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RESEARCH

2022 Dennis Dean Undergraduate Research & Creative Scholarship Conference

APRIL 29, 2022

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Contents

Jill C. Sible, Ph.D.
Associate Vice Provost for
Undergraduate Education,
Professor of Biological Sciences

Welcome

Welcome to Virginia Tech's Spring Undergraduate Research and Creative Scholarship Symposium. This event celebrates the creative and scholarly accomplishments of undergraduate students' campus- wide. Our program reflects the quality and diversity of undergraduate research at Virginia Tech. Many of the projects are the result of collaborations among several students.

Undergraduate research is recognized as one of the high impact practices in undergraduate education. Students who participate in undergraduate research are more likely to thrive and persist in their education. They become co-creators of knowledge, makers of objects that are useful and beautiful. At the heart and soul of these projects are collaborations between undergraduates and their mentors. Many thanks to the faculty, graduate students, and others who commit to these scholarly endeavors with undergraduate students.

We also welcome local high school students who have engaged in research under the mentorship of Virginia Tech faculty. We hope that your experience has sparked a passion for research and a lifetime of curiosity.

Many thanks to Keri Swaby, Director of the Office of Undergraduate Research, for her steadfast leadership and advocacy for undergraduate research and to the entire team in the Office of Undergraduate Research.

Thanks to the Fralin Life Sciences Institute, and to Dr. Dennis Dean for continuous support and advocacy for undergraduate research and to the many colleagues who have contributed to building an endowment for this symposium.

My best,

Jill C. Sible, Ph.D.
Associate Vice Provost for Undergraduate Education

Office of Undergraduate Research

Keri Swaby
Director of
Undergraduate Research

Welcome to the annual Dennis Dean Undergraduate Research and Creative Scholarship conference at Virginia Techhosted by the Office of Undergraduate Research (OUR). This year we are so excited to be back in person to celebrate the exceptional work of our undergraduates. Today's event will showcase the breadth of research and creative scholarship taking place across campus every day at Virginia Tech andwill demonstrate how broadly we define this impactful form of experiential learning.

Presenting results of a research or creative project is an important part of a student's overall journey because it provides them with the opportunity to learn to effectively communicate to a broad audience, defend their work, exchange ideas, and even be inspired for future directions in their work. This year we will feature the work of almost 300 students, including eight (8) students from Blacksburg High School and a special guest presenter from JMU! I invite you to take your time and explore the many offerings at the conference and I challenge you to stop at posters with titles that that intrigue you, but also those that scare you. You will be impressed by the variety and high quality of the work on display.

This year we have almost returned to our pre-COVID operations, having learned much about our capabilities and resiliency through this difficult and often uncertain time. I would like to recognize the hard work and unwavering support of our Program Assistant, Nicole Bottass, and Project Manager, Shu Pan; the guidance of an active and insightful advisory board; and the army of amazing Ambassadors who share their passion every day as they help students navigate undergraduate research. Without these dedicated people, the operations of the OUR would not be possible.

I must recognize and specially thank the Fralin Life Sciences Institute and the Institute for Critical Technology and Applied Science, whose financial support allows us tocelebrate undergraduate research and creative scholarship every day.

As always, I am humbled by the quality of work on show as part of this symposium and invite you to marvel at the wealth of research and creative scholarship the university has to offer. I invite you to engage, to explore, to connect,and to have fun!

Keri Swaby
Director of Undergraduate Research

ACC Meeting of the Minds

The 2022 ACC Meeting of the Minds (ACC MOM) was held at theUniversity of Virginia. The scheduled conference dates were April 1-3, 2022. The Office of Undergraduate Research would like to recognize the students who presented.

Each year, 5-10 outstanding undergraduate researchers (accompanied by a faculty/staff member) from each ACC university gather at a host institution to present their research, either orally or as a poster. Virginia Tech representatives are selected by a competitive refereed process. It is truly an honor to be invited to participate in this conference. Student name, academic major, title of presentation, and faculty mentor listed below alphabetically.

Lauren Evans (Animal and Poultry Sciences)

HOUSING BROILER CHICKENS IN COMPLEX ENVIRONMENTSWILL BENEFIT THEIR BEHAVIOR

Dr. Leonie Jacobs

Yulia Kirina (Material Science and Engineering)

SELF-CORROSION OF AN Al-Mg-Ga ALLOY IN A NaCl SOLUTIONFOR AL-AIR BATTERY AND SACRIFICAL ANODE

Dr. Mitsu Murayama

Yusuf Rafiqzad (Clinical Neuroscience)

BBB LEAKAGE CAUSES AN ATYPICALPHENOTYPE AFTER EARLY mTBI/CONCLUSSION

Dr. Stephanie Robel

Hannah Upson (Political Science)

“WHEN THE RIGHT TO ACCESS (LIFE) BECOMES A BURDEN”: ACCESSIBILITY TO PUBLIC HEALTH FOR DISABLED PEOPLE IN VIRGINIA DURING THE COVID-19 PANDEMIC

Dr. Ashley Shew

Julia Wakefield (Biomedical Engineering)

HEMODYNAMICS OF INSECT WINGS

Dr. Anne Staples

NCUR

Due to the COVID-19 pandemic the 2022 National Conference on Undergraduate Research (NCUR) was held virtually. The scheduled conference dates were April 4-8, 2022. The Office of Undergraduate Research would like to recognize thestudents who were selected to present.

The National Conference on Undergraduate Research (NCUR), established in 1987, is dedicated to promoting undergraduate research, scholarship, and creative activity inall fields of study by sponsoring an annual conference for students. Unlike meetings of academic professional organizations, this gathering of young scholars welcomes presenters from all institutions of higher learning and from all corners of the academic curriculum. Through this annual conference, NCUR creates a unique environment for the celebration and promotion of undergraduate student achievement, provides models of exemplary research and scholarship, and helps to improve the state of undergraduate education.

Student name and academic major listed below alphabetically.

Connor Hall (Chemical Engineering)

Emilie Hollingsworth (Civil Engineering)

Hannah Peacock (Psychology)

Jessie Yu (Psychology)

Loralee Hoffer (Psychology)

Tulasi Baddela (School of Architecture + Design)

Yazmin Farzan (Chemical Engineering)

Informational Booths

We invite you to visit and talk with representatives from several graduate programs, from across Virginia Tech's Blacksburg, Roanoke, and National Capital Region campuses.

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Travel Grant Awards 2021-2022

The VT Office of Undergraduate Research encourages studentsto present their research at conferences. OUR travel support program will coverexpenses related to presenting at a conference. This rolling review process is designed to assist undergraduate students who have had their research or creative scholarship accepted for presentation at a regional, national or international conference. This program will provide travel funding to students who, without this support, may not be able to attend a conference to present their work. Current undergraduates from any discipline are eligible to apply for travel support.

Javier Ortiz Alvarado (Chemistry, College of Science)
Faculty Mentor: Dr. Michael Schultz
ACS Spring 2022 - March 20-24, 2022

Henry Claesson (Mechanical Engineering, College of Engineering)
Faculty Mentor: Dr. David Gray
2022 ASEE Annual Conference and Exposition - June 26-29, 2022

Grace Dinges (Clinical Neuroscience and Chemistry, College of Science)
Faculty Mentor: Dr. Michael Schulz
Southeastern Regional Meeting ACS (SERMACS) - November 10-13, 2021

Nicholas Dunn (Psychology, College of Science)
Faculty Mentor: Rosanna Breaux
Association for Behavioral and Cognitive Therapies (ABCT) Conference -November 18-21, 2021

Agustin Fiorito (Chemical Engineering, College of Engineering)
Faculty Mentor: Dr. Michael Schultz
Southeastern Regional Meeting of the American Chemical Society (SERMACS) - November 10-13, 2021

Connor Hall (Chemical Engineering, College of Engineering)
Faculty Mentor: Dr. Huiyuan Zhu
Southeastern Catalysis Society 2022 Symposium - February 20-21, 2022

Sanmeel Vijay Lagad (Mechanical Engineering, College of Engineering)
Faculty Mentor: Dr. Rolf Mueller
181st Meeting of the Acoustical Society of America (ASA) - November 29- December 3, 2021

Benjamin Lewis (Biochemistry, College of Science)
Faculty Mentor: Dr. Kylie Allen
ASBMB -April 1-3, 2022

Travel Grant Awards continued…

Piper Macnicol (Chemistry, College of Science)
Faculty Mentor: Dr. Michael Schultz
Southeastern Regional ACS Meeting - November 10-13, 2021

Zoie Sadler (Biochemistry, College of Agriculture and Life Sciences)
Faculty Mentor: Dr. Kylie Allen
Experimental Biology 2022 - April 2-5, 2022

Peter Schiff (Microbiology, College of Science)
Faculty Mentor: Dr. Alex Cumbie
Virginia Mosquito Control Association - January 25-27, 2022

Zachary Sherman (Geography, College of Natural Resources and Environment)
Faculty Mentor: Thomas Sherman
American Geophysical Union (AGU) - December 13-18, 2021

Rebecca Trimble (Biochemistry, College of Agriculture and Life Sciences)
Faculty Mentor: Dr. Gillian Eastwood
Virginia Mosquito Control Association Conference - January 25-27, 2022

Melanie Turner (Biology, College of Science)
Faculty Mentor: Dr. Gillian Eastwood
Virginia Mosquito Control Association Conference - January 25-27, 2022

Tamer Whittle-Hage (Clinical Neuroscience, College of Science)
Faculty Mentor: Dr. Sarah Clinton
52 Annual Meeting of the American Society for Neurochemistry (ASN) - April 10-14, 2022

Office of Undergraduate Research Ambassadors

Alex Tucker (Graduation: Spring 2022)
PSYCHOLOGY, SOCIOLOGY + CRIMINOLOGY – EMOTION REGULATION, EMOTION SOCIALIZATION AND POLICING IN THE UNITED STATES

Caroline Harrop (Graduation: Spring 2022)
CLINICAL NEUROSCIENCE – NEUROIMAGING OF PSYCHIATRIC DISORDERS AND NEUROBIOLOGY OF PSYCHIATRICS DISORDERS

Drew Hynes (Graduation: Spring 2022)
BIOLOGICAL SCIENCES – INFECTIOUS DISEASE ECOLOGY AND COINFECTION

Hana Mir (Graduation: Spring 2022)
PHYSICS – DARK MATTER PARTICLE PHYSICS, NON-EQUILIBRIUM STATISTICAL MECHANICS AND POPULATION DYNAMICS

Jennie Lee (Graduation: Spring 2023)
CHEMISTRY – MICROPLASTIC TRANSPORT, FATE OF POLLUTANTS, ATMOSPHERIC SCIENCE

Julia Pimental – Lead Ambassador (Graduation: Spring 2022)
MATERIALS SCIENCE AND ENGINEERING – ADDITIVE MANUFACTURING (AM), COMPOSITES, MATERIAL CHARACTERIZATION

Loralee Hoffer (Graduation: Spring 2023)
PSYCHOLOGY – PROSOCIAL BEHAVIOR, EXPRESSIONS OF GRATITUDE, POSITIVE PSYCHOLOGY, AND PSYCHOLOGICAL ASPECTS OF WELLBEING

Madison LaRoche (Graduation: Spring 2023)
CLINICAL NEUROSCIENCE & HONORS COLLEGE – DRUG ADDICTION, PSYCHIATRIC DISORDERS, NEUROGENETICS AND PREVENTATIVE MEDICINE

Olivia Basco (Graduation: Spring 2023)
BIOLOGICAL SYSTEMS ENGINEERING & FRENCH – ANTI-OPIOID ADDICTION VACCINES & TRANSMISSION OF PNEUMONIA THROUGH THE WATER SUPPLY

Sasha Mintz (Graduation: Spring 2024)
PHYSICS – ASTROPHYSICS, COSMOLOGY, PARTICLE PHYSICS

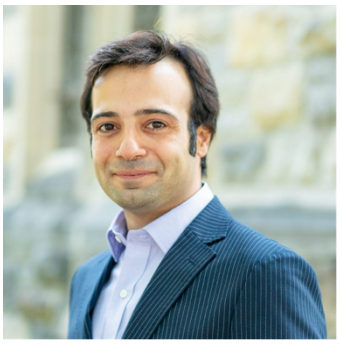
Victor Mukora (Graduation: Spring 2022)
COMPUTATIONAL MODELING AND DATA ANAYTICS – SOLAR ENERGY, SPECIFICALLY APPLYING DATA ANAYTICS TO ENHANCE SOLAR PANEL EFFCIENCY

Yasmin Farzan (Graduation: Spring 2023)
CHEMICAL ENGINEERING – ORGANOMETALLICS AND CATALYSIS

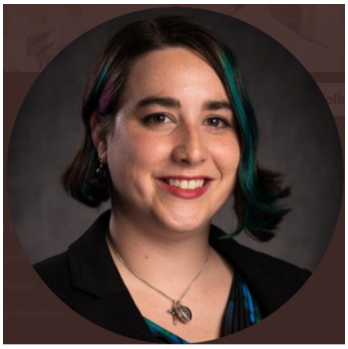
2021 Outstanding Undergraduate Research Mentor Award

An often overlooked, unrecognized and unrewarded mode of teaching is mentoring undergraduate students in research. Four years ago, the Office of Undergraduate Research launched the Outstanding Undergraduate Research Mentor Award- for a Faculty and a Graduate Student- to recognize the hard work, time, dedication, and guidance that research mentors provideto undergraduate students.

Undergraduates were asked to nominate one Virginia Tech faculty or graduate student research mentor from any discipline for this award. We received 15 nominations: 8 nominations for faculty members and 3 nominations for graduate students. It was extremely humbling and inspiring to review the thoughtful and passion-filled nominations. Many recognized the tireless and often unrewarded efforts of their mentors and indicated that their mentor made their VT experience unique and overwhelmingly had a positive impact on their future plans.



The recipient of this year's Outstanding Undergraduate Research FACULTY Mentor Award is Shahabedin Sagheb, PhD, Assistance Collegiate Professor with the Calhoun Discovery Program, who received four nominations. In their nominations, the students described Dr. Sagheb as supportive, innovative, caring, resourceful, kind, and encouraging.



The recipient of this year's Outstanding Undergraduate Research GRADUATE STUDENT Mentor Award is Rebecca Kriss (Civil and Environmental Engineering), who received four nominations. In her nominations, Rebecca was described as caring, welcoming, professional, compassionate, knowledgeable, and loyal.

Thank you to all undergraduate research mentors. Without mentors, students could not engage in research and without exceptional mentors, students would not gain as much out of the research experience!

Thank you...

For sharing your knowledge, experience, advice, and hard labor with us and your fellow students, faculty, and staff at Virginia Tech. The Office of Undergraduate Research would not have near the impact or be able to provide near the opportunity without your incalculable dedication and support.

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Abstract

Mithil Adsul
Virginia Tech/Electrical Engineering
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Jasmine Walker
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Natalie Kinnamon
Virginia Tech/Graphics Design
Devina Bawa
Virginia Tech/Graphics Design
Lauren Sartori
Virginia Tech/Graphics Design

Hokienauts Space Suit Augmented Reality Interface

The Hokienauts are an undergraduate design team that is developing a space suit augmented reality (AR) interface for the 2022 NASA Spacesuit User Interface Technologies for Students (SUITS) Challenge. NASA has developed this challenge to gain inspiration for their space suit heads-up display (HUD) that they are developing for the Artemis mission, as well as to promote STEM and prepare the future NASA workforce.

The Hokienauts are developing this interface using the Microsoft HoloLens 2, and it will assist astronauts with accomplishing tasks on the lunar surface including navigation, lunar search and rescue (LunaSAR), terrain sensing, vital display, lunar rover control, science sampling, note-taking, and tool identification. The development of this interface has been a multidisciplinary approach: graphics designers are developing the menus and icons, software engineers are programming those concepts to life, and hardware engineers are developing external devices to interface the HoloLens with the external lunar environment. Once completed, the team aims to test with 20 test subjects at Virginia Tech to receive feedback on metrics such as comfort, usability, legibility, task-time, and errors. After this, the team will travel to the NASA Johnson Space Center (JSC) in Houston to test onsite at a simulated lunar environment and receive feedback from NASA experts.

Mentor(s): Wallace Lages (School of Visual Arts), Virginia Tech

Noora AlAmiri
Virginia Tech/Chemical Engineering
Jennie Lee
Virginia Tech/Chemistry

Detection of Atmospheric Microplastic Fallout in the Southwestern Appalachian Mountain Region

Global plastics production was estimated to be 367 million metric tons in 2020. A large portion of these plastic products become waste and dispersed in the environment. Larger plastic fragments break down into minuscule plastic fragments called microplastics, which are typically less than 5 mm in size. Due to their small size and density, microplastics have been recently detected in urban, suburban, and even remote areas, suggesting the potential for long-distance atmospheric transport. Throughout this study, atmospheric microplastic deposition in Blacksburg, Virginia will be investigated. Field samples collected in a multi-day pilot study will be analyzed using microscopy/spectroscopy techniques for microplastic abundance and composition. An air mass back-trajectory analysis will be carried out to track the origin and distance of the microplastic transport in the atmosphere. These preliminary findings will act as the foundation for a long-term sampling passive sampler study in the Appalachian Mountain region.

Mentor(s): Hosein Foroutan (Civil & Environmental Engineering), Virginia Tech
Nishan Pokhrel (Civil & Environmental Engineering), Virginia Tech
Charbel Harb (Civil & Environmental Engineering), Virginia Tech

Tyler Allen
Virginia Tech/Biological Sciences

Impact of microplastics on Native Crayfish ectosymbiosis: Are fitness and growth affected?

Plastic pollution in aquatic systems has proven to be a current and long-term issue in environmental science. The formation of microplastics from fragmented plastic debris has resulted in increased research to understand how microplastics impact organisms. An estimated 80% of coastal debris comes from inland areas, highlighting freshwater systems as hotspots for plastic and microplastic pollution. Research in freshwater systems lags behind marine regarding the ecological consequences of microplastic pollution. The purpose of our study was to determine if microplastics are acutely toxic to crayfish following a 96-hour exposure and whether microplastic exposure can disrupt crayfish ectosymbiotic relationship with Brachiobdellidans or crayfish worms. Crayfish worms have been documented to improve the fitness and fecundity of crayfish. If microplastics impact this relationship, there are consequences for freshwater systems as crayfish are keystone species. In our study, we exposed crayfish and worms to polyethylene microplastics at four different concentrations (0, 33, 66, and 100 mg/L) to assess a dose-response relationship between mortality and concentration. After exposure, crayfish and worms were placed in depuration tanks to observe growth over two months. We found that crayfish mortality was 4% after initial exposure, suggesting crayfish resiliency regarding microplastic exposure. During the observation period, mortality ranged from 2.8 to 5.6% across treatments. Percent changes in mass ranged from -0.01 to 0.45 in the 33 and 66mg/L treatment, respectively. Our findings provide baseline information regarding microplastics and crayfish and how this pollutant may impact symbiosis.

Mentor(s): Austin Gray (Biological Sciences), Virginia Tech
Bryan Brown (Biological Sciences), Virginia Tech

Emma Argo
Virginia Tech/Biochemistry
Sabrina Allen
Virginia Tech/Biochemistry
Kaustubhram Wooputur
Virginia Tech/Biochemistry

Investigating the effect of size and composition of various sugar molecules on binding affinity to glucokinase

Glycolysis is a metabolic process that breaks down the different sugars you ingest to release energy and pyruvic acid to feed into the Krebs cycle. At the start of glycolysis, the enzyme glucokinase phosphorylates glucose into glucose-6-phosphate. The binding site of glucokinase is very small, which limits the size and in turn, the molecular composition of the ligands that it is compatible with to modify and typically favors smaller, less complex molecules. To better understand different sugar molecule ligand affinity for glucokinase, molecular docking was performed to analyze the binding affinities of three different molecules - glucose, glucose-6-phosphate, and sucrose. These molecules were docked to glucokinase in order to determine which fits most favorably into the binding pocket. Interestingly, results indicated that the binding affinity results show the bigger molecules to be more negative, or more favorable, but as a result, they didn't bind into the actual binding site of glucokinase. This would not activate glucokinase or result in a phosphorylated molecule. Glucose-6-phosphate and sucrose bound to a more solvent-exposed area rather than the binding cavity. An all-encompassing binding box was chosen to prevent unbiased docking, which is why this occurred. In practice, different ligands change the function of the protein so neither sucrose nor glucose-6-phosphate is more compatible than glucose in glucokinase, as it is needed to progress through glycolysis.

Mentor(s): Anne Brown (Biochemistry), Virginia Tech

Marhawe Asmerom
Virginia Tech/Statistics
Joshua Long
Virginia Tech/Environmental Conservation and Society

Under Represented Minorities Participation in Outdoor Activities

The disparity between socioeconomic and race are factors that diminish growth for underrepresented minorities in outdoor activities. The lack of accessible nature activities for these groups has led to an increase in participation in activities in local communities. This literature review outlines reasons for the lack of diversity in nature activities. The researchers utilized university libraries, Google Scholar, and other Virginia Tech sponsored databases to search for literature. Data was organized by topic and year to remain consistent. These include expense of equipment and access to activities in proximity to where the population lives. In the last decade, national parks have begun taking steps to make the outdoors more inclusive through various avenues that include the recognition of underrepresented demographics in parks, facing internal discrimination, and projects dedicated to increasing access. The data from these parks have shown improvement with underrepresented minority (URM) involvement. In order to stimulate participation in outdoor activities, groups at local, regional and national levels should try to remove financial barriers, increase programming for URM populations, eliminate the lack of unpaid roles in the outdoor industry, show the history of URMs in nature, improve and expand educational efforts, and create a safe habitat for attendants of state parks. Implementing these steps creates space for environmental conservation and sustainability and closes the racial gap in outdoor activities.

Mentor(s): Tiffany Drape (CALS), Virginia Tech

Sofia Ayala Rodriguez
Virginia Tech/Biochemistry
Allie Sweeney
Virginia Tech/Human, Nutrition, Foods, and Exercise

The Impacts of Mental Illness and Suicidality on Siblings

The current research examined how personal stress, burden, distress, and closeness in the sibling relationship are impacted by the presence of mental illness and suicidal thoughts and behavior in siblings. We had 202 participants fill out an online survey asking about themselves and a chosen sibling. Participants were classified into three groups: those who had a sibling with mental illness and a known history of suicidal thoughts and behavior (MI/SI SIbs), those who had a sibling with mental illness, but no known history of suicidal thoughts or behavior (MI Sibs), and those whose sibling had no mental illness or suicidal thoughts or behavior (NMI Sibs). Our results showed no significant differences between the MI Sibs and the NMI Sibs on any outcomes; however, MI/SI Sibs reported significantly higher levels of personal stress, burden, distress, and worry about their sibling. There were no significant group differences at all in sibling closeness. These results are important in many ways. First, they show that the presence of mental illness itself in a family does not seem to negatively impact siblings. Second, it shows that known suicidal thoughts or behavior can impact siblings, as well, not only the person experiencing suicidality. However, this impact does not seem to extend to the sibling relationship itself. This finding is especially important, as families and individuals can use this maintained closeness between siblings to encourage the processing of suicidal thoughts and behavior in a healthy and supportive way.

Mentor(s): Carolyn Shivers (HDFS), Virginia Tech

Jalen Baine
Virginia Tech/Electrical Engineering

Angle of Repose for Stinkbugs

The brown marmorated stink bug (Halyomorpha halys, Stal) is an invasive species and a significant agricultural pest and domestic nuisance. They are popularly known for their tendency to overwinter in human structures. Buildings are typically complex systems, with a variety of materials and parts. The interaction of H. halys with these systems is of interest to building occupants and pest management professionals, who seek to trap insects or reduce intrusion.
One useful tool in experimental design for insect interaction with physical geometry is the application of hydrophobic polymers to surfaces, which interferes with climbing. This work presents a study of the response of H. halys to glass surfaces treated with these polymers, to determine the angle of repose, or slope at which a surface becomes unclimbable. We found that difficulties began for both males and females at 45 degrees, with slopes being unclimbable at 60 degrees. We also evaluate the persistence of H. halys in the face of these unclimbable surfaces. These results provide a better understanding of the ambulatory capabilities and behaviors of H. halys on hydrophobically treated glass, which may support future experimental design, as well as effective trapping methods.

Mentor(s): Benjamin Chambers (Engineering Education), Virginia Tech

Kevin Bayne
Virginia Tech/Wildlife Conservation

Analyzing Stereotypic Stress Behaviors in Captive Wild Caught American Black Bears (Ursus americanus)

The Black Bear Research Center (BBRC) at Virginia Tech was operational from 1988-2009 to study American black bear (Ursus americanus) behavior, reproductive, and hibernation physiology in collaboration with the Virginia Department of Wildlife Resources. It was reopened from 2012-2016 under Dr. Marcella Kelly from the Department of Fish and Wildlife Conservation, housing 19 more bears. Through a unique dataset collected from 2015-2016 at the BBRC, we monitored the 5 bears present that year with 24/7 video surveillance. With this video data, we can gain insight into the behavioral ecology of these bears. A single bear exhibited unusually high stress (stereotypic) behaviors, inevitably resulting in her early release. We compared her stress levels to the other bears housed at the BBRC by summarizing the proportions of all normal and stereotypic behaviors exhibited by this bear vs. the other bears. During the first 20 days in the enclosure, the stressed bear exhibited a high portion of stereotypic behaviors (0.0-0.36). These 20 days were isolated and compared to the average stress behavior portions of the other four bears (<0.001) during their first 20 days at the BBRC. Further, proportional weight gain was compared between bears, and we found no significant difference in weight gain between the stressed bear and the average of the other four bears. Our findings show irregular periods exhibiting high levels of stress behaviors followed by lengthy periods of resting behaviors but no significant weight loss in the stressed individual. This research can help wildlife managers to better understand effects of captivity on some wild-caught species.

Mentor(s): Marcella Kelly (Department of Fish & Wildlife Conservation), Virginia Tech
Brogan E. Holcombe (Department of Fish & Wildlife), Virginia Tech

Ursilia Beckles
Virginia Tech/English

The Socioemotional Development of Minority Women in Majority White Evangelical Spaces

This study aims to better understand the relationship between participation in predominantly white evangelical institutions by minority women (including Black, Indigenous, Hispanic, Asian, and mixed-race individuals) and later socio-emotional outcomes. We have examined socio-emotional outcomes through self-report and interview analysis to create bonds and friend groups to strengthen participation in social life outside of their institution. This data analysis aims to form potential future individual strategies and programs for improving socio-emotional outcomes.

Mentor(s): Katie Carmichael (English), Virginia Tech
Dr. Tameka Grimes (School of Education), Virginia Tech

Adam Bowen
Virginia Tech/Psychology
Charlotte Koogle
Virginia Tech/Human Development

A Study into Perceived Dialect Boundaries of Southwest Virginia

Southwest Virginia (SWVA) is an ill-defined area of Virginia bordered by West Virginia, Kentucky, Tennessee, and North Carolina. In the Appalachian Regional Commission's report on the different regions of SWVA, it is split in half by Central Appalachia and South Central Appalachia (Subregions in Appalachia, 2021). However, to date there is no evidence that this boundary is linguistically meaningful: There have been studies done of English in surrounding areas (e.g, Greene 2010; Reed 2016), but to our knowledge there have been no linguistic studies focusing on SWVA. As a first step towards describing language variation in the area, we are investigating where SWVA locals perceive dialect boundaries.
In order to try and define these perceived linguistic differences, we are using a pile-sort task (Tamasi, 2003). For this task participants are given the names of towns in SWVA as well as the surrounding areas and asked to sort the town names into different piles where they believe that people talk the same. After the piles are made then more follow up questions are asked. So far preliminary data is showing that this east/west divide shown in the ARC's report holds true in local's perceptions of dialect variation in SWVA.

