

13th Annual Student Center for Science Engagement Research Symposium

In Partnership with NIH MARC U-STAR

October 1, 2021
Whova Virtual Platform
8:30 AM to 4:00 PM

Northeastern
ILLINOIS UNIVERSITY
Student Center for Science Engagement

The Student Center for Science Engagement
Thirteenth Annual Research Symposium

Friday, October 1, 2021
Northeastern Illinois University
Whova Virtual Platform

Student Center for Science Engagement

Sudha Srinivas, Ph.D., Associate Dean, College of Arts and Sciences

Kenneth Voglesonger, Ph.D., SCSE Director
Associate Professor, Earth Science

Shreya Patel, Ph.D., STEM Advisor

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Beth Reinke, Ph.D. Assistant Professor, Biology

Rachel Trana, Ph.D. Assistant Professor, Computer Science

Andrew Young, Ph.D., Assistant Professor, Psychology

Thirteenth Annual Student Center for Science Engagement Research Symposium

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Student Center for Science Engagement (SCSE)
MISSION AND GOALS

The mission of the SCSE is to significantly improve recruitment, retention and graduation rates for students in STEM disciplines, with an emphasis on minority, low-income, and first generation students. The goals of the SCSE are being achieved by enhancing academic support through tutoring, advising, faculty-student research projects, and mentoring. We provide professional development opportunities to students through internships, networking opportunities, and connections with leaders in STEM industries and academic institutions. We also foster career exploration in STEM fields and the development of programming focused on reaching minority, low-income and first generation students. The SCSE is proud to serve NEIU and support future student success in the sciences.

Thirteenth Annual Student Center for Science Engagement Research Symposium

Message from the College of Arts and Sciences

The Thirteenth Annual Student Center for Science Engagement (SCSE) Research Symposium reflects the hard work of motivated teams of students, working under the mentorship of our faculty, on undergraduate research in the STEM fields. Today, these students report back on the work they have done all summer.

This symposium is not merely a culmination of undergraduate research completed this summer – it represents an important step in the journey through which our students become engaged scientists and researchers. To our students presenting their work today, congratulations! You have learned a lot through this experience, and I hope you have appreciated the joys that come from delving deep into a topic and making it your focus. Do continue to nurture the sense of curiosity and engagement that led you to seek this summer research experience in the first place, along with the enthusiasm that has allowed you to come this far. To the faculty mentors who have aided this sense of curiosity and engagement, thank you for your dedication to our students!

Congratulations to the students, the faculty mentors and to the staff at the Student Center for Science Engagement for your work this summer and fall!

Sudha Srinivas
Professor of Physics and Acting Associate Dean
College of Arts and Sciences

Thirteenth Annual Student Center for Science Engagement Research Symposium

SCSE Director's Message

Welcome everyone to the 13th Annual Research Symposium of the Student Center for Science Engagement (SCSE), co-sponsored with the NIH MARC NU-STAR Program! All of us in the SCSE are excited about the research and collaborations that were part of the summer program, both at NEIU and at other institutions. With the commitment of students, faculty and staff, the tradition of STEM research at NEIU through the SCSE has continued to flourish. Our 2021 Summer Research and Professional Training Program, with 32 students and 14 faculty involved in 12 different research groups speaks to the strength of this tradition. It is a huge credit to the dedication of our students and faculty that we were able to continue the tradition of a strong and vibrant summer research program, capped off with this Symposium that will celebrate our students' achievements. This work is only possible with the support and efforts of faculty mentors that work together with students to form strong and authentic research communities.

Vital support also came from the NEIU College of Arts and Sciences, NEIU Academic Affairs, the NEIU College of Business and Technology, the U.S. Department of Education Hispanic Serving Institutions Title III program, the National Institutes of Health MARC NU-STAR Program, and the National Science Foundation Illinois Louis Stokes Alliance for Minority Participation. The funding provided by these offices and secured by faculty were vital to the success of the program this year. I also want to recognize the work of the SCSE staff, Shreya Patel and Laura West for their work on student-centered professional development, supporting all aspects of our summer program, and their dedication in organizing and coordinating this Symposium. The SCSE is an office that takes on many different roles in the support of our students, none of which would be possible without the excellent work of these two individuals.

Finally, I want to emphasize the excellent work that was done during the program this year. Once again, I am amazed by what our students are capable of, and humbled to get to work with them. The high-caliber research that was conducted this year is a testament to the quality of our STEM programs, our STEM students, our STEM staff, and our STEM faculty. This is the result of all those involved, especially the talents, abilities, dedication, enthusiasm, and determination of our students. Congratulations to everyone! I hope that you all enjoy the day!

Ken Voglesonger, Ph.D.
Director, Student Center for Science Engagement
Associate Professor of Earth Science
College of Arts and Sciences

Thirteenth Annual Student Center for Science Engagement Research Symposium

TITLE: Using the Past to Inform the Present and Future in Both Career and Research

Progressing through undergraduate and graduate school involves building upon previous knowledge learned not only through courses but life experiences. I share not only how I used my past to guide my trajectory to earning my dream job as a professor but also how I used the past to guide management decisions for a federally threatened dune thistle, *Cirsium pitcheri* as well as understanding the ecology of Lyme disease whose causative agent is *Borrelia burgdorferi,* a tick-borne disease that has over 150 wildlife reservoirs. Ultimately, creativity and diversity of thought is key to pursuing your goals.

KEYNOTE SPEAKER BIOGRAPHICAL SKETCH:

Samniqueka Halsey is currently an Assistant Professor of Ecosystem Health in the School of Natural Resources and the Faculty Fellow for Diversity for the College of Agriculture, Food and Natural Resources. She earned her Ph.D. in Ecology, Evolution and Conservation Biology from the University of Illinois, Urbana-Champaign. Her research stresses the importance of using long-term data sets, GIS, and remote sensing. She uses computational approaches to understand the mechanisms involved in the patterns we see in nature. Most of her work involves using modeling approaches to delineate how spatial and temporal changes in ecological interactions influence a focal species. She holds a particular interest in informing management actions with her models. As a computational ecologist, she takes integrative approaches to modeling complex systems while examining the consequences that management actions on biodiversity conservation and emerging disease systems play across a hierarchy of spatial and temporal scales.

*** Keynote speaker was sponsored by the NIH Maximizing Access to Research Careers (MARC) U-STAR Program**

* The National Institutes of Health MARC U-STAR (Maximizing Access to Research Careers Undergraduate Student Training in Academic Research) Program at Northeastern Illinois University is a comprehensive research training program for college juniors and seniors who wish to pursue a PhD in biomedical/behavioral fields after completion of their Bachelor's degree from NEIU. The MARC Program comprises innovative curriculum developments that integrate quantitative sciences into the program of study of the STEM disciplines, diverse research experiences that include summer research training in research-intensive universities, and structured mentoring and advising. In addition, the MARC Program provides a stipend of $13,500/year for two years and covers 60-100% of tuition. **Applications to accept four students will open at the beginning of the Spring 2022 semester. For more information, please visit MARC website: cs.neiu.edu/marc.**

