive youth separating itself from a conservative institution, or whether there is a more complex and intimate set of role and structure systems at play.

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The Demand for Black American Faculty by Universities

Despite being consistently small, black American faculty ratios vary considerably across institutions. Prior research (The Journal of Blacks in Higher Education, 1993) on black American faculty has however focused predominately on why their overall ratios are low, rather than on why their ratios per institution may vary. Through a focus on supply side determinants, these studies analyze the disincentives of black Americans to pursue higher education and seek careers in academia. In contrast, this paper adopts a demand side focus, drawing inspiration from a past gender study (Rajeswaren 2000) and organizational study (Tolbert and Oberfield 1991), which have shown the significance of certain institutional characteristics in affecting faculty diversity. Understanding the drivers of black faculty ratio variation is important, particularly in light of the growing trend of university investment in initiatives aimed toward creating a pipeline for diverse scholars by supporting emerging faculty.

This thesis tests the hypotheses that the demand for black faculty per institution is influenced by whether the institution is public or private, by the institution's endowment per capita, and by the institution's black American student body. In addition, it is hypothesized that institutions located in states with a higher population of black Americans- in tandem to a greater number of black legislators- will have greater proportions of black faculty. To lastly account for negative regional preferences toward blacks that may be racially or historically based, this study tests a series of dummy variables to measure demographic racial attitude with relative accuracy (i.e. a university's home state's number of Department of Justice violations relating to minority discrimination).

The explanatory variables suggested by the hypotheses are examined using cross-sectional data and tested through a series of univariate regression models. The results generally support all of the hypotheses raised. In specific cases where they do not, possible reasons are explored. To cite one case, the proportion of black legislators of an institution's home state is inversely correlated with an institution's black faculty proportion. However, the black legislators proportion is positively correlated with an institution's ratio of black chairs. This paper therefore theorizes that black Americans may have a greater predilection for leadership positions over faculty positions in regions where more black Americans are in positions of power.

The implications of this thesis for future studies of institutional variation in black faculty ratios, or minority faculty ratios, is discussed.

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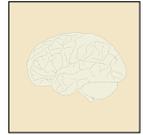
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Applying Game Theory to Understand Investor Rationality during the 1997 Asian Financial Crisis

Malaysia, Singapore, Indonesia, Korea, Thailand and the Philippines were affected by a severe financial crisis over 1997-1999, the Asian Financial Crisis. It is widely believed that the primary cause of the crisis was a rapid and unexpected withdrawal of investments by foreign investors. This study thus seeks to examine the rationality behind this withdrawal. Applying the assumption that investors always seek to maximize their returns, Game Theory models are leveraged to answer this question. Two specific types of models are used: a Normal Form game, which builds a foundation into the strategic decision investors were facing at specific times, and a Repeated Game which examines the. From both models, it appears that during the crisis, investors had an opportunity to earn high returns by investing in Asia, but chose to forego these rewards and withdraw their investments. This therefore signals that during times of a financial crisis investment strategies tend to become distorted, leading to investors making sub-optimal investment decisions that result in them earning lower returns.

STATUS

Student - Undergraduate

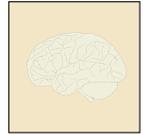
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Strategy and Society: National Culture and Corporate Responsibility in a Global World

Current organizational research shows that in an increasingly globalized world, a central challenge for multi-national firms is navigating the complex diversity of rules, regulations, ethics and cultures across countries. Organizations have placed a great emphasis on becoming more responsible actors socially and environmentally, and corporate responsibility has become a source of competitive advantage. For a firm operating across a range of countries, a critical issue is how to determine what constitutes responsible behavior given differences across countries. In this study, I examine the impact national culture has on the corporate responsibility (CR) behavior of multi-national firms. Using a sample of firms from CSRhub.com, a database of over 15,000 corporations in over 130 countries, and utilizing Hofstede's cultural dimension scores (power distance, uncertainty avoidance, masculinity and individualism) for the host country of each corporation, I run multiple regression analyses to explore whether national culture has an impact on the CR behavior of firms operating in the global market. After reviewing the results of the analyses, I discuss potential implications for CR behavior and managerial practice.

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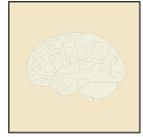
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Exploring the role of intersectionality: The causal effects of racial and gender discrimination on negative affect, substance use and risky sex cognitions among Black women