Mentor(s): Abby Walker (English), Virginia Tech

Benjamin Bowman
Virginia Tech/Environmental Resources Management

Examining the impact of alternative drought measures for Pastureland Insurance on producer payouts across the US

Pasture, rangelands, and forage areas account for over half of the total US land area. Along with improving ecosystem services and wildlife habitat, these land uses also provide important support for livestock production. However, these areas suffer with drought, which often lowers revenue and requires changes to producer operations. Since 2009, the US government has offered rainfall anomaly based insurance coverage to producers operating on these land use types. The program uses NOAA precipitation data aggregated to approximately 25km by 25km grids. However, finer resolution precipitation datasets (approximately 5km by 5km) are available. This study seeks to examine how the use of finer resolution data would yield different precipitation deficit patterns, and therefore affect the number and magnitude of insurance payouts. We resampled the NOAA dataset to the resolution of the Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS) precipitation dataset and examined variations in the magnitude of precipitation accumulation across the US for a sample month of August in 2017. We find that the CHIRPS dataset estimates nearly 160,000 inches less of total accumulated precipitation across the US for that month, with a corresponding lower mean and max value (means of 74 and 82 mm, max values of 632 and 1124mm, respectively, for CHIRPS and NOAA). There are few regions where the datasets agree, and higher precipitation appears to correlate with higher estimate differences. Moving forward, we will examine differences over time, and translate the differences in precipitation to producer payouts using the USDA payout formulas.

Mentor(s): Elinor Benami (Agriculture and Applied Economics), Virginia Tech

Isabel Byrne
Virginia Tech/Mathematics

Expected Number of Distinct Patterns in a Random Permutations

Let π be a uniformly chosen random permutation on [n]. Analyzing the interaction between the numbers in two overlapping sets of k-positions, denoted π_1 and π_2, we have found the probability that the sets are order isomorphic. This probability comes from a critical lemma which proves that, in order for two sets to be order isomorphic, their overlap entries must also be order isomorphic. Once I have established the probability that π_1 is order isomorphic to π_2, I will use this to find the expected value of the number of distinct permutations in π by defining a function of the overlap. This function is based on a second lemma where we show that the number of repeated patterns is less than or equal to the number of pairs of order isomorphic patterns, which helps us to derive an upper bound on the required expectation. I will describe our significant progress in showing that the expected number of distinct permutations is 2n(1 – o(1)).

Mentor(s): Anant Godbole (Mathematics), East Tennessee State University

Ella Callahan
Virginia Tech/Clinical Neuroscience
Jack Daniels
Virginia Tech/Psychology

Social Media and Attention

Increased availability of the Internet through mobile devices has led to the rise of unrestricted and problematic smartphone usage. Previous research has suggested that even the presence of a smartphone in one's environment is related to decreased cognitive performance. Research has also shown that more media and technology use is negatively associated with academic performance. This research investigates links between self-control, social media use and attention. Participants include 45 college students (71% female). Participants completed self-report questionnaires on Disordered Social Media Use (DSMU) and Self-Control (SC). A Go/No-Go task was used to measure errors in attention when a participant did not respond appropriately to a stimulus. We hypothesized that lower levels of SC would predict more DSMU, which would predict more errors in attention. We also predicted that smartphone presence will mediate this relation, such that the relation between DSMU and attention errors would be stronger for participants who had their phones out during the attention task. Our initial analyses found that while SC did not predict DSMU, DSMU did predict errors in attention; however, smartphone presence did not moderate the relation between these factors. These findings suggest that problematic social media use is related to errors in attention, regardless of the immediate presence of a smartphone. This work has important implications for college students' academic performance.

Mentor(s): Benjamin Katz (Human Development and Family Science), Virginia Tech

Sara Carter
Virginia Tech/International Relations

Eins, Dos, Three! Investigating Language Inhibition in Trilingual Students

Trilingual speakers in this study are defined as people who have formally learnt a second (L2) and third (L3) language in addition to their first, native language (L1).

In my language classes at VT, I began noticing that my trilingual classmates and I often mistakenly used L2 words when speaking in our L3, instead of using L1 words. One reason for this could be that a speaker's L1 is more actively suppressed/inhibited when speaking their L2 compared to the reverse (Misra, et. al 2012). My study seeks to explore inhibitory processes in language switching with trilingual students, largely replicating a similar study done by Philipp, Gade, and Koch (2006).

This study, designed in EPrime Studio, tests trilingual students and their ability to switch between any two given languages at designated times. The study runs approximately 30 minutes and uses 10 black and white images (Snodgrass and Vanderwart 1980). Primed by a color, students then see an image and have to say the noun out loud in the language requested. This study is broken up into 3 blocks in which they have to switch between their L1 and L2, their L2 and L3, and then their L1 and L3.

This study hypothesizes that for each language pairing, the shift cost would be larger for the dominant language than for the nondominant language (Phillip, Gade, and Koch 2006), due to the fact that it is believed that bilingualism influences inhibitory control (Thanissery, Parihar, and Kar 2020). This study is still in the process of data collection, but preliminary patterns in errors does appear to confirm the hypothesis.

Mentor(s): Abby Walker (English), Virginia Tech

Victorjose Catalan
Virginia Tech/Wildlife Conservation

Projecting species distribution models across state landscape for conservation

Frogs and toads derive their body temperature primarily from their environment, making them sensitive to shifts in temperature expected with climate change. Common species, which tend to have abundant observational data, can represent a majority biomass in a landscape and thus indicate the health of the ecosystem. Since climate change will alter a species distribution, understanding where species currently exist on the landscape can aid conservation efforts for frogs and toads. The goal of this project was to assess a common species' current presence across Virginia for state level management, and evaluate how its distribution varies across the landscape. Species distribution models can assess areas where the frog could exist by correlating known locations with climate data. I developed a Max Entropy model in R to estimate the potential distribution of spring peeper (Pseudacris crucifer) based on location data collected from a citizen science project, iNaturalist. I paired this locational data with historical temperature and precipitation-related environmental variables to model spring peeper distribution. Our best model of spring peeper distribution had high model fitness (AUC = 0.817), with Precipitation of Wettest Quarter as the most important variable to current distribution. By understanding variation in a generalist species distribution, we can identify areas most likely used by them for local/state level habitat restoration and conservation.

Mentor(s): Meryl Mims (Department of Biological Sciences), Virginia Tech
Dr. Traci DuBose (Department of Biological Science), Virginia Tech

Tran Chau
Virginia Tech/Statistics

Understanding the cell type relationship between major grain crops using single-cell RNA-sequencing

A major goal of agriculture research is to increase the production of grain crops such as Rice (Oryza sativa) and Maize (Zea Mays) to feed the growing world population. Understanding the genetic control of root growth for these species will provide insight into developing varieties that can grow better under stressed conditions. Comparing single-cell RNA sequencing from different species can help explain the relationship between cell types and transfer cell type annotations. Such a comparison relies on marker gene sets to define major cell types and subcell types. However, the complex gene homology relationship poses a challenge in determining the marker genes for cell types in these species. Here, we use single-cell RNA-seq to identify shared and species-specific cell types of two closely related plant species. To overcome the challenges posed by the diverse gene set, we use the average standardized expression of the one-to-many gene orthologs and the smaller number of one-to-one gene orthologs to combine the two datasets together. Along with unifying gene sets from two species, the single-cell integration method embeds two species' cells into a shared two-dimensional plot that allows for visualizing cell types from different species in the same space. We use several machine learning methods of multi-class classification algorithms to predict which cell types share a common pattern across two species. This is important in advancing the study of biological relationships by revealing the divergence and convergence of cell types between plants.

Mentor(s): Song Li (School of Plant and Environmental Sciences), Virginia Tech
Prakash Timilsena, Postdoc Associate (School of Plant and Environmental Sciences), Virginia Tech

Leah Childers
Virginia Tech/Mathematics

The Failed Zero Forcing Number of Grid Graphs

Given a graph G = (V, E) and a set of vertices marked as filled, we consider a color-change rule known as zero forcing. A set S is a zero forcing set if filling S and applying all possible instances of the color change rule causes all vertices in V to be filled. A failed zero forcing set is a set of vertices that is not a zero forcing set. Given a graph G, the failed zero forcing number (f.z.f.n) F (G) is the maximum size of a failed zero forcing set. In a 2015 Involve paper, “The failed zero forcing number of a graph” by Katherine Fetcie, Bonnie Jacob, and Daniel Saavedra, the authors determined the f.z.f.n. of a square grid graph, but left open the question of the f.z.f.n. of a rectangular grid graph. In our research, we determined the f.z.f.n. of 2 × n and 3 × n grid graphs, examined aspects of general m × n grid graphs including a lower bound for every grid graph, and are continuing to work on proving an upper bound for every grid graph

Mentor(s): Eric Ufferman (Mathematics), Virginia Tech

Samantha Cobb
Virginia Tech/Public Health

Role of Technology Use on Adolescent Depression and Anxiety Before and During COVID-19

Technology use among adolescents increased considerably in the past decade, this is especially true of certain populations such as adolescents with attention-deficit/hyperactivity disorder (ADHD). Research has highlighted both dangers and possible benefits of media use. However, no studies have examined the impact of technology use both before and during the COVID-19 pandemic among adolescents with and without ADHD.

Participants include 238 adolescents (44.5% female; 49.6% diagnosed with ADHD and 25.4% diagnosed with an anxiety or depressive disorder pre-COVID-19), who were 15 to 17 years old at the start of the COVID-19 pandemic. The Technology Use Measure (Bourchtein et al., 2019) and Revised Children's Anxiety and Depression Scale (Chorpita et al., 2005) were used to assess technology use and depression and anxiety symptoms, respectively. Multiple regression analyses using the PROCESS macro in SPSS were run to examine the relationships between technology use and well-being.

Not surprisingly, technology use significantly increased from pre-COVID-19 to during stay-at-home orders, $t=6.27$, $p<.001$. Pre-COVID-19 there was not a significant association between technology use and depression or anxiety, $b=1.22$ and 2.43, $ps>.167$. During stay-at-home orders, higher rates of technology use were associated with higher levels of depression and anxiety, $b=4.54$ and 4.43, $ps<.012$; these associations did not differ for adolescents with vs. without ADHD.

Results suggest that increased technology use may be correlated with higher rates of depression and anxiety during COVID-19. This research helps parents make informed decisions regarding children’s technology exposure. Further research is needed to see if this correlation remains outside of stay-at-home orders.

Mentor(s): Rosanna Breaux (Psychology), Virginia Tech

Molli Coleman
Virginia Tech/Food Science and Technology
Anthony Laub
Virginia Tech/Biology
Catherine Carrion
Virginia Tech/Marine Fish Conservation
Harper Schwartz
Virginia Tech/Medicinal Chemistry
Kai Berlin
Virginia Tech/Wildlife Conservation
Michael Bailey
Virginia Tech/Biology
Josh Byrd
Virginia Tech/Wildlife Conservation
Matt Day
Virginia Tech/Biochemistry

A Living Learning Community Functional Genomics Investigation

The Orion Living Learning community enrolls first year students in the COS 1016 course in which students engage in hands-on research projects. In our project, a second year Biochemistry student in the primary investigator (PI) role guided students in a functional genomics project. The project was based on a previously funded NIH project called Partnership for Research and Education in Plants (PREP), which engages local high school biology classes in elucidating the function of genes in the widely studied plant model system, Arabidopsis thaliana. Students grew transgenic Arabidopsis thaliana plants that harbored a gain-of-function allele in one of two genes, ITPK1 and VIP2KD. These genes are involved in the Inositol Phosphate (InsP) signaling pathway, a focus of the Gillaspy lab which provided the plants, materials, and guidance for this study. In fall 2021, Orion students completed lab safety training and investigated primary and review literature on plant InsP signaling in preparation for the spring. In January 2022, groups of 4 students initiated the experiments, selected treatments, and designed hypotheses to test gene function. Treatments included supplementation with sodium phosphate or potassium nitrate. Wild type plants and plants that received no treatment were used as controls. Students measured rosette diameter and time to flowering, and made qualitative observations of leaf color biweekly . At the end point of the study, the students were able to draw conclusions about how their hypothesized treatments affected plant growth and development. Additionally, the data generated in this project can further help the Gillaspy Lab to learn more about these genes. Finally, this project provided evidence that with guidance, first year college students can successfully conduct authentic hands-on research within their living learning communities.

Mentor(s): Glenda Gillaspy (Department of Biochemistry), Virginia Tech

Kara Crudup
Virginia Tech/Animal and Poultry Science

Cellular Food: The Current State of Cellular Meat and Fish in US Agriculture

Cellular food is grown from live animal cells, this is meat that is not the result of raising and slaughtering livestock but is still meat at a cellular level. It is important to examine the potential underlying impacts of growing cellular food. Specifically, we need to investigate the global and environmental impact, consumer marketability, health benefits, risks, and methods used to produce cellular food. As part of this study, extensive research on existing methods of growing cellular food successfully and marketing the product is being conducted.

This literature review revealed that these cellular grown foods are comprised of animal cells, skeletal muscle, fat, and connective tissue such as myoplasts or other microcarriers. Current trials face several obstacles due to the structural complexity, including replicating the flavor of traditional animal flesh. There are only a few companies leading in the cultured meat and seafood revolution; such as Mosa Meat (hamburger), Memphis meats (chicken nuggets and beef meatballs), and Finless Foods (bluefin tuna). Additionally, the product is not yet marketable because these firms are still working to improve the process of creating cellular-generated food. When it comes to the impact of cultured food on the environment, there are some advantages. The Good Food Institute revealed that by using cultured techniques, land consumption may be reduced by 63% to 95%, which is significant. In other words, these meat-production factories will have a smaller environmental footprint than current methods. In the same way that this is good for the environment, it is also good for human health since it reduces air pollution and foodborne illnesses.

This study was funded by USDA.

Mentor(s): Tiffany Drape (The Department of Agricultural, Leadership, and Community Education), Virginia Tech

Charlotte Cullen
Virginia Tech/Cognitive and Behavioral Neuroscience
Alyssa Ganino
Virginia Tech/Animal and Poultry Sciences
Vera Gliga
Virginia Tech/International Relations
Paige Kramer
Virginia Tech/Biochemistry
Rohith Mahesh
Virginia Tech/Secure Computing (CS)
Lauren P Maunder
Virginia Tech/National Security and Foreign Affairs
Sean M Murray
Virginia Tech/Environmental Informatics
Kiara A Scott
Virginia Tech/Sustainable Biomaterials: Creating a Sustainable Society
Taha Shaikh
Virginia Tech/Machine Learning

Investigating Barriers to Sustainable Behaviors at Virginia Tech

Sustainable and pro-environmental actions at the individual level are influenced by a myriad of external and internal factors. The "value-action gap" describes the disconnect between one's values and attitudes, and their actual behaviors. While many acknowledge that climate change is a major threat in today's world, there exists a multitude of structural and psychological barriers which prevent them from engaging in eco-friendly practices. The goal of our research is to investigate Virginia Tech students' views on sustainability, and identify potential psychological barriers to pro-environmental behaviors. Identifying what prevents students from changing their habits and behaviors would enable us to help guide institutional efforts to promote a culture of sustainability on our campus.
Our data was collected through a survey which was distributed to various populations among the Virginia Tech student body in order to reach a representative sample. The survey was developed using the New Ecological Paradigm (NEP) (Dunlap et al. 2000) and Dragons of Inaction to Psychological Barriers (DIPB) measurement scales (Gifford 2011; Lacroix et al, 2018).
In total, the survey received 765 responses. Results are preliminary, as the data analysis advances. Significant trends or patterns detected in the survey data will inform the Office of Sustainability's efforts on campus. By understanding how students view and practice sustainability on an individual level, measures can be implemented that more effectively address and overcome psychological barriers to pro-environmental behaviors faced by Virginia Tech students. This study is part of a course-based undergraduate project in the Honors Culture of Sustainability Lab.

Mentor(s): Najla Mouchrek (Honors College), Virginia Tech

Kailee David
Virginia Tech/Biomedical Engineering

Using High Frequency Irreversible Electroporation to Treat Canine Lung Adenocarcinomas

Irreversible Electroporation(IRE) therapy is an innovative cancer treatment in which we are able to ablate cancerous tumors using pulsed electric fields. IRE is a preferable alternative to thermal ablation techniques because we are able to control the boundaries of the treatment area to maximize therapeutic effects while minimizing unwanted heating of healthy tissue. Preserving the integrity of surrounding structures within the body is necessary to ensure a quick recovery time for patients. In this study, in vitro experiments were performed on a canine lung adenocarcinoma cell line (CLAC) to observe the effects of high frequency IRE (HFIRE). HFIRE uses bipolar nanopulses which minimize muscle contractions and cardiac arrhythmias during treatment administration unlike traditional IRE. Hydrogels containing CLAC cells were used to model the tumor microenvironment to observe the cell line's response to treatment. Treatment was applied using a VoltMed pulse generator and a single needle grounding ring setup as our electrodes. Confocal microscopy was then used 24 hours after treatment to produce high resolution images of the resulting ablation areas. Based on the areas measured in the microscopy images, an electric field threshold (EFT) was calculated for each treatment group. Once the EFTs are determined, the results will be compared to those of the in vivo canine treatments. Immunohistochemistry assays were performed by the Animal Cancer Care and Research Center and indicated that HFIRE fully treated the intended ablation area with no adverse events from the canine patients. The results of the in vitro hydrogel study are intended to verify and support their findings.

Mentor(s): Rafael Davalos (Biomedical Engineering and Mechanics), Virginia Tech
Dr. Joanne Tuohy, Virginia Tech

Alexander Davis
Virginia Tech/Chemical Engineering

Bimetallic Approaches for C-H Bond Functionalization

In this project, we seek to find alternative methods for cleaving C-H bonds in order to make more useful compounds. The problem is that C-H bonds are nonpolar and unreactive via traditional methodologies. Typical methods used in pharmaceutics and industry employ lengthy syntheses, require high temperatures, or expensive metal catalysts (e.g., platinum) to bypass some of these issues, which is costly and not sustainable in the long term. The focus of our research is to use first-row transition metals (which are abundant and cheap) and manipulate the steric hindrance around the metals to improve the catalytic potential of these metals and thus more efficiently cleave C-H bonds. The specific intention of this research is to synthesize various metal complexes with a large ligand backbone to develop electron-poor and electron-rich metal pairs. As the interaction of an electron-poor and rich metal complex will be controlled by the steric hindrance we hope that could enhance the reactivity of the two species and induce cleavage of C-H bonds without the need for extreme conditions.

Mentor(s): Diana Iovan (Chemistry), Virginia Tech

Maeve Davis
Virginia Tech/Animal and Poultry Science

The Number and Distribution of Stem Cells in the Small Intestine of Chickens

The small intestine is the site of nutrient absorption and consists of villi, which contain absorptive and secretory cells, and crypts which contain stem cells. The objective of this study was to compare intestinal morphology using Olfm4 staining of cells from a commercial broiler line (Cobb 500), low weight select (LWS) and high weight select (HWS) lines. These data will help provide insight into the time course for the development of the crypts and villi among the different types of chickens. Learning more about stem cells will improve our basic knowledge about the development of absorptive cells along the villi essential for the uptake of nutrients from the intestine. RNAscope in situ hybridization was used to identify the stem cells from the three chicken lines (n=6) on embryonic day 19, day of hatch, and days 1.5, 3, 5, and 7 post-hatch. Villus height and crypt depth (region staining for stem cells) were measured. After post-hatch day 3, LWS birds have short villi compared to Cobb 500 and HWS which may explain why they have lower body weight compared to Cobb 500 and HWS. In addition, Cobb 500 had a greater VH/CD ratio on day 7 because it had a smaller crypt whereas the HWS had a greater crypt, which decreased the VH/CD.

Mentor(s): Eric Wong (Animal and Poultry Science), Virginia Tech

Katherine D'Ercole
Virginia Tech/Psychology
Christine Berry
Virginia Tech/Human Development

Relations Between Parents' and Children's Math Anxiety along with Children's Math Avoidance and Math Performance in Elementary School

Children's math anxiety has been studied as an important predictor of their math performance. However, the relation between parents' own math anxiety and their children's math avoidance has not been explored much as it relates to their children's math anxiety and performance. Math avoidance refers to the behavior of ignoring math, whether that be not completing homework, procrastinating on math work, or engaging less with math in general. The current study is unique by introducing this new construct of math avoidance. The current study surveyed 59 2nd-4th grade children (Mage = 9.00 years) and their parents. Children also completed a math problem-solving assessment. We examined the following two research questions: (1) What are the relations among parents' math anxiety, children's math anxiety, and children's math avoidance? (2) How are these attitudes associated with children's math performance? Results indicated that children's math anxiety was significantly related to children's math avoidance; however, there was no relation found between parents' math anxiety and children's math avoidance or anxiety. In separate models, children's math anxiety and math avoidance were each significantly associated with their math performance; however parent's math anxiety was not. In a combined model, children's math avoidance explained the most variance in performance. Results provide evidence that math avoidance is an important factor involved in children's math learning.

Mentor(s): Caroline Hornburg (Human Development and Family Science), Virginia Tech
Jisun Kim, Graduate Student (Human Development), Virginia Tech

Chloe DeSanto
Virginia Tech/Biology
Kathleen Cardi
Virginia Tech/Psychology
Kenna Kooshian
Virginia Tech/Psychology

The Power of Gratitude

We evaluated the impact on the mood states of students after they delivered a customized thank-you card (TYC) to a professor after class. Two students in a university class were TYC benefactors–a research student and another student unaffiliated with the research. Both students completed a mood survey before class. After class, the students gave their TYCs to the class instructor and then completed the mood survey again.

The TYC includes a space for the benefactors to record their experience delivering the TYC, as well as the reactions of the beneficiary of the TYC. An analysis of these comments indicated uniformly positive emotions, often positive surprise, from the professor who received the TYC. Although some students expressed stress before delivering a TYC, every benefactor recorded positive reactions after distributing the TYC. The mood survey was essentially a semantic differential with 15 pairs of contrasting mood states (e.g., sad vs. happy, tired vs. energetic, nervous vs. calm, unmotivated versus motivated) and a rating scale with “1” at the extreme negative end and “10” at the extreme positive end of the differential.

A total of 64 different students gave a TYC to a professor after class. Every professor displayed a positive emotion, the most common being surprise, after receiving the TYC. The students’ overall positive mood states increased significantly by an average of 1.36 after delivering a TYC to a professor after class, providing evidence of the beneficial impact of expressing interpersonal gratitude.

Mentor(s): Scott Geller (Psychology), Virginia Tech

Sophia DeSimon
Virginia Tech/Biochemistry
Anthony Briganti
Virginia Tech/Biochemistry

Combating Antibacterial Resistance: Characterizing Ribosomal Antibiotic Binding Pockets to Advance Bidentate Design

Antimicrobial resistance (AMR) is a growing problem in modern medicine and there is a need for new antibiotic technologies to continue being able to treat common diseases. In 2019 globally, there were 4.95 million deaths associated with drug-resistant infections, and 1.27 million of these deaths were directly attributable to drug resistance. Triazole derivatives of pleuromutilin class antibiotics were also synthesized and tested experimentally for minimum inhibitory concentrations. Computational testing was able to predict the efficacy of these drugs. A potential tool for combatting antibiotic resistance is the creation of modified antibiotic molecules and novel bidentate antibiotic that targets the bacterial ribosome. A bidentate antibiotic has two known antibiotics covalently linked that simultaneously target two binding sites of the ribosome. Molecular docking studies of antibiotics were completed, and their ribosomal binding sites were characterized to determine strong candidates for the creation of high efficacy derivatives and a bidentate antibiotic. The antibiotics amicetin, lefamulin, and blasticidin were chosen to create the first bidentate antibiotic due to successful molecular docking studies completed with root mean square deviation (RMSD) values of approximately 2Å and low rates of errors. These strategies will reduce antibiotic production turnaround time and can increase the arsenal of tools we have to fight antimicrobial resistance.

Mentor(s): Anne Brown (Biochemistry), Virginia Tech
Andrew Lowell, (Chemistry), Virginia Tech

Ethan Desverreaux
Virginia Tech/Biochemistry

Using MD Simulations to Characterize Biologic Peptide Folding for Disrupting PD1/PD-L1 Interfaces

Cancer treatments over the last three to four decades have readily evolved and improved as the knowledge base of cancer biology and drug design have continued to grow. However, current biologics on the market are costly to synthesize and can dangerously suppress patient immunity. Small biologic peptides have recently gained promising support as cheaper, less toxic, and more accessible alternatives to chemotherapy or immunotherapy. Interference of PD1 (Programmed Cell Death Receptor 1) interface with its ligand PD-L1 specifically has been a primary target of drugs treating lung, bladder, and skin cancers. Previously determined biologics derived from the binding region of PD-L1 have shown binding affinities higher than wild type PD-L1 to the interface region; however, there is need for more specific and potent biologic inhibitor design. Utilizing molecular dynamics (MD) simulations, the designer peptide (MN1.1) was simulated bound and unbound to PD1. Random folding and beta hairpin secondary structure motifs were noted in MN1.1 when unbound, however when bound to PD1 beta hairpin structure was observed at significant percentages. This formation of beta-strand structure increases the stability and reliability of MN1.1 to bind to PD1 and suppress tumor proliferation. The increased cystine content and resultant disulfide bonds of the MN1.1 sequence are believed to stabilize this secondary structure and support the binding of this peptide into the protein-protein interface. Small molecule therapies such as this have the potential to revolutionize cancer treatment costs and side effects.

Mentor(s): Anne Brown (Biochemistry), Virginia Tech

Katherine Duffett
Virginia Tech/Clinical Neuroscience
Kaitlyn Irons
Virginia Tech/Experimental Neuroscience
Bevan Forrest
Virginia Tech/Psychology

The Influence of Self-Compassion, Mindfulness, and Future Valuation in a Population with Substance Misuse

Mindfulness-based therapies have been used to support recovery in individuals with substance use disorders. However, the behavioral mechanisms through which mindfulness supports substance use recovery is unknown. Therefore, in this cross-sectional study, we sought to examine how mindfulness and other psychological factors support successful recovery outcomes. Participants (n=96) were members of the International Quit and Recovery Registry (IQRR) with self-identified substance misuse. Participants engaged in a series of neuropsychological assessments including those that assessed mindfulness, self-compassion, delay discounting, personality, anxiety, depression, cravings, quality of life and openness to the future. Pearson's Correlations were used to assess the relationships between mindfulness, other psychological factors, and recovery status. Results indicate that mindfulness was significantly positively associated with self-compassion ($r=0.804$, $p<0.001$) and significantly negatively associated with depression ($r=-0.525$, $p<0.001$) and anxiety ($r=-0.472$, $p<0.001$). Mindfulness was also positively correlated with days in substance use recovery ($r=0.353$, $p<0.001$). Overall this study reveals that mindfulness may support successful recovery through both increasing periods of abstinence and enhancing positive affective states. Future interventional studies utilizing mindfulness-based therapies should examine the behavioral mechanisms supporting successful recovery outcomes.