Thirteenth Annual Student Center for Science Engagement Research Symposium

SYMPOSIUM SCHEDULE

8:30 – 9:00 A.M.
Coffee & Chatting

9:00 - 9:40 A.M.
Welcome & Opening Remarks

9:45 - 10:45 A.M.
First Podium Presentation Sessions

10:45 - 11:00 A.M.
Break

11:00 - 11:45 A.M.
Second Podium Presentation Sessions

11:45 A.M. - 12:00 P.M.
Break

12:00 - 1:00 P.M.
Keynote Speaker and Q&A

1:00 - 1:30 P.M.
Lunch Break

1:30 – 2:30 P.M.
First Poster Presentation Session

2:30 – 2:45 P.M.
Break

2:45 – 3:45 P.M.
Second Poster Presentation Session

3:45 – 4:00 P.M.
Closing Remarks

FIRST PODIUM PRESENTATION SESSION ABSTRACTS

MOLECULAR DYNAMIC SIMULATIONS – EXPLORING THE DNA-HISTONE COMPLEX WITH A COARSE GRAINED MODEL

David Henry Ibezim[1] and Marcelo Carignano, Ph.D.[2]
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The organization of chromatin consists of either condensed or relatively relaxed clusters of DNA, RNA, and proteins. These structures are pivotal to the regulation of eukaryotic cells. Though researchers have made advances experimentally and computationally to understand the mechanics of packing the chromatin fiber, there are still many unknowns and therefore there is a need to integrate experiments and simulations to further advance our understanding. The current analysis explores the DNA and histone complex using a coarse graining computational method to study the chromatin's conformation at the scale of 10 to 100 nucleosomes. Data are drawn from multiscale simulations of a DNA chain using GROMACS, a Molecular Dynamic Simulation software that mimics atoms' movements within an energy potential field. The analysis examines the scaling behavior of the DNA chain as a function of length in the process of forming the chromatin fiber primary component. Understanding the nature of a bare DNA chain and the DNA chain combined with histones provides insights of the chromatin dynamics, such as how DNA transcriptions relate to functions. In other words, the simulations will aid in explaining the complex processes exhibited by chromatin in the cell.

UNCOVERING HIDDEN BIODIVERSITY USING MACHINE LEARNING

Sean Cullen[1], Beth McDonald, M.S.[2], Tom Campbell Ph.D.[2,3], Francisco Iacobelli Ph.D.[1], Rick Ree Ph.D.[2], Ryan Fuller M.S.[2], and Matt von Konrat Ph.D.[2]
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[3]Department of Biology, Northeastern Illinois University, Chicago, IL 60625

As museum herbarium collections all over the world become digitized, the question becomes: how can we use computers to accelerate scientific research? Research in other disciplines shows that machine learning models are great at categorizing images. In this study, we attempted to train a convolutional neural network model to identify leaf images from the genus *Rhododendron*. *Rhododendron* is a genus rich with species complexes, each with potentially distinct differences in leaf size, shape, and color patterns. Though these features may sound distinctive, they can be hard to identify due to their small size and complexity. Our goal was to train machine-learning models to identify differences and correctly sort them into five species groups based on a taxonomic key. After experimenting with training nearly 60 models, we were able to achieve a maximum test accuracy rate of 89.4%. While our image sets included both abaxial and adaxial surfaces of the leaves, models trained only on abaxial surfaces achieved a higher accuracy, despite decreasing the size of the dataset. To increase the size of our datasets, several image augmentation techniques were tested. The augmentations that yielded the best results were a rotation of up to 90° and vertical flipping. These results are extremely promising for the future of machine learning classifications of digitized herbarium specimens. Future research projects include attempting to do multi-class classifications on all five species groups at once, as well as increasing the data set size to attempt to classify the plants at the species level.

INTEGRATING SPEECH IN AN INTELLIGENT TUTORING SYSTEM FOR LOW LITERACY BREAST CANCER SURVIVORS

Joshua Westgor[1], Naomi Singleton[2], David Velasquez[3], Dan Stille[1], Mohammed Faizaan Kahn[1], Jessica Garber[1], and Francisco Iacobelli, Ph.D.[1]
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[2]Department of Biology, Northeastern Illinois University, Chicago, IL 60625
[3]Pritzker School of Medicine, University of Chicago, Chicago, IL 60637

For many low literacy breast cancer survivors, it is very difficult to find reliable information about their health and this has a detrimental effect on their quality of life. While there are support groups and other ways for them to get the necessary information, these options are still quite limited on resources and do not scale. This project aims to build the first iteration of an Intelligent Tutoring System (ITS) that communicates verbally and elicits information from the user, giving comments based on the user's input. This, however, is challenging because of behaviors exhibited by our population. In particular, we have observed that low literacy breast cancer survivors tend to produce long pauses while developing ideas. This may result in incomplete understanding of their utterances as systems commonly use pauses as a cue to take the floor and process speech. Therefore, this project aims to integrate a speech interface that is able to detect when the user pauses, but means to continue, versus when they are actually done speaking. The ITS achieves this by implementing a speech interface which uses pyaudio and google libraries and that uses examples of complete sentences to detect whether the pause was after a complete sentence or in the middle of a sentence. This is aimed at low literacy breast cancer survivors and incorporates algorithms to mitigate problems that other voice interfaces may experience with our population. In the future, the ITS should be able to deal with more linguistic features that are present in Latina breast cancer survivors.

INTELLIGENT TUTORING SYSTEM FOR BREAST CANCER SURVIVORS

Daniel Stille[1], Francisco Iacobelli PhD[1], Jessica Garber[1],
Mohammed Faizaan Khan[1], Naomi Singleton[2], David Velasquez[3], and Joshua Westgor[1]
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Low literacy breast cancer survivors can experience reduced quality of life, as well as sub-optimal management of health conditions. Although there are many online educational resources for breast cancer survivorship, they rely on a high level of literacy and/or they are hard to scale. This paper examines the feasibility of an Intelligent Tutoring System (ITS) that educates about breast cancer related topics for low literacy breast cancer survivors. Building on Constructivism, the theory that learning is not passive, but engages a learner's prior knowledge, we created the first iteration of an application that elicits deep responses from users about breast cancer survivorship topics. To build this application, we used Google Voice's Applied Programming Interface to transcribe user utterances and our own algorithms to detect sentence completion and to manage dialogue relating to breast cancer survivorship. The application engages the user in dialogue by voice and asks questions about breast cancer related topics. The application determines likeness of the user's response to text relevant to breast cancer survivorship managed by the application and then moves the dialogue forward to new topics once those responses pass a certain threshold of similarity and match key terms associated with target answers. Our application will take into account our target group's use of cognates and use of shorter, simpler expressions. We anticipate that this ITS, to be made available from home computer or mobile device, will scale, providing our target group with accurate information about breast cancer, and we hope this will empower them towards self-care. Future work includes testing the ITS with members of the target population and assessing their interactions.

THE IMPACT OF INSTRUCTIONAL GESTURE ON CHILDREN'S MATH EXPLANATIONS

Jackelyn Castaneda, Samantha Macksey, Kayla Nuszen, Michele Villacres, Jan Rodriguez-Cruz,
R.B. Church, Ph.D., and Andrew Young, Ph.D.
Department of Psychology, Northeastern Illinois University, Chicago, IL 60625

U.S. children fall far behind other industrialized countries in math competency. This study explores how video instruction can improve young children's understanding of math. Previous research suggests that instruction that includes gestures can improve understanding of math concepts beyond the speech. We examine specifically, how gesturing with verbal instruction affects children's learning of mathematical equivalence (i.e., understanding the equal sign as a relational symbol). Expanding on previous research, we examine children's verbal explanations of their problem solutions before and after instruction. Explanations provide more detailed information about a child's mental representations of math concepts not afforded by solutions to math problems. Children aged 7-11 years (n = 131) were randomly assigned to *Gesture+Speech* or *Speech-Only* video instruction conditions in a pretest-instruction-posttest protocol on Zoom. During the pretest and posttest, children solved math equivalence problems (e.g., 3+4+5=_+5) and explained how they arrived at their solutions. Children's explanations were coded for uptake (i.e., adoption) of the strategies expressed in the instructional videos, some of which were exclusively conveyed via gesture in the *Gesture+Speech* condition. Children's problem solving accuracy showed similar improvement from pretest to posttest in both conditions. Furthermore, there was no difference in strategy uptake between the two conditions. These findings critically suggest instructional gestures may not be effective on remote instruction platforms such as Zoom.