Among women living with HIV in DC, 92.6% are Black women (Government of the District of Columbia Department of Health, 2013), distinguishing HIV as a women’s health issue that highlights racial disparities. The majority of these infections are due to risky sexual contact, which is exacerbated by substance use (CDC, 2015). Such disparities are shaped by social factors, including discrimination, and are potentially amplified by the intersectional nature of race- and gender-based discrimination. The present study used the social exclusion Cyberball paradigm (a computerized ball-tossing game in which the participant plays three other bogus players) to manipulate feelings of exclusion and perceptions of discrimination. A sample of 119 Black women, aged 18-29, from the DC community were randomly assigned to be excluded by either Black women, Black men, White women or White men. Following Cyberball, participants reported substance use and risky sex cognitions—both factors related to HIV-risk. To further elucidate the relationship between experiences of discrimination and risk cognitions, we also measured the extent to which participants attributed their exclusion to race or gender discrimination, and measured both internalizing (depressive and anxious) and externalizing (angry and hostile) mood states following exclusion. Results revealed that participants excluded by Whites attributed their exclusion to racial discrimination ($p < .001$), and participants excluded by males attributed their exclusion to gender-based discrimination ($p < .001$). Participants excluded by White males reported marginally higher gender versus racial attributions ($p < .08$). In addition, racial exclusion and gender exclusion interacted to predict mood states, such that exclusion by White females resulted in the highest levels of externalizing mood ($p < .10$), depressive mood ($p < .09$), and anxious mood states ($p < .04$). There was a significant effect of racial exclusion among those excluded by females, but not males, for externalizing mood states ($p < .02$) and internalizing anxious mood states ($p < .04$). Participants excluded by White peers reported higher willingness to drink ($p < .04$). There was no effect of gender exclusion on alcohol willingness. Racial and gender exclusion interacted to predict intentions to have unprotected sex with a casual partner, such that women excluded by Black males and White females reported the highest intentions ($p < .04$). These results indicate that exclusion by White women seemingly leads to greater levels of risky health cognitions and negative affective states among Black women, in comparison to exclusion by White males, Black males, or other Black females.

STATUS

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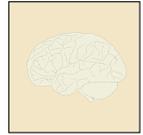
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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

How Executive Hiring Practices Can Influence Organizational Success Through The Lens of Organizational Structure

Our study explores the relationship between organizational leadership selection and organizational success, moderated by organizational complexity. Utilizing the 2013 Fortune 500's list of the largest U.S. corporations by revenue, we identified firms that had experienced a change in leadership (CEO) between 2008 and 2013. From this list, we drew a sample of 120 firms and categorized the firms' new CEOs as either an internal or external hire. Using each firm's annual financial records, we calculated the percent change of return on equity (ROE) two years before and after each CEO change, as well as gathered additional financial information. Organizational complexity was defined as the number of a firm's reportable business segments, as identified from financial records. Utilizing this data, we explored the relationship between a firm's performance and new leadership selection, and whether this relationship is moderated by the complexity of the firm. Results are discussed in terms of their implications for leadership selection and future research.

STATUS

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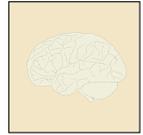
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Longitudinal cortical development during youth and adolescence in Autism Spectrum Disorder

Autism spectrum disorders (ASD) are associated with atypical early brain development followed by cortical thinning in adolescence. Here, we compare longitudinal changes in cortical thickness among adolescents and youth with ASD versus typically developing (TD) youth. 13 youth with ASD (diagnosed using DSM-IV criteria and the ADI/ADOS) and 17 TD youth provided two high-resolution 3 Tesla anatomic magnetic resonance imaging scans obtained at two time points. Groups were matched on age (ASD scan 1 mean=13.23 +/- 2.66, scan 2 mean=14.86 +/- 2.72; TD scan 1=13.75 +/- 2.45, scan 2=15.52 +/- 2.49), IQ (ASD mean=107.69 +/- 14.09; TD mean=106.88 +/- 10.91), sex ratio (male:female - ASD=13:2; TD=13:4), and duration between scans (ASD mean=1.63 +/- 0.29; TD mean=1.58 +/- 0.30). The SurfStat image analysis suite was used to derive vertex-level cortical thickness values and to complete longitudinal analyses. There is a difference between the ASD group and the TD group in annualized rate of change in cortical thickness in differential areas across the brain. Specifically, an area in the left hemisphere that encompasses the left insula demonstrates thinning in the ASD group and concomitant thickening in the TD group. An area in the right anterior temporal pole shows the opposite effect; thickening in the ASD group and thinning in the TD group. A further exploration of main effect of group at each time point revealed that this longitudinal annualized change is driven by greater rate of thinning of the ASD group at timepoint 2, particularly in the aforementioned left hemisphere region.

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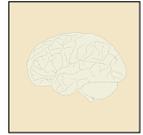
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SOCIAL SCIENCES



COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Preparing for Disasters: The relationship between self-efficacy and distress

Our research aims to assess the effectiveness of Red Cross Emergency Preparedness presentations in the Virginia, Maryland, and DC area on psychological factors that affect preparedness in the general population. We are examining psychological factors that might be important in predicting levels of preparedness behaviors before and after presentations, such as distress and self-efficacy. To date, roughly 180 participants have attended and completed pre and post surveys during the designated emergency preparedness presentations. Measures included in the survey include past exposure to disasters, perception of threat of disasters, self-efficacy for emergency-preparedness, distress, emergency preparedness behaviors, and demographic questions. We are continuing to collect and code data. In this study we set out a series of preparedness scales and psychological scales, that are self-reported and randomly ordered throughout the pre and post presentation surveys, in order to find correlations between levels of preparedness and psychological factors. This pre-post evaluation design included measures of demographics (e.g., race, gender, income) and emergency preparedness behaviors (20 items measuring behaviors recommended by FEMA and the National Red Cross—in three domains—“build a kit,” “make a plan,” and “be informed”). Analyses examined the degree to which demographic characteristics affected whether participants planned to implement the Red Cross’s recommendations for emergency preparedness. This study will help us understand the role of demographic factors in preparedness and increase their effectiveness in the future.