Mentor(s): Julia Basso (Human Nutrition, Foods, and Exercise (HNFE)), Virginia Tech
Sarah Lynn (Human Nutrition, Foods, and Exercise (HNFE)), Virginia Tech

Gabrielle Dugan
Virginia Tech/Biological Systems Engineering
Nicole Gaspari
Virginia Tech/Biological Sciences

Restoring connectivity: impact on ant seed-dispersal mutualisms

This study describes how corridors affect functional traits in Solenopsis invicta and influence seed-dispersal mechanisms. Land managers use corridors- linear strips of land connecting isolated patches- to mitigate the effects of habitat fragmentation. Habitat fragmentation is increasing worldwide and the implementation of tools, like corridors, is vital to understanding the effects of fragmentation on multi-species interactions. The purpose of our research is to better understand the effects of corridors on ant seed-dispersal mutualisms. The Savannah River Site Corridor Experiment is a long-term ecological system investigating how corridors function at the landscape scale. Previous work in this experiment shows that ants move seeds farther in habitat patches connected by corridors than in isolated patches. For our study, we measured two traits of S. invicta: thorax length and femur length, which can be indicative of an ant's ability to move seeds. We found no significant differences in mean thorax length or mean femur length across patch types. We did find that the range of both the thorax length and femur length values varied. Patches with high connectivity and high edge had the smallest range in thorax length (0.504mm; 0.600-1.104mm) and femur length (0.4335mm; 0.5045-0.938mm). While patches with low connectivity and low edge had the largest range in thorax length (0.617mm; 0.656-1.273mm) and femur length (0.546mm; 0.535-1.081mm). Additional research will investigate these trends and further describe how corridors affect ant seed-dispersal mechanisms.

Mentor(s): Susan Whitehead (Biological Sciences), Virginia Tech
Melissa Burt (IGC Fellow in Biological Sciences under the Whitehead Lab), Virginia Tech

Khaled Dulli
Virginia Tech/Mechanical Engineering
Sushant Dasari
Virginia Tech/Neuroscience

Development of a countertop scale mini anaerobic digestion system

Anaerobic digesters are used to process manure and food waste into fertilizer and hydrocarbons. These digesters are traditionally large and outdoors. Recently, smaller household scale models have come to market in the U.S., and even smaller indoor models are in development. However, there is little research available on household designs intended for the U.S. market, and the function of these devices is not well known or understood by the public. The aim of this project is to develop a miniature and portable counter-top scale miniature anaerobic digester that is designed to show the inner workings of the system, for educational and demonstration purposes, and is easy and inexpensive to build. This mini digester is designed to use plastic soda bottles as reaction chambers, with a 2 liter main chamber. Bottles and tubing are clear for demonstration and testing. The mini digester is placed in a framing structure for portability. The design functions by the feeding of very finely chopped straw, to demonstrate flow processes and the movement of kitchen scraps through the digester. The design is tested for the passage of this chopped straw, as well as flow volume, solids delivery, and frequency of clogging. This work will be useful in communicating about anaerobic digestion, and also as a test bed for innovations that can be used for household scale digesters.

Mentor(s): Benjamin Chambers (Engineering Education), Virginia Tech
Zachary Dowell, Doctoral Student (Building Construction), Virginia Tech

Brock Duma
Virginia Tech/Mechanical Engineering

An Optimized Whitewater Helmet Prototype Designed Using a Newly Developed Helmet STAR Evaluation System and 3D Printing

Whitewater sports result in 50 deaths and thousands of concussions every year, and the currently available helmets are insufficient. The objective of this study was to create an optimized whitewater helmet prototype designed using the newly developed Whitewater Helmet STAR Evaluation System and 3D Printing. The 21 helmet models that were evaluated using the Whitewater STAR methodology were cut vertically and horizontally to allow for cross sectional padding analysis. A material testing system (MTS) was used to evaluate each helmet's padding stiffnesses. The padding Vinyl Nitrile (VN) 600 and VN 740 were found to have the greatest correlation with the highest performing helmets through linear regression and energy absorption analysis. Rhino 3D software was utilized to create the new model of the whitewater helmet. The helmet shell was developed as a modified ellipsoid with a length of 28.5 cm and a height of 13.0 cm above the midline. Three different materials of Accura 60, Nylon, and Accura ClearVue were selected for the helmet shell in order to test a variety of material properties. Using these materials, three different prototypes were constructed in order to optimize the padding and retention of the helmet design. A custom pendulum impactor device was used to test the three different helmet prototypes in accordance with Whitewater STAR. The prototypes were impacted at 3.1 m/s and 4.9 m/s to the front, side, and rear. The final prototype produced a STAR value of 0.01 and performed 25 times better than the best currently available whitewater helmet.

Mentor(s): Mark Begonia (ICTAS - Institute for Critical Technology and Applied Science), Virginia Tech
Katharine Davis, Blacksburg High School

Lauren Duma
Virginia Tech/Clinical Neuroscience

The Biomechanics of Head and Chest Impacts from Falls in Equestrian Sports

Equestrian sports are the greatest contributor of sports related traumatic brain injuries (45.2%). The objective of this study was to quantify the biomechanics of equestrian riders as they fall, and to determine the most common impact locations. This data can be used to determine which impact locations to use when testing equestrian vests and helmets when designing new standards.

A total of 100 videos of real-world equestrian falls were collected from the three events: cross country, show jumping, and dressage. For each fall, a still-frame image was taken of the beginning of each fall event, the actual drop height, and the impact location. Body impacts were categorized as chest, side, back, or buttocks, and head impacts were categorized as front, side, back, or top.

Each of the 100 recorded falls involved a body impact, with 36 impacts to the back, 27 impacts to the side, 24 impacts to the buttocks, and 13 impacts to the chest. There was a total of 66 head impacts, with 31 impacts to the back, 24 impacts to the side, and 11 impacts to the front. For all fall events, 82% of the riders grabbed the horse's neck and reduced the overall fall height.

For all equestrian falls, impacts most often occur on the back and side for both head and chest regions. Another interesting observation was that the rider rarely falls from the full height of the horse. These data will be critically important when designing new standards for helmet and chest protection devices.

Mentor(s): Stefan Duma (ICTAS), Virginia Tech

Colin Dunn
Virginia Tech/Wildlife Conservation

Uses and Perceptions of Two Appalachian Wildflowers: Bloodroot (Sanguinaria canadensis) and Red Trillium (Trillium erectum)

Many wild, native plants are harvested across Appalachia for human uses, including medicine, food, or income. For example, Bloodroot has been harvested for medicinal applications such as treating skin ailments, inflammation, or as an emetic. Red Trillium has also been used to treat inflammation and ulcers. They are also harvested for local sale or to sell to larger aggregators for broader commercial use. Harvesting of wild native plants is an important part of people's cultural identity in parts of Appalachian; however, some of these herbs face threats from over-harvesting and poor harvesting practices as well as predicted habitat loss from global climate change. We surveyed 15 Appalachian harvesters of these plants and analyzed the results to look for changes in the availability of these plants as well as to better understand how these species are used. The majority of respondents were in the 36-50 or 51-75 year age classes. They were surveyed across 4 states and mainly harvest these plants for personal or monetary purposes. The harvesters' motives are similar to those who harvest ramps and other forest products, however bloodroot and red trillium cannot be used for food unlike many other harvested plants. The predicted effects of climate change on these species highlights the urgent need to better understand the medicinal properties and cultural value of these two plants, as well as inform efforts to mitigate climate change impacts.

Mentor(s): Jordan Metzgar (Biological Sciences), Virginia Tech

Madeline Eberhardt
Virginia Tech/English Pre-Education
Ursilia Beckles
Virginia Tech/English Pre-Education

“This city will be chocolate at the end of the day”: Racial identity, colorism, and generational change in the New Orleans Black and Creole communities

Midlo-Hall & Rowell (2006:1049) describe New Orleans as “the most African city in the United States.” Culturally, we see this through the foodways, music, and cultural traditions of the city–though Blackness in New Orleans is anything but straightforward, due to the particular historical development of the city. New Orleans played a central role in the Trans-Atlantic Slave Trade and has continued to be at the center of civil rights struggles in the US (most famously with the Plessy v. Ferguson case, the desegregation of schools by young Ruby Bridges, and of course the ways that racial inequity was televised live after Hurricane Katrina flooded the city). In a less public-facing way, we observe internal struggles with the idea of Blackness and the role of Blackness in the city’s history and current traditions, through the lens of conversations, centering on racial identification, racism, and colorism in the city.

During the colonial period, New Orleans featured a three-tiered racial hierarchy between Europeans, Free People of Color (who were often but not always mixed race), and enslaved Africans. The privileges afforded to Free People of Color, who came to be known as Creoles after the Civil War in acknowledgment of their partial European heritage, continued on to the Civil Rights era due to colorism and passing privilege (Domínguez 1977). As such, the Black and Creole communities (who also differ in key cultural ways, in terms of Creole’s French and Catholic heritage in contrast with predominantly Anglo protestant descendants of enslaved Africans) have frequently been pitted against each other, causing deep and lasting rifts in the communities of color which are equally acknowledged by both Black and Creole New Orleanians.

In our sample of interviews with 30 Black and Creole New Orleanians collected in 2018, we encounter narratives of colorism and internalized racism, but also a common thread amongst participants from Creole families in terms of their shift over time to identify specifically (and sometimes solely) as Black. As one participant explained, “I look at Creole as disavowing my blackness.” In our analysis of themes from interviews, we mobilize the concept of ‘muted Creoles’ or members of the Creole community who are frequently erased (e.g. Irvine & Gal 2000) from the public imagining of what a Creole is due to their lack of conformity to Creole standards–in particular, but not solely, due to darker skin tone. We also probe the question of the revaluation of Black identity in New Orleans both in historically Creole families as well as more broadly, and consider the role of the Civil Rights Era as well as more recent reclaiming of Blackness such as the BLM movement in these shifts in personal identity. Crucially, our qualitative analysis is underpinned by community-based participatory research, as one of our team members identifies as Black and Creole and provided key insider insights into our interpretations of the narratives we present upon. We thus offer novel insights about intergenerational change in racial identification in New Orleans that is grounded in the personal experiences of community members and their views on the shifting racial landscape in the city.

Mentor(s): Katie Carmichael (ENGL), Virginia
Natalie Cook, PhD. (Virginia Tech, Public Health),Virginia Tech

Amber Edwards
Virginia Tech/Agriculture Technology
Matthew Lucas
Virginia Tech/Agriculture Technology

Weight gain benefits of creep feeding claves

We wanted to determine if creep feeding calves gained sufficient weight to justify the expenses. A local producer worked with us to monitor four groups of pre-weaned calves. Three of those groups were creep fed and one group was a pastured control group. The calves were weighed before feed was introduced and again at 47 days at the time of weaning. During those 47 days the average daily rate of gain for our feed groups was 1.6 whereas our control group was 0.9. We monitored them an additional 49 days after weaning and found that the average daily rate of gain for the feed groups was 3.3 and the control groups was 3.

Mentor(s): Wesley Gwaltney (Agriculture Technology), Virginia Tech

Khadija ElBouchti
Virginia Tech/Ocean Engineering

An Inquiry-Based Approach to Exploring the Effect of Engineering Decisions of Ecological Systems

This project applied inquiry-based learning theory to develop a lesson plan for fourth grade students to explore the effects of engineering decisions on ecological systems. An inquiry-based approach helps students develop research and questioning skills during instruction and promotes overall engagement. This method of information delivery can be integrated into the curriculum because through self-motivated investigation, students can gather the information that is required in the standards of learning in a way that is more conducive to information retention. This project addresses standard 4.5 of the Virginia Board of Education fourth grade science curriculum. The specific objective was to have students connect the impacts of buildings and landscape in their school on the local flora and fauna. The lesson plan consists of having students research the habitat of an organism that lives in the immediate environment around their school. After they know what the organisms need in their habitat, they go outside and analyze the habitat that the organisms are actually living in. They then consider whether or not the environment is providing the organisms with what they need to thrive and further brainstorm ways that their school could be designed in a way that is more accommodating to the wildlife in the area. This lesson can be tested in an elementary school with measures of effectiveness that include the quality of the research on habitats that is done and the level of thinking that is evident in the submissions of modifications to the design of the school.

Mentor(s): Ben Chambers (Engineering Education), Virginia Tech

Yasmin Farzan
Virginia Tech/Chemical Engineering

Synthesis of Oxygen-Based Ligands for C-H Bond Activation Catalysts

The cleavage of specific C-H bonds is very useful for many companies including the fuel and pharmaceutical companies. The foremost issue in this research is the strong energy barrier that needs to be overcome to cleave them, meaning that the main ways that have been implemented to overcome this issue involve expensive catalysts such as platinum complexes or energy-intensive processes that require high temperatures. While this process is ultimately effective in its purpose, it does not achieve this transformation in any specific fashion, as it is often uncertain which C-H bond will break first under such extreme conditions, thus leading to many byproducts (which are typically discarded) and waste generation. In this research, we try to find a catalyst that would lower the activation energy of carbon-hydrogen bond cleavage and use earth-abundant, cheap metals instead (e.g., first-row transition metals). The result of this research would be a step towards stopping global warming and increasing the availability of important products such as energy and drugs to many people, especially in developing countries.

Mentor(s): Diana Iovan (Chemistry), Virginia Tech

Liz Fellinger
Virginia Tech/Meteorology
Thomas Chase
Virginia Tech/Meteorology
Morgan Crum
Virginia Tech/Wildlife Conservation
Ethan Richards
Virginia Tech/Statistics
Aidan Sherlock
Virginia Tech/Statistics

Assessment of Water Quality of Stroubles Creek in Blacksburg, VA as Indicated by Macroinvertebrates

Stroubles Creek is an impaired stream located in Blacksburg VA. The Stroubles Creek Watershed is a valuable part of the Blacksburg community as it contributes to the New River, Blacksburg's primary source of drinking water. The increased urbanization and agriculture in the surrounding areas contribute to polluted runoff entering the stream. This project, in partnership with Dr. Brown of the VT Stream Team and the Orion Living Learning Community, explored how test sites along Stroubles Creek show differing levels of water quality and the causes for this difference. It also explored how the distance from Virginia Tech and the levels of stream restoration affect the overall stream quality. The water quality of a test site is indicated by the macroinvertebrate species found in collected samples. These macroinvertebrates act as an indicator species due to their different tolerances to pollution. These samples were sorted and identified at the family level. Metrics such as tolerance, species richness, species diversity, and abundance were used to analyze results. We expect that the water quality of Stroubles Creek will improve as we move to test sites further away from the urbanized areas of Virginia Tech and Blacksburg. Additionally, we anticipate seeing an increase in macroinvertebrates that indicate good stream quality as we move away from urbanization.

Mentor(s): Temperance Rowell (College of Science), Virginia Tech
Dr. Bryan Brown (Biological Science), Virginia Tech

Nathan Ferguson
Virginia Tech/Wildlife Conservation
Kalin Davis
Virginia Tech/Wildlife Conservation

Predicting Population Growth of an Introduced Minnow Species Chrosomus oreas Threatening the State Endangered Chrosomus tennesseensis

Habitat loss, invasive species, pollution, and overharvesting are significant threats to freshwater species around the globe, a third of which are currently endangered. In Virginia, species may be unintentionally introduced by humans moving bait among freshwater watersheds. Many people are unaware that introduced minnows can create ecological harm to endangered species such as Chrosomus tennesseensis (Tennessee Dace). The goal of this study is to evaluate the potential population growth of Chrosomus oreas (Mountain Redbelly Dace) outside of its native range, the Holston River drainage in Virginia. The state-endangered C. tennesseensis is located in an adjacent tributary to the study site and could be threatened by this recently introduced species. C. oreas were collected by the Virginia Department of Wildlife Resources using a backpack electroshocker in a tributary of the Holston River in southwestern Virginia. Of the fish collected, a subsample of 45 fish in three length classes was selected to remove otoliths to determine age and estimate egg production by averaging egg counts of females. From these data, and assuming a stationary age distribution, Leslie projection matrices were created to predict future population growth based on average egg count and survivorship between age classes. Over time, these matrices projected rapid exponential growth of this population. To prevent further expansion, the models predicted survival would need to be below 5-10% from year one to year two. Future work is planned to replicate this study and to inform resolution strategies to prevent C. oreas from threatening populations of C. tennesseensis.

Mentor(s): Holly Kindsvater (Fish and Wildlife Conservation), Virginia Tech
Kevin Hamed, Fish and Wildlife Conservation), Virginia Tech
Mike Pinder (Virginia Department of Wildlife Resources), Virginia Tech

Amy Fiorellino
Virginia Tech/Environmental Science

Poison Ivy Urushiol Levels Are Not Correlated With Microbe Levels Nor Reproductive Metrics

Amy Fiorellino, Xiyuan Zhang, MD Sahadat Ali, Emma Lear, Brice Crum, and John G. Jelesko

Urushiols, the chemical compounds responsible for the characteristic rash resulting from poison ivy (Toxicodendron radicans subsp. radicans) exposure, have long been considered a chemical defense to deter predation of the species within the Toxicodendron genus. However, the adverse reaction seen in humans has yet to be observed in any native plant herbivore. Ergo, this project aims to evaluate microbes as a potential target of this chemical defense system, as well as potential metabolic trade-offs of urushiol production in relation to reproductive traits. In order to assess the effect of urushiol content on microbial viability, a series of microbe extractions were conducted on T. radicans drupes collected form three separate locations in Virginia to estimate the culturable bacterial and fungal colony forming units (CFUs) and corresponding drupe urushiol congener content. Linear regression modeling of these two variables showed no significant correlation between the two, indicating that urushiol has negligible effects on microbial viability. In order to assess the effect urushiol content has on reproductive traits, T. radicans drupes were collected from the same lianas, and were assessed for various metrics of reproductive fitness, such as drupes/panicle, drupes/branch, panicles/branch, and seedling germination rate. It was found that none of these reproductive metrics were significantly correlated with developing drupe urushiol levels, suggesting that urushiol content did not affect T. radicans reproductive fitness.

Mentor(s): John Jelesko (School of Plant and Environmental Sciences), Virginia Tech

Rebekah Fogarty
Virginia Tech/Biochemistry

Molecular Dynamics Simulations of the G-Quadruplex Present in the human-VEGF Promoter Region

Cancerous tumors rely on utilization of blood vessels to obtain nutrients and oxygen for proliferation and metastasis. Blood vessels are formed via a process known as angiogenesis, which within humans requires the presence of vascular endothelial growth factor (VEGF). An overexpression of this growth factor is implicated in various types of cancers, and a 22-nucleotide segment of the VEGF promoter region has been found to form a G-quadruplex (GQ) under experimental conditions. Due to the enrichment of GQ structures within promoter regions, it is suggested that they may serve as regulators of transcription. Therefore, it has been proposed that by stabilizing the VEGF promoter GQ, the overexpression of the growth factor that allows for increased angiogenesis may be inhibited. In turn, this stabilization via small molecule therapeutics could help slow cancer growth. To better understand the structural features that stabilize this GQ and later design chemotherapeutic agents, we conducted molecular dynamics simulations of the VEGF Pu22-T12T13 mutant and wild-type GQs with the Drude-2017 polarizable force field. This force field has been shown to produce more robust simulations of GQs by more accurately modeling electronic behavior. We found that bulk K+ ions readily interacted with the exposed tetrads and the 4-nucleotide loop region of the GQ. The presence of a high affinity ion-binding “pocket” between the core and loop was demonstrated within both systems. Additionally, the loop region manifested a higher flexibility than the GQ core within both systems. Our analysis illustrates differences within ion-binding interactions and structural behaviors due to the presence of the mutation explored. These observed differences in characteristic behaviors can then be exploited for more specific drug design.

Mentor(s): Justin Lemkul (Biochemistry), Virginia Tech

Abigail Frye
Virginia Tech/Biology and Psychology
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Virginia Tech/Psychology and Human Development
Olivia Salazar
Virginia Tech/Psychology

Emotion Regulation Moderates the Association Between Vocabulary and Externalizing Behavior in Early Childhood

The aim of this study was to examine the moderating role of emotion regulation in the association between vocabulary and externalizing behaviors in childhood. This research is of developmental relevance as externalizing behaviors have previously been associated with later academic difficulties and poor social competence (Cohen & Mendez, 2009). In this longitudinal study, participants included 181 children (92 females). At the age 3 lab visit, child vocabulary was assessed using the Peabody Picture Vocabulary Test (Dunn & Dunn, 2007) and children's
emotion regulation skills were assessed using the Frustrating Puzzle task (Perry et al., 2017). At the age 6 lab visit, the child's caregiver completed the Child Behavior Checklist (Achenbach, 1991) as a measure of children's externalizing problems (rule-breaking and aggressive behavior). Moderated multiple regression was conducted using the PROCESS macro (Hayes, 2013) with child sex/maternal education entered as covariates. The model was significant, $F(5, 181) = 4.719$, $p < .002$, adj. R squared = 0.09, and age 3 emotion regulation abilities significantly moderated the predictive association between children's vocabulary size at age 3 and their externalizing problems at age 6, $\beta = -.159$, $p = .036$. The results indicate that among children who exhibit marked difficulty regulating their emotions as preschoolers, early vocabulary size serves as a protective factor against externalizing problems during the elementary school years. These findings have important implications in child development, as efforts to improve children's early emotion regulation and verbal skills may result in diminished externalizing behaviors and thus improved child outcomes.

Mentor(s): Martha Ann Bell (Psychology), Virginia Tech
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Jared Fyfe
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Evaluating discharge status and routine outcome monitoring (ROM) adherence in anxiety and non-anxiety clients in a psychology training clinic.

Routine outcome monitoring (ROM) utilizes standardized, continuous measurement to aid the therapeutic process (Cooper et al., 2021). ROM has been shown to decrease dropout and improve treatment outcomes (Lambert, et al., 2018). This study examines discharge status and adherence to ROM of anxiety patients.
Participants from a community-based psychology training clinic were divided into anxiety clients (n = 40) and non-anxiety clients (n = 40) based on a semi-structured interview (e.g, ADIS) and DSM-5 criteria. Anxiety clients varied in age from 19-58 (*M* = 28.85; SD = 11.5), and were predominantly female (n = 22, 55%) and white (n = 31, 77.5%). Clients in the non-anxiety group varied in age from 18-59 (*M* = 28.8; SD = 10.56), were predominantly male (n = 22, 55%) and white (n = 34, 85%). Non-anxiety clients were matched for age and gender.ROM compliance was calculated by dividing the number of times a client completed measures by their total number of sessions. Discharge status was determined by clinician-generated discharge information forms.
Completion rates for ROM were significantly higher in the anxiety group (*M* =.903, SD =.136) compared to the non-anxiety group (*M* =.801, SD =.234), t(78) =2.32, p = .003. Total session number was not significantly different between the anxiety group (*M* =25.1, SD =.18.59) and the non-anxiety group (*M* =22.85, SD =17.64), t(78) =.555, p = .677. Discharge status between groups will be compared and evaluated in more detail in the poster.

Mentor(s): Lee Cooper (Psychology), Virginia Tech

Ria Garg
Virginia Tech/Aerospace Engineering

Simulating Ice Deformation Patterns through The Computational Modeling of Real-Time Geographic Mesh Inputs in Relation to Climate-Based Conditions

Predictive computational modeling serves the purpose of determining how systems may behave and evolve through the quantitative documentation given by real-time patterns. An ongoing problem that requires the use of computational modeling is the accelerating ice loss from ice sheets and glaciers. In efforts to understand these glaciological processes, an evolutionary model is needed to assist scientists in concluding a deformation rate which will determine the interactions of the environment and human activity. The following model studies the Larsen ice shelf as a case study for discovering how current climate conditions will impact the body over a period of time. Computational processes on this ice sheet begin with extracting geographical coordinates from the NASA Earth Data database. From here, the model is simulated with FEniCS, an open-source computing platform, to determine flow patterns around the ice shelf using the Navier-Stokes equations. The flow velocities that are calculated will assist in locating which areas of the ice shelf are most susceptible to deformation and ice loss. By utilizing stress and strain relationships over a period of time, those chosen fields will indicate when and where fracture points will appear. To then apply the current day climate conditions, variables that are dependent on temperature and salinity are altered within the model to represent how the ice shelf would react under these factors. The compilation of these methods will result in a deformation rate that is determined by the material failure of the ice shelf at certain times in its evolutionary process.

Mentor(s): Justin Kauffman (Aerospace and Ocean Systems Laboratory), Virginia Tech

Roshan George
Virginia Tech/Industrial & Systems Engineering
Mark Seymour
Virginia Tech/Industrial & Systems Engineering

5G Opportunities in Warehousing

As 5G capabilities improve, adoption will go beyond current urban cellular networks into industrial settings enabling the IoT landscape. 5G primarily delivers value by enhancing mobile broadband through ultra-reliable, low-latency signals and massive machine-type communications. With the concurrent development of 5G and industrial automation, replacing Wi-Fi and LTE services with 5G networks offers an opportunity to enhance scheduling, latency, jitters, and redundancy in demanding applications. Additionally, the equipment redesigns and upgrades to operate in 5G will pave the way for innovation in operational strategies previously constrained by network capabilities. In this research, we consider the warehouse operations and functions that are most likely to benefit from 5G adoption. The main areas we believe 5G will impact warehousing are robotic operations, such as AGVs/AMRs; augmented reality devices for picking, training, and maintenance; inventory management through real time asset tracking; equipment battery life from network slicing; and data security. In general, the capacity and low-latency through 5G will support continuous data transfer that is sufficient to support real-time analytics and decision-making. Knowing which functions will benefit most from 5G will provide strategic guidance for upgrading equipment and operations and aid in developing the factory of the future.

Mentor(s): Natalie Cherbaka (Industrial & Systems Engineering), Virginia Tech
Kimberly Ellis (Industrial & Systems Engineering), Virginia Tech

Carson Gilmore
Highschool

Comparing Disintegration Rates of Various Disintegrants

Disintegrants are excipients used in solid oral dosage formulated medications with the purpose of helping to release the active ingredient. This research is set up to compare the disintegration rates of maltodextrin, and hypromellose. The research was conducted by running tablets containing these disintegrants through a simulated gastric disintegration machine, using simulated gastric fluid. Results in the form of time were measured and recorded. Two different formulas, both with hypromellose took 93:30.00 minutes and 89:08.16 minutes to fully disintegrate. The maltodextrin tablet took 56:58.20 minutes to disintegrate. These results show that - 1. The tablet formulation does not affect the efficiency of disintegrant in the two tablets containing hypromellose, and 2. Maltodextrin is a more efficient disintegrant that hypromellose. Knowing this information is useful when formulating a tablet to target a specific goal regarding disintegration time.

Mentor(s): Katharine Davis, High School
Cynthia Jones (Marshall University School of Pharmacy)

Mariel Gomez
Virginia Tech/Sustainable Biomaterials

Synthesis of novel alpha-1,3-glucan Polymer Derivatives for Amorphous Solid Dispersion Technologies

Many of the current drugs accessible for purchase have water solubility limitations that inhibit their bioavailability in the body. One way to address these problems is through functionalizing plant-polysaccharides to formulate oral drug delivery carriers called amorphous solid dispersions (ASDs) which are solid-state, miscible, amorphous polymer/drug matrices. Properties for high-performing ASDs include a high Tg, the incorporation of ω-carboxyl groups for targeted GI tract drug release, favorable drug/polymer interactions, and improved water solubility. To design these polymers, our research has focused on functionalizing amorphous polymer excipients like α-1,3-glucans. The only differences between the α-1,3-glucan and cellulose (β-1,4-glucose) are their linkages (1 3 compared to 1 4) and the conformation at the anomeric carbon (α compared to β). Both differences make the glucan more water-soluble since they create “kinks” in the polymer’s chain. These kinks create helices that could form complexes with the drugs in ways that traditional cellulose-based ASDs don’t. We aim to create α-1,3-glucan acyl derivatives of varying degrees of substitution, then esterifying the acylated polymer with succinic or glutaric anhydride to incorporate the ω-carboxyl groups to the backbone. We can tune the amphiphilicity of the polymer so that it is hydrophobic enough to form a miscible formulation with the drug while still being water-soluble enough to release it from its matrix, inhibiting crystallization in an aqueous environment. Characterization will include NMR, GPC, and DSC. Future work will involve in vitro structure-function studies using induction time to drug crystallization experiments.