BILINGUALISM, WHAT IS IT GOOD FOR? CHILDREN'S MATH LEARNING

Jan Rodriguez-Cruz, Jackelyn Castaneda, Samantha Macksey, Kayla Nuszen, Michele Villacres,
R. B. Church, Ph.D., and Andrew Young, Ph.D.
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The Cognitive Reflection Test (CRT) was designed to assess whether intuitive or reflective processes are used to make decisions. Past studies provided evidence of bilingual university students taking longer to answer CRT questions but also answering questions more accurately than their monolingual counterparts do. These results suggest that bilingual students have better inhibitory control, thus allowing for more reflective thinking. Previous research has only examined CRT with adults, in the current study we sought to examine the association between CRT and bilingualism in children. CRT has also been shown to be a good predictor of math capacity for children and adults. Here we examine how CRT and bilingualism impact math learning in children. One-hundred and twenty-nine 7- to 11-year-olds participated in a pretest-instruction-posttest design over Zoom. First, parents completed a questionnaire about their children's language history (e.g., the number of languages spoken and when they were acquired). Next, we measured children's cognitive reflection, working memory, and math problem solving before and after video instruction. We hypothesized that bilingual children would score higher on the CRT-D, have larger working memories, and will benefit more from instruction than monolingual children. Results show that bilinguals benefited from instruction significantly more than monolinguals. However, there was no bilingual advantage for CRT or working memory. These data further our understanding of specific cognitive advantages that are (un)associated with bilingual experience during childhood.

USING HISTAMINE TO VIEW THE IMPACT IN THE ON AND OFF RESPONSE IN AN ERG: ASSERTING THE ROLE OF THE CENTRIFUGAL FIBERS IN MODULATING RETINAL SIGNALS

Michelle Vargas[2,1], Jennifer Parral[1,2], and Shannon Saszik, Ph.D.[2]
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Changes in the *b*-wave of the electroretinogram (ERG) in schizophrenia are hypothesized to be due to histaminergic inputs from cortex to the eye. The current study proposes to examine the direct effect of histamine on the ON (*b*-wave) and OFF (*d*-wave) components of the ERG. Zebrafish are selected and placed into control, L-Histamine systemic exposure (HIS), and L-Histamine injection (HII). The HIS group will be dosed with histamine (0.8 mM) in a beaker. After exposure, the fish are anesthetized and ERGs recorded. For HII, ERGs will be recorded, then histamine (0.1 mM) is injected directly into the eye and ERGs recorded again. To record light adapted ERGs, an electrode is placed in the eye and nose. A fiber optic is placed next to the eye for stimulus presentation. The stimuli consist of white light flashes imposed on a rod saturating white light background. Two flash durations (50 and 100 ms) will be tested to examine the *b*- and *d*-waves of the ERG. Changes in the time to peak (TTP) of the response and the peak amplitude (PA) will be determined for an incremental series of flashes. Results are expected to show a decrease in the TTP and the PA of the b-wave of the ERG post-histamine, with the injection more effective in drug delivery than systemic exposure. Importantly, this study will confirm the role of histamine in altering the ERG response, providing evidence for the role of centrifugal fibers in modulating the responses on retinal neurons.

LEARNING MATH: DOES WORKING MEMORY OR SOCIOECONOMIC STATUS MATTER?

Michele Villacres, Jan Rodriguez-Cruz, Jackelyn Castaneda, Samantha Macksey, Kayla Nuszen,
R.B. Church, Ph.D., and Andrew G. Young, Ph.D.
Department of Psychology, Northeastern Illinois University, Chicago, IL 60625

U.S. elementary school children have a poor understanding of the equal sign (i.e., mathematical equivalence) which may partially explain our poor international rankings in math competency. Up to 80% of children treat the equal sign as an operational symbol (e.g., meaning add up all the numbers) rather than a relational symbol that reflects that both sides of an equation are the same. Two factors that may be related to children's learning about the equal sign are working memory capacity (WMC) and socioeconomic status (SES). Prior research has shown that high WMC and high SES predict math learning in both children and adults. However, no study has directly examined how WMC and SES may interact with children's learning of mathematical equivalence. We hypothesize that low SES children will perform worse at pretest than high SES children (i.e., an SES achievement gap). U.S. 2nd-5th graders (N = 131) completed a pretest-instruction-posttest study via Zoom. Children's mathematical equivalence understanding was measured before and after instruction. We also measured children's WMC and SES (e.g., parent education). Both SES and WMC predicted children's mathematical equivalence understanding prior to instruction. However, only WMC predicted children's learning (i.e., improvement from pretest to posttest), SES was unrelated to learning. These findings suggest WMC critically underpins learning about mathematical equivalence, and further highlight that cognitive resources (e.g., high WMC), not environmental resources, are what is critical to learning.

ARTIFICIAL FLOATING WETLANDS IMPROVE HABITAT QUALITY FOR AQUATIC MACROINVERTEBRATES IN URBANIZED RIVERS

Samantha García[1] and Pamela Geddes Ph.D.[1,2]
[1]Environmental Science Program, Northeastern Illinois University, Chicago, IL 60625
[2]Department of Biology, Northeastern Illinois University, Chicago, IL 60625

Artificial floating wetlands (AFWs) have been used for beautification of urban, aquatic landscapes and may provide additional and higher quality habitat for water-dwelling wildlife. Assessing habitat quality can be achieved by identifying the diversity of organisms that are bioindicators, like benthic macroinvertebrates such as insects, mollusks, and crustaceans that live in freshwater. To determine if AFWs deployed in the Chicago River provide higher quality habitats compared to sections of the river without AFWs, we compared the identity and abundance of macroinvertebrate taxa at both sites during the summer of 2020. Our experimental design included two treatments, the AFW site and a control site that lacked AFWs, with nine replicates per treatment. Macroinvertebrates were collected using Hester-Dendy samplers that were submerged for 7 weeks and later preserved in 80% ethanol. We taxonomically identified the individuals in each sample using a dissecting microscope. We predicted that macroinvertebrate taxa richness and diversity would be higher for the AFW site, indicating that the AFWs provide a higher quality habitat than aquatic environments lacking AFWs. The statistical analysis indicated that there was not a significant difference in the taxa richness of the two sites however; the analysis indicated that the diversity of the AFW site was significantly higher than that of the control site based on the t-test conducted on the Shannon diversity index (H) of the two sites. This study allowed us to determine that AFWs are a feasible way to improve habitat quality for wildlife in urbanized rivers.

UNDERSTANDING THE CHANGE IN IRRIGATION METHODS IN MICHIGAN AND INDIANA, OVER THE LAST FIFTEEN YEARS

Erica N Belloso[1] and Younsuk Dong, Ph.D.[2]
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[2]Department of Biosystems & Agricultural Engineering, Michigan State University, East Lansing, MI 48825

The conservation of water has always mattered. In recent times, it has become of utter most importance. Not only have our agricultural needs increase as our populations grow, but also the demand for water. With rising temperatures because of global warming, we are faced with the dire need of water but in exchange, we are living the consequences of severe weather conditions, one of them being severe droughts. In efforts to better understand the utilization of our water, this study will explore data provided by the United States Department of Agriculture, and the National Agriculture Statistics Service data from the years 2003, 2018. Because Michigan is the second leading state in agriculture, we will be focusing on Michigan and Indiana. From the data, we will calculate the percent change of irrigation methods in efforts to better understand water usage over the last 15 years. Because agriculture is one of our main sources of food, we hope that our research can shine some light in how to be better equipped, informed, and prepared in prevention of water scarcity. Results from percent change in the "methods used when deciding when to irrigate" show that there has been an overall increase in almost all the irrigation methods used to irrigate acres over a 15-year period.