STATUS

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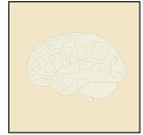
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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Exploring Predictors of Internship Satisfaction

A large body of research has investigated job satisfaction, but internship satisfaction receives little attention. Several differences exist between employees and interns, such as expected length of employment, experience, and purpose for employment. Thus, it is likely that job satisfaction and internship satisfaction are different constructs with different predictors.

Possible predictors of internship satisfaction are alignment with desired career, interests, and occupational self-efficacy. Interns should look for internships similar to a desired career in order to determine if they want to follow that career and to gain appropriate experience. Given the use of occupational interests to guide young people in career decisions, matching interests with internships should result in satisfaction. Occupational self-efficacy may be crucial for interns, given their lack of experience and job-specific skills. This study evaluated the ability of occupational self-efficacy, interests-internship fit, and perceived fit between internship and desired career (desired career fit) to predict internship satisfaction.

GW Students ($N=203$) completed an online survey about an internship experience. A hierarchical multiple regression analysis showed that trait satisfaction and desired career fit significantly predicted internship satisfaction, $F(2, 197) = 31.740, R^2 = .244, p = .000$. Interest fit did not explain incremental variance, $F\Delta(1, 196) = .000, R^2\Delta = .000, p = .000$; however occupational self-efficacy did, $F\Delta(1, 195) = 10.159, R^2\Delta = .038, p = .002$.

These results demonstrated that desired career fit and occupational self-efficacy are important predictors of internship satisfaction, while interest fit is not. The findings have important theoretical and practical implications. University career centers often utilize interest inventories to aide career development. However, this research suggests interests may not be as important as determining desired career fit. Interns may be more oriented toward self-discovery or future employment, rather than focusing on the nature of the current work. Thus, an internship that supports the development of knowledge, skills, or confidence towards the desired career may be more important than interests. This approach is supported by the finding that occupational self-efficacy predicts internship satisfaction. University career centers should consider using skills assessments, and the administration and faculty should focus on developing job skills. As an alternate interpretation, current models of interests may be outdated; since Holland's work in the 1950s, the workplace has changed drastically. Future research should reevaluate interests taxonomies, investigate internship skill assessments and skill development, and continue to explore predictors of internship satisfaction.

STATUS

Student - Undergraduate

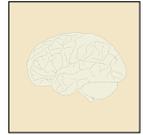
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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Do I Sound Transgender? It Depends Who You Ask

Research previously conducted with male-to-female transgender (i.e., transwomen) speakers has largely focused on analyzing the speech and assessing what people think sounds “male” or “female”. However, little is known about the listeners who provide perceptual measures frequently used in this area of research and the factors that influence their decisions. Furthermore, gender performance is increasingly viewed as a continuum rather than a binary. Current literature shows a high degree of agreement among listeners judging binary gender of cisgender voices, most likely due to ceiling effects. However, by introducing transgender voices, listener agreement decreases. This study aims to understand how transwomen’s voices are perceived by listeners using a multi-dimensional analysis. Furthermore, this study also aims to investigate the influence of listener’s sex and sexual orientation on perception of speaker’s sex and gender performance, avoiding potential ceiling effects by incorporating sex atypical voices of transwomen.

Twenty cisgender men, 21 cisgender women, and 22 transwomen provided a reiterative reading sample of “The Rainbow Passage.” Ninety-three listeners were placed into four groups based on gender (male/female) and sexual orientation (straight/non-straight). Listeners provided perceptual measures of speakers’ sex (male/female), gender performance (1-100, 1 = very masculine, 100 = very feminine), and sexual orientation (1-9, 1 = straight, 9 = gay).

For both perception of speaker sex and gender performance, the group of transwomen was statistically distinct from the male group, but also from the female group. The sexual orientation of transwomen was often rated as “other”, indicating that even when listeners do not judge the transwoman to be female, they do not simply perceive her to sound like a gay man. Listener sexual orientation was a significant factor in perception of gender performance of the transwomen voices; non-straight listeners perceived the transwomen voices as more feminine compared to straight listeners. While the non-straight group was significantly more likely to have friends or close colleagues who identify as LGBTQ, this did not have a main effect on perceptions.

We propose that speech of transwomen be characterized along multiple dimensions since it appears to be distinct from both cisgender groups. Measures used in this study can be regularly applied as outcome measures in the voice feminization process. Furthermore, the influence of a listener’s sexual orientation on auditory perception of a speaker’s femininity has implications for future studies of perception and clinical practitioners serving transwomen. Transwomen may also consider these findings when interpreting feedback from communication partners.