Mentor(s): Kevin Edgar (Sustainable Biomaterials), Virginia Tech
Stella Petrova, Ph.D. Student, (Sustainable Biomaterials), Virginia Tech

Juan Gonzalez
Virginia Tech/Environmental Horticulture

Rooting for Shoots: Enhancing Plant Regeneration through Inducible Morphogenic Transcription Factors

Advancements in molecular biology, such as CRISPR/Cas9 and other gene-editing tools, have generated ways for combating the growing demands of global food production. Precision gene editing allows plant breeders to introduce desired traits to crop varieties; however, plant regeneration is a bottleneck in the application of these molecular tools. Many critical crops are recalcitrant to regeneration techniques and the molecular basis of regeneration is not well understood. Regeneration of plants takes place through organogenesis or embryogenesis and relies on the totipotency of plant cells to regenerate organs or embryos that develop into plantlets. Previous studies have shown that plant regeneration can be improved through ectopic expression of morphogenic transcription factors (MTFs). MTFs are transcriptional regulators involved in the development of organs and embryos. While constitutive expression of MTFs could result in an abnormal growth in regeneration, inducible expression allows for control of the timing and location of MTF expression. The goal of our project is to evaluate the regeneration efficiency of MTFs induced by estradiol treatment at certain stages of the root-to-shoot regeneration method in Arabidopsis. Young root segments were transferred to a callus-inducing medium (CIM) for 7 days and then transferred to a shoot-inducing medium (SIM) for 21 days, each with or without the addition of estradiol. Quantification of roots with shoots, as well as shoots per root, was used to determine the regeneration efficiency of inducible MTFs. Preliminary results suggest that the inducible expression of select MTFs (STM and WIND1) does improve regeneration efficiency, also affected by the timing of estradiol induction on CIM and SIM.

Mentor(s): Bastiaan Barmann (School of Plant and Environmental Sciences), Virginia Tech
Kelsey Reed (School of Plant and Environmental Sciences), Virginia Tech

Christa Greatorex-Potter
Virginia Tech/Biochemistry

Using In-Silico Techniques to Design Novel Antagonists for Propanediol Dehydratase

The gut microbiomes of humans and animals consist of a wide variety of healthy bacteria. Escherichia Coli (E. coli) are a typical bacteria in the human body, and while most strains are harmless, certain strains can lead to etiopathogenesis. Adherent Invasive E. coli (AIEC) is an example of a pathogenic E. coli strain, as they invade and adhere to the lining of the intestines, causing inflammation. The inflammation caused by AIEC has been linked to the development of Crohn's Disease (CD) through the use of the propanediol metabolic pathway. Propanediol dehydratase is involved in this metabolic pathway that allows AIEC to thrive and inflame the intestinal lining. Because current treatments for CD are highly limited and non-curative, novel antagonists of propanediol dehydratase are needed to effectively prevent AIEC from colonizing the intestinal lining and causing inflammation. Molecular docking and computer-aided drug discovery (CADD) was utilized to predict the interactions between the ligand 1,2-propanediol and propanediol dehydratase at the atomistic level, and used to propose structural hypotheses on ligand binding modes to improve targeting and inhibition of propanediol dehydratase. Fingerprinting and pharmacophore modeling was used to identify a hydrophobic region in the binding cavity surrounding 1,2-propanediol. Potential key residues to exploit for inhibitor interactions within this region are H143, D335, and F374. In future work, these residues will be investigated further in order to design antagonists of propanediol dehydratase that could lead to the development of improved treatment options for CD patients.

Mentor(s): Anne Brown (Biochemistry), Virginia Tech

Paige Greenberg
Virginia Tech/Materials Science and Engineering
Brian Parker
Virginia Tech/Materials Science and Engineering
Elise Kingry
Virginia Tech/Mechanical Engineering
Megan Phan
Virginia Tech/Mechanical Engineering

Heat Switch

Heat switches are devices that allow for manual or autonomous control of the amount of heat going into or out of a system. These systems are typically used in conjunction with a cooling system to remove heat from systems that have energy and heat sensitivities. Ideally, these devices are infinitely conductive in the closed state and not conductive in the open state. Current heat switches are typically made of state-changing material like paraffin wax, bimetal materials, or actuating solenoids. Applications for the heat switch range from fluid pumps to opening and closing circuits. These systems can be applied to magnets as well as ferro-fluids. The goal of this project is to determine the thermomagnetic material properties of gadolinium near its second-order phase transition temperature and to use these data in a custom-written multi-physics model to guide the design of an autonomous magnetothermal heat switch. In this project, we have developed the magnetic and thermal components of a multi-physics model using Finite Element Method Magnetics (FEMM) and OctaveFEMM. We have also designed and built a custom temperature control system to indirectly characterize the intrinsic magnetic properties of the material, and have developed approximate expressions for the parameters for use in our multi-physics model. We recently began researching the creation of a gadolinium-based ferrofluid to be used in the heat switch. Our goals for this semester are to combine the thermostatic and magnetostatic simulations into a multiphysics model and to draft a journal publication reporting the physical properties of gadolinium.

Mentor(s): David Gray (Engineering Education), Virginia Tech

Connor Hall
Virginia Tech/Chemical Engineering

Development of Porous Yolk-Shell Catalysts for Acetylene Semihydrogenation

In this work, we aimed to increase the selectivity and activity of metal heterogeneous catalysts for the semihydrogenation of acetylene. This reaction helps to remove acetylene from hydrocarbon mixtures produced after steam cracking. Because acetylene poisons catalysts used in hydrocarbon polymerization, it must be removed before the downstream reactions of ethylene. The main challenge of this project is to make a catalyst highly selective towards ethylene while maintaining a high enough activity to remove acetylene. A variety of metal catalysts are potentially effective in this process. Palladium and platinum are notable for their high activity, while gold is for its high selectivity. Palladium on its own will over-hydrogenate acetylene to ethane if untreated. To further increase the selectivity of catalysts, we focused on suppressing the over-hydrogenation reaction by intentionally poisoning our catalyst. By adding an iron oxide shell around spherical palladium nanoparticles, then treating it with high temperatures and hydrogen gas, we were able to turn the shell into a porous structure. The porous structure allows the highly active palladium to directly contact acetylene while creating discontinuities on the palladium surface to prevent full hydrogenation. We synthesized a palladium-based catalyst with 100% conversion, which used an iron-oxide porous yolk-shell to achieve 82.58% selectivity at 70 °C. For future development, we have discovered potential from adding the porous yolk-shell to alloy nanoparticle spheres. We believe this will strongly suppress the full hydrogenation reaction by further decreasing palladium continuity on the exposed surfaces.

Mentor(s): Huiyuan Zhu (Chemical Engineering), Virginia Tech
Zihao Yan, PhD Student (Chemical Engineering), Virginia Tech

Dominic Hanna
Virginia Tech/Automotive Engineering
Grace Mun
Virginia Tech/Biological Sciences
Christopher Barrett
Virginia Tech/Electrical Engineering

Courtesy Horn

The standard horn equipped on automobiles is a harsh, abrasive, single-tone indicator that conveys little information and carries a negative connotation. The purpose of this study is to develop and gauge feedback on a "courtesy horn" system with an additional palette of sounds to use in conjunction with the standard car horn. Such a system would hopefully increase the specificity of communication on the road while reducing negative emotions, with the ultimate goal of improving road safety. Our methods of gauging feedback on this system will include two testing groups: one control group that only has access to the standard horn and one experimental group that has access to the courtesy horn system. Scenarios will be run with two participants: one to operate the horn system and the other to act as the target of that communication. Each participant will be shown a video from separate perspectives of the same interaction on the road. The participant in control of the horn system will respond with the tone that they feel is appropriate for the situation. Following this, both participants will be polled on their interpretation of what was happening in the scenario. The participant operating the horn system will indicate their intended message while the other participant will indicate the message they felt was conveyed. We have yet to conduct testing, but we hypothesize a greater understanding of what message was intended in the experimental group than in the control group.

Mentor(s): David Gray (Engineering Education), Virginia Tech

Cynthia Harrison
Virginia Tech/Biological Sciences

The effect of temperature on fomite survival of _Mycoplasma gallisepticum_

Infectious disease ecology addresses questions such as how abiotic factors, including temperature, impact disease transmission. This project focuses on how temperature affects environmental survival of the bacterial pathogen Mycoplasma gallisepticum (MG) to help explain the heightened prevalence of MG among wild house finches in colder seasons. Because MG has limited environmental survival, extended survival at colder temperatures could increase MG transmission via fomites such as bird feeders that harbor MG. To test this, bird feeders were suspended in two temperature-controlled environments: one at 25°C (representing summer) and one at 9°C (representing winter). Feeder ports at each temperature were inoculated with either MG or suspension media (control) and swabbed once at an assigned time point including 0, 1, 2, 4, 8 and 24 hours after inoculation, with 6 replicates and 2 controls per time point per temperature. Samples underwent DNA/RNA extraction and qPCR to quantify the amount of MG remaining over time. Results from 0, 1, 2, and 4 hours post-inoculation indicate similar levels of MG DNA between the temperatures. with slightly higher DNA levels detected at the colder temperatures at 8 hours (results from 24 hours are pending). Ongoing testing of extracted RNA, which should better reflect viable MG levels relative to DNA, are expected to show more variation between temperatures at earlier time points.

Mentor(s): Dana Hawley (Biological Sciences), Virginia Tech

Caroline Harrop
Virginia Tech/Clinical Neuroscience

Neural Circuits for Self-Harm and Aggression

Self-harm is the deliberate act of physically damaging one's body. Aggressive behaviors towards others and self-harm often occur simultaneously, yet little is known about the neural circuits from which these behaviors arise. Clinical research suggests that self-harm and aggression are derived from early life trauma (ELT) in the forms of abuse and neglect. However, little is known about the neurobiological features of individuals that experience ELT and the exact circuits that are fundamental to increased risk of self-harm and aggression. Therefore, elucidating the neural mechanisms of self-harm and aggression is critical for developing novel prevention and therapeutic strategies for the behavioral symptoms of numerous psychiatric disorders that result from early traumas. From previous research, the L-type calcium channels (LTCCs) agonist, Bayk 8644 (Bay k) has shown capabilities of eliciting self-biting behaviors in young adult mice. We found that ELT mice display increased self-harm and aggression following Bay K administration and the thalamic nucleus reuniens (RE) is a critical brain area involved. To examine the circuit-specific role of the RE in controlling self-harm/aggression, we manipulated projection-specific RE neuronal activity using chemogenetics and found that bidirectional modulation of ventral hippocampus-projecting RE neurons is both necessary and sufficient for inducing self-harm and aggression. These results transform our understanding of self-harm and social aggression and provide new insight into the circuit-specific roles of RE neurons in driving the risk of self-destructive behaviors in numerous psychiatric diseases.

Mentor(s): Sora Shin (Human Nutrition, Foods, and Exercise), Virginia Tech

Will Heltzel
Virginia Tech/International Relations
Joe Harrison
Virginia Tech/Statistics

Accommodation in Colloquial Singapore English

Linguistic convergence is the phenomenon where people shift their speech towards who they are talking to. An extensive body of research has been done on this subject, showing proof that speakers exhibit a tendency to slightly shift their speech to mimic the dialect of their interlocutor (Babel 2011; Walker, 2015). Such studies, however, have largely been conducted using monodialectical and monolingual population sets. This begs the question: How does convergence work in a multi-dialectical environment? Additionally, does the dialect of the interlocutor influence the degree to which a speaker shifts? Singapore is an interesting case study of such linguistic phenomena. Within this small island nation exist two forms of spoken English, Standard Singapore English (SSE) and Colloquial Singapore English, or Singlish (CSE). Often referred to as a lingua franca, CSE is a form of English that features many cross-linguistic influences, including lexical and syntactic structures from Malay, Cantonese, Tamil, and other nearby languages. Generally, SSE is known to be the form of English spoken in formal situations, while CSE is used in any other event (Teo 2020). This study aims to determine to what extent speakers of CSE converge or diverge their pronunciations of certain minimal pairs, in response to different English accents. They will be responding to spoken cues in SSE, CSE, Southern British English (SBE), and Mainstream US English (MUSE). Our study, which has not yet collected data, will record volunteer participants in question-responding and word shadowing tasks.

Mentor(s): Abby Walker (English), Virginia Tech
Ming Chew Teo (English), Virginia Tech

Christine Herzog
Virginia Tech/Biochemistry

Fungi of Stadium Woods

Old-growth forests are ancient woods that have survived for centuries mostly untouched by major disturbances. Fungal biodiversity could be a key factor in understanding the effects of ecological disturbances on woodlands. Stadium Woods is an 11.3 acre urban old-growth forest on the Virginia Tech campus. It is comprised of more than 500 living trees and is dominated by white oaks, some over 400 years old. This rare on-campus primary forest suffers from many human impacts, including construction, heavy foot traffic, and litter. Center Woods is a 39.5 acre secondary-growth forest dominated by a mixture of oak and hickory, located off of the main campus. Center Woods is impacted by several research programs but overall suffers considerably less human traffic. We are surveying the funga of both forests and have collected over 140 specimens, with at least 30 different genera represented. We predict that the heavy foot traffic in Stadium Woods has resulted in this forest having similar levels of lignicolous fungi and lower level of soil fungi compared to Center Woods due to impacts from trampling. We also hypothesize that Stadium Woods will have a higher frequency of ruderal species. Our project will assess the fungal component of Stadium Woods' unique ecosystem and provide useful baseline data to track changes in the forest's health over time. This analysis will improve our understanding of the myco-plant relationships of old-growth forests as a whole.

Mentor(s): Jordan Metzgar (Biological Sciences), Virginia Tech

Ian Hicklin
Virginia Tech/Biochemistry

In Silico Exploration of Inhibitors of the Type IV Pilus Extension Protein PilB in Clostridioides difficile

An increase in antibiotic resistance among pathogenic bacteria, such as Clostridioides difficile, has necessitated new routes and targeting mechanisms of anti-virulence drugs. Type IV pili are virulence factors necessary for motility, adhesion, and creation of biofilms, and are common throughout the most antibiotic resistant bacteria. Type IV pili growth and polymerization of pilin subunits is catalyzed by the PilB ATPase. PilB is a cyclic hexamer, and the monomers are organized into pairs of three conformations that rotate to catalyze ATP to ADP. Prior work in PilB from Chloracidobacterium thermophilum found that two small molecules, quercetin and levodopa, were able to inhibit the function of PilB. Using in silico techniques, homology models of PilB from C. thermophilum and C. difficile were produced, and ATP and ADP were docked within them. Using MM-GBSA, the affinity for each ligand in each protein could be calculated. The binding energy of quercetin and levodopa correlated with calculated IC50s for those ligands in CtPilB. An additional inhibitor, tilorone, demonstrated an effective binding affinity for CdPilB, but not for CtPilB. Complete understanding of inhibitor binding cannot be determined without fully understanding the conformational changes that occur when different ligands are bound. Additional molecular dynamics (MD) simulations are being performed to determine the precise mechanism of changing conformation before additional work developing a screening method can proceed. Further understanding the exact mechanism PilB functions allows for increased development of anti-virulence drugs against C. difficile as well as potentially other antibiotics resistant bacteria.

Mentor(s): Anne Brown (Biochemistry), Virginia Tech
Dr. Zhaomin Yang (Department of Microbiology), Virginia Tech

Robert Hodge
Virginia Tech/Industrial and Systems Engineering
Henry Claesson
Virginia Tech/Mechanical Engineering

Kicking Assets

This undergraduate research project aims to explore the impacts of virtual collaboration environments (VCE) on first-year engineering students in the context of an online engineering design course. There is a scarcity of literature that has investigated how VCEs scaffold students' collaborative teamwork in an engineering design course where teaming plays an essential role in student learning. This study fills this gap by investigating the impacts of using a VCE, i.e., Microsoft Teams, on first-year students' teaming and collaboration experiences. A Likert survey, focusing on three predetermined pillars of successful collaboration (e.g., file sharing, communication, and task management) was distributed to 406 students in an synchronous online-only engineering design course at a suburban mid-Atlantic institution during the Spring semester of 2021. Students completed the survey at the beginning of the semester and were then divided into control and experimental groups. The students in the control group were allowed to choose their own collaboration environment, and the students in the experimental group were required to use Microsoft Teams as their VCE. At the end of the semester, the same survey was re-distributed to gather data about change in students' perceived success in teaming throughout the project. The collected data was analyzed using t-tests to determine if there is a significant difference in the means of survey score for each question between the control and experimental group. The analyzed data suggest that the use of VCEs in engineering design courses has positive impacts on the students' perceived expereinces of collaborative teamwork.

Mentor(s): David Gray (Engineering Education), Virginia Tech

Loralee Hoffer
Virginia Tech/Psychology
Kevin Sandler
Virginia Tech/Industrial and Systems Engineering

Does a Sunny Day Enhance a Sunny Disposition? Effects of Weather on Expressions of Interpersonal Gratitude

Weather can have a significant effect on mood states throughout the day. Rainy and cold weather can produce more dreary or rundown feelings; and the reverse is true for warm, sunny days. This field study investigated whether the weather has any impact on frequency of interpersonal expressions of gratitude. Our research hypothesis was that sunnier or warmer weather will influence more occurrences of interpersonal gratitude. Interpersonal gratitude was operationalized as pedestrians waving a sign of thanks to drivers who stopped for them as they crossed a marked crosswalk. Research students sat unobtrusively next to targeted crosswalks and observed a total of 36,882 pedestrians while they crossed the street, and recorded the temperature, weather conditions (sunny, rainy, cloudy, or snowy), and whether pedestrians waved a sign of gratitude as they crossed the street. These data enabled a calculation of the percentage of pedestrians who displayed a sign of gratitude to drivers who stopped for them (a low 10.29%), which was then compared to the different weather conditions observed. Linear regression and ANOVA techniques were applied to evaluate significance and produced the following results. Weather did not have any significant impact on pedestrian waves of gratitude, with regard to neither the temperature or the degree of sunshine (e.g., sunny or raining). However, when categorizing the data according to the most extreme temperatures (i.e., the top and bottom 10%), the higher temperatures showed higher rates of gratitude expressions. These findings indicate that future studies of interpersonal gratitude should record weather conditions and temperatures.

Mentor(s): Scott Geller (Psychology), Virginia Tech

Loralee Hoffer
Virginia Tech/Psychology
Hannah Peacock
Virginia Tech/Psychology
Chris Pereira
Virginia Tech/Psychology

Pre-COVID vs. Post-COVID: Did the Pandemic Influence Expressions of Interpersonal Gratitude?

The COVID-19 pandemic has caused many people to lose family members, jobs, and livelihoods. While clearly a tragedy, for some this hardship resulted in having a greater appreciation for what they still have–contrasting social comparison. This field study observed whether the pandemic influenced expressions of interpersonal gratitude from one individual to another. We operationalized interpersonal gratitude as pedestrians waving a sign of thanks to drivers who had stopped for them as they crossed a clearly marked crosswalk. Trained observers sat unobtrusively at targeted crosswalks and recorded whether each pedestrian who crossed the street waved a sign of gratitude to the driver. They also recorded other potentially influential factors such as weather, temperature, and time. This study compared the average percentage of pedestrians waving a sign of gratitude for the first four weeks of each semester–from Spring 2018 until Spring 2022 (excluding those during the peak of the pandemic when all University operations were virtual). Considering four semesters pre-COVID and two semesters post-COVID, the percentages of gratitude per semester were as follows: Spring 2018 (8.66% of 10,304 pedestrians), Fall 2018 (8.37% of 14,799), Spring 2019 (9.22% of 11,991), Fall 2019 (6.07% of 42,182), Fall 2021 (9.80% of 7,786), and Spring 2022 (8.42% of 4,749). The results suggest that the pandemic did not influence expressions of interpersonal gratitude on Virginia Tech's campus. However, the low percentages of pedestrians waving a sign of gratitude both before and after the pandemic is certainly disappointing, and perhaps reflects a cultural dynamic requiring intervention.

Mentor(s): Scott Geller (Psychology), Virginia Tech

Loralee Hoffer
Virginia Tech/Psychology
Jessie Yu
Virginia Tech/Psychology
Hannah Peacock
Virginia Tech/Psychology

The Positive Impact of Interpersonal Gratitude on Subjective Well Being: How Can We Be More Grateful?

The individualistic culture of the U.S. is a breeding ground for entitlement and self-serving behavior. However, expressing interpersonal gratitude can increase the wellbeing of both the benefactor and the beneficiary. This field study aims to investigate if an intervention can increase gratitude expressions. The research integrated applied behavioral science and positive psychology by implementing a community-based prompting intervention to increase the frequency of pedestrians who waved a sign of gratitude to the drivers who stopped for them at crosswalks on our campus. Research students sat unobtrusively next to targeted crosswalks and observed pedestrians while they crossed the street, recording who waved. This data enabled a calculation of the percentage of pedestrians who displayed a sign of gratitude to drivers who stopped for them. We employed ABA-reversal and multiple-baseline designs to assess the impact of a simple prompting intervention, which was a sign placed prominently at the crosswalk with the message, “Please Thank Drivers with a Wave.” Each research design demonstrated functional control of the prompting intervention. The overall mean percentage of waves during the observation sessions was 8.61% of 15,124 pedestrians during baseline, 10.31% of 25,993 pedestrians during intervention, and 6.11% of 60,764 pedestrians during the second baseline. The overall impact of the prompting intervention proved to be statistically significant, but more importantly, we showed that adding a simple reminder to express gratitude can significantly increase the frequency of this desirable behavior, and thereby add some positivity to the daily lives of many individuals.

Mentor(s): Scott Geller (Psychology), Virginia Tech

Loralee Hoffer
Virginia Tech/Psychology
Sonia Warrior
Virginia Tech/Psychology
Rhianna Sullivan
Virginia Tech/Psychology
Chris Pereira
Virginia Tech/Psychology

Social Modeling versus Diffusion of Responsibility: Determining the Role of Order in Pedestrian Expressions of Gratitude

This observational field study researched contrary predictions of two prevalent theories of psychological science: social modeling versus diffusion of responsibility. More specifically, this research examined whether pedestrians wave a sign of gratitude to drivers of vehicles who stop for them at designated crosswalks. Social modeling predicts that if a person waves at a driver for stopping, then those walking behind him are more likely to wave an expression of gratitude because they are copying the behavior they see. However, diffusion of responsibility predicts that if the first person waves, then those who follow behind are less likely to wave because they feel the first person took responsibility for the entire group. Research students sat unobtrusively next to designated crosswalks and observed 36,882 pedestrians over 12 weeks, documenting how many crossed the street, how many waved, and the order in which they crossed. The results of the study showed that the first person in a group is much more likely to wave (21.8%), compared to the second (7.13%), third (4.81%), and so on. This decline in gratitude expressions as the groups grow larger suggest that diffusion of responsibility is in effect, that is, as the group expands, pedestrians are less likely to wave because they feel that the responsibility to do so falls on the others in the group. These conclusions could provide support for the psychological understanding of gratitude and social behavior, which in turn could lead to interventions to increase gratitude in everyday life.

Mentor(s): Scott Geller (Psychology), Virginia Tech

Jacqueline Hou
High School

The Effects of Inflammatory Neutrophils on Endothelial Cell Integrity

Endothelial vascular leakage is responsible for the pathogenesis of diverse acute and chronic inflammatory diseases, such as COVID-19 and influenza, heart disease and arteriosclerosis. In particular, COVID-19 infection exacerbates fluid extravasation to the surrounding tissues, eventually leading to systemic inflammatory diseases that induce sepsis and multiorgan failure. These processes are mediated by inflammatory cytokines and first-responding leukocytes, such as neutrophils; however, the effects of neutrophils on endothelial cell integrity mechanisms have not been well examined to date. In this in vitro study, it is shown that naive neutrophils cause significant leakage in brain endothelial tissue, the most restrictive vascular barrier, through the integrated analysis of three perspectives: dye-leakage assay, cell morphology, and molecular biology. An optimized Evans Blue Dye Assay was developed to determine the interaction of murine-derived neutrophils and endothelial cells in vitro; when tested, it was revealed that the endothelial cell barrier was disrupted significantly by neutrophils. Under light microscopy, endothelial cells cultured with naive neutrophils shrink and demonstrate finger-like morphology with oblique gaps. Neutrophils negatively affect the intactness of endothelial cells by reducing expression of adhesion and tight junction endothelial markers E-Cadherin, Catenin beta-1, ESAM, and JAM-1, examined via flow cytometry. Collectively, this data challenges the current understanding that naive neutrophils are non-inflammatory, significantly altering targeted therapeutic intervention for inflammatory diseases such as COVID-19. The methodology of this study provides an optimized in vitro assay to advance the study of drug development affecting endothelial vasculature.

Mentor(s): Liwu Li (Biological Sciences), Virginia Tech
Ms. Katharine Davis, Blacksburg High School

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Virginia Tech/Biochemistry
Logan Dunston
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Lauren Blalock
Virginia Tech/Biochemistry
Jack Fenn
Virginia Tech/Biochemistry

Identification of key residues involved in antagonist binding in the Mu-opioid Receptor in Mus musculus

The opioid epidemic is a rapidly growing concern in the US. In 2019, nearly 70,000 people in the United States died from opioid-related overdoses. The mu-opioid receptor is a G-protein coupled receptor (GPCR) and is involved in the binding of opioids. Understanding the mechanisms by which this GPCR binds and responds to opioids and opioids analogs will give valuable insight into protein structure-function relationships. It is important to identify key residues that influence ligand binding. In this project, molecular docking was performed on the mu-opioid receptor of Mus musculus (PDB ID: 4DKL) to better understand ligand binding and recognize ligand binding mutation in the receptor binding cavity. A key amino acid, D147, was mutated to A14, to determine if important hydrogen bonding interactions were lost within the opioid receptor. This project will determine the impact of binding affinity of ligands based on mutated residues in the binding pocket. This project aims to understand the binding between the key amino acid, D147 and the receptor opioid by using a computational mutagenesis feature to mutate the key amino acids and using computational data to determine binding affinity.