A PHYLOGENETIC ANALYSIS OF IRIDESCENCE IN SQUAMATES

Hayden J.S. O'Connell[1], Kirsty J. MacLeod, Ph.D.[2], and Beth A. Reinke, Ph.D.[1],
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Iridescence is the angle-dependent reflection of light present in the integument of many animals. We know very little about the function of iridescence, despite its potential importance for species survival. Squamates, also known as lizards and snakes, are a widespread group of vertebrates, occupying many habitats and having diverse life histories, behaviors, and appearances. Many squamates have iridescent scales, but the extent to which iridescence is present in the group has never been documented. We used phylogenetic comparative methods (PCMs) to investigate the evolution of iridescence across over 1,000 species of squamates. We also used ancestral state reconstruction to estimate how long ago iridescence evolved, and we discussed potential functions of iridescence based on ecological correlates. Understanding the evolution of iridescence is necessary to determine its importance in different squamate groups and could have conservation implications for species in peril.

SECOND PODIUM PRESENTATION SESSION ABSTRACTS

BITCOIN PRICE PREDICTION

Salma Elannani and Manar Mohaisen, Ph.D.
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When investing in Bitcoin, most investors cannot guarantee the direction in which the prices will go in the short- and long-term. They can only have assumptions and must risk their money based on speculations that might be inaccurate. To alleviate the consequences of such inaccurate speculations, statistical analysis of the price history can be performed, and those results are used to train statistical models that can predict future values. Machine learning is an emerging field of data science that includes a variety of models that are able to predict future values. Such models are trained and tested versus unseen datasets to provide a close approximation to the actual future prices of a currency. In this research, we train two different models: Long-Short Term Memory (LSTM) and Support Vector Regression (SVR), using Bitcoin historical data. Both models were able to provide very close predictions of the actual price, but most importantly were able to keep up with the overall trend of the currency prices. In conclusion, these machine learning models were successful in predicting the price of Bitcoin. When comparing the two models, the SVR model works better than the LSTM model, with an 84.5% accuracy compared to an 82.1% accuracy using LSTM. However, both results are exceptionally optimistic, and with the appropriate set of algorithms and features, we will be able to use these models in real-world investment environments and extend them to other currencies and stocks as well.

A MODIFIED CUBIC SPLINE METHOD AND ITS APPLICATIONS

Chen Tang and Zhonggang Zeng, Ph.D.
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Cubic spline interpolation is one of the standard methods for approximation of a smooth function using function values at a sequence of points. The so-called natural spline is arguably the most frequently mentioned on numerical analysis textbooks. It requires adding two seemingly harmless equations to an underdetermined linear system. In this project, we design a novel approach by solving the underdetermined linear system directly for its minimum norm solution and the numerical general solution. From our experiment, the minimum norm cubic spline is a more accurate approximation than the standard natural cubic spline. Since the numerical general solution of the underdetermined linear system has two degrees of freedom, we can solve an optimization problem that minimizes the arc length of the spline path. Our experiment shows that the combination of Newton's iteration and Gradient Descent together achieves good results. This approach can be applied to find the shortest path of a robot. In summary, we propose a modified method for computing the cubic spline approximation that appears to be more accurate than the natural cubic spline and provides a mechanism for optimizing various objectives such as robot shortest path.

PYTHON-BASED SIMULATED CYBERSECURITY ATTACKS USING VIRTUALIZATION

Brian Prado, Kevin Baez, Deontae Allen, Anne Ryan, Manar Mohaisen, Ph.D., and Ahmed Khaled, Ph.D.
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As we move further in our technological advancements, cyber-attacks become an ever-growing problem due to the breaches and huge damage they may cause on our devices and data. As such, it is important to be informed about the different types of cyber-attacks and how they work, in a safe and secure environment. One way to do so is through the different promising virtualization technologies. With virtualization, the creation and maintenance of a virtual machine (VM) becomes feasible. Developers can include servers, switches, routers, and computers as VMs to build a network and to develop and test applications. Virtualization is achieved through a software layer known as hypervisor, which shares a computer's hardware among multiple VMs, and controls the virtual environment and the communication between the different VMs. Using type-2 hypervisors, we built a virtual network that consisted of three Kali Linux VMs and an OpenWrt edge router. With this network, we were able to simulate common cyber security attacks, and control simulation through different parameters. These cyber-attacks include the Smurf Attack, Ping of Death, Man-in-the-middle (MITM), TCP session hijacking, SYN flooding, ARP cache poisoning, and Overlapping Fragments. The attacks were coded in Python language and Scapy - python package used to create, send, and sniff packets during the different cyber-attacks. The project was then integrated with a graphical user interface (GUI) using PyQT5, to give users a simple and interactive way to input parameters and simulate attacks through the virtual network.

IMPROVING THE ACCURACY FOR PRIVACY-PRESERVING POINT-OF-INTEREST RECOMMENDER SYSTEMS

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In the digital era, an essential ingredient of numerous online vendors and various types of websites is a recommender system. This technology immensely reduces users' search time when looking for the contents of their interest. Recommender systems make suggestions based on individual preferences learned from their users. Generally speaking, users have to unconditionally share personal search and/or purchase history with service providers, who also have full access to their private preferences. In this research, we have implemented a privacy-preserving point-of-interest recommender system based on a framework with three major components: a mobile app IncogniToGo, a vendor-hosted aggregate server, and a remote central server. Furthermore, we improved the system's prediction accuracy by estimating each anonymous user's GPS location and incorporating this information into the recommendation process. Our current model integrates the Google Cloud Platform (Maps and Firebase), a wireless communication standard called Wi-Fi Direct, and machine learning algorithms. IncogniToGo allows a user to rate a place in Google Maps. Internally, it computes the user's current location based on their rated places and communicates this data using a random user ID via Wi-Fi Direct to the aggregator server. User groups are created on the aggregator server, and the corresponding group preferences are then sent to the Firebase (central server). Machine learning algorithms are performed on the server to extract latent features of the shared data. Finally, IncogniToGo pulls such features from Firebase and generates personalized recommendations locally on the user's device, which prevents the server from learning users' individual preferences.

A MACHINE LEARNING-BASED COURSE ENROLLMENT RECOMMENDER SYSTEM

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At Northeastern Illinois University, the Computer Science (CS) department offers students a wide range of unique courses. These courses reflect the diversity of options available at the university. Students can choose from three concentrations within the CS major. Nevertheless, students pursuing a degree in computer science will not always be enrolled in the same courses. They often have difficulties choosing which courses to enroll in as part of their concentration. This research proposes a personalized course recommender system to help current and future students find the courses in which they need to enroll. It will generate a list of suggested courses for each student to consider registering for the upcoming semester. The system utilizes a collaborative filtering algorithm to profile each student with respect to their registration preferences. The algorithm extracts latent features of students and courses by performing stochastic gradient descent to optimize our objective function. The learning process takes into account auxiliary information, such as course instructors, meeting times, and delivery methods (online/in-person/hybrid). When making recommendations, the filtering step of the system follows program requirements to refine the output by removing unnecessary courses and substituting courses with their prerequisites, when necessary. We evaluated our proposed model on a CS enrollment dataset. In the experiments, we conducted an extensive study on the hyperparameters of the model and visualized each parameter. The results show that our model can produce high-quality recommendations, whose accuracy is comparable to state-of-the-art research. A web application that demonstrates the framework is also implemented.