STATUS

Student - Graduate

AUTHORS

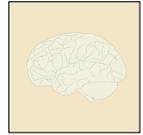
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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Subclinical Eating Disorder Traits are Correlated with Cortical Structure in Regions Associated with Food Perception and Food Reward

Although many studies have found atypical brain structure associated with clinically-diagnosed eating disorders, no studies to date have explored individual differences in brain structure as a function of subclinical eating disorder traits within a broader population. Because traits associated with eating disorders can be viewed continuously and extend into the general population, we can seek to identify neural endophenotypes in large and relatively unconfounded (no comorbidities) subclinical samples.

Therefore, in the current study we correlate variation in one component of gray matter structure, cortical thickness, among young adults with scores on the following Eating Disorder Inventory-3 subtests: Bulimia and Drive for Thinness. 548 participants (373 female:175 male) reported (non-zero) drive for thinness trait ratings, and 310 participants (203 female:108 male) reported (non-zero) bulimia trait ratings. Each participant also provided one anatomic magnetic resonance imaging scan. The CIVET brain-imaging pipeline (v2.0) along with the SurfStat image analysis suite, were used to derive vertex-level cortical thickness values and complete analyses.

There was a significant negative correlation between drive for thinness traits and cortical thickness in the right precuneus and right insula (FWE corrected $ps < .05$). There was also a negative correlation between bulimia traits and cortical thickness in the left insula, left primary somatosensory cortex, right orbitofrontal cortex, and right parahippocampal gyrus (FWE corrected $ps < .05$).

To our knowledge, this is the first study to examine structural neural correlates of subclinical eating disorder traits. Strikingly, self-ratings of drive for thinness and bulimia traits were correlated with thickness in distinct cortical regions (e.g., insula and orbitofrontal cortex) that are crucial to food perception and food reward more broadly. These findings complement the clinical literature, which has consistently shown structural abnormalities in these brain regions among individuals with anorexia or bulimia. Therefore, the current results provide additional evidence that these shared neural signatures can serve as informative endophenotypes for future genetic studies.

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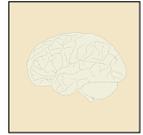
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Education and Unemployment: Examining the Effect of Educational Attainment on the Labor Market in Post-Recession United States

Previous research has led to the belief that education insulates individuals from unemployment. However, the Great Recession led to widespread unemployment among people of all levels of educational attainment. This paper demonstrates how upon becoming unemployed, further levels of education did not provide insulating effects. Additionally, as the part-time labor force grew following the recession, almost all groups experienced proportional representational increases in part-time labor as well, indicating that no one level of educational attainment is more likely to be found in part-time labor than another. It does appear though that in general those with the highest level of education are likely to be more represented in the labor force compared to their less-educated peers. This research was performed using data from the Bureau of Labor Statistics and primarily through graphical analysis.

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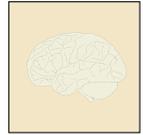
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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Cognitive Disabilities and 22q11DS Mouse Model of ASD

Autism spectrum disorder (ASD) is a complex neurodevelopment disorder characterized by three predominant behaviors: social impairments, communication difficulties, and restricted, repetitive, and stereotyped patterns of behavior. Currently, the underlying attributing factors to ASD are generally unknown, but an accepted consensus among autism researchers is that genetics plays an important role in ASD. Because of the genetic complexity of the non-syndromic condition, recent attention has been focused on related monogenic disorders (e.g., fragile X and Rett) and copy number variants (CNVs) where the genetic mutation is known. For example, the CNV, 22q11 Deletion Syndrome (DS), is one of the most significant known genetic risk factors for ASD with risk estimates as high as 50%. In addition to social difficulties, 22q11DS children display a constellation of cognitive impairments that are particularly evident in the domains of executive function (directed attention, planning, flexibility) and spatial cognition. These cognitive abilities impact information processing strategies that are central to the development of normal social behavior. The genomic lesion that causes 22q11DS—heterozygous deletion of a set of genes on chromosome 22—can be modeled precisely in mice (*LgDel*). It has previously been shown that *LgDel* mice, as is the case with human patients, display impaired executive abilities. To further explore the cognitive phenotype seen in the mouse model, a discrete-trial rewarded alternation task was used to measure spatial memory in *LgDel* mice and wild-type littermate controls. *LgDel* mice were severely impaired on this measure of spatial cognition, thus showing the pattern of deficits apparent in the 22q11 mouse model closely mimics the neurocognitive profile seen in human patients. The findings suggest that cognitive assays can serve as sensitive, reliable, and relevant biomarkers for ASD that could be related to underlying pathophysiology and be potentially useful for evaluating possible therapeutic interventions.

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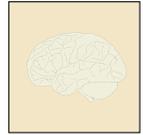
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SCHOOL OF BUSINESS

Learning and Retention in Principles of Economics

One of the main goals of higher education is to give students the skills and knowledge that they will need for their careers as well as in everyday aspects of their lives such as personal finance, voting, etc. However, this requires that students actually retain the information they learn in the classroom. Previous research suggests that the more a concept is reinforced after it has been learned, the more likely students are to remember it. Frequent testing is one way to reinforce exposure to a concept.