Mentor(s): Anne Brown (Biochemistry), Virginia Tech

Jennifer Irwin
Virginia Tech/Animal and Poultry Sciences

Developing a short-term, used litter model to evaluate co-products from craft brewing for promotion of growth and health in broilers

This study investigated effects of mixed brewery wastes (MBW) on 1-24 day old broilers grown in battery cages with access to used litter on performance and intestinal health. Chicks were housed in raised-wire starter battery cages (58.5 in2/bird) for 10-d and transferred to raised-wire developer batteries (78 in2/bird) until 24-d with plastic sheets inserted into the cages and used and clean litter added to a depth of ~2.54 cm. The four treatments included a control diet without treatment for chicks housed on clean pine shaving (PC), the same diet for chicks housed on used shavings (NC) and 0.2 and 1% MBW for chicks housed on used shavings (0.2MBW and 1.0MBW). Treatments were replicated 15 times using 9 chicks per cage resulting in 540 mixed sex chicks. Body weight gain (BWG), feed intake, and mortality corrected feed conversion ratio (FCRm) were calculated over the 0-10 and 0-24 d periods. On d 10 and 24, one chick per pen was dosed with 8.32 mg/kg of fluorescein isothiocyanate-dextran (FITC-d) and a blood sample was collected from the brachial vein to determine serum FITC-d. This assay is an indirect measurement of intestinal tight junction gap health because a sound intestinal track has minimal FITC-d leakage. Chicks with compromised intestinal health will have a higher serum FITC-d. All data were analyzed using ANOVA in JMP 14 ($P \leq 0.05$). Although birds were exposed to used litter that contained coccidial oocysts, no differences in BWG (944 v. 968 g), FCRm (1.512 v. 1.507 g/g) or serum FITC-d (261.4 v. 263.6 (ng/ml) were noted between the NC and PC ($P > 0.05$). Although the model was not successful, feeding MBW at 0.2% and 1% of the diet did not have negative effects on either BWG (969 and 975 g), FCRm (1.481 and 1.493 g/g) or serum FITC-d (259.0 v. 266.2 ng/ml) in comparison to the PC ($P > 0.05$).
Keywords: Coccidia model, mixed brewery waste, FITC-dextran, broiler performance

Mentor(s): Micheal Persia (Animal and Poultry Sciences), Virginia Tech

Srinidhi Jayakumar
Virginia Tech/Psychology

Intolerance of Uncertainty is Associated with Suicidal Ideation and Depression in Adolescents and Emerging Adults During the COVID-19 Pandemic

Intolerance of Uncertainty (IU), an individual's inability to react positively to uncertain situations due to the fear of a negative event, has been extensively linked to mental health outcomes. However, few studies examined these relations during the COVID-19 pandemic (a time of high uncertainty), with this research focusing largely on clinical populations of individuals with autism spectrum disorder or anxiety. This study investigates whether IU is associated with self-harm, suicidal ideation (SI), suicidal behaviors (SB), and depression symptoms in adolescents and emerging adults during the COVID-19 pandemic.

Participants included 220 adolescents and emerging adults (Mage=16.91 years; 63.2% female; 47.3% white). Participants completed the Intolerance of Uncertainty Scale, Self-Injurious Thoughts & Behaviors Interview, and Mood and Feelings Questionnaire-Short. Multiple regression analyses were run with age (adolescent, ages 10-17 vs. emerging adult, ages 18-25) and IU as predictors.

Adolescents displayed higher levels of depression symptoms (β=0.22), self-harm (β=0.21), SI (β=0.21), and SB (β=0.43) than emerging adults. IU was significantly associated with depression symptoms (β=0.49) and SI (β=0.15), but not self-harm or SB. Moderation analyses did not find a significant interaction between IU and age for any outcome.

Findings highlight that adolescents may be experiencing greater negative mental health impacts than emerging adults as a result of the COVID-19 pandemic. Further, results suggest that targeting IU in therapy with adolescents and emerging adults could help reduce depression and SI during times of high uncertainty, such as the ongoing COVID-19 pandemic.

Mentor(s): Rosanna Breaux (Psychology), Virginia Tech

Chantal Johnson-Schuster
Virginia Tech/Animal and Poultry Sciences

Impact of cattle feeding paradigms on key meat quality attributes

Although it is known that postmortem metabolism plays a vital role in determining meat quality attributes, the underlying mechanisms by which beef cattle feeding paradigms affect muscle metabolism and meat quality remain poorly understood. The aim of this study was to investigate the role of concentrate feeding on changes in meat color development and proteolysis. 30 backgrounded Simmental crossbred steers were randomly assigned into three treatment groups. Group 1 (n=10) were fed forage only; group 2 (n=10) were fed a concentrate diet for 90 days; Group 3 (n=10) were fed a concentrate diet for 120 days. Upon harvest, longissimus lumborum samples were collected 5 minutes post exsanguination (0 h sample) and at hour 24. Steaks were collected and aged for 7, 14, and 21 days. Lower ($P < 0.05$) L* values and lower ($P < 0.05$) 0 h pH was observed in group 1 steaks, whereas there were no differences in ultimate pH among the groups. Group 3 demonstrated a nearly two-fold increase of ($P < 0.05$) in calpain-1. Using RT-qPCR gene expression of calpain-1 was the highest ($P <. 005$) in group 3 and the lowest ($P<.05$) in group 1. Gene expression of calpastatin was the lowest ($P<.05$) in group 2. These data show that high concentrate feeding increases the expression of calpain-1 at the gene and protein levels, implying that high concentration feeding may lead to increased proteolysis. Together, our study suggests that manipulation of feeding paradigm can impact both postmortem metabolism and the calpin-calpastatin system.

Mentor(s): Tim Shi (Animal and Poultry Sciences), Virginia Tech

Meghana Kamineni
Virginia Tech/Medicinal Chemistry

Computational Analysis of the Amphipathic Helix A and B Region of Brome Mosaic Virus Replication Protein 1a

Brome Mosaic Virus (BMV) is a positive-strand RNA virus that drastically reduces the yield of cereal plants through mottling, necrosis, and stunting. Replication protein 1a is encoded by BMV and contains an N-terminal capping domain with an alphavirus-like methyltransferase region and membrane association region; and a C-terminus with an ATP-dependent helicase-like domain. The interaction between protein 1a and the peripheral ER membrane causes invaginations to form on the surface of the membrane, which contain viral replication complexes (VRCs). Helices A and B are amphipathic α-helices located in the capping domain of 1a, that are linked to perinuclear ER membrane association and VRC formation. Little is known about the impact and importance of these helices on membrane association. A potential structure of protein 1a was derived using a structural prediction program which utilizes a deep neural network. Molecular dynamics (MD) simulations of the full protein 1a and the Helix A and B region were conducted to determine how the protein structure changes in a cellular environment. The Helix A and B region with known mutations was simulated to understand the structural impact of the point mutations. The results identify a probable structure of protein 1a in a cellular environment and the effects of mutations on the protein structure. These insights can also be applied to MD simulations containing protein 1a and a membrane to understand the membrane association interactions. This can reveal the mechanism through which BMV affects cereal plants and reduces crop yield.

Mentor(s): Anne Brown (Biochemistry), Virginia Tech
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Téa Katsiris
Virginia Tech/Psychology
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Virginia Tech/Psychology
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Virginia Tech/Psychology

Child Vocabulary Mediates the Longitudinal Association Between Maternal Parenting and Child Social Competence

Identifying factors that promote social competence in childhood is important given the role social skills play in predicting children's later school achievement/mental health (Jones & Bouffard, 2012). Although previous research illustrates that parenting influences the development of children's social skills (Scaramella & Leve, 2004), the mechanism underlying this relation is unclear. The purpose of this study was therefore to evaluate whether child vocabulary mediates the association between maternal caregiving and preschool social competence.

In this longitudinal study, participants included 181 children (192 females) and their mothers. At age 2, maternal parenting (positive affect, attention facilitation, and intrusiveness) was coded during a parent-child interaction task. At age 3, child vocabulary was measured using a behavioral assessment (Peabody Picture Vocabulary Test, Dunn & Dunn, 2007). At age 4, child social competence was assessed via parent-report using the Social Interaction Survey from the Vineland Adaptive Behavior Scales (Sparrow et al., 2005). The mediation model was tested using the PROCESS macro (Hayes, 2013) with bias-corrected bootstrapping (n = 10,000). Maternal parenting had a direct effect on child vocabulary, $\beta = 0.19$, $p = .007$, and child vocabulary had a direct effect on child social competence, $\beta = 0.25$, $p = .002$. The indirect effect of parenting on child social competence via child vocabulary was significant, $\beta = 0.05$, $SE = 0.02$, 95% CI [0.011, 0.104]. These findings identify vocabulary acquisition as a mechanism through which parenting behavior influences the development of children's social skills, which has important implications for early childhood intervention research.

Mentor(s): Martha Ann Bell (Psychology), Virginia Tech
Madeleine Bruce, (Psychology), Virginia Tech

Sadie Kee
Virginia Tech/Psychology

Customer satisfaction in, depletion out: The Big Five on depletion in customer service

High levels of neuroticism lead to increased ego depletion (Uziel & Baumeister, 2011). High levels of conscientiousness and extraversion lead to less burnout after a depleting task (Leikas & Ilmarinen, 2016; Armon et al., 2012). Depletion is a state of diminished energy that impacts efficient work (Wagner et al., 2014). I hypothesized that:

Hypothesis 1: Conscientiousness will negatively covary with average depletion.
Hypothesis 2: Extraversion will negatively covary with average depletion.
Hypothesis 3: Neuroticism will positively covary with average depletion.

Participants were 128 undergraduate students who were majority female (71.4%) and 19.46 years old on average (SD = 1.58). Participants completed an opt-in survey, including informed consent and the Big 5 personality measure. Participation included a series of surveys and completing an emotion regulation task in which they responded to voice recorded negative restaurant reviews on a computer for a duration of 20 minutes. Depletion throughout the study was operationalized as the average of depletion across the four timepoints.
A multiple linear regression was used to predict average depletion based on conscientiousness, extraversion, and neuroticism. Participants who reported having greater conscientiousness showed less average depletion throughout the study ($b = -0.05$, $p < 0.001$), providing support for Hypothesis 1. Extraversion was not significantly related to average depletion ($b = -0.01$, $p > 0.05$), failing to provide support for Hypothesis 2. Neuroticism positively covaried with average depletion ($b = 0.02$, $p < 0.05$), supporting Hypothesis 3. Customer service employers may consider using personality measures to hire to manage employee depletion.

Mentor(s): Charles Calderwood (Psychology), Virginia Tech
Emily Rost, (Psychology), Virginia Tech

Amanda Kendrick
Virginia Tech/Biochemistry
Albert Le
Virginia Tech/Biochemistry
Emma Morahan
Virginia Tech/Biochemistry
Abhinav Krishnan
Virginia Tech/Biochemistry

The Comparison of Retinol and Retinal Binding to Squid Isorhodopsin

If the agonist is paired with a 3AYN protein molecule, then the free energy of the docking will be positive and the reaction will be more favorable. Rhodopsin is an important protein related to vision as it allows us to study the biochemical processes in a squid's eye to gain a better understanding of eye function as a whole. We are using a squid as our model organism as squid are able to use their eyes in the depths of the ocean where little to no light exists. Understanding how rhodopsin in squid works in almost complete darkness in comparison to how our eyes work provides us with insight on the significance of retinol and retinal binding to squid isorhodopsin. For this experiment, we are utilizing molecular docking to better understand how an agonist will bind compared to the binding of retinol. In the beginning of the experiment, structural information of isorhodopsin bound to retinol was utilized (PDB ID: 3AYN). To begin with the control, retinol was docked to isorhodopsin using Webina. For comparison, retinol was replaced with the agonist in Webina, using the same docking procedure. After running these experiments the free energy values received which describe the favorability of ligand binding. The free energy values are then used to compare the retinol and the agonist to understand which reaction will be more favorable. It is important to understand the protein structure-function relationship of ligand binding to rhodopsin to understand the impact of the environment on vision.

Mentor(s): Anne Brown (Biochemistry), Virginia Tech

Yulia Kirina
Virginia Tech/Materials Science and Engineering

Self-corrosion of an Al-Mg-Ga alloy in a NaCl solution for sacrificial anode applications

The main goal of this research is to understand the potential environmental effects of an Al-Mg-Ga alloy used in Al-air battery and sacrificial anode applications. In addition, multi-scale characterization of the alloy is aimed at determining how it is altered by interaction with a NaCl solution (a proxy for seawater). Based on a high energy capacity and low cost, the Al-air battery is attracting considerable attention as a power source and energy storage device. Additionally, this battery type can be a fairly practicable system if improvements are implemented to limit severe self-corrosion behavior during battery discharge. The Al-air battery is also considered a clean energy source, as it is commonly assumed that the battery does not generate byproducts of concern for the environment. The combined addition of Mg and Ga to the Al-air battery is likely to enhance the performance of the Al anode, thus attempts have been made to optimize the microstructure and electrochemical performance of the Al-Mg-Ga series alloys. On the other hand, little research has been done to assess the actual environmental impact of the Al-Mg-Ga alloy for battery and sacrificial anode applications, especially what potential nanoparticles may be discharged into the environment. In this study, scanning and transmission electron microscopy (SEM, TEM) as well as X-ray photoemission spectroscopy (XPS) techniques were used to characterize the self-corrosion behavior of an Al-Mg-Ga alloy reacted with a 2M NaCl solution, in an effort to identify any nanoscale corrosion products present in solution. In addition, the bulk specimen itself was characterized using a SEM-based serial sectioning technique in order to examine any correlations between the corrosion behavior and the microstructures present.

Mentor(s): Mitsu Murayama (Materials Science and Engineering), Virginia Tech

Madeline Kogelis
Virginia Tech/Electrical Engineering

Low level Control of Humanoid Robots

Low level controls, particularly in humanoid robotics, relies heavily on sensor readings to control each joint and communicate the obtained information to the high level controller. This research outlines the hardware design on two printed circuit boards (PCB). A sensor board was built as an extension of the TM4C123GXL TIVA microcontroller launchpad and another shield was built off the AZBDC12A8 analog servo drive, or rather, the motor controller. These PCB's allow for sensor integration with circuits that route, filter, or manipulate data obtained from the sensors. The goal of the sensor board design was to create an interface between sensors and the microcontroller by taking readings from a force sensor, absolute encoder, quadrature encoder, as well as adjusting the PWM signal that is sent to the motors. The motor controller shield's main purpose is to supply three phase AC power to the motor but also was designed as a circuit that filters current readings. Various designs were considered and compared based on observed performance. The final design was then built in the PCB design software Eagle. The next step will be to solder the components on the boards and build a test bed to observe the overall performance. If problems are present, additional versions of the boards can be developed. Overall, these sensor boards will allow for better sensor integration from the previous versions and expand on data acquisition capabilities for a more effective low level controller.

Mentor(s): Alexander Leonessa (Department of Mechanical Engineering), Virginia Tech

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Virginia Tech/Human Development

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Virginia Tech/English with Pre-Education

YeaJi Lee
Virginia Tech/Industrial and Systems Engineering

Jordan Teel
Virginia Tech/Clinical Neuroscience

Devanshu Vajir
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Jisun Kim
Virginia Tech/Human Development and Family Science

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Virginia Tech/Computer Science

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Virginia Tech/Human Development and Family Science

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Sasha Holt
Virginia Tech/Industrial and Systems Engineering

Hamda Almahri
Virginia Tech/Industrial and Systems Engineering

Sing, act, and dance with robots: A child-robot musical theater afterschool program for STEAM education.

Although “robotics for all” efforts have been initiated to emphasize a cohesive learning paradigm based on real-world applications, major challenges remain in finding diverse approaches for young learners. We designed a 13-week long afterschool program focused on child-robot musical theater, combining child-friendly humanoid and animal robots and familiar activities (acting, music, dancing, drawing) to engage children in Science, Technology, Engineering, Arts, and Math (STEAM) education. A sample of 16 children (8-10 years; 37% girls) from a Title 1 elementary school (with a high proportion of low-income students) participated in the program, and nine of them consented for research. Children completed 4 surveys to periodically report their engagement in the program in addition to pre- and post-surveys about their interest and confidence in STEAM and curiosity in robots. Children reported a high level of engagement throughout the program (*Ms* = 3.5 out of 4). Following the program, all children reported increased interest in STEAM. Children’s confidence in STEAM (*Mpre* = 3.02, *Mpost* = 3.09; out of 4) and curiosity in robots (*Mpre* = 3.7, *Mpost* = 3.6; out of 4) were high pre- and post-program. The findings suggest that our program effectively maintained children’s engagement and improved their interest in STEAM. Further research is needed to increase sample size, identify ways to enhance children’s curiosity and confidence, and take into account children’s demographic diversity.

Mentor(s): Koeun Choi (Human Development), Virginia Tech
Myounghoon Jeon (Industrial and Systems Engineering), Virginia Tech

Kathryn Lacey
Virginia Tech/Psychology
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Virginia Tech/Psychology
Elaine Watts
Virginia Tech/Psychology
Tyler Parker-Rollins
Virginia Tech/Psychology
Mackenzie Davis
Virginia Tech/Psychology

Bagless Blacksburg: A Prompting Intervention to Increase the Use of Reusable Grocery Bags

Without an effective large-scale intervention, the annual flow of plastic into the ocean is predicted to triple over the next two decades (King, 2020). Reusable bag use can reduce this waste, but most grocery-store customers choose disposable over reusable bags, making a behavior-change intervention necessary. For the first portion of this field study, undergraduate researchers from the Virginia Tech Center for Applied Behavior Systems observed the frequency of disposable and reusable bags used at two large grocery stores, and found plastic bags to be the predominant choice of customers. The study also found that the patrons under the age of thirty used a disproportionately small number of reusable bags. Based on this information, the student researchers will implement a prompting intervention that places large posters at the exit doors for each grocery store. These posters will be emblazoned with the slogan “Hokies, choose to reuse!” above the percentage of customers who used reusable bags the prior week at the particular location. This phrase intends to promote prosocial behavior by bringing the customer into an in-group through the university slogan “Hokies” while also promoting reusable bag use as a normative behavior through the prompt to reuse. The weekly updates on reusable bag use will remind customers of the impact of their behavior, and indicate whether they are supporting the environmental-protection norm. The pre and post intervention data will be compared systematically to determine the impact of the intervention. Given the potential power of social influence to change behavior and the ongoing climate crisis, we hypothesize that these comparisons will reveal a significant increase in the use of reusable bags as a result of the prompting intervention.

King, S. (2020, May 13). Single-use plastics are a health risk, period. Greenpeace Canada. Retrieved October 28, 2021, from https://www.greenpeace.org/canada/en/story/37806/single-use-plastics-are-a-health-risk-period/.

Mentor(s): E. Scott Geller (Psychology), Virginia Tech

Natalie Larsson
Virginia Tech/Biological Systems Engineering

Salinity in Tidal Irrigation Sources

Salinity levels in coastal irrigation sources have a tendency to fluctuate . As sea levels rise, saline fronts can move up tidal rivers and increase salinity levels of water sources. The goals of this project are to determine if salinity is affected by tide levels and river discharge rates and to create irrigation plans that minimize crop damage. Salinity data were collected from the main stem of the Rappahannock River and a nearby stream. This was compared to discharge data from the Fredericksburg station and tide level data from the Windmill Point station. Graphs of salinity versus discharge and salinity versus tide level were generated to determine relationships between salinity and water trends. Results show that salinity levels increase when discharge is low. Our critical discharge level is approximately 500 cubic feet per second at the Fredericksburg station. When discharge levels drop below this threshold, salinity can spike to unsafe levels for irrigation use. There does not appear to be a correlation between salinity and tide levels. Suggested strategies for growers to manage salinity in irrigation include monitoring discharge trends and directly testing irrigation water if able. Understanding the sensitivity of specific crops to salinity is critical. Irrigation plans must be developed for specific crops based on their unique response to saline water.

Mentor(s): Julie Shortridge (Biological Systems Engineering), Virginia Tech

Katerina Leedy
High School

Elucidating the Subcellular Localization of NLRX1 in Pancreatic Cancer Cells

Pancreatic cancer is one of the leading causes of cancer-related deaths worldwide, with a 5-year survival rate of less than 11%. NOD-like receptors are under-researched intracellular receptors that appear to play a multitude of cancer-related roles, including regulating inflammation, mitochondria-associated immunity, and metabolism. One NOD-like receptor, NLRX1, has been shown to attenuate inflammation and have potential tumor suppressing effects. However, the roles and activity of NLRX1 in pancreatic cancer are not fully understood. While it is broadly agreed that NLRX1 modulates several immune and metabolic pathways, the exact mechanisms by which this occurs and even the location of NLRX1 in the cell is disputed. Determining the subcellular localization of NLRX1 is important for better describing its role in pancreatic cancer development. Preliminary analysis using a mitochondrial proteomics database, MitoMiner 4.0, predicted a mitochondrial targeting sequence in both mouse (*M. musculus*) and human (*H. sapiens*) NLRX1. Immunofluorescence microscopy on a murine pancreatic cell line (Pan02) was then used to perform colocalization analysis between NLRX1 and mitochondria. NLRX1 was associated with the mitochondria in samples both untreated and co-incubated with TNF, a pro-inflammatory cytokine known to stimulate NLRX1. These results indicate that NLRX1 is associated with the mitochondria in Pan02 cells. To further specify where in the mitochondria NLRX1 is located, this research begins developing an electron microscopy protocol for Pan02 cells. Use of immunogold labeling to image NLRX1 under a transmission electron microscope provides a feasible method to determine the location of NLRX1 at or within the mitochondria.

Mentor(s): Irving Allen (Department of Biomedical Sciences and Pathobiology), Virginia Tech
Margaret Nagai-Singer (Department of Biomedical Sciences and Pathobiology), Virginia Tech
Katharine Davis (Department of Chemistry), Virginia Tech and Blacksburg High School

Laurel Logan
Virginia Tech/Mechanical Engineering
Hannah Franklin
Virginia Tech/Mechanical Engineering

Acousto-Optic Nondestructive Inspection

Residual strain significantly influences material performance, and further, the anisotropic nature of composite materials complicates the development of models to predict the behavior and strain residuals of these materials. Thus, a better method to rapidly determine the strain state of as-manufactured composite components is needed. The novel acousto-optic nondestructive inspection (AONDI) system will function by categorizing the scattering of acoustic waves via an interferometric scan in order to create a map of subsurface flaws and defects in a test specimen. This system has the ability to transform post-production testing of various materials due to its large area non-intrusive scanning mechanism. This semester's efforts were focused on the demonstration of a DC interferometric scan, which included inducing surface waves into a material, observing the wave diffraction patterns with an interferometric probe system, and transforming and postprocessing the captured data. This demonstration serves as a proof of concept for the AC acousto-optic nondestructive inspection system that is to be built in future semesters. Overall, the acousto-optic nondestructive inspection system is relevant to engineers and scholars alike due to its potential to alter the way that post-production materials testing is performed.

Mentor(s): David Gray (ENGE), Virginia Tech

Adia Long
Virginia Tech/Agribusiness

Examining Linkages Between Population Change and Water Quality Violations in the U.S.

Water quality in the U.S. has significantly improved in recent decades. However, there are still nearly 70,000 bodies of water that fail water quality standards. With this project we are examining any possible linkages between water quality noncompliance and population change (more specifically population decline). The federal EPA has questioned the hypothesis that population decline and the subsequent reduced taxpayer base can be linked to an increase in Clean Water Act violations in the U.S. If we are able to discover linkages present, then this might be valuable insight that can help regulators and policy makers better understand the reasons for violations and as a result implement more effective strategies to improve water quality across the country. This work involves a combination of document analysis, spatial analysis, and US Census Bureau data and EPA ECHO data analysis. So far, we have examined the population rate of change in Virginia and the violation status of NPDES permit-holding facilities in VA in the last 3 years. We have not observed a statistically significant relationship, however we plan to expand this analysis to the entire United States, and over a longer time frame. We also plan to limit this analysis to publicly-funded facilities as this should give more accurate results and more closely align with our hypothesis.

Mentor(s): Elinor Benami (Agriculture and Applied Economics), Virginia Tech

Kaine Lovill
Virginia Tech/Biological Sciences

Exploring ontological knowledge to study miniaturization in fishes

Ostariophysi is a diverse group of fishes including about 6500 species with 223 'miniature' taxa (i.e., size < 26mm). Despite previous research, little is known about the evolutionary implications of 'miniaturization'. Are miniature fishes convergent in their phenotypes? Or are there multiple evolutionary paths to miniaturization? The goal of this project is to study miniaturization in the orders Characiformes, Siluriformes, Gonorynchiformes, and Cypriniformes. We investigated the anatomical entities affected by miniaturization, the types of changes that occur, how many times it has evolved, and which groups are affected. We performed a review on 33 papers searching for candidate anatomical traits associated with miniaturization. This was complemented with ontology information from the Phenoscape Knowledgebase. Ontologies are formal representations of relationships among concepts and can help us to describe dependencies among anatomical entities. We obtained a data set for 1206 species and 91 discrete traits plus body size. Then, we conducted analyses to model trait evolution using observed and simulated data. It was found that 219 entities are affected, distributed across skull (78), postcranial axial skeletal system (51), appendicular skeletal system (18), fins (35), and integumental system (37). Losses and reductions were the most common types of changes observed. Overall, miniature fishes evolved at least 33 times; 11 in Characiformes, 11 in Siluriformes, and 11 in Cypriniformes. Analyses with ontological knowledge showed that affected entities are heterogeneous across different fish groups and body regions. Our results expand on current knowledge of fish miniaturization and open up avenues for employing ontology-informed evolutionary analyses.

Mentor(s): Josef Uyeda (Biological Sciences), Virginia Tech

Sydney Luttazi
Virginia Tech/Psychology
Anabelle Theodat
Virginia Tech/Psychology
Brian Baker
Virginia Tech/Psychology

Autism in the Workplace: Addressing Social and Cognitive Ability and its Connection to Collaboration.

This study explored the impact of neurodiversity in a collaborative problem-solving task between autistic and non-autistic adults. We recruited eight dyads consisting of three autistic and 13 non-autistic adults to complete the Wechsler Abbreviated Scale of Intelligence (WASI-II; *M* =110.69, *SD*=17.24), Social Responsiveness Scale-2 (SRS-2; *M*=51.3, *SD*=10.47), and two Minecraft coding tasks with a partner participant (*M*=13.60 minutes [task 1], 11.02 minutes [task 2]). For each task, one participant gave instructions while the other operated the game and both rated levels of perceived difficulty on each task from 1 (extremely easy) to 7 (extremely difficult; *M*=3.56, 2.94); roles were counterbalanced between tasks. We hypothesized that higher WASI-II and SRS-2 scores would predict effective collaboration, measured by a task completion time. In multiple hierarchical regressions, WASI-II (βs=-0.32 to -.171, ps=.161-.440) and SRS-2 (βs=0.28-0.11, ps=.181-.606) did not predict problem-solving in either task even when controlling for perceived task difficulty, role order, and prior Minecraft experience (task 1: $F(5,10)=4.45$, $p=.022$; task 2: $F(5,10)=3.47$, $p=.045$). In both regressions, only perceived task difficulty predicted longer task completion (i.e., lower problem solving; βs=0.50-0.52, ps=.025-.042). These findings provide some evidence that cognitive abilities and social communication may not impact collaborative problem-solving between neurodivergent adults, yet future research would benefit from including more autistic adults.

Mentor(s): Angela Scarpa-Friedman (Psychology), Virginia Tech
Megan Fok, Ph.D. candidate (Psychology), Virginia Tech

Olivia Madigan
Virginia Tech/Wildlife Conservation

Predicting the Range of Two Southern Appalachian Wildflowers (Sanguinaria canadensis & Trillium erectum) Under Future Climate Change Scenarios

Sanguinaria canadensis (bloodroot) and Trillium erectum (red trillium) are native North American flowering plants that have been collected for generations for their medicinal properties. These two Appalachian wildflowers have served an important role for modern pharmaceutical uses as well as traditional medicinal uses. The rhizome of bloodroot is harvested to treat inflammation, coughs, and infections. The leaves and rhizomes of red trillium are harvested and used as an antiseptic and a diuretic. Anthropogenic climate change poses an impending threat that could also increase the risk of overharvesting for some populations of both species. We estimated the potential effects of anthropogenic climate change on Sanguinaria canadensis and Trillium erectum by constructing ecological niche models (ENM) by synthesizing occurrence data with Bioclim climate data. Our model predicts drastic declines for both species in the southern Appalachians and mid-Atlantic under both mild and extreme carbon emission scenarios by 2070. The need for more detailed current harvest data is reflected in our results due to the severe implications of declining habitat availability for both species. Our research will contribute to the conservation of these charismatic species and preserve their valuable role as sources of traditional herbal medicine in many southern Appalachian communities.