APPLYING A USER-CENTERED CO-DESIGN APPROACH TO DEVELOP A WEB APPLICATION FOR EMPOWERING CANCER SURVIVORS WITH DISABILITIES

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The transition from active treatment to long-term cancer survivorship leaves the needs of many cancer survivors unaddressed as they struggle with physical, cognitive, psychological, and social consequences of cancer and its treatments. The lack of guidance following treatment has forced cancer survivors to manage long-term effects on their own, impacting their overall health, quality of life, and social participation. We aim to develop a mobile health (mHealth) application using an iterative co-design research approach to empower the community of survivors to self-manage the lifelong effects of their cancer treatments. Alongside 'survivor scientists', cancer survivors with disabilities (n=5), our team is conducting three co-design workshops to develop a high fidelity prototype. During the first workshop, participants critiqued personas created by the research team to identify the needs and challenges of target users. In the second workshop, survivors provided critical input into features of applications they liked and disliked and methods for presenting content to cancer survivors to aid in the design of a prototype. In our third workshop, the survivor scientists will evaluate and critique this prototype to finalize the design. The results of this research will lead to the development of an mHealth application for cancer survivors with disabilities that will offer interventions to improve their quality of life and increase their self-efficacy to manage cancer as a chronic condition. We expect the co-design process to lead to a prototype best suited to meet the needs of cancer survivors suffering from long-term cancer effects.

THE INFLUENCE OF POSTNATAL GROWTH RESTRICTION ON HEART MORPHOLOGY

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Growth restriction caused by undernutrition following birth is associated with a variety of chronic diseases, with cardiovascular disease being the most common. Cardiovascular disease includes a variety of pathologies, but in growth-restricted mice, it has been observed that the heart displays functional signs of fibrosis and eventual heart failure. In order to develop therapeutic countermeasures to reduce the incidence of mortality from cardiovascular disease it is necessary to evaluate the heart of growth-restricted mice for structural (size of the left ventricle), functional (metabolic profile), and fibrotic characteristics. To accomplish our objective, a cross-fostering model was used where the pups born from control mice dams were nursed on control dams (20% protein) or dams on a low protein diet (8% protein) from birth to postnatal day 21 (PN21). Following PN21, all pups were fed the control diet until adulthood. At PN70 mice were euthanized and the hearts paraffin-embedded for histological analysis. The hearts were stained with Hematoxylin and Eosin (H&E) to determine the size of the right and left ventricle, Trichrome to determine the presence of cardiac fibrosis, and Periodic-Acid Schiff (PAS) to quantify the amount of glycogen in the heart cells. With this technique, we hope to understand the development and structural changes the heart undergoes following a growth restriction diet.

ELUCIDATING THE INTERACTION OF THE TAZ-CAMTA1 FUSION PROTEIN WITH EPIGENETIC MODIFIERS

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Epithelioid hemangioendothelioma (EHE) is a vascular sarcoma that metastasizes early in its clinical course and lacks an effective medical therapy. A central event in the pathogenesis of EHE is perturbation of the Hippo signaling pathway. The pathway is a regulator of tissue growth and organ size composed of a serine/threonine kinase cascade. Studies have shown that the Hippo pathway plays a central role in 66% of all sarcomas. Two transcriptional coactivators in this pathway, TAZ and YAP, are Hippo end effectors that drive oncogenic transcriptional programs. Chimeric proteins consisting of the N-terminus of TAZ or YAP fused in frame to the C-terminus of CAMTA1 or TFE3, respectively, promote cell transformation in EHE. In order to elucidate the mechanisms by which TAZ and YAP fusion proteins promote sarcomagenesis and metastasis, our lab deleted the transactivation domain (TAD) of the TAZ-CAMTA1 fusion protein, which is present in approximately 85-90% of EHE tumors. The TAD is ***hypothesized*** to interact with key epigenetic modifiers including the ATAC histone acetyltransferase complex. Retroviral expression vectors were transfected into HEK293T cells and the packaged retrovirus was used to transduce NIH-3T3 cells to express the truncation mutant (TAZ-CAMTA1ΔTAD) as well as the full-length fusion protein. A negative control of empty plasmid was used to compare growth of cell colonies in soft agar, which were then quantified. Although TAZ-CAMTA1ΔTAD demonstrated fewer colonies while growing in soft agar compared to full-length TAZ-CAMTA1, its expression was not detectable by western blot, suggesting that deletion of the TAD decreases its stability.

QUANTIFYING ERK ACTIVITY ALONG THE EGL-15 PATHWAY IN *C. ELEGANS*

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Fibroblast growth factor receptors (FGFRs) are cell-surface receptor tyrosine kinases (RTKs) that regulate essential cellular processes. Mutations that disrupt FGFR signaling can cause developmental abnormalities and cancer. Study of EGL-15, the sole FGFR in the nematode *C. elegans*, has led to the discovery of key RTK signaling components. EGL-15 regulates important biological processes, including body fluid homeostasis, via the RAS-RAF-MEK-ERK cascade. Mutations that disrupt the phosphatase CLR-1 hyperactivate EGL-15 signaling, causing an excessive accumulation of clear fluid, leading to a dramatic Clr (clear) phenotype. Conversely, mutations that compromise EGL-15 signaling can reduce this hyperactivity and confer a Suppressor of Clr (Soc) phenotype. While the outline of the EGL-15 signaling pathway has been derived from such a phenotypic analysis, a deeper mechanistic understanding will require a more quantitative analysis of EGL-15 signaling in various mutant backgrounds. To quantify EGL-15 signaling activity, we have begun to analyze the activation state of MPK-1/ERK, via an ERK-Kinase Translocation Reporter (ERK-KTR) biosensor. Phosphorylation of ERK-KTR is monitored through its nuclear/cytoplasmic localization within the cell. In the absence of ERK activity, ERK-KTR is not phosphorylated and is nuclear-enriched. In the presence of ERK activity, ERK-KTR is phosphorylated and its localization becomes cytoplasmic. Preliminary results demonstrate that ERK-KTR is a faithful reporter of ERK activation in the hypodermis. Additionally, we show that *clr-1* mutants have significantly elevated ERK activity compared to wild type, indicative of increased EGL-15 activity. We aim to use ERK-KTR to obtain a deeper mechanistic understanding of the principles of EGL-15 signaling.

FIRST POSTER PRESENTATION SESSION ABSTRACTS

DOES WORKING MEMORY AND STRATEGY VARIABILITY INFLUENCE A CHILD'S READINESS TO LEARN?

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The U.S. ranks 30th among industrialized countries in math competency. Math achievement in algebra and beyond critically depends on children's correct interpretation of the equal sign as meaning *the same as* (i.e., mathematical equivalence). Prior research shows that young children (4-6 year-olds) produce multiple and inconsistent strategies when solving math problems just prior to acquiring new arithmetic concepts. This variability in strategy use is theorized to reflect openness to conceptual change. However, strategy variability is not well understood with respect to pre-algebraic concepts learned by 7-11 year-olds. Children's working memory capacity (WMC) is critical to math achievement, yet the relationship between WMC and strategy variability in children is poorly understood. Here we examine how children's WMC and strategy variability interact with math instruction in the domain of mathematical equivalence. Children aged 7-11 years (N = 130) completed a pretest-instruction-post-test protocol on Zoom. We measured children's WMC and use of multiple strategies on mathematical equivalence problems (e.g., 3 + 4 + 5 = _ + 5) before and after watching a video lesson. Contrary to our hypothesis, we found that children with greater strategy variability (i.e., using two or more problem solving strategies at pretest) learned less from instruction and had lower WMC. Notably, high WMC was strongly associated with learning from instruction. These findings further our understanding of the critical individual differences in cognitive factors that do (and do not) underpin children's math learning and subsequent achievement.