This project compares final exam scores from an introductory economics course in Spring 2014 and Spring 2015 to see the effect, if any, of more frequent testing and reinforcement of concepts. Final exam scores were chosen as the dependent variable as they allow students to best display their knowledge and understanding of all topics covered over the course of the semester.

The course was structured differently over the two years. In Spring 2014 students were given four quizzes, a midterm, graded online homework assignments, and they were allowed to bring a notecard to the final exam. In Spring 2015 students were given six quizzes, two midterm exams, ungraded (optional) online homework assignments, and they were not allowed to bring a notecard to the final exam. Compared to 2015, students' scores on the final exam were higher by an average of 4% in 2014.

To understand the results better, students were split into groups based on their scores on an algebra assessment given at the beginning of the semester. There was no difference in final exam scores between 2014 and 2015 among students who scored 60% or lower on the algebra assessment (had poor math skills). Students who scored between 65% and 80% had a 4.5% higher score on the final exam in 2014. Students who scored above 80% did better in 2014 by 3.3%.

Our results do not support findings from previous research. It is possible that the outcome of lower exam scores in 2015 is because students were not required to do homework or allowed to bring a notecard to the final exam. When this study is run again, treatments would only differ in the frequency of testing and the level of reinforcement. Frequency of testing would be increased to weekly quizzes.

STATUS

Student - Undergraduate

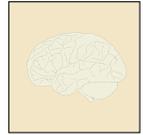
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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

Aging Through Change: Gentrification, Social Capital, and Senior Citizens of Washington DC's Wards 1 and 6

This study investigated the social wellbeing of senior citizens in Wards 1 and 6 of Washington, DC, as affected by elements of gentrification and rapid urban change. Informed by literature from the fields of gerontology, human services, and urban studies, preliminary research shows that gentrification acts as a lifestyle barrier, inhibiting seniors' interactions with their neighborhoods and the ability to age in place with familiar social support. To locate participants and identify areas of highest need, the researcher partnered with Age-Friendly DC and We Are Family, two prominent local organizations working towards inclusivity of seniors and intergenerational activity in DC. A mixed methods research design first utilized quantitative data from 600 responses to the Age-Friendly DC 2015 Livability Survey, identifying needs across all 8 wards of the city. Second, qualitative data collected during focus groups with seniors from Wards 1 and 6 provided deeper understanding of the first-person experience of aging through gentrification. Initial themes include affordability, respect and inclusion, interracial and intercultural relations, and the deep desire for independent, purposeful, and supported aging. In an era of unprecedented growth of the senior demographic, the results yielded by this study may inform policymakers and direct service providers in Washington, DC; in addition, questions raised about the role of seniors in changing urban contexts will have implications for cities nationwide.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

South Asian International Students' Professional Help-Seeking Attitudes

THEORETICAL BACKGROUND:

International students often face significant social and cultural adjustment challenges (Tung, 2011). Findings have been mixed regarding factors that contribute to mental health services utilization among South Asian (SA) students. For instance, Loya, Reddy, and Hinshaw (2010) found that Asian students, including SA students and Asian international students (AIS), held less positive attitudes towards counseling compared to their Caucasian counterparts, had less exposure and openness to counseling, less self-perceived need for counseling, and a greater stigma towards counseling (Joon & Jepsen, 2008). Similarly, Yakunina and Weigold (2011) found that AIS endorsing more traditional Asian values reported less positive counseling attitudes and lower help-seeking intentions. However, loss of face and stigma concerns was associated with stronger intentions to seek counseling among AIS (Yakunina & Weigold, 2011). Given the social and structural barriers to help-seeking on college campuses, and the unique challenges faced by international students, the current study sought to examine the associations between attitudes about help-seeking, loss of face concern, family stigma, and professional help-seeking barriers.

PARTICIPANTS AND PROCEDURES:

172 SA international graduate students (76.70% male, mean age 23.95 (SD=1.97), range = 21-33 years) from a private liberal arts university completed online questionnaires that included demographic information, the Barriers to Adolescent Seeking Help (BASH) (Kuhl et al., 1997; alphas = 0.90 (Male) 0.92 (Female)), the Family Stigma Scale (Komiya et al., 2000; alphas = 0.87 (Male) 0.90 (Female)), and the Loss of Face scale (Zane & Yeh, 2002; alphas = 0.93 (Male) 0.95 (Female)). Participants also reported whether they had experienced a serious emotional problem within the past year.

RESULTS:

Slightly more than one-third of the participants (38.82%) reported experiencing serious psychological distress during the past year (24.24% female; 75.76% male). Pearson's Correlation analyses indicated a significant negative correlation between barriers to help-seeking and both family stigma ($r = -0.75$) and loss of face concern ($r = -0.42$, respectively). In addition, loss of face concern was positively correlated with family stigma ($r = 0.26$). Independent sample t-tests revealed no significant gender differences on any of the major study variables.