Mentor(s): Jordan Metzgar (Biological Sciences), Virginia Tech

Hannah Madren
Virginia Tech/Human Development

NOVA Natives vs Other VA Natives: Perceptual Dialectology in Virginia

The present study is the first inquiry about perceptual dialectology within the state of Virginia. Using a map-labeling task (Preston, 2002), 92 participants labeled areas in Virginia where they believed people spoke differently. In addition to the map-labeling task, participants answered a five-question demographic survey. Almost every participant made some sort of southern or country distinction on their map. I then split participants into two groups based on their regional background: "NOVA for participants from Northern Virginia, and "VA" for participants from elsewhere in the state. Participants from NOVA were more likely to just use the label "southern" for some regions while participants from VA used more descriptive labels for those regions like "border state southern," "country," and "country/southern." Participants from VA were more likely to label an area as "northern" than participants from NOVA and were more likely to leave a more detailed map labeling more regions and more than two labels. That is, native Virginians seem to view linguistic variation in the state differently depending on if they are from NOVA or other regions in Virginia. These results replicate findings from other studies that perceived dialect boundaries differ depending on where people are from (Bucholtz et al., 2007 & Villarreal, 2016).

Mentor(s): Abby Walker (English), Virginia Tech

Anna Makarov
Virginia Tech/Biological Sciences

How do Cells Maintain Very Low Noise?

Cells must produce mRNAs and proteins to stay alive and fulfill their functions. Surprisingly, the production of mRNA and protein fluctuates randomly over time, creating gene expression “noise”. These fluctuations are unavoidable and can be beneficial or detrimental. How cells regulate noise remains an important question in cell biology.

Our group recently found a set of genes in a eukaryotic model organism, Schizosaccharomyces pombe, that show extremely low mRNA noise. How cells reduce noise to these levels is unknown, and finding the mechanism will be key to understanding how cells suppress gene expression noise. Our initial results suggest that mRNA synthesis from these ultra-low noise genes is more “noisy” than the resulting mRNA concentration, thus we are focussing on later stages of the mRNA life cycle. Degradation is one factor which may affect fluctuations. The 3’ untranslated region (UTR) of an mRNA is a regulatory region which can influence mRNA degradation. Therefore, altering it may reveal a role for degradation in suppressing mRNA noise.

In my project, I am swapping the 3’UTR of the ultra-low noise genes with that of the well-characterized Saccharomyces cerevisiae ADH1 gene. I am then asking if and to what extent this changes mRNA concentration and “noisiness”, using fluorescence in situ hybridization to label single mRNAs. These results will allow us to test the role of the 3’UTR and degradation in promoting ultra-low mRNA noise, and therefore may shed light on how cells keep noise under control.

Mentor(s): Silke Hauf (Biological Sciences), Virginia Tech

Nishad Manohar
Virginia Tech/Physics
Matthew Aguilar
Virginia Tech/Physics
Nicholas Burlbaugh
Virginia Tech/Physics
Stephen Shinnick
Virginia Tech/Physics
Pranshu Bhaumik
Virginia Tech/Physics

Project Title: Intragalactic Death Stars: The Damage of a Close-Ranged Gamma Ray Burst (GRB)

The highest energy emission humans have ever seen is a gamma ray burst (GRB). Emanating from either neutron stars or supernovae, GRBs release as much energy in an instant as our sun will in its lifetime. Our project aimed to answer what effects a close-range GRB would have on the environment if one hit the Earth. The goal of this research was to investigate potential effects of a close-range GRB and identify any mitigation factors through a literature review in an independent research project for the Orion Living Learning Community. We identified dangers GRBs pose to humanity and their environment (e.g., Earth) We found that a close-range GRB would destroy the ozone layer on that side of the planet, causing the UV radiation to burn that part of the Earth into a sterile site.. While the ozone layer would take the brunt of the GRB's impact with only 10% of its radiation reaching the Earth's surface, this would cause vast damage to the Earth's environment. We also found that there are not many mitigation approaches since GRBs propagate at the speed of light.

Mentor(s): Temperance Rowell (College of Science), Virginia Tech

Jacob Mason
Virginia Tech/Biochemistry
Jacqueline Anthus
Virginia Tech/Biochemistry
Cole Souders
Virginia Tech/Biochemistry
Zimmie Phillips
Virginia Tech/Biochemistry

Utilization of Computational Techniques to Analyze the Effect of the Mutation of Residue S101 of the JAR-1 Protein Complex of Arabidopsis thaliana.

JAR-1 is a protein found in all plants that plays a key role in the stress response pathway by regulating growth inhibiting molecules and defensive compounds that assist with repairing damage. One of the key functions of JAR-1 is to catalyze the conjugation of jasmonic acid with isoleucine to form the jasmonic acid-isoleucine complex (JA-Ile). It is important to study this interaction because this molecule plays a vital role in the signaling pathway that responds to stress experienced by the plant. The purpose of this experiment is to understand the impact of the mutation of serine (S101), into phenylalanine (S101F) using AutoDock Vina v1.2.0. Molecular docking of JA-Ile with both the mutated and wild-type protein was used to investigate the differences in the free energy of the potential orientations, measured in kcal/mol, as a result of the mutation. It was hypothesized that if key residue S101 was mutated into phenylalanine, JA-Ile would bind with a less negative binding affinity, or bind less strongly, as a result of the increased size of the residue, which physically blocks the interaction. Using the PyMOL v2.3.2. mutagenesis wizard, the residue S101 was mutated into phenylalanine. JA-Ile was then docked with the mutated protein using molecular docking with AutoDock Vina. The difference in affinities between the originally docked protein and the newly docked protein showed that the binding of JA-Ile with the mutated protein is less energetically favorable to occur than with the wildtype protein. Based on the results of this study, the residue S101 is critical to the damage and stress response mechanisms of plants.

Mentor(s): Anne Brown (Biochemistry), Virginia Tech

Catherine McGrath
Virginia Tech/Wildlife Conservation

Fantastic Beasts and Urbanization: Understanding Spatial Effects on Artificial Cavity Use by Eastern Screech Owls

Urbanization is a pervasive threat to wildlife as it is associated with habitat fragmentation and loss of key habitat features for nesting and roosting of many bird species. The literature focuses on the breeding season, so we lack information on how these lost features affect non-breeding populations. Eastern Screech Owls (EASOs), which depend on cavities to breed and roost, are currently declining in parts of their range including Virginia. EASOs use cavities often found in dead trees or snags, habitat features that urban areas frequently lack. The absence of natural cavities in urban areas may be a contributing factor in their decline. I investigated this hypothesis by monitoring 20 EASO nest boxes installed in backyards, town parks, and conservation easements in the Blacksburg area from 2019 to 2021. Boxes were visited on a weekly basis and contents were photographed. Each nest box monitored for this study was scored using a standardized urbanization scale. I detected EASOs or proof of use in 5 total boxes and community members reported EASO box uses during opportunistic box checks. As no owls were found in rural area boxes, research suggests that urban environments may be cavity-limited, and that artificial cavities may be an important tool to support urban adaptation by EASOs and other cavity-dependent animals. Future work should study areas around nest boxes to assess the density of natural cavities near boxes and determine if the presence of natural cavities varies across the landscape and influences the use of artificial nest boxes.

Mentor(s): Ben Vernasco (Biological Sciences Department), Washington State University
Kevin Hamed (Fish and Wildlife Conservation), Virginia Tech

Eric McKenzie
Virginia Tech/Environmental Horticulture

Industrial Hemp Forage Potential

Industrial hemp has potential as a feed and forage for livestock. Hemp plants and grain have high concentrations of protein, fat, and fiber; healthy fatty acids offer anti-inflammatory benefits. However, agronomic knowledge regarding crop management is limited; production and nutritional evaluations are necessary to judge the viability of hemp as a forage.

This experiment tested the effect of harvest timing on yield and nutritive value of two Canadian cultivars: 'Grandi', bred for grain production, and 'Joey' a dual purpose (grain + fiber) crop. Hemp was planted 5/13/21; harvests began 6/7/21 and continued weekly for 6 weeks (7 harvests). Plants were cut at 10-cm height from within three, 0.25-m2 quadrats placed randomly within each experimental unit. Whole plant samples were dried and ground through a 1-mm screen with a stainless-steel mill. Ground samples were scanned with an NIRS and data were generated using a robust equation developed from alfalfa.

Grandi was more productive at first harvest (0.45 vs. 0.27 Mg/ha) but yields were similar for Grandi and Joey (3.1 vs. 3.2 Mg/ha) at the final harvest (7/19/21). Average crude protein (CP) at first harvest was 31.1%, decreasing to 19.8% on 6/28/21. However, CP increased to 24.9% on 7/12/21 as grain fill occurred. Fiber concentrations (NDF = 44.4%; ADF = 37.6%) were greatest at the mid-way sampling date (6/28/21) prior to grain fill. In contrast, lignin concentration increased from 4.24% on 6/7/21 to 9.37% on 7/19/21. Preliminary data indicate hemp has potential value as a forage.

Mentor(s): John Fike (School of Plant and Environmental Sciences), Virginia Tech

Daniel McWilliams
Virginia Tech/MSE

Investigation of Varying Interstitial Fluid Flow Rates on Glioma Stem Cell Invasion

Introduction

Glioblastoma is a severe brain cancer that causes debilitating damage to patients and carries a life expectancy under 5 years after diagnosis. This project will shed light on the understanding behind tumor heterogeneity by analyzing how results of tumor invasion vary across multiple cell lines. Furthermore, this project will follow engineering design principles to build a working vacuum chamber with the use of 3D printing and Inventor software.

Methodology

Glioma Stem Cell lines (G34, G267, G528, GL261) were cultured in T25 polystyrene flasks and stored in a 37 degrees Celsius incubator. These cells were fed with endothelial growth factor (EGF), fibroblast growth factor (FGF) and GSC media 3 times a week. The glioma stem cells were seeded into 3D collagen-based hydrogels and pipetted into a 96 trans well plate with a porous membrane featuring 8-micron pores. The varying flow rates ranging from 0.5μm/s to 3μm/s were created by placing varying volumes of media on top of the transwell plates. After 18 hours the cells were washed with PBS and the cell nuclei were stained with DAPI. Images were subsequently taken using an EVOS microscope and cell migration was calculated using this data. A 3D printed flow device made of PLA (poly lactic acid) was printed using Inventor software and an Ultimaker 3D printer. The device was tested for proof of concept by using non cell loaded gels and an in lab vacuum hose .

Results

Results from this study are anticipated to show increased cell migration as a result of higher flow velocity[1]. Differences are anticipated to occur across the cell types with the G528's demonstrating the greatest difference in cell migration due to an altered cell morphology compared to the other GSC's.

[1] K. M. Kingsmore, D. K. Logsdon, D. H. Floyd, S. M. Peirce, B. W. Purow, and J. M. Munson, "Interstitial flow differentially increases patient-derived glioblastoma stem cell invasion via CXCR4, CXCL12, and CD44-mediated mechanisms," Integr Biol (Camb), vol. 8, no. 12, pp. 1246-1260, Dec. 2016, doi: 10.1039/c6ib00167j.

Mentor(s): Jenny Munson (BEAM), Virginia Tech
Caleb Stine, graduate student (Biomedical Engineering in the Munson Lab), Virginia Tech

Lauren Meier
Virginia Tech/Clinical Neuroscience

Examining Discrimination as a Distal Moderator of the Proximal Association Between LGBTQ+ College Students Alcohol Use and Cyber Dating Abuse

Intimate partner violence (IPV) is a prevalent and serious public health problem (Shorey et. al) that has expanded in recent years to include new technological means through which it occurs. A growing body of literature indicates that cyber dating abuse (CDA; harassing, threatening, monitoring, humiliating, or verbally abusing one's partner via technology; Leisring & Giumetti, 2014) is prevalent among young adults. Problematically, CDA among LGBTQ+ young adults remains understudied despite emerging evidence that CDA is more prevalent among these populations relative to heterosexual populations. Scant research examined CDA risk factors for LGBTQ+ college students with no studies examining proximal correlates of CDA perpetration. Guided by theories of sexual minority stress, the present study addressed this gap by examining distal discrimination and proximal alcohol use in relation to LGBTQ+ college students' CDA perpetration. We hypothesized that the likelihood of subsequent CDA would increase as the number of drinks an individual consumes on a given day increases and that higher levels of LGBTQ+-based discrimination would strengthen this association.
LGBTQ+ college students completed a baseline survey of LGBTQ+-based discrimination before completing daily reports of their alcohol use and CDA for 60 days. Multilevel modeling using fixed slopes and full maximum likelihood estimation were used.
Significant main effects for alcohol use, hostility, and incivility emerged. Unexpectedly, on days when participants consumed more alcohol than they typically do, they were less likely to perpetrate CDA. Individuals who experienced greater hostility and incivility due to their sexual orientation/gender identity were less likely to perpetrate CDA as well. Across models, individuals who consumed more alcohol compared to their peers were not more likely to perpetrate CDA.
Results do not support theories of alcohol-related partner abuse and underscore the need for a more nuanced examination of factors that account for negative associations among study variables. Implications will be discussed.

Mentor(s): Meagan Brem (Psychology), Virginia Tech

Antonia Mendrinos
Virginia Tech/Biology

Poultry concentrated animal feeding operations on the Eastern Shore, Virginia, and geospatial associations with adverse birth outcomes

Concentrated animal feeding operations (CAFOs) emit pollution into surrounding areas and previous research has found associations with poor health outcomes. The objective of this study is to investigate if home proximity to poultry CAFOs during pregnancy is associated with adverse birth outcomes, including preterm birth (PTB) and low birth weight (LBW). This study includes birth occurring on the Eastern Shore, Virginia from 2002-2015 (N=5,768). A buffer model considering CAFOs within 1km, 2km and 5km of the maternal residence and an inverse distance weighted (IDW) approach were used to estimate proximity to CAFOs. Associations between proximity to poultry CAFOs and adverse birth outcomes were determined using regression models, adjusting for available covariates. We found a -52.8g (-95.8, -9.8) change in birthweight and a -1.51 (-2.78, -.25) change in gestational days for the highest tertile of inverse distance to poultry farms. Infants born with a maternal residence with at least 1 CAFO within a 5 km buffer weighed -47g (-94.1, -1.7) less than infants with no CAFOs within a 5 km buffer of the maternal address. More specific measures of exposure pathways via air and water should be used in future studies to refine mediators of the association found in the present study.

Mentor(s): Julia Gohlke (Population Health Science's), Virginia Tech

Antonia Mendrinos
Virginia Tech/Biology

Impact of nonpharmacological Interventions on COVID-19 outcomes

The goal of this project is to better understand how non-pharmacological interventions (NPIs) affect SARS-CoV-2 outcomes. A better understanding of NPI's role in infectious disease outcomes is crucial in the planning and execution of response strategies during a public health crisis. Human mobility data were collected from Safegraph and Google. SARS-CoV-2 outcomes (infection rate and death rate) as well as other NPI data, such as testing capacity and hospital capacity, were gathered from the University of Maryland. Associations between NPIs and SARS-CoV-2 outcomes were determined using regression models, adjusting for available covariates. We anticipate seeing a negative relationship between NPI use and SARS-CoV-2 infection.

Mentor(s): Cori Ruktanonchai (Population Health Science), Virginia Tech

Erik Midkiff
High School

How do Differing Sensor Systems Respond to Natural Environmental Conditions?

In a rapidly modernizing society, vehicular transportation industries are increasingly implementing sensor-based automation systems in commercially available vehicles. Complex algorithms and machine learning are unable to make up for unreliable data or data that is simply not present. One leading factor which may cause such anomalies is the presence of natural environmental factors. As computational technology advances, sensors may soon become the bottleneck for safe automated vehicles in adverse weather conditions. In this work, various sensor systems utilizing fundamentally different technologies including LiDAR and radar were tested in rainy weather conditions as induced by the Virginia Smart Road. Two high-accuracy GPS systems also tracked true vehicular location, providing highly accurate true location data against which sensor data could be compared. Statistical analysis demonstrated a significant difference in sensor reading degradation and accuracy between the two datasets. LiDAR was the most negatively impacted, with one tested system experiencing over a 30% increase in degradation. High-frequency radar at 77GHz also demonstrated statistically significant degradation, while low-frequency sensors including 24GHz radar and optical sensors showed insignificant differences in reading degradation. The analysis of the responses of different sensor systems to natural environmental factors is a critical step in determining ideal sensor system setups and configurations.

Mentor(s): Katharine Davis, Blacksburg High School

Erika Miyazaki
High School

Environmental Fate and Impact of Commonly Used Disinfection Wipes

This paper analyzes the environmental movement and impact of 3 chemicals, Alkyl (C12, C14, and C16) Dimethyl Benzyl Ammonium Chloride (ADBACs), active compounds present in many disinfectant wipes sold on the market. All 3 chemicals have shown ecotoxicity effects on aquatic organisms and inducing antimicrobial resistance in microorganisms. For this 50-day study, 2 types of disinfection wipes from the same brand were used. One wipe was buried in the middle of a clay pot. Every 5 days, leachate was collected after 300 milliliters of water was added to the surface of the soil in a pot. Every 10 days, soil and wipes were collected and observed under the microscope for soil organism activity and signs of wipe degradation. The leachate and soil samples were analyzed for the presence of the 3 ADBACs using ultraperformance liquid chromatography/tandem mass spectroscopy. It was observed that the compostable cleaning wipes started to show signs of breakdown on Day 30, while the disinfectant wipes did not even at Day 50. The mobility of soil organisms from both types of wipes were similar. It was also found that at each sampling time there was an average of 0.0004% and 0.01% of total ADBACs embedded in a disinfectant wipe were present in the leachate and soil samples, respectively. The amount of compounds adsorbed on soil particles were 280 times more than that in the leachates. This study has demonstrated that the 3 ADBACs can gradually leach in small amounts through the soil over time.

Mentor(s): Kang Xia (School of Plant and Environmental Sciences), Virginia Tech
Katharine Davis, Blacksburg High School

Victor Mukora
Virginia Tech/Computational Modeling and Data Analytics

Practical Application of Machine Learning to Solar Energy

Forecasting how various weather conditions interrelate to influence solar energy enables enhanced decision making related to the most cost-effective optimizations for photovoltaic cells. Consequently, by testing, creating, and validating an energy prediction model that correlates several environmental predictor variables known to impact solar panels, improvements in solar panel adjustments (like cooling), design, and optimizations can be performed. While research has already been done in this field, our research offers both prediction and interpretability to better understand the underlying relationships these conditions have on the solar energy yield. In this project, prediction models including artificial neural networks (ANN), Gradient Boosting Regression Trees (GBRT), multiple linear regression (MLR), Auto Regression (AR), lasso, elastic net, and ridge regression will be used for relating environmental variables such as temperature, humidity, or wind chill to the energy production of a home-based solar panel. Several functions provided from the model performance package in R verified whether the assumptions for the linear models were met. Using Mean Squared Error (MSE) as the benchmark, cross-validation will be utilized for hyperparameter optimization and hold-out validation for overall predictive model selection. Auto regression performed the best overall and the most dominant conditions were humidity and barometric pressure. This work will help in analyzing optimal locations for solar panel farms and optimizing solar panel design to curb the impact of environmental conditions.

Mentor(s): Anne Brown (Department of Biochemistry), Virginia Tech
Mr. Briganti (DataBridge), Virginia Tech

Katherine Murray
Virginia Tech/Psychology
Olivia Shaw
Virginia Tech/Clinical Neuroscience
Mahrukh Butt
Virginia Tech/Psychology
Elizabeth Iddings
Virginia Tech/Psychology
Haylee Shown
Virginia Tech/Psychology

An exploratory comparison of therapeutic alliance before and after the implementation of telehealth in a community-based clinic

The Covid-19 pandemic forced many mental health clinicians to transition services from in-person to telehealth. A critical concern of clinicians regarding telehealth is decreased therapeutic alliance due to the lack of physical intimacy in online platforms (Douglas et al., 2020). It was hypothesized that clients utilizing telehealth would have lower therapeutic alliance than clients who attended in-person therapy. Eleven telehealth clients were included in the study. Clients were 18-39 years-old (*M*=29.18; SD=7.4), primarily white (n=7, 64%), and female (n=8, 73%). A group of in-person clients (n=11) were matched based on age and gender for comparison. They were between ages 18-48 years-old (*M*= 29.27; SD=9.34), primarily white (n=7, 64%), and female (n=7, 73%). Routinely administered therapeutic alliance scales included the VT Working Alliance Inventory Short Form (VT WAI-S) and the Working Alliance Inventory-Short Form Revised (WAI-SR). Independent t-tests assessed differences in therapeutic alliance scores between the two groups. Z-scores were created to standardize measure scales using global means and standard deviations. Telehealth clients demonstrated significantly higher therapeutic alliance scores (*M*=0.54, SD=0.39) than in-person clients (*M*=-0.44, SD= 0.83), ($t(20)= 3.54$, $p=.002$). The analyses suggest that telehealth may not reduce therapeutic alliance as hypothesized. This is a promising finding that telehealth may be a viable alternative for clients. Not only is telehealth more accessible and cost-effective for low-income and rural populations, clients may also benefit from feeling safe and comfortable in a familiar environment, in turn increasing alliance.

Mentor(s): Lee Cooper (Psychology), Virginia Tech
Hayoung Ko (Psychology), Virginia Tech
Sydney B. Jones (Psychology), Virginia Tech

Neha Nauman
Virginia Tech/HNFE
Eliza Thurman
Virginia Tech/Agricultural Sciences

Agriscience Teachers' Confidence in Microscopes as a Teaching Tool

The purpose of this study was to explore agriscience teachers' efficacy and confidence in using a microscope. A previous study showed growth in the teacher's mean scores for the Science Teaching Outcome Expectancy (STOE) and Personal Science Teaching Efficacy Beliefs (BSTEB), showing us the importance of these professional development courses. (Ferand et al., 2020). This research project served to gauge where teachers felt confident in their work with microscopes and their ability to instruct students in using them as well. This study's population was composed of agriscience teachers (N = 18) who participated in the STEM-it Up professional development program. STEM-it Up focused on the STEM concepts in SBAE plant science curricula and consisted of a three-day virtual conference in the summer of 2021 with one, 90-minute follow-up session each month from July to December. One of the follow-up sessions focused on using the Foldscope, an ultra-low-cost origami-based paper microscope. A Foldscope education specialist led the participants through three plant-based lab activities utilizing the Foldscope. A researcher-developed instrument based on Keller et al. (2018) was distributed via Qualtrics to participants immediately before and after the microscope-focused session. The instrument focused on teachers' level of agreement in their confidence in finding plant structures, seeing microorganisms, or planning lessons that utilize a microscope. Respondents rated their confidence using a summated rating scale of 1 - 5 with 1 = strongly disagree to 5 = strongly agree for nine total items. Microsoft Excel was used to calculate the means and standard deviation of the population. Results indicated an increase in teachers' pre and post-test scores, as well as a more uniform level of confidence across the participants as seen by the smaller standard deviation for the post-test. The results of the study showed a clear increase in the confidence levels of the microscope skills of the teachers in all the different areas of study that were included in the pre-test.

Mentor(s): Natalie Ferand (School of Education), Virginia Tech

Pete Ngwa
Virginia Tech/Computer Science
Martha-Patience Taah
Virginia Tech/Computational Neuroscience
Ezana Mekonnen
Virginia Tech/Biochemistry

OpenBCI Brain Control

OpenBCI is described as an open-source brain-computer interface platform that seeks to distribute biosensing and neurosensing hardware at a low-cost. When paired with the service's free-to-download Graphical User Interface (GUI), anyone with access to the hardware can analyze a live data stream of different brain waves and patterns from school, work, or the comfort of their own home. With this data, users can perform a variety of tasks, from implementing deep learning algorithms to control a bionic arm, to coding and playing a video game paired with software that predicts movement from the live stream of data. This semester, we set out to do just that. Upon gaining access to a 3-D printed Electroencephalography (EEG) and the OpenBCI services brain-wave reading electrodes, our team of three initially began this semester's research aiming to translate human thought to some kind of mechanical movement, with the ultimate goal of controlling a prosthetic arm with a subject's neurofeedback responses.
Executing this project required many interdisciplinary fields, including neuroscience, in order to analyze the different brain signals and patterns, mechanical engineering, in order to properly integrate the helmet, microcontroller, motors, and other moving parts, and computer science, in order to predict trends in the live data stream, as well as interface between the different OpenBCI, Arduino, and Matlab software. Similar innovations are being worked on with the target audience of transhumeral amputees, and the commoditization of this accessible and relatively affordable technology could lead to a future of similarly accessible and affordable prosthetics.

Mentor(s): David Gray (Engineering), Virginia Tech

Kiana Nowall
Virginia Tech/Wildlife Conservation

Preparing a Guide to Common Poisonous Plants for Virginian Dogs

There are a variety of flora that are potentially toxic to pets, including canids. These plants range from herbs and vegetables used in everyday cooking to weeds or other outdoor plants. Focusing on Virginia, there are both native and non-native plants that pose a problem for dogs. Many pet owners are unprepared for their animal consuming a toxic substance. According to the Animal Poison Control Center (APCC), there were 5,967 calls regarding dog poisonings in Virginia between 2001-2021. The APCC is a nationwide hotline that can be used by owners when they believe their pet has come into contact with a poisonous substance, with incident details being recorded in the AnTox database. Using these APCC data, I am creating a guide to describe the symptoms of the most common plant poisons found in SWVA. We used only plant-based poisonings found in the AnTox database and narrowed our focus to genera that were responsible for more than 50 occurrences. The guide includes common names, photos, information about the plants, and symptoms that are caused by ingesting or touching the plant. This guide will help not only the everyday owner, but will also help veterinarians to diagnose and treat poisonings faster and more efficiently. This guide will help to streamline lifesaving procedures for dogs that have been poisoned by local plants.

Mentor(s): Jordan Metzgar (Biological Sciences), Virginia Tech

Helen Oker
Virginia Tech/Biochemistry

Species-Specificity in Thermopreference and CO2-Gated Heat-Seeking in Culex Mosquitoes

Combining thermopreference (Tp) and CO2-gated heat-seeking assays, we studied the thermal preferendum and response to thermal cues in three Culex mosquito species exhibiting differences in native habitat and host preference (e.g., biting cold and/or warm-blooded animals). Results show that these species differ in both Tp and heat-seeking behavior. In particular, we found that Culex territans, which feed primarily on cold-blood hosts, did not respond to heat during heat-seeking assays, regardless of the CO2 concentration, but exhibited an intermediate Tp during resting. In contrast, Cx. quinquefasciatus, which feeds on warm blooded hosts, sought the coolest locations on a thermal gradient and responded only moderately to thermal stimuli when paired with CO2 at higher concentrations. The third species, Cx. tarsalis, which has been shown to feed on a wide range of hosts, responded to heat when paired with high CO2 levels and exhibited a high Tp. This study provides the first insights into the role of heat and CO2 in the host seeking behavior of three disease vectors in the Culex genus and highlights differences in preferred resting temperatures.