CELLULAR STRESS RESPONSE PATHWAYS THAT INFLUENCE NEURONAL PROTEINOPATHIES IN *C. ELEGANS*

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Molecular chaperones are highly conserved molecular machines that maintain the cellular folding environment. The proteostasis network preserves the quality of protein folding, preventing protein aggregation and proteotoxicity. One hallmark found in neurodegenerative diseases, resulting from chronic proteotoxicity, such as amyotrophic lateral sclerosis (ALS) is the accumulation of misfolded proteins. A correlation between aging, neurodegenerative diseases and chaperone dynamics has been shown. For our research, we expressed human TDP-43, an RNA binding protein, associated with ALS, in the nervous system of the nematode *C. elegans*. We performed an in-depth assessment to reveal changes in the active translatome and identified cellular stress response pathways that change when TDP-43 is neuronally expressed. I analyzed the impact of the Insulin-like signaling (ILS) pathway, a key cellular pathway that influences an organism's longevity by modulating stress responses. Analysis of the differentially expressed genes revealed approximately 85% of those genes were affected by mutations in the insulin receptor and over 10% of these genes were impacted by three downstream transcription factors, HSF-1, DAF-16, and SKN-1. Our analysis suggests that the ILS pathway fails to protect neurons from proteins that trigger proteostasis imbalances leading to neurodegenerative disease. To test this experimentally, we introduced a mutation in the insulin-like receptor that will activate the ILS pathway to determine whether this pathway protects neurons from TDP-43. I am testing the function of motor neurons to see

if activation of the ILS pathway restores function in the TDP-43 expressing animals. From this experiment, we hope to identify the relationship between TDP-43 and the ILS pathway that participates in longevity and proteostasis.

CORN PROCESSING: ENVIRONMENTAL MONITORING RISK AND ASSESSMENT

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Food processing facilities such as corn processing plants use an environmental monitoring program to test for pathogenic risk on equipment. High risk of pathogen contamination includes sites previously confirmed positive or that are similar to previously confirmed positive sites. This research was done at a corn processing facility in Bedford Park, IL to create a standardized risk assessment, assess the pathogenic risk in the dry starch buildings of the facility, and to create fixed swab sites based on the assessment. Data from the dry starch buildings were collected over a 4-year span for presence of confirmed pathogens. This data allowed creation of a pathogenic risk assessment and assigned risk to the dry starch buildings. High-risk areas were found to be locations proximate to finished product and heavy traffic. Equipment such as conveyor belt framework, silo walls, operator office doors, and finished product lines within the high-risk areas were determined to be possible contamination sources and were photographed to then create fixed swab sites. Standardization of risk assessment and swab sites allows this facility to efficiently monitor for pathogen presence and traceability. Similar facilities can utilize this research in formation of their own environmental monitoring program.

CONFIGURATION INTERFACE FOR AN INTELLIGENT TUTORING SYSTEM

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Survivors of breast cancer are often confronted with treatment-related and other long-term symptoms that negatively impact their life. Delivering cancer-related knowledge can help survivors to optimize their long-term follow-up care thus having a positive impact on their lives. An Intelligent Tutoring System (ITS) can be a great tool to educate low literacy survivors about their condition. An ITS is a computer program that leverages the learner's knowledge and uses natural conversations with a constructivist approach to elicit deep responses from the learner. However, the configuration of such systems can be complex and may require expertise that is outside of those with expertise in breast cancer education. This project aims to develop a configuration interface that makes it easier for non-computer-oriented educators to train the system. This interface will convert the human-readable text prepared by an educator to a document database known as JSON, which will further be used to train the system. The JSON file will be used by the ITS which then will use its inbuilt constructivist approach to deliver cancer related knowledge to the survivors. The resulting configuring interface will be deployed as an interactive web interface that can be easily accessible by educators. By developing an easy way to configure our ITS, we aim to reach those with the most breast cancer education expertise, and motivate them to build, and constantly update the material that will result in an ITS that can educate and help improve the health-related quality of life of breast cancer survivors at scale.

SODIUM CHLORIDE REMEDIATION UTILIZING *PLEUROTUS OSTREATUS* IN RIVER WATER

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An oyster mushroom (*Pleurotus ostreatus),* a mushroom commonly known for its edible qualities and ability to grow in a variety of environments, will improve water quality by reducing the amount of chloride in a sample of river water. Samples of river water were inoculated with cultures of *P. ostreatus* and examined for the presence of biological and inorganic contaminants. These samples were left to incubate for a period of 6 weeks. Straw was used as a substrate for the growth of *P. ostreatus*. As such, our controls included both samples of uninoculated river water as well as river water samples with only straw substrate. All samples were measured for contaminant levels, before and after the 6-week incubation. Of all the biological and inorganic contaminants that were measured, chloride showed the most significant reduction. Levels of chloride steadily decreased across samples in the following order from highest to lowest: river water only, river water plus straw, and river water, which had been inoculated with *P. ostreatus*. The marked decrease in chloride as a contaminant, compared to the other sources of contamination drove further research in that direction, in a second trial of the experiment. Currently, the experiment is undergoing a second phase, to confirm results of chloride reduction.

EFFECT OF THAWING ON THE STABILITY OF LACTOFERRIN AND sIgA IN DONOR MILK; EFFECT OF HUMAN LACTOFERRIN ON VIABILITY OF HELA CELLS

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The immune system of newborn infants is not developed and they depend on mother's milk for immunity. Breast milk contains compounds, such as lactoferrin and secretory IgA (sIgA) antibody that protect the infants against pathogens, especially prematurely born infants, who are susceptible to necrotizing enterocolitis. Lactoferrin has an antimicrobial effect by chelating iron required for microbial growth. In addition, bovine lactoferrin has also been reported to inhibit the proliferation of cancer cells. sIgA provides immunity to infants against a variety of pathogens. If mother's milk is not available, milk banks provide pasteurized donor milk to infants. Currently, milk banks collect milk from donors at different stages of lactation to analyze it for nutritional content and pool the milk from different donors of the same lactation stage to ensure equal nutrition in all samples. The pooled milk batches are stored frozen until use. However, the lactoferrin and sIgA content of pooled milk is not measured, thus not much is known about the effect of storage and thawing on the sIgA and lactoferrin content. The goal of this work is to determine by ELISA, the maximum storage period that retains the biological activity of lactoferrin and sIgA in milk. These results will provide the milk banks important information about the length of storage period optimal for donor milk. We will also investigate whether treatment of HeLa cells (epithelial cancer cell line) with lactoferrin leads to cell death. Depending on our results, we will investigate the mechanism of action of lactoferrin on cancer cells.

REVEALING GENE EXPRESSION PATTERNS OF TP53-INDUCED GENE 11 (PIG11) PARALOGS, A FAMILY OF TUMOR SUPPRESSOR PROTEIN IN ZEBRAFISH (*DANIO RERIO)* USING WHOLEMOUNT *IN SITU* HYBRIDIZATION

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Cancer affects 1 in 1.8 billion humans each year. At its most basic, cancer is unregulated cellular division. In addition, it has been observed that cancer cells sometimes ignore the signals to self-destruct, a natural cellular process called apoptosis. Apoptosis helps regulate cell numbers and dispose of abnormal cells. Many of the molecular signals that promote apoptosis are considered potent tumor suppressor proteins. This summer we have been investigating a family of tumor suppressor proteins called TP53-Induced Gene 11 (PIG11). Previous studies have shown that PIG11 in humans promotes apoptosis, but its mechanism of action is not understood. The zebrafish genome encodes at least 70% of all human genes, including two paralogs of *pig11*, which we call *pig11a* and *pig11b*. What is not known is where these genes are expressed during development. By revealing the expression patterns of *pig11a/b* we may gain insight into their evolutionary conservation and function in zebrafish development. Given their similarity in amino acid sequence, we predict that *pig11a/b* will be expressed in cells undergoing developmentally regulated programmed cell death. To determine the spatial expression pattern of *pig11a/b* in embryonic zebrafish, we used whole-mount *in situ* hybridization to reveal which tissues express these genes at 24, 48, and 72 hours of development. To date we have not been successful with our whole-mount *in situ* hybridization protocols. We tried using two *in situ* protocols, both requiring *pig11a*, *pig11b*, and *pig11* DIG-labeled probes; these are used to detect targeted DNA or RNA. Future directions will be to adapt existing protocols to our needs.