DISCUSSION:

Findings support previous research (Yakunina & Weigold 2011) suggesting that international students who perceive greater loss of face concern and family stigma around mental health issues may be more likely to seek professional help for emotional problems. Further discussion of the results as well as implications for future research and culturally sensitive mental health service provision will be provided.

STATUS

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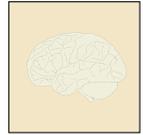
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SCHOOL OF MEDIA & PUBLIC AFFAIRS

Fifty years of feminism: Framing the American women's movement, 1964-2014

This article analyzes the framing of feminism in The New York Times, Time magazine and NBC Nightly News over the past fifty years (1964-2014). A content analysis of 350 news articles, editorials and columns, and news broadcasts reveals reform feminism was the most common ideology described in mainstream news, consistent with past studies. In contrast to past literature, however, the most common frame used across the 50-year period was that feminism was explicitly necessary. When articles did frame feminism negatively, they were most often about third-wave feminism or radical feminism, and frequently presented the movement as divided. Though coverage of feminism throughout the entire period was limited, overall when feminist activism and ideology were covered, it was within a positive framework.

KEYWORDS:

feminism, framing, mainstream news, United States

STATUS

Student - Undergraduate

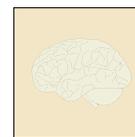
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An Examination of Water in the Sustainability Plans of US Cities

Cities across the United States face a whole host of problems with their water supply, from diminishing quantity of water, to severe water quality issues, and finally challenges with controlling flooding. This ongoing research project examines how the sustainability plans of a selection of twenty US cities address water quality, water quantity, and flooding. The purpose is to determine why cities are concerned about water, and how they plan to address these problems. Thus far, the research shows that cities have a large number of reasons for concern about water such, such as an apprehension about the effects of climate change and severe weather events, a growing population, a decreasing water supply, or EPA-mandated action to clean up water bodies. The areas within water that cities choose to focus on are frequently influenced by geography; for instance, Southwestern cities are worried about protecting their water supply, whereas East Coast cities tend to have more issues with flooding. Overall, the plans tend to focus on increasing water conservation through methods such as fixing leaks in water mains or raising awareness about water use through educational campaigns. For water quality and flood management, there is a heavy focus on the adoption of green infrastructure. The goal of this project is to learn more about the water issues in American cities, and analyze the most common proposed actions for these issues in order to determine their effectiveness.

STATUS

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ELLIOTT SCHOOL OF INTERNATIONAL AFFAIRS

The Struggle for Islam: Decolonization Processes and Gujarati Muslim Religious Identity in South Africa

This paper examines how Islam is constructed amongst South African Muslims of Gujarati descent. Although for many Gujarati identity is often subsumed into broader Indian or Muslim identities, Gujarati descent is highlighted as this paper emphasizes the trade history of Gujarati communities, which is distinct from the history of indenture amongst other members of the Indian community. The author uses secondary and primary sources to examine the historic context through which Gujarati trade networks were established in the African continent. These trade connections preceded the colonization of the Indian Ocean by the Portuguese and British, and depended upon cultural interactions and transactions. However, the travel and trade by Gujarati Muslims was further facilitated by the colonization of both India and South Africa by the British Empire. Following the de-colonization process, many Gujarati Muslims stayed in independent African states that promoted nationalist and xenophobic rhetoric at the expense of internal minorities. In South Africa during the period of Apartheid, Indians were set as racially distinct, given a status between black and white. The responses developed by Muslims of Gujarati descent to colonization, local and global decolonization processes, of which includes the overcoming of Apartheid, impacted the ways in which they practiced and presented religion, and perceived religious community. This paper employs Fanon's ideology of "National Culture" towards the practice of Islam in the Gujarati Muslim community - to conclude that struggle, which builds the post-colonial nation, also shifts the community's understanding of, and practice of Islam. The decolonization struggle opens a space through which Islamic pluralism can exist. This paper employs 24 life histories along with analysis of the Islamic media, and the work of religious scholars and activists to illustrate that in South Africa, religious identities of Muslims of Gujarati origin both challenge and comply with racial discrimination, xenophobia, patriarchy and class disparities.

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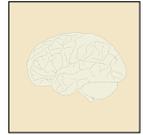
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The Truth Behind The Stories and Myth of Japanese Commercials

Japanese television commercials have been recognized to approach advertising from an interesting perspective. These television commercials range from being seen as absurd and random with no information on the good or service provided, to having stimulating stories that are not directly advertising the good or service. It is uncommon for the commercials to include much information on the product, or to elaborate on the function or description of the product either. Therefore, many successful commercials are created with an approach to reach out to the viewer in a 'natural' manner. The commercials send the message indirectly to the viewers through their subconscious so the viewer does not even realize what they are being fed by the commercial. Hence, this research paper will examine both successful and unsuccessful television commercials from Japan and analyze how it 'naturally' sends messages to their viewers. I will be analyzing Pocari Sweat's commercial "*Pokari Suetto Runa Purojekuto - Joshi Manējā Hen 30 byō*" which aired in August 2014 as the successful model, and Nisshin Foods' commercial "*Seishun no Shushoku*" which aired in 2009 as the unsuccessful model. They will be examined by using Roland Barthes' concept of Myth, which was expanded on Ferdinand De Saussure's study of Semiology. As Roland Barthes has done in his book *Mythologies*, I will also break down advertisements to help the viewer understand how advertisement messages are being comprehended. However, I will be adjusting Barthes' method to examine a television commercial rather than a still advertisement and will also elaborate on the importance of cultural and social context.