Mentor(s): Chloe Lahondere (Biochemistry), Virginia Tech

Javier Ortiz Alvarado
Virginia Tech/Chemistry

Synthesis of Glycopolymers and Evaluation of their Antibacterial Properties

Antibiotic resistance is a prevailing problem in the fight against pathogenic bacterial infections. New treatment methods are needed to combat worldwide morbidity, but the search for novel antibacterial drug candidates is a persistent challenge. Glycomaterials have potential in this application since many pathogens adhere to glycans present on cell surfaces to initiate infection. Additionally, antibiotic polymers have demonstrated less susceptibility to bacterial resistance, broad-spectrum antibacterial activity, and enhanced biocompatibility when compared to traditional small-molecule antibiotics. We have synthesized a series of glycopolymers with four pendant monosaccharides (galactose, glucose, N-acetyl-glucose, and mannose) via ring-opening metathesis polymerization (ROMP) and evaluated their antibacterial activity. Minimum inhibitory concentration (MIC) assays revealed that the mannose-functionalized glycopolymers had the highest antibacterial activity against Escherichia coli, with a MIC value of 1.25 mg/L . Additionally, higher molecular weight polymers had improved antibacterial activity, possibly due to the cluster glycoside effect. These results suggest that certain glycomaterials have inherent antibacterial properties, which might be exploited to produce novel polymer antibiotics.

Mentor(s): Michael Schulz (Chemistry), Virginia Tech

Kathryn Paasch
Virginia Tech/Biochemistry

Biochemical Characterization of a Flavin-Dependent Monooxygenase from Zonocerus variegatus

Flavin-dependent monooxygenases describe the group of proteins that are involved in the metabolism of xenobiotics. These enzymes can be classified into eight subclasses - A, B, C, D, E, F, G, and H. In our research, we focus on ZvFMO, a class B flavoprotein monooxygenase (FMO) found in the African-painted grasshopper (Zonocerus variegatus). This insect has been responsible for approximately half of the losses of valuable crops, such as bananas and cassava, in primarily agricultural countries in Central and Western Africa. In recent years, it has been shown that this grasshopper species has become resistant to the crops' defense systems, which may be due to ZvFMO. Furthermore, we aimed to identify possible inhibitors of this FMO.

To identify and confirm ZvFMO's active site, we proposed a mutation of the phenylalanine in the 383rd position to alanine. The recombinant ZvFMO was then expressed in E. coli cells and purified. Two SDS-PAGE Gels were run to compare the protein before and after purification and then the concentration of the protein found using a Braford Assay. The steady-state kinetics with varying concentrations of monocrotaline, a substrate, were obtained using an oxygen consumption assay.

It was anticipated that the catalytic constant (kcat) would remain the same between the F383A mutation and the wild-type enzyme. Indeed, the mutated alanine residue and the wild-type enzyme had catalytic constants that only differed by one tenth (s-1) with varying monocrotaline concentrations. The wild-type ZvFMO had a more efficient specificity constant (kcat/KM) that was a 3-fold increase from the mutated residue. The steady-state kinetics data suggests that we have identified the location of the substrate binding site, which may aid efforts to design an inhibitor against ZvFMO.

Mentor(s): Pablo Sobrado (Biochemistry), Virginia Tech
Sydney Johnson, PhD candidate (Biochemistry), Virginia Tech

Sara Pacini
Virginia Tech/Biochemistry

Characterizing intracellular survival of the ‘oncomicrobe’ Fusobacterium nucleatum

Fusobacterium nucleatum is a human oral opportunistic pathogen that causes severe tissue infections and is involved in the pathogenesis of multiple cancers. A key survival and virulence mechanism is an intracellular life cycle in healthy and cancerous epithelial cells, as well as fibroblasts and other stromal cells. Despite our knowledge of an intracellular niche, no proteins have been identified that would allow for the survival of F. nucleatum within the harsh, antimicrobial environment produced inside of cells. While other intracellular bacteria have been shown to counteract antimicrobial proteins such as lysozyme by producing lysozyme inhibitory proteins, none have yet been characterized in F. nucleatum. Therefore, the goal of my project is to identify and characterize lysozyme inhibitor proteins expressed by Fusobacterium nucleatum to understand how this bacterium survives intracellularly in cancer cells.

I first bioinformatically identified three genes, Gene 177, 279, and 1005, that encode for lysozyme inhibitor proteins in the strain F. nucleatum 23726. I then continued with the goal of targeted gene deletion using a galactose selection system, followed by functional assays to determine if loss of lysozyme inhibitor proteins contributes to decreased intracellular survival in colorectal cancer cells, or decreased survival in the presence of purified lysozyme. Next I cloned, expressed, and purified these lysozyme inhibitory proteins with the goal of characterizing their function and structure in bacterial survival.
In conclusion, understanding the contribution of lysozyme inhibitory proteins will further our understanding of how survives intracellularly and within tumors, which could lead to a novel method to control intratumor F. nucleatum levels.

Mentor(s): Daniel Slade (Biochemistry), Virginia Tech

Esther Palmer
Virginia Tech/Microbiology

Constitutively expressed Green Fluorescence protein in Bartonella tamiae

The purpose of this project is to create a strain of Bartonella tamiae that constitutively expresses the gene encoding green fluorescent protein (GFP). B. tamiae is a Gram-negative human pathogen that was isolated in 2008. Creating a strain of B. tamiae that always produces GFP will allow for easier use of florescence microscopy in further studies on this organism. In order to accomplish this, the promoters of three housekeeping genes were amplified and will be fused to GFP. The promoter-GFP fusions will then be placed in a replicating plasmid, as well as chromosomally integrated using the Tn7 transposon. This should result in 6 different strains of Bartonella, with each of the 3 promoters attached to GFP either on a plasmid or on the chromosome. This project comes with the benefit of being able to directly compare the strength of each promoter. As B. tamiae is severely understudied, it is unknown how frequently these promoters are expressed. The amount of GFP produced, and therefore the amount of fluorescence, should directly correlate to the activity of the promoter. The brightest strain can then be subjected to further mutagenesis allowing for easy phenotypic analysis with fluorescence microscopy.

Mentor(s): Clay Caswell (Biomedical Science and Pathobiology), Virginia Tech

Samantha Paulus
Virginia Tech/CMDA

Real-time Streaming Data Products from a Large Sensor Network in a Remote Permafrost Region

In August 2021, a fiber optic distributed acoustic sensing (DAS) array was deployed in Utqiaġvik, Alaska to monitor permafrost characteristics. Utqiaġvik is an Arctic community where infrastructure is threatened by permafrost degradation. The goal of this project is to understand and forecast long-term variations of permafrost characteristics in Alaska using sensing, data transmission and analysis, and modeling. Changing ice content is related to seismic wave velocity, so we aim to use passive seismic monitoring to detect changes in shear and surface wave velocities. DAS arrays utilize fiber-optic cable and a laser interrogator unit (IU) to measure seismic vibrations and record strain, strain rate, or velocity data. DAS measures vibration values approximately 500 times per second at locations spaced approximately 2 meters apart, generating roughly one terabyte per week for this project. Due to a lack of high-performance computing resources and limited network bandwidth in Utqiaġvik, there is a need to calculate data products and compress data on-site as the data is collected. We developed software modules to fetch live data and generate streams of data products. Our modules calculate data products that reduce data size by 25x using the IU's application programming interface (API) to access live data. These data products allow us to enable remote data quality checks throughout the study and focus on the portions of raw data best suited to ambient seismic noise analysis.

Mentor(s): Eileen Martin (Math), Virginia Tech

Madison Payne
Virginia Tech/Biochemistry

The Impact of Elevated Inositol Pyrophosphates on Root Physiology in Response to Nutrients in Arabidopsis thaliana

Phosphate (Pi) is a crucial macronutrient for plant growth and development, but is often limited in soils. Inositol pyrophosphates (PP-InsPs) are signaling molecules involved in Pi sensing and homeostasis. Under limited Pi, levels of PP-InsPs decrease, resulting in the induction of morphological changes to scavenge Pi, known as the Phosphate Starvation Response (PSR). Induction of the PSR causes plants to increase lateral root number, length, and root hair number to increase access to available Pi in the soil. Adding sucrose in low Pi conditions is known to induce the PSR. The objective of this study is to understand how two different PP-InsP mutants respond to varied sucrose conditions. Plants which overexpress the last two enzymes in the PP-InsP synthesis pathway (the ITPK1 and VIP2 enzymes) were grown on agar plates containing either 1% sucrose or no sucrose, and root growth parameters were measured. We hypothesized that ITPK1 overexpressor (ITPK1 OX) and VIP2KD OX plants, which contain elevated PP-InsPs, would have a suppressed PSR, a longer primary root, and a decrease in lateral roots compared to the wildtype (WT). We found that when grown on non-sucrose plates, both types of overexpressor plants had shorter primary roots and longer lateral roots compared to WT. All genotypes grown on sucrose plates resulted in increased primary and lateral root growth as compared to the non-sucrose plates. In order to further understand the impact of sucrose on these genotypes, their root physiology, and PSR, more investigation needs to be conducted.

Mentor(s): Glenda Gillaspy (Biochemistry), Virginia Tech

Carter Phillips
Virginia Tech/Crop and Soil Science

Using Native Warm-Season Grasses to Develop a Well-Balanced Forage System

Although tall fescue (TF) (Schedonorous arundinaceus), a cool-season grass, is the dominant forage species in Virginia's grazing systems, it is most productive in the spring and fall with lower productivity during the hot summer months. In contrast, native warm season grasses (NWSG), such as big bluestem (Andropogon gerardii), little bluestem (Schizachyrium scoparium), and Indiangrass (Sorghastrum nutans), are most productive in the summer months and are well-adapted to Virginia's climate and soils but have seen limited use as forage. The objective of this study was to determine forage productivity and nutritive value, and consequent performance of stocker cattle grazing NWSG pastures during the summer months compared to novel-endophyte infected TF. Forty-two steers were assigned to the NWSG mixture (big bluestem, little bluestem, and Indiangrass) or 'Jesup MaxQ' TF and rotationally grazed forage throughout the 2021 growing season. Steers grazing NWSG had an average daily gain (ADG) of 0.60 kg d-1 from June 11 to September 3, while the steers grazing TF had an ADG of 0.64 kg d-1. The native warm season grass mixture had an average neutral and acid detergent fiber of 651 and 341 g kg-1, respectively, throughout the growing season, whereas average NDF and ADF of TF was 575 and 301 g kg-1, respectively. The greater nutritional value of novel tall fescue, even under heat stress, was able to translate into higher steer weight gains in the first year of this study.

Mentor(s): Kathryn Payne (SPES), Virginia Tech

Yusuf Rafqzad
Virginia Tech/Clinical Neuroscience

BBB leakage causes an atypical neuronal phenotype after early mTBI/concussion

In the United States, around 1.7-3.8 million cases of traumatic brain injuries (TBI) occur each year, the majority of which being classified as mild TBI (mTBI). Currently, there is no clear treatment to prevent the cascade of events leading to post-concussive consequences, making the understanding of the cellular mechanisms following TBI crucial. Previous studies in our lab have shown that blood brain barrier (BBB) disruption after mTBI induces an atypical astrocyte phenotype, characterized by the downregulation of astrocytic proteins important for brain homeostasis, such as glutamate transporter-1 (glt-1). Within the areas of atypical astrocytes, a downregulation of the neuronal marker NeuN was also present, suggesting that the blood-borne factors may induce a similar phenotype in neurons and affect their function. To further investigate the phenotype of neurons present in areas of BBB leakage, we analyzed the expression of two distinct proteins in neurons, Parvalbumin (PV) and CamKII at early timepoints through the use of the mTBI mouse model, immunohistochemistry, and confocal microscopy. A dysfunction in PV+ or CamKII+ neurons may create an imbalance of excitatory and inhibitory neurons, increasing susceptibility to neurological disorders. Upon analysis, a significant change in protein expression was seen in both PV + and CamKII+ cells at early timepoints. These findings suggest that after TBI, BBB leakage induces an atypical neuronal phenotype in PV+ and CamKII+ cells, as also seen in NeuN.

Mentor(s): Stefanie Robel (Department of Cell, Developmental and Integrative Biology), University of Alabama at Birmingham

Kiya Rahn
Virginia Tech/Wildlife Conservation

Characterizing plant poisoning trends in domestic animals using data from an animal poison control hotline (2001 - 2021)

From cultivars to native plants, outdoors and inside, many plants can pose dangerous health risks to domestic pets. The Animal Poison Control Center (APCC) is a diagnostic and treatment hotline that condenses reports of pet poisonings and details them in call logs via a database system called AnTox. We examined the call log dataset provided by APCC that covered 2001 to the beginning of 2021. The call log consisted of 96,658 total poisoning records; after quality control and data filtering, plant-related poisoning records in Virginia accounted for 7.25% of the total call volume. Canines accounted for 73.6% of the data, while felines accounted for 26.4%. We examined these data further for temporal, geographic, and other demographic trends and characteristics. We found Falls Church City, VA has the highest ratio of plant-related poisoning reports per capita. Additionally, we found the plant families Vitaceae (grapes) to be responsible for 29.9% of canine poisonings and Liliaceae (lilies, a common houseplant family) to be responsible for 32.4% of feline poisonings. We are also compiling non-technical guides to toxic plants in Virginia for cat and dog owners to provide a quick reference for recognizing common signs and symptoms of toxicosis in companion animals and to identify potentially toxic plant genera in the home. Our findings reflect the importance of educating pet owners on the plant species they may encounter in or around the home that could endanger their pets.

Mentor(s): Jordan Metzgar (Biological Sciences), Virginia Tech

Kaitlyn Rasnick
Virginia Tech/Human Development
Gwen Roman
Virginia Tech/Childhood Pre Education
Hailey Reid
Virginia Tech/Psychology

The Role of Parental Age as a Predictor of Maternal Sensitivity in Early Childhood

Maternal sensitivity is defined as a responsiveness to their child's bids for attention in an appropriate, prompt, and consistent manner (Ainsworth, 1969). Maternal sensitivity has been established as a key variable in child development, with greater maternal sensitivity being linked to more optimal child outcomes such as greater prosocial behavior and more optimal executive functioning (Bernier, Tarabulsy, Cyr, & Matte-Gagné, 2021) Parenting behaviors such as maternal sensitivity are thought to be informed by the individual characteristics of a parent (Abidin, 1992, Belsky, 1984).

We hypothesized that maternal age would be associated with maternal sensitivity, predicting that older mothers would have higher ratings of sensitivity. The current study examined 2 different samples (n = 130, n = 136) of parents, a majority of whom were mothers, and their young children. The mean age of parents in the samples were 32.83 (SD = 4.45) and 39.25 years (SD = 4.90), respectively. Maternal sensitivity was measured through behavioral observations of a free-play task where mothers were asked to play with their children as they would at home using toys provided. Maternal sensitivity was coded on a 4-point scale, and average scores were computed to combine coding episodes. Higher scores reflected greater sensitivity. Correlation analyses revealed that there was no direct relation between parent age and sensitivity for either sample. Implications for findings will be discussed.

Mentor(s): Cynthia Smith (Human Development & Family Sciences), Virginia Tech
Meredith Atanasio, M.S., Virginia Tech
Diana Devine, M.S., Virginia Tech
Nari Kang, M.S.Ed., Virginia Tech

Trisha Ravigopal
Virginia Tech/Psychology

The Impact of Temperament on Levels of Externalizing Behaviors in 9-Year Olds

Externalizing behaviors are problem behaviors directed towards the external environment that include aggression, impulsivity, and hyperactivity (Keil & Price, 2006). Previous research has shown that childhood temperament is linked with externalizing behaviors (Oldehinkel et al., 2004). Temperament is the individual differences in reactivity and self-regulation (Rothbart & Derryberry, 1981). Three constructs relevant to temperament are negative affect (NA), effortful control (EC), and affiliativeness. NA is the experience of negative emotions such as fear and anger (Rothbart & Bates, 2007). EC is the ability to modulate attentional and emotional responses (Ahadi & Rothbart, 1994). Affiliativeness is the formation of social competent bonds with others using actions that are understood to be pleasing (Rothbart & Bates, 2007). The present study examined how NA, EC, and affiliativeness predict externalizing behavior in 9-year-old children. Data was collected from 191 nine-year-old children. The EATQ-R (Putnam et al., 2001) was used to measure NA, EC, and affiliativeness. Externalizing was measured via the CBCL (Achenbach and Rescorla, 2001). We used SPSS 26 to run a multiple regression analysis with NA, EC, and affiliativeness as predictors and externalizing as the outcome variable. The regression model was significant ($F=28.23$, $p<.001$), with NA ($beta=0.846$, $p<0.001$), EC ($beta=-0.779$, $p<0.001$), and affiliativeness ($beta=-0.147$; $p=0.019$) significant as predictors. Results indicate that as NA increased, externalizing had increased, and that as affiliativeness and EC increased respectively, externalization decreased. Findings suggest that children with greater negative emotion, lesser self-regulation and sociability are more prone to struggling with externalizing behaviors.

Mentor(s): Martha Ann Bell (Department of Psychology), Virginia Tech
Mohamed Zerrouk (Department of Psychology), Virginia Tech

Lucas Raymond
Virginia Tech/Biology

PHENOLOGY AND DISTRIBUTION OF IXODID TICK SPECIES IN SOUTHWEST VIRGINIA

Ticks are renowned globally as ectoparasites and vectors of a variety of pathogens of medical and veterinary importance. In the United States, Borrelia burgdorferi (the causative agent of Lyme disease) vectored by the blacklegged tick, Ixodes scapularis (Ixodida: Ixodidae) infects more people annually than any other autochthonous vector-borne disease; this makes monitoring blacklegged tick populations and others of utmost importance. Southwest Virginia, like most of the United States, is home to a variety of tick species, including the blacklegged tick, the lone star tick, Amblyomma americanum (Ixodida: Ixodidae), the American dog tick, Dermacentor variabilis (Ixodida: Ixodidae), and the newly invasive Asian longhorned tick, Haemaphysalis longicornis (Ixodida: Ixodidae). Over the course of 2021, multiple sites across 9 counties throughout Southwest Virginia were sampled for the presence of ticks using standard flagging methods. All collected ticks were identified morphologically, and various environmental conditions were recorded regarding their collection including date, habitat, tick abundance, temperature, and relative humidity. In this study, we present a summary of phenological and species distribution results for these surveys in 2021 including the identification of the Asian longhorned tick in a new county in the Commonwealth of Virginia.

Mentor(s): Gillian Eastwood (Entomology), Virginia Tech

Kathleen Reuwer
Virginia Tech/Experimental Neuroscience
Kacey Wickum
Virginia Tech/Experimental Neuroscience
Khushi Talajia
Virginia Tech/Cognitive Neuroscience
Michaella Bono
Virginia Tech/Experimental Neuroscience
Eliza Overlock
Virginia Tech/Experimental Neuroscience
Anabel G Zier
Virginia Tech/Experimental Neuroscience
Olivia G Ramsey
Virginia Tech/Experimental Neuroscience
Yuhang Pan
Virginia Tech/Experimental Neuroscience
Ana M Montoya
Virginia Tech/Experimental Neuroscience
Spencer Chase
Virginia Tech/Experimental Neuroscience
Anna K Prater
Virginia Tech/Clinical Neuroscience

Airborne sound sensation and short-term memory in C. elegans

A recent study demonstrated the novel discovery that Caenorhabditis elegans could sense airborne sound with a notably aversive response (Iliff et al., 2021). The role of airborne sound in the context of memory and learning of C. elegans has yet to be established, providing an opportunity for further investigation.We hypothesized that sound aversion can be overcome in C. elegans after forming a positive association between a chemoattractant and food through the establishment of short-term memory. To assess this, we first trained C. elegans to associate Escherichia coli (food source) with either the chemoattractant 2-butanone or the attractant plus sound stimulus. Then, we performed a novel phono-chemotaxis association assay in which C. elegans was exposed to different combinations of the chemoattractant 2-butanone, E. coli, and/or a sound stimulus to evaluate its ability to overcome airborne sound aversion through the formation of learned associations. Our results will indicate whether or not sound aversions can be overcome through learned associations. This information will be useful in enhancing our understanding of the mechanisms of auditory learning.

Mentor(s): Jennifer Rainville (School of Neuroscience), Virginia Tech

Zoie Sadler
Virginia Tech/Biochemistry

Lysine-2,3-aminomutase and a newly discovered glutamate-2,3-aminomutase produce β-amino acids to overcome salt stress in methanogenic archaea

Many methanogenic archaea synthesize Nε-acetyl-β-lysine and/or β-glutamate as osmolytes that allow survival in high salinity environments. Methanococcus maripaludis C7 contains two genes encoding radical S-adenosylmethionine (SAM) enzymes with sequence similarity to lysine-2,3-aminomutase (KAM). MmarC7_0106 is immediately upstream of an acetyltransferase and expected to be the KAM involved in the biosynthesis of Nε-acetyl-β-lysine. To confirm this, the gene was cloned and expressed with a hexahistidine tag in E. coli, followed by anaerobic purification and biochemical characterization. Although the bacterial KAMs in Clostridium subterminale and E. coli have been well-characterized, the archaeal KAM had never been studied in vitro before. In the presence of L-lysine, SAM, and dithionite at 37°C, this archaeal KAM had a kcat = 0.42 s-1 and a Km = 17.8 mM. The product was shown to be 3(S)-β-lysine and was highly specific for L-lysine. We further report the function of MmarC7_1783, a putative radical SAM aminomutase with a ~160 amino acid extension at its N-terminus. Bioinformatic analysis of possible substrate binding residues suggested a function as glutamate-2,3-aminomutase, which was confirmed here through heterologous expression in a methanogen followed by detection of β-glutamate in cell extracts. Finally, we investigated the differences in amino acid compatible solute usage amongst M. maripaludis C7 and M. maripaludis S2 in different salt concentrations. Taken together, this work defines the biosynthetic routes for β-amino acids in methanogenic archaea expanding the importance and diversity of radical SAM enzymes.

Mentor(s): Kylie Allen (Biochemistry), Virginia Tech

Karim Said
Virginia Tech/Computer Engineering
Jordan Harrington
Virginia Tech/Computer science
Roshen Arun
Virginia Tech/Mechanical Engineering
Aryan Yadav
Virginia Tech/Computer science

NESTAI

-Developing a first-generation AI for temperature control (NESTAI Google).
-This includes building a framework for the machine learning, determining what the test data should look like, collecting some training data, and demonstrating the system.
-Implementing and training the AI using external temperature, internal temperature, and humidity to create a first-generation NESTAI.
-Used Anaconda, Numpy, Jupyter Notebook, and Pandas.
-Using python and raspberry pi.
-developed a first prototype to train the AI

Mentor(s): David Gray (Engineering Endocation), Virginia Tech

Helen Salko
Virginia Tech/Water: Resources, Policy, and Management

Examining the Impact of High CSMR and Nitrate Levels on Lead Release from Lead Solder

Nationwide, water utilities are experiencing increased levels of lead in drinking water due to the presence of certain contaminants. This includes salt due to the application of road salt, as well as nitrate from fertilizer use. Increased lead and copper levels are exceeding the allowed amount regulated by the EPA. At present, the theory is that zinc orthophosphate inhibitors can aid a majority of these cases, but there is still a question as to when it is the best time to use them along with how much should be applied. In this experiment, 8 inch copper pipe and 0.5 inches of submerged lead solder were tested to 27 varying water conditions. The water conditions were made up of the following: three alkalinities (low, moderate, and high), three different CSMRs, and inhibitors (none, orthophosphate, and zinc orthophosphate). For two weeks, these pipes were measured based on electrochemical corrosion potential, current, voltage, and composite samples. Water was changed every Monday, Wednesday, and Friday. In the next set of two weeks, nitrate was added to all of the water conditions. The same procedure was conducted with the addition of nitrate. Lead data showed a change in both the moderate and high alkalinity water conditions with high CSMR. The addition of zinc orthophosphate in the high alkalinity condition already stated went from a lead concentration of 1080.6 ppb to 894.2 ppb after four weeks of testing. Due to the results so far, this project will continue to be tested further.

Mentor(s): Marc Edwards (Environmental and Water Resources Engineering), Virginia Tech
Kathryn Lopez, PhD student in (Civil and Environmental Engineering), Virginia Tech

Peter Schiff
Virginia Tech/Microbiology

Surveillance of Pathogens in Blacklegged Ticks from Southwest Virginia

Southwest Virginia is a suggested hotspot for tick-borne pathogens, specifically those carried by the blacklegged tick (Ixodes scapularis). In this study we surveyed blacklegged ticks from three counties in Southwest Virginia in 2021 (Floyd, Wythe, and Montgomery), and screened them for various pathogens including Borrelia burgdorferi, Borrelia miyamotoi, Babesia microti, Anaplasma phagocytophilum, and Powassan virus. Ticks were collected via traditional flagging techniques and were stored at -80oC prior to morphological identification and nucleic acid extraction. DNA and RNA were extracted from ticks pooled by site and life stage and were tested for the aforementioned pathogens using real-time PCR assays. All counties contained positive results for all pathogens except for Babesia microti. Two of the three counties showed evidence of Powassan virus. High rates of Anaplasma phagocytophilum were detected in each of the counties, however, further sequencing is needed to identify if it is the deer or human variant. Further expansion on this study should include the addition of more counties and additional tick pools to test in each county, along with Sanger sequencing for confirmation of pathogens. Such studies are useful indicators of tick- borne pathogen prevalence for public health in the region.

Mentor(s): Gillian Eastwood (Entomology), Virginia Tech
Alex Cumbie (Entomology), Virginia Tech

Kate Schiller
Virginia Tech/Political Science

Fossil Capital's Perpetual Cycle

Fossil capital can be described as a system of perpetual economic venture and gain via the fossil and oil industry. Fossil capital, thus, influences many aspects of our daily lives, in which humanity's innate drive to constantly improve is sustained by our rapid-moving society. This project aims to describe the ways in which fossil capital perpetuates a seemingly endless cycle of energy production and consumption, specifically through the lens of the big technology and oil industries, and what can be done to break the cycle and move toward a more sustainable future.

In order to uncover the links between the nature of fossil capital, big tech and oil corporations, various academic journals were used as well as primary sources, (Malm 2013; Carroll 2020; Altavater 2007; Sweeney 2018; and Battistoni, Purdy 2020). By piecing together themes presented in these materials, such as fossil capital itself, neoliberal theory, and energy colonialism, it can be suggested that dynamics endorsed by fossil capital, including slavery, take modern forms vested in the technology and oil industries. Furthered by energy colonialism, fossil capital allows for various exploitations of labor at the cost of many.

As a result, it can be argued that the only way to break the cycle perpetuated by fossil capital is to shift from our capital-oriented, centralized democracy to one that is decentralized and less capital-oriented in nature. If this shift were to occur, the deregulation of renewable resources would allow for methods of clean, sustainable energy.

Mentor(s): Jennifer Lawrence (Political Science), Virginia Tech

Amelia Schmidt
Virginia Tech/Animal and Poultry Sciences

Creating a Guide to Poisonous Plants for Felines

Cats have been kept as companions ever since the Bronze Age. In the US, feline poisonings account for around 7% of calls to the Animal Poisoning Control Center (APCC). Owners must be aware of potentially toxic plants in their homes to properly ensure their animals' health and welfare. Domesticated cats are at risk of interacting with toxic plants due to a cat's behavioral interactions and innate curiosity. I am compiling a guide to poisonous plants for cat owners in Virginia to increase owner efficacy in the identification of potentially toxic plant genera, as well as educating owners on the signs and symptoms of toxicosis in felines. The guide addresses the 16 most reported plant genera recorded through the ASPCA poisoning hotline and provides information regarding plant identification and toxicological effects when ingested. Though a total of 198 plant genera were reported as toxic to felines via the hotline, those with under 20 occurrences were excluded from the guide. Most plant genera cited in the guide were non-native ornamental plants. These ornamentals are common house plants, and are likely used in decorative settings. The most common symptoms of toxicosis among all the genera noted include gastrointestinal tract upset, anorexia, lethargy, and ataxia. Overall, the guide aims to provide owners with the knowledge about toxins their cats may be exposed to in order to prevent feline poisonings and ensure that their feline companion remains safe in their home environment.