USING A NOVEL FEEDING METHODOLOGY AS AN INDICATOR OF APATHY IN NEUROLOGICAL DISEASE MODELS.

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Apathy (AP) is seen in several psychological disorders, such as Parkinson's Disease (PD) and schizophrenia (SZ) and impacts an individual's quality of life. The purpose of the current study is to examine the use of a novel feeding paradigm to differentiate behavioral changes to define apathy in zebrafish after exposure to chemicals that induce PD and SZ. Adult zebrafish are randomly selected and separated into control and treated (MPTP (PD) and MK-801 (SZ)). The treated fish will be exposed to MPTP (0.8 mM) or MK-801 (0.1 mM). After recovery, fish are individually placed into the test tank that has a clear Plexiglas barrier at the top water line to prevent access to the food. After 3-minutes of acclimation behavior is recorded, the food stimulus is presented and behavior recorded again. The process is repeated until all fish are recorded. Total distance (TD) and average velocity (AV) is used to examine motor function, whereas AP is used to examine neurological changes through swim behavior pre- and post-food. AP is measured by the amount of time spent near the Plexiglas barrier, greater time indicates less AP. It is hypothesized that exposure to MPTP will reduce AV, TD, and increase AP reflecting PD-like symptoms, whereas exposure to MK-801 will show an increase in AV, TD, and AP reflecting SZ-like symptoms. Results from this study will help establish the use of the novel feeding paradigm and changes in swim behavior will differentiate between different neurological changes related to PD and SZ.

SECOND POSTER PRESENTATION SESSION ABSTRACTS

IMPACT OF PHOSPHATASE ACTIVITY IN *C. ELEGANS* EXPRESSING TDP-43, AN AMYOTROPHIC LATERAL SCLEROSIS ASSOCIATED DISEASE PROTEIN

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Amyotrophic lateral sclerosis (ALS) is a progressive and fatal neurodegenerative disease. Mutations in the TAR DNA-binding Protein of 43 kDa (TDP-43), an RNA binding protein, have been linked to familial cases of ALS. The accumulation of hyperphosphorylated TDP-43 in the cytoplasm of affected neurons is considered a pathological hallmark of the disease. However, the role of phosphorylation in disease progression remains unclear. To understand the impact of phosphorylated TDP-43 on neuronal function, we are using the nematode *C. elegans*, a transparent worm that has a short lifespan, a simple nervous system and is amenable to genetic manipulation. Transgenic animals that express human TDP-43 pan-neuronally have a decline in the function of motor neurons and chemosensory neurons. Actively translated mRNAs from *C. elegans* expressing neuronal TDP-43 were compared to wild type animals and 100 differentially translated genes were identified. I performed a Gene Ontology analysis to identify biological processes that were enriched in our gene list. Interestingly, the "peptidyl-tyrosine dephosphorylation" GO term was overrepresented. I selected two phosphatase-related genes of interest from this GO term list. Currently, I am crossing strains that carry deletions of each phosphatase gene to the TDP-43 transgenic line. With the newly constructed strains, I will assess the effect of the missing phosphatases on neuronal function using behavioral assays. I hypothesize that the deletion of the phosphatases will reduce neuronal functionality in the TDP-43 animals. These studies offer insight into potential therapeutic strategies targeting TDP-43 phosphorylation to alleviate ALS pathology.

NOVEL CARBON NANODOTS FOR THE DETECTION OF HEAVY METAL CONTAMINANTS

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Newly discovered carbon nanodots represent a growing and promising field with the potential to help aid in the recognition of heavy metal contaminants in the environment. These nanoscale carbon nanodots have low toxicity, are ecofriendly, and their economical synthesis process makes them versatile and viable for such applications. We are expanding this area in the nanometer scale for the use of blue carbon nanodots to detect contaminants in bodies of water or other environments, relying on the carbon nanodots' special properties due to their size, shape, and dimensions. We will be experimenting with ways to synthesize the carbon nanodots using fructose, sulfuric acid and a microwave oven so we can have a standard and reliable way of producing long-lasting fluorescent blue nanoparticles. Those dots and the most appropriate ligand combinations will help us identify common river and lake contaminants via fluorescence spectroscopy and other analytical techniques. In this project, the fluorescence spectra of standardized blue dots interacting with contaminants will be the main property studied. Based on preliminary data and previous results using High Performing Liquid Chromatography, we expect to develop methods for detection of specific heavy metal contaminants and possibly other contaminant species.

CREATING DISTRIBUTION MODELS FOR MIDWEST BRYOPHYTES

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Herbarium specimens collected in the past can play an important role in determining the response species have to environmental changes over time. Previous studies have used herbarium collections to study phenological, genetic, and landscape changes as a response to anthropogenic factors. In this study, we used digitized collections at the Field Museum of Natural History to determine potential changes in distribution patterns over time and to investigate the impacts of anthropogenic factors on species distribution. We also wanted to create a tutorial for how this process can be utilized. The Consortium of North American Bryophyte Herbaria (CNABH) was used to access collection information from common bryophyte species found in Illinois and environmental data was obtained from WorldClim.org. Map shapefiles for the United States were downloaded from GADM.org and opened with QGIS. Predictive maps were created using Maxent and then opened in QGIS for better visualization. This process may be applied for other fields of science such as animal migration patterns or studying how pollution affects certain organisms. The resources used are all open source, which allows others to easily follow this tutorial.

DO ALL DONOR MILK SAMPLES FROM THE MILK BANK PROVIDE THE SAME LEVEL OF SECRETORY IMMUNOGLOBULINS TO INFANTS?

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At birth, an infants' immune system is not developed enough to protect it from microorganisms, making them susceptible to necrotizing enterocolitis, which can be fatal in preterm infants. However, secretory IgA antibody (sIgA) as well as lactoferrin present in mother's milk provides protection against infections. In the absence of mother's milk, donor breast milk can be provided to infants by milk banks. The composition of breast milk changes over the lactation period, from colostrum to term milk. Milk banks provide milk for different lactation stages depending on the age of the infant. Milk obtained from different donors at each stage of lactation is pooled and each batch is tested for caloric and nutritional components. However, sIgA content of the resulting mixture is not tested. Milk from donors may vary in sIgA content, depending on the health status of the mother and the microbes to which she has been exposed. It is thus important that the sIgA content of milk be tested to ensure optimum protection for infants receiving donor milk. Our research aims to determine the sIgA content of colostrum, pre-term early term and term milk, by ELISA using sIgA specific antibody. Our preliminary results show that sIgA levels are highest in colostrum and decrease over the lactation period. This pattern coincides with the needs of the developing infants. The results of this work will be an important step towards allowing milk banks to consider the immune content as well as the nutritional content when pooling milk.