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The Wrongfully Convicted: Should a Guilty Plea Prevent Their Compensation?

This project explores theoretical and practical problems with statutory schemes that compensate people who were wrongfully convicted of criminal offenses. It seems evident that individuals who have been convicted of a crime and later found to be innocent deserve to be compensated by the government for the harm inflicted on them. Currently, the Federal Government, the District of Columbia and 30 states have compensation statutes of some form, which serve to indemnify individuals who have been wrongfully convicted. However, in almost half of the states that have compensation statutes, relief is limited by provisions that forbid compensation for those deemed to have “contributed” to their own conviction. States interpret this to deny compensation to innocent people who, for whatever reason, pled guilty.

This project explores reasons for guilty pleas, how pleas relate to compensation schemes, and the practical effect of these policies. Innocent defendants are likely to feel compelled by the criminal justice system to: (1) engage in plea bargaining, and (2) plead guilty to avoid harsh sentences, thereby “contributing” to their own conviction. The project explores the dynamics of the plea bargaining process in order to identify reasons a defendant may accept blame for a crime he/she did not commit. Particular attention is given to the excessive power granted to the prosecutor, stark mandatory minimum sentences and statutory sentences, and sentencing guidelines. The project surveys state laws, considers theoretical frameworks, draws on prior empirical studies, and explores specific examples as case studies.

In light of findings regarding the realities of the plea bargaining process, the project considers policies that deny compensation to those who might have plead guilty or falsely confessed. The project argues that “contributed to their own conviction” provisions place an unreasonable burden on exonerees and unnecessary hurdle to compensation they are rightly due. It explores contemporary law reform efforts, and the author hopes to use this research in collaboration with advocacy organizations. Although considerable public attention has successfully been brought to some cases of wrongful convictions, there has been little public or academic attention to the real impact of “contributed to their own conviction” limitations on compensation or scholarly attention to the interplay between these provisions and concerns about the plea bargaining process.

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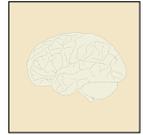
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ELLIOTT SCHOOL OF INTERNATIONAL AFFAIRS

Sociopolitical Behavior of Entrepreneurs in Egypt

Included among the many empowered individuals who emerged from the Arab Spring are thousands of entrepreneurs, creating small businesses out of both a need and desire for economic opportunity. Egypt in particular has demonstrated a recent swell in entrepreneurial activity from 2012-2015. Many of the entrepreneurs that have emerged are expanding technological access, education, and business opportunities to thousands of Egyptians, and the community is still growing. This is in addition to the fact that the entrepreneur and small and medium business community constitute approximately 99% of all private enterprises and nearly 80% of all private sector employment. As a result, we must reevaluate both the way that this community is observed but also its potential impact on society and policies in the country.

For the purpose of this study, I explore the following question: Can we characterize the sociopolitical behavior of small-scale entrepreneurs in Egypt? Why or why not? The small business community in Egypt, though growing and providing business models that offer many of the social, economic, and educational utilities listed above, is not without its challenges. Egypt's environment for business is frequently described as bureaucratic and cumbersome. Registering property, acquiring construction permits, and enforcing contracts are all identified as some of the biggest barriers to nascent entrepreneurs who wish to start their own small businesses. As the small business community continues to develop and respond to these and other challenges, several of its characteristics can be observed. In this work, I aim to understand whether these observable characteristics fit within a sociopolitical framework. I explore sociopolitical behavior through participatory engagements with government and also through the formation of associations and networks.

There is very little work that addresses the intersection between entrepreneurs and government policy to date. This community in Egypt remains largely academically untapped. If characteristics of this group of entrepreneurs are indeed observable and explained, we can use them to draw larger conclusions about the development of this community, its place in Egyptian society, and its impact on policy making. Given Egypt's prominent role in the region, understanding the entrepreneurship community can also provide insight to the trajectory of similar communities that are emerging in the Middle East region. This work also has implications for the way in which we view democracy and governance promotion and policy in Washington.

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COLUMBIAN COLLEGE OF ARTS AND SCIENCES

When Worlds Collide: A World Systems Analysis of the Alien Torte Statute, 1789 - 2015

In *Beyond Center and Periphery: A Comment on the Contribution of the World System Approach to the Study of Development* circa 1979, Peter Evans discusses what was then the current excitement in Social Science analysis around the launching of Immanuel Wallerstein's 'world-system approach'. Evans found Wallerstein's emphasis on a country's position within a single world system frame to be refreshing at a time when the question of outside influences on development were usually discussed in terms of strength or weakness of links between the core and a given peripheral country. Assuming that all areas of the world should be seen as comprising a single ongoing division of labor revealed new consequences for the direction of future research. If the possibilities open to a given nation for capital accumulation are constrained by its structural position, positions are hierarchically ordered, not just specialized. In addition, neither the mode of production associated with a given structural position nor the structural position assumed by a given nation are seen as fixed. Leaving one structural position means taking on a new structural position in the overall division of labor, not escaping the system. Wallerstein asserts that "it is not possible for all nations to 'develop' simultaneously." "Of course, some countries can 'develop,'" he says. "But the some that rise are at the expense of others that decline" (1974: 5). Evans asks "How can we evaluate this series of assertions regarding the nature and role of the 'semi-periphery'? Only with great difficulty. Some of them are plausible and exciting; others seem wrong. The amount of evidence needed to validate any one of them is intimidating" (1979: 17).

This poster reflects on Immanuel Wallerstein's World-Systems Analysis through practical application, a case study. My intention is to use one history of American transnational human rights litigation, the particular lens of the Alien Tort Statute, to expound Wallerstein's theory. By analyzing the behavior of world-system actors in this 'real world' setting, the goal is to clarify world-system operations in a substantial and meaningful way. I will then draw conclusions based upon the ramifications of the litigation process and the insight those ramifications have afforded, within the contemporary framework of the current world-system.

STATUS

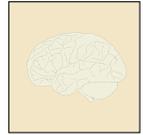
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Mental Health in Diverse Populations and the Importance of Individualized Care

Mental health stigma and limited accessibility of care for diverse populations have represented some of the key factors accounting for mental health difficulties on college campuses. Though some steps have been taken to address these issues, more can be done to bridge the gap between those needing services and the university's resources. Diverse mental health needs from different populations merit targeted interventions for mental health issues, which are not currently being put in place. The current study seeks to provide support for the implementation of population-specific mental health interventions. As part of National Depression Screening Day (NDSD) in the past five years, mental health screeners were administered to a sample of GWU undergraduate students ($n=126$) who expressed an interest in being screened. Specifically, student clinicians from the Meltzer Psychological Center asked participants to anonymously, through a self-report questionnaire, indicate any symptoms they have experienced related to major depression, generalized anxiety disorder, bipolar disorder, and posttraumatic stress disorder. When comparing participants from a racial minority background with those from a non-minority background, there was found to be very little difference in mean symptom severity across groups. However, when minority students were analyzed separately, group differences in mean scores were notable, with some racial minority groups reporting more severe symptoms than others. Our findings reflect previous findings that diverse populations will have diverse mental health needs, and may respond to interventions and questionnaires such as the NDSD screener in different ways. This suggests that culturally tailored interventions may be necessary to provide the best possible mental health care for diverse undergraduates in need. Additionally, researchers should note that analyzing racial minority groups individually, rather than as one group, may provide a more thorough understanding of distinct mental health concerns.

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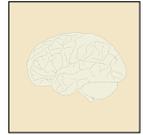
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Drivers of Consumer Emotional Attachment and its Effect on Brand Romance

Given my experience working at the Paris and New York Fashion Weeks (2015), I have gained unique insight into the business and creative processes surrounding the fashion industry. The current study is designed to explore one of the world's largest and most profitable markets—luxury goods. In an effort to explore how major luxury brands have maintained success over time despite changing landscapes (i.e., economic, political, social, and creative), this study examines the impact of brand heritage saliency, consumer experience, and emotional brand-attachment—all of which can be drivers of brand romance (a la Patwardhan & Balasubramanian, 2011). Within the context of a mixed-methods survey design, quantitative and qualitative data will be collected to test four research hypotheses; and it is anticipated that—as brand heritage saliency, consumer experience, and emotional brand-attachment increase—brand romance will likewise increase. Links between emotional attachment and brand romance (i.e., pleasure, physiological arousal, and dominance—Patwardhan & Balasubramanian, 2011), and possible connections to a variety of luxury goods and services (e.g. hospitality, travel, food & beverage, automobile, and wellness) will be explored.

STATUS

Student - Undergraduate

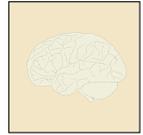
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SOCIAL SCIENCES



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Financial Capability and Business Ownership among U.S. Millennials

Business creation drives economic growth and creates new jobs. Such is the importance of entrepreneurship. Many studies have focused on the importance of entrepreneurial education and its various approaches, little have been done to understand the important role of financial literacy and education in their business ownership, particularly among Millennials. Over the past decade, financial literacy has been recognized as an essential life skill in order to fully participate in today's economy. Increasingly complex financial instruments demand each individual to make informed decisions about their personal finances. Using data from the 2012 National Financial Capability Study (NFCS), my analysis demonstrates that young American business owners, like others in their generation, lack the essential financial knowledge in their personal finances. Their behaviors in debts and alternative financial services are particularly alarming. Early financial education for young entrepreneurs would not only benefit their business practices but also help to create more thriving new businesses that drive economic growth.

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