USING CONSTRUCTIVIST STRATEGIES TO TRAIN AN INTELLIGENT TUTORING SYSTEM FOR BREAST CANCER EDUCATION

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Low literacy Hispanic breast cancer survivors are at a disadvantage when looking for information online. The high level of literacy and potential sources of misinformation can lead to unnecessary stress and lower quality of life. An Intelligent Tutoring System (ITS) –a system that utilizes constructivist strategies to elicit deep responses from the learners - designed for breast cancer survivors is a step towards mitigating these outcomes. However, an important issue in the development of an Intelligent Tutoring System is creating material to train it. This material must be appropriate to be used with constructivist strategies. During this project, we adapted content about breast cancer survivorship from previous research, to match a constructivist approach. Two researchers highlighted misconceptions, important concepts and keywords, and divided the content into small units. In addition, we added additional details to help the system understand more nuanced answers. With this information, the system is able to build a database of questions and use them to tutor the user, while understanding the user's responses as they use their own words. Future work involves refining the system and testing its feasibility with a representative sample. By developing this ITS, we aim to empower Hispanic women to counteract false notions about breast cancer.

CAN CONCEPTUAL INSTRUCTION REDUCE THE PUBLIC-PRIVATE SCHOOL GAP IN CHILDREN'S MATH ACHIEVEMENT?

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Children who attend private schools perform better than those who attend public schools on many national and international assessments. This public-versus-private school gap is particularly notable in mathematics, thus reducing public school children's access to STEM careers. This may be due to the vast social and economic resources available to many private school students, but not very many public school students. One such resource characterizing private school math instruction over public school instruction is a focus on conceptual principles rather than a focus on procedures for solving math problems. Early mathematical concepts are essential for later academic achievement; therefore, we ask how to decrease the public-private gap in math performance. To address this question, we explored math instruction that emphasized a conceptual approach. We additionally compared *speech-only* instruction to instruction that included gestures (*speech+gesture*), as instructional gestures have been found to support children's acquisition of math concepts. We used the Zoom platform to individually test 130 2nd to 5th graders using a pretest-instruction-posttest design. Children's mastery of complex pre-algebraic math problems (e.g., 3 + 4 + 5 = _ + 5) was tested before and after watching video math instruction. Overall, both public and private school children learned from conceptual instruction. However, private school children learned more from *speech+gesture* than *speech-only* instruction, whereas public school children benefitted similarly from both instruction formats. These results suggest conceptually based instruction may reduce the public-private gap in math achievement, and highlight how features of learning environments can modify the effects of instruction.

USP7I AND GLUCOCORTICOIDS IN T-CELL ACUTE LYMPHOBLASTIC LEUKEMIA (T-ALL)

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T cell acute lymphoblastic leukemia (T-ALL) is a form of leukemia with a peak incidence in children aged 2 to 5 years old. It is suggested that sensitivity to glucocorticoids (GCs) in treatment is a reasonable indicator of positive treatment outcome. With this, it is advantageous to determine a way in which we can make cells more sensitive to GCs. Previous research has suggested that inhibiting a deubiquitinase enzyme (USP7i) increases GC sensitivity *in vitro*. When administered, GCs bind to glucocorticoid receptors (GRs) which interact with a proapoptotic gene called *BIM*. In this study, we aimed to determine the differences in *BIM* expression between untreated T-ALL cells and those treated with USP7i in the context of GCs. To do this, we followed a CUT&RUN protocol in USP7i treated and control cells to extract genetic material, purified the DNA, sequenced it using quantitative PCR for validation, and sent the data to a bioinformatics team for analysis for high-throughput sequencing. We hypothesize that we will see increased expression on the glucocorticoid receptor (GR) gene at a region designated as the intronic GR-binding region (IGR). We are currently in the data analysis stage and do not have results for this experiment.

DEVELOPMENT OF AN IN-SITU PROPELLANT ROCKET THRUSTER

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Resource-constrained trips to the Moon or to Mars require the use of in-situ produced propellant for the return flight. Otherwise, this propellant will be part of the cargo manifest of the mission vehicle, and as such, will reduce the capacity for other purposes. Hydrogen peroxide propellant is a promising candidate for in-situ production on the moon. Lunar water may be converted to high concentration hydrogen peroxide (HTP) using a properly designed electrosynthesis cell. The goal of this project was to demonstrate a ground support / propulsion system that produces and uses in-situ HTP in a rocket engine. During the initial phase of this project, we only hoped to complete the first milestone of this work, Design & Fabrication of a HTP Monopropellant Thruster. Following design of the thruster using AutoDesk Fusion 360, a plastic prototype was produced using 3D printing. It was tested for fit and configuration. In the coming months we plan to fabricate the thruster in stainless steel and test its operation.

ABOUT THE STUDENT CENTER FOR SCIENCE ENGAGEMENT (SCSE)

The Student Center for Science Engagement (SCSE) is a resource to help students succeed at NEIU and in their future careers in the sciences. We serve all students interested in the sciences, and we support the following departments and programs: Biology, Chemistry, Computer Science, Earth Science, Environmental Science, Mathematics, Physics and Psychology.

We offer:

- **One-on-One Professional Advising** – STEM advisors guide students in exploring majors and career options and assist with applying for internships and graduate school. Advisors support students in advancing their professional training by securing resources that support their academic and professional goals.

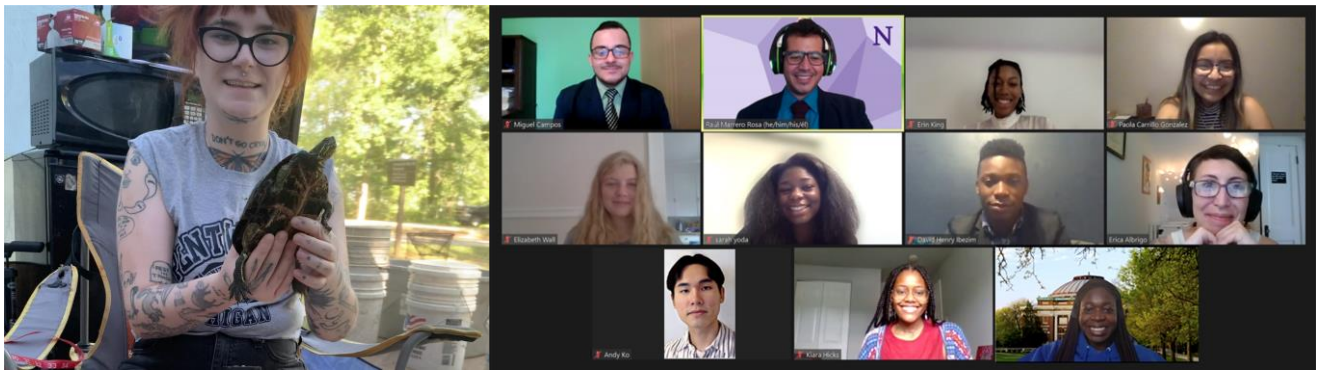
- **Signature Workshops** - Workshops cover a broad range of topics including study skills, time management, graduate school preparation, and career planning. The SCSE emphasizes building strong professional development skills.

- **Tutoring and GRE Preparation** - The SCSE provides daily tutoring services in upper-level Biology, Chemistry, Computer Science, Earth Science, Genetics, Mathematics, Physics and Psychology courses. Free GRE preparation classes are offered annually during the summer.

- **Research Opportunities** – Students are encouraged to gain valuable hands-on experience through summer research opportunities with NEIU faculty as well as with faculty and researchers at other institutions.

- **Conference Attendance and Participation** - The SCSE supports students to attend and present their research at conferences locally and nationally.

- **Invited Speakers -** The SCSE invites individuals representing organizations and industry to speak with students about internships and career opportunities in a broad range of fields.



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