Mentor(s): Jordan Metzgar (Biological Sciences), Virginia Tech

Sarah Seay
Virginia Tech/Biochemistry

STRUCTURE-ACTIVITY RELATIONSHIP STUDIES OF SPNS2 INHIBITORS

The transmembrane transport protein, spinster homolog 2 (Spns2), is responsible for the extracellular transport of sphingosine-1-phosphate (S1P) [1]. S1P is a chemotactic signaling molecule that promotes the directional movement of the lymphocytes towards the area of inflammation [2]. Consequently, the S1P pathway is studied for its potential applications in treating kidney fibrosis, psoriasis, and multiple sclerosis [3]. Previously, our group identified compound SLF1081851 as an Spns2 inhibitor with an IC50 of 900 nM in vitro. Herein, we aim to complete a structure-activity relationship (SAR) study looking at different urea, carbonate, and amide functional groups. The goal of this work is to assess the role of hydrogen bonding in Spns2 inhibition and prevent in vivo metabolism of our small molecule inhibitor. We report the preliminary hit-to-lead modifications of our initial inhibitory molecule. Specific focus will be given to moieties in an effort to further improve activity and pharmacokinetic properties.

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(3) Spampinato, S. F.; Obermeier, B.; Cotleur, A.; Love, A.; Takeshita, Y.; Sano, Y.; Kanda, T.; Ransohoff, R. M. Sphingosine 1 Phosphate at the Blood Brain Barrier: Can the Modulation of S1P Receptor 1 Influence the Response of Endothelial Cells and Astrocytes to Inflammatory Stimuli? Plos One 2015, 10 (7).

We thank NIH for funding (R01 GM121075).

Mentor(s): Webster Santos (Chemistry), Virginia Tech
Mr. Daniel Foster (Chemistry), Virginia Tech

Lindsey Sestak
Virginia Tech/Biological Sciences
Jillian Burgan
Virginia Tech/Environmental Science

The Effect of Intermittent Stream Flow on Macroinvertebrate Community Composition in Sinking Creek, VA

Intermittent rivers and ephemeral streams are waterways that vary temporally while providing vital habitat and temporary refuge for benthic macroinvertebrate communities. These waterways shift between lotic, lentic, and dry phases, requiring macroinvertebrates to employ resistance and resilience based strategies, such as burrowing and drift behaviors, to withstand drying events. Flow intermittence is a natural part of ephemeral stream networks, however human activities such as water abstraction and climate change have led to increased intermittence and therefore increased amounts of disturbance at the community level. In the face of growing flow intermittence, directly measuring resistance and resilience behaviors could improve current biomonitoring practices while providing insight into aquatic diversity in ephemeral stream networks. The objective of this research is to measure and monitor community assembly of benthic macroinvertebrates in Sinking Creek, an intermittent waterway located in Giles County, VA. Hydroperiod was recorded along with flow data and both benthic samples and drift samples were taken over the course of the study. During drying events community composition was found to be more diverse when compared to the lotic and lentic phases. A distinct separation between macroinvertebrate assemblages between flowing and dry phases was also recorded demonstrating species turnover during these dry events. Overall, these findings are important in understanding how flow intermittence affects community assemblage, the strategies benthic macroinvertebrates use to withstand drying events, and could inform current biomonitoring practices as climate change continues to impact ephemeral waterways.

Mentor(s): Bryan Brown (Biological Sciences), Virginia Tech
Sara Cathy (Biological Sciences), Virginia Tech

Olivia Shaw
Virginia Tech/Clinical Neuroscience
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Virginia Tech/Psychology
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Virginia Tech/Psychology

Examining differences in treatment duration and outcomes between adult and child transfer and non-transfer clients in a psychology training clinic

Due to the nature of academic training programs, it is common to transfer patients between clinicians. Transfer can result in negative emotions for clients including feelings of rejection, anger, and hostility toward the new clinician (Clark et al., 2011). We hypothesized that transfer clients would experience an increase in treatment duration and a decrease in treatment effectiveness, compared to non-transfer clients.
Participants in this study included 18 adult and 18 child clients in both the transfer and non-transfer groups (n = 72). Transfer clients were 4 to 52 years old (*M* = 19.64, SD = 10.74), primarily male (n = 24, 67%), and white (n = 26, 72 %). Non-transfer clients were matched on diagnosis, age, gender, and race. Measures of treatment effectiveness were administered at intake and discharge. Change scores were created to examine differences in intake and discharge symptoms across measures, calculated as: (raw intake score - raw discharge score)/total possible measure score. Treatment outcomes were evaluated using independent t-tests.
Transfer clients completed more sessions than non-transfer clients ($t(70) = -4.01$, $p = 0.00015$), for both adults and children. Adult transfer clients exhibited significantly poorer treatment outcomes ($t(34) = -2.60$, $p = .01$) then adult non-transfer clients. Child transfer clients had no significant difference in outcome scores ($t(34) = -1.07$, $p = 0.29$) when compared to child non-transfer clients.
Results indicate transfer clients require more sessions than non-transfer clients. Adult transfer clients experience less improvement, while child clients have similar outcomes to their non-transfer counterparts.

Mentor(s): Lee Cooper (Psychology), Virginia Tech
Hayoung Ko (Psychology), Virginia Tech
Sydney Jones (Psychology), Virginia Tech

Zachary Sherman
Virginia Tech/Geography

Upscaling linear chemical reactions in porous and fractured media with a continuous time random walk framework

The exchange of surface and subsurface waters plays an important role in understanding and predicting large scale transport processes in streams and rivers. Faithfully representing the influence of small-scale physical and chemical processes associated with the subsurface on exchange is necessary for developing reliable upscaled predictive models at the reach scale and beyond. In this work, we introduce a novel continuous time random walk model to predict transport in an open channel system with hyporheic exchange and linear reactive processes in the subsurface. The methodology uses particle trajectory data from direct numerical simulations of a turbulent channel. We study the influence of chemical species' properties (via Damkohler numbers) and subsurface bed depth influence emergent large-scale transport behavior in the surface.

Mentor(s): Thomas Crawford (Geography), Virginia Tech
Thomas Sherman (CRCL Solutions), Virginia Tech

Elyse Shoppell
Virginia Tech/Biology

Elucidating Auxin Signaling Specificity Through ARF/IAA Interactions Using Synthetic Biology and Circular Polymerase Extension Cloning (CPEC)

Auxin is a hormone that plays essential roles an almost all aspects of plant growth and development. Harnessing Auxin signaling could allow us to control plant development and may have numerous applications in advancing agriculture and could be invaluable in combating global hunger. To do this, we can try to manipulate proteins that respond to auxin. These proteins are called auxin response factors (ARF) and Aux/IAA transcriptional repressors. This system of ARF and Aux/IAA interactions is highly complicated and interconnected. By using synthetic interaction domains, we hope to isolate ARF and Aux/IAA pairings and elucidate the functions of specific combinations. One way to insert the synthetic interaction domains is the Circular Polymerase Extension Cloning (CPEC) . The CPEC technique allows two pieces of DNA to be joined together using overlapping regions of DNA. The vector containing an ARF protein of interest and insert containing the synthetic interaction domain then act as primers for eachother and, using a high-fidelity polymerase, they are brought together. This technique was verified using colony PCR and restriction enzyme digest to confirm that they were successfully cloned. CPEC allowed us to quickly replace the interaction domain of an ARF protein with a synthetic interaction domain. This technique shows potential to replace more costly cloning methods that require expensive enzymes like BP cloning. In the future, we plant to further evaluate CPEC and its benefits compared to other cloning methods.

Mentor(s): Bastiaan Bargmann (Translational Plant Sciences), Virginia Tech

Elizabeth Sicking
Virginia Tech/Biological Sciences

Determining the range and distribution of the Opuntia humifusa complex in Virginia

Cacti are succulents distinguished by their variety, adaptability, and colorful flowers which make them well-loved plants in settings ranging from natural areas to home gardens. Although typically associated with deserts and other environments with low rainfall, native cactus species can be found in 46 of the contiguous states in the USA, including Virginia. The prickly pears (Opuntia) consist of over 150 species and have agricultural and medicinal uses throughout the world. Originally treated as a single species, the Opuntia humifusa complex consists of eight taxa found in the eastern United States. Three members of the O. humifusa complex occur in Virginia: O.mesacantha subsp. mesacantha, O. cespitosa, and O. humifusa. We clarified the range and distribution of each of these three species within Virginia using a combination of herbarium specimens, iNaturalist observations, and field collections. Opuntia mesacantha subsp. mesacantha is found primarily in eastern Virginia within the coastal plains and O. cespitosa is found in western Virginia in the Ridge and Valley region. Opuntia humifusa is a hybrid of O. mesacantha and O. cespitosa found throughout the state. Our research documents isolated disjunct populations to assess conservation concerns for each species. By providing basic biodiversity information on these species, our study may assist broader research on conservation biology and the characterization of uncommon species.

Mentor(s): Jordan Metzgar (Biological Sciences), Virginia Tech

Benjamin Siedlarz
Virginia Tech/Nanomedicine
Clayton Lundberg
Virginia Tech/Nanomedicine

Site-directed mutagenesis approach to identifying functional motifs of the circadian factor period2 in response to genotoxic stress

The ability of Metazoan cells to identify, repair, and halt the replication of DNA damage is strongly correlated to the prevention of tumorigenesis. As one defense mechanisms, eukaryotic cells employ rhythmic proteins such as the circadian factor period2 that play a role in regulating cell cycle progression through DNA damage response mechanisms and various other post-translational events that function to shut down cellular replication and, in some cases, undergo apoptosis. There have been studies suggesting per2 cellular localization affects its function, however the relevance of per2 in DNA damage response is not fully understood. To better understand the mechanisms at play, a variety of site-specific single nucleotide polymorphisms (SNPs) and insertion/deletion polymorphism (indels) were induced on a per2 transcript, transfected into NIH3T3, a non-cancerous mouse fibroblast cell line, subjected to radiation, and stained with immunofluorescent probes for imaging. Following gamma radiation, wt per2 was seen to localize in the nucleus, a threonine to alanine mutation along the casein kinase 1 epsilon binding domain of per2 caused both nuclear and cytosolic localization, and a threonine to glutamic acid mutation along the same region caused nuclear localization. Mutants effect on RNA expression of cell cycle regulators and apoptotic factors was also measured using RT-qPCR.

Mentor(s): Carla Finkielstein (Biological Sciences), Virginia Tech

Katherine Sinclair
Virginia Tech/Psychology

Associations Between Somatic Complaints and Aggression Across Childhood

Research has suggested that somatic complaints (SCs) and aggressive behaviors (ABs) are associated, but the work is largely contradictory (Jennings et al., 2011). However, a positive association between externalizing and internalizing behaviors has been established (Weiss & Catron, 1994), suggesting a positive link between ABs and SCs (given that the latter variables are respectively similar to the former ones). Other research has demonstrated that maternal intrusiveness (mINT) might predict these behaviors (Egeland et al., 2008). Therefore, the goal of this study was to examine the associations between ABs, SCs, and mINT during childhood. Mother-child dyads (n = 120) visited the lab when the children were 36-months (T1), 48-months (T2), 6-years (T3), and 9-years (T4). Child ABs and SCs were reported by mothers using the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001). mINT was observed by researchers at each time point during an interaction task. Correlation was used to examine the associations. ABs at T1 were significantly correlated (all p-values ≤ .001) with ABs at T2 (r = .733), T3 (r = .512), and T4 (r =.612). SCs at T2 were significantly correlated (all p-values ≤ .005) with SCs at T1 (r = .542), T3 (r = .392), and T4 (r = .207). ABs were also significantly correlated (all p-values ≤ .001) with SCs at each age. mINT was not associated with either variable. These results suggest that ABs in early childhood is predictive of continued ABs across childhood. Additionally, they suggest a positive association between ABs and SCs.

Mentor(s): Martha Ann Bell (Psychology), Virginia Tech
Jennifer J. Phillips M.S., (Psychology), Virginia Tech

Anna Soffin
Virginia Tech/Biological Sciences

The Effect of Life History Characteristics on Primate Dental Evolution

The inhibitory cascade model (ICM) explains an ontogenetic model in which the size of molars is affected by the previous molar through a balance of activation and inhibition. Through a perfect balance, M1≈M2≈M3. However, when inhibition exceeds activation, M1>M2>M3, or conversely M1<M2<M3 when activation exceeds inhibition. Another proposed rule, Schultz's rule, states that species with a faster life-history erupt molars faster, but secondary dentition erupts later. Those with slow life-histories erupt molars later, but the secondary teeth erupt earlier. However, there is no understanding of how the ICM and Schultz's rule interact to affect molar row morphology. The purpose of this study is to consider how strongly various life-history characteristics affect the sizes of molars as opposed to sequence of eruption. We used phylogenetic generalized least square regression analysis on a sample of 155 species of primates to examine the relationships between various traits and tooth morphology, specifically the ratio between the second and third molar in relation to the first molar. The results did not show strong relationships, except between the M2 ratio and gestation period and maximum longevity. This fits with Schultz's rule as these characteristics are most closely related to speed of development. Inspection of the regressions reveals a positive relationship between M2 and gestation period, but a negative relationship between M2 and maximum longevity. While these opposite relationships require further exploration, they show that life-history characteristics can affect tooth development and morphology, suggesting that we can use this association to gain further insight into both fossil and living species biology.

Mentor(s): Josef Uyeda (Department of Biological Sciences), Virginia Tech
Dr. Fabio Machado (Department of Biological Sciences), Virginia Tech

Sarah Spradlin
Virginia Tech/Biochemistry
Molleigh Parker
Virginia Tech/Biochemistry
Vy Nguyen
Virginia Tech/Biochemistry
Nathan Curran
Virginia Tech/Biochemistry

The Specificity of Binding Interactions Between Glucokinase and other Carbohydrates in E. coli.

The enzyme glucokinase is responsible for the first step of glycolysis, which generates energy for cells. Glucokinase is a hexokinase isoform with two discrepancies, unlike hexokinase, the results of its reactions, glucose- 6- phosphate, do not impede glucokinase and reduced binding affinity for glucose compared to other oxidase enzymes. The goal of our research is to determine how specific glucokinase is for an alternative sugar. Will other simple sugars work just as well in the enzyme? The Autodock Vina software was used to dock the ligands and protein. Glucose, fructose, and sucrose were each docked into glucokinase. By docking these, we can determine which ligand best fits the glucokinase enzyme and has the highest affinity. We hypothesize that of the three sugars, glucose will bind most favorably because Glucose is the original substrate of glucokinase. We found that sucrose and fructose have a similar binding affinity to glucokinase because glucose is composed of fructose and sucrose. We concluded that sucrose had the greatest binding affinity for glucokinase.

Mentor(s): Anne Brown (Biochemistry), Virginia Tech

Gareth Starratt
Virginia Tech/Nanoscience

Developing a Hybridized Multi-Agent pSLAM/RRT*/MCL/R-CNN Algorithm Applied to Autonomous Multi-Sensory UAV Navigation

Recently, breakthroughs in advanced pathfinding, data processing, and LiDAR technologies has enabled low-cost, adaptable robotics applications. Through heavy modification and optimization of Multi-Agent P/VSLAM,RRT*,MCL, and RCNN, a full-featured indoor navigation system is possible. This technology has a range of applications, although this project specifically focuses on search and rescue operations in hazardous indoor environments. Multi-Agent adaptations are made to vSLAM and RRT* which enable significantly faster exploration of unknown environments. Similarly, Hybridized LiDAR-Thermal point cloud generation enable a modified version of RCNN which not only make standard object detection, but also gain further information such as the health status of a victim. Finally, an "external processing" model is used where a broader dataset is streamed over local 5GHz connection and a remote processor runs lower-priority tasks such as advanced particle filtration and object detection while higher priority tasks such as RRT* are run locally and then the result is streamed. This enables several, low-cost UAV agents to simultaneously build the dataset simultaneously. This project uses Anaconda (ROS) and Matlab. All of the sensor input is currently simulated but hardware testing will begin Q3 2022. Current memory usage estimates and performance results are a success, although data streaming has still not been finished and will likely only be concluded after hardware assembly and testing.

Mentor(s): Keri Swaby (Office of Undergraduate Research), Virginia Tech

Connor Stein
Virginia Tech/Biochemistry
Rebecca Kenealy
Virginia Tech/Biochemistry
Isabel Fluegel
Virginia Tech/Biochemistry
David Culhane
Virginia Tech/Biochemistry

The Effect of Ligand Type on Binding Affinity to the Mu-Opioid Receptor

Opioid class drugs bind the opioid receptors in the body and lessen feelings of pain, however the effectiveness of these drugs makes them extremely valuable and dangerous due to the likelihood of dependenecy. The goal of this study is to examine the role drug structure has in binding affinity to the mu opioid receptors. Investigating how pain relieving drugs bind to the pain receptors in the brain plays a major role in understanding drug addiction. Fentanyl and morphinan opioid antagonists bind to the mu-opioid receptor in the central nervous system. Molecular docking with Autodock Vina was used to bind the fentanyl agonist and the morphinan antagonist to the mu-opioid receptor. The binding affinities were compared and it was found that the morphinan antagonist had a higher binding affinity than fentanyl. After careful analysis of the structure and character difference between fentanyl and morphinan, it was concluded that the binding affinity was most influenced by the hydrogen bonds between the ligand and the D147 amino acid in the opioid receptor. When considering the possible negative effects of pain medication such as addiction and dependence, the number of hydrogen bonds between the positively charged ligands and the negatively charged D147 amino acids of the receptor, alongside the ligand structural characteristics of the drug, should be considered.

Mentor(s): Anne Brown (Biochemistry), Virginia Tech

Christine Tan
Virginia Tech/Medicinal Chemistry

Enhancing Functionality of Ynamides via Borylations to Synthesize (Z)-Beta-Alkenylamide Boronate

Boron and its derivatives have a significant role in medicinal and synthetic organic chemistry. It is notable in anti-cancer activity against non-Hodgkin's lymphoma, antifungal treatment to onychomycosis, antiviral activity towards HIV, and bacterial infections. Additionally, employing boron with a non-transitional metal catalyst reduces the toxicity and costly consequences that many reactions involving transition metals produce, but metal-free methods are under explored. We report a method to install boron on ynamides to generate (Z)-Beta-alkenylamide boronates in a metal-free fashion by using catalytic amount of tributylphosphinie. Notably, the hydroboration reaction proceeded in a cis fashion wherein boron added on the carbon distal to nitrogen. The reaction conditions tolerate a variety of substrate, and the products are afforded with moderate to good yield. To demonstrate the versatility of the products, the boryl moiety was converted to a trifluoromethyl group expanding the scope of borylated ynamides in medicinal chemistry. The stereo- and regioselectivity of the products were unambiguously confirmed by single crystal X-ray crystallography.

Mentor(s): Webster Santos (Chemistry), Virginia Tech

Abby Tenney
Virginia Tech/Forestry
Lesley Merkel
Virginia Tech/Environmental Science

Gas exchange and light utilization of invasive and native understory shrubs in an old growth Appalachian urban forest

Invasive plants can take over a forest's understory. In Virginia Tech's old growth urban forest commonly known as Stadium Woods, fighting invasives is a constant struggle that requires time and resources. Much is still unknown about the physiology of invasives. Are invasive plants so competitive because they have greater light use efficiency than their native counterparts in the understory? We compared the photosynthetic light use of two native shrubs, (blackhaw (Viburnum prunifolium L.) and spicebush (Lindera benzoin (L.) Blume)), and two invasive shrubs, amur honeysuckle (Lonicera maackii (Rupr.) Herder) and privet (Ligustrum sp.)). Our objectives were to: 1. compare gas exchange rates of the understory shrubs of amur honeysuckle, blackhaw, privet, and spicebush and 2. determine if photosynthetic light utilization of the invasive species is greater than that of native blackhaw and spicebush.
The LI-COR-6800 Portable Photosynthesis System was used to take leaf gas exchange measurements. Photosynthetic light curves were constructed and then analyzed with an Excel spreadsheet model from Loba et al 2013. Variables generated from the curves were analyzed using an analysis of variance with JMP software (SAS Institute Inc.,Carey NC). Blackhaw and amur honeysuckle had the highest light compensation points and dark respiration rates. Amur honeysuckle had the greatest point of 85% and 90% light saturation. Although insignificant, amur honeysuckle had the highest maximum photosynthesis. Amur honeysuckle also had greater stomatal conductance and levels of transpiration. Amur honeysuckle, but not privet, may have a definitive physiological advantage over the two native shrubs.

Mentor(s): John Seiler (Forest Resources and Conservation), Virginia Tech

Erin Thetga
Virginia Tech/Animal and Poultry Sciences

The Effects of Direct Fed Microbials (DFM) in Combination with Dietary Enzymes on the Digestibility and Performance of Broiler Chickens

This experiment aims to determine the feeding value of the combination of DFM, phytase and non-starch polysaccharide degrading enzymes on the performance and nutrient digestibility of young broiler chicks. In total, 972 chicks were randomized into 6 treatments, of 18 replicate cages over the 16 day experimental period. The control groups included a positive control providing the required daily nutrients (PC), and a negative control containing a diet with reduced phosphorus, calcium, energy, and amino acid (NC). Treatment groups included NC + phytase, NC + phytase and DFM, NC + phytase and xylanase, and NC + phytase and DFM and xylanase. Feed and water were provided ad libitum. Body weight, feed intake and feed conversion ratio were calculated over the 16 day period. Excreta and ileal samples were collected on day 16 to determine apparent metabolizable energy (AMEn) and amino acid digestibility (aad). The NC resulted in reduced performance in comparison to the PC, and all treatments returned performance to that of the PC. Phytase alone greatly increased AMEn with more modest increases in AMEn with additional enzymes or when DFM were also fed. Enzyme or DFM did not increase aad. In conclusion, phytase was able to return performance responses and the majority of the energy response suggesting that dietary phosphorus was limiting performance and potentially reducing energy utilization of the broiler chickens.

Mentor(s): Michael Persia (Animal and Poultry Sciences), Virginia Tech

Ashutosh Tiwari
Virginia Tech/Computer Science
Jordan Harrington
Virginia Tech/Computer Science
Karim Said
Virginia Tech/Computer Engineering

Natural Language Processing to Support Scalable Assessment

This study explores the use of machine learning as it relates to developing an integrated system that enables instructors and researchers alike to collect and process large amounts of transcribed data with the purpose of improving educational practices. This will be accomplished by processing large amounts of text-based, free response data into more easily digestible information, enabling the user to rapidly collect meaningful feedback on services, processes, pedagogy, and more. Teachers at Virginia Tech have expressed interest in such a tool as they struggle to provide honest and helpful feedback on essays in an organized format given the sheer quantity of essay submissions. Our goal is to develop a Natural Language Processing (NLP) algorithm to solve this issue.

Mentor(s): David Gray (Engineering Education Department), Virginia Tech
Dr. Andrew Katz (Engineering Education Department), Virginia Tech

Megan Toms
Virginia Tech/Biological Sciences

Probing the Influence of Inhibitor Presence on the Dynamic States of Sphingosine Kinase Isoforms

Sphingosine kinase (SphK) is an enzyme that catalyzes the formation of sphingosine-1-phosphate (S1P). When S1P is elevated, it increases lymphocytic trafficking and thus can increase inflammation and possibly tumorigenesis. Two isoforms of SphK exist, SphK1 and SphK2, and selective targeting of each isoform individually or in combination with inhibitors are of interest for enhanced therapeutic design. There is currently limited information on the dynamic landscape and structural transitions that these isoforms sample to enhance isoform-specific drug design. This work examines both SphK isoform binding sites and structural morphologies with and without natural substrates including, sphingosine, ATP, and isoform-specific inhibitors (1312, 1469, and 1592). Atomistic molecular dynamics (MD) simulations were used to determine the structural morphologies and examine the binding pocket with and without substrates and inhibitors bound to the isoforms. Paired with dominant morphology percentages, the root-mean-square deviation analysis showed that SphK2 systems were stable and can be used for structural analysis. The solvent accessibility for all structures showed that there were no large conformational changes in the isoforms as a result of ligand binding, with values of 85 nm2 and 135 nm2 observed for SphK1 and SphK2, respectively. The predicted free energy of binding of each isoform was analyzed to assess ligand affinity. The predicted free energy of binding energy results indicate favorability in the binding of all inhibitors to SphK1, however, inhibitor binding favorability was greatly impacted by ATP presence in SphK2. Further research and analysis are currently being conducted to understand the impact and change of the SphK2 binding pocket that contributed to structural changes based on ligand presence.

Mentor(s): Anne Brown (Biochemistry), Virginia Tech
Amanda Sharp (Biochemistry), Virginia Tech

Rebecca Trimble
Virginia Tech/Biochemistry

Pathogen spillover into the Asian longhorned tick, Haemaphysalis longicornus in Virginia

The Asian longhorned tick (Haemaphysalis longicornis), is a recently invasive tick species in the US with confirmed populations in 36 counties in Virginia, and evidence of generalized feeding on a wide range of vertebrate hosts. Since its detection in the US (2017), the ability for this species to acquire and transmit pathogens from local tick species is of concern. In general, vector-borne diseases are increasing, including the emergence and transmission of tick-borne viruses into new areas. The main purpose of this study was to assess the prevalence of three emerging tick-borne viruses in Virginia (Powassan virus, Heartland virus, and Bourbon virus) in Asian longhorned ticks collected from sites in Southwest Virginia. These viruses are traditionally transmitted by Ixodes scapularis (the blacklegged tick) and Amblyomma americanum (the lone star tick), respectively, but have the potential to spill over into H. longicornis populations through sharing of hosts and co-feeding. In this study, we extracted DNA and RNA from pools of Asian longhorned ticks, and tested those extractions for Powassan, Bourbon, and Heartland viruses using reverse transcriptase qPCR. We also tested for an agricultural protozoan parasite emerging in Virginian cattle associated with Asian longhorned tick populations, Theileria orientalis, in order to determine prevalence levels of this pathogen in ticks of in Southwest Virginia. Thus far, we have detected the presence of Bourbon virus in one nymphal Asian longhorned tick from Patrick County, Virginia. The study contributes to surveillance for emerging tick-borne pathogens, and improved understanding of the risk that invasive tick species pose to public and animal health.

Mentor(s): Gillian Eastwood (Entomology), Virginia Tech

Rachel Tuosto
Virginia Tech/Psychology

An Innovative Approach to Measuring Subjective Well-Being: Lessons from confirmatory factor analysis

This exploratory cross-sectional study compared the construct and predictive validity of two self-report measures of positive mood or subjective wellbeing (SWB) - an innovative assessment tool that applied a semantic-differential approach and a well-known positive/negative affect self-report survey (PANAS-X). We hypothesized that the PANAS-X would perform better than our experimental device, and that a confirmatory factor analysis would categorize the items of both assessment tools into two factors - positive and negative affect. A total of 390 Virginia Tech undergraduate students took both surveys back-to-back on Qualtrics. The statistical analysis showed that both assessment tools categorized the items into three, rather than two, factors and that our innovative semantic-differential approach was more accurate in predicting positive affect. However, the PANAS-X was more effective in categorizing negative affect. The second and third factors of our innovative tool distinguished between a participant's relaxed and lethargic state. The third factor of the PANAS-X showed that "guilty" and "ashamed" did not significantly correlate with positive or negative affect, suggesting that these two items should be removed from the PANAS-X.

Mentor(s): Scott Geller (Psychology), Virginia Tech

Melanie Turner
Virginia Tech/Biology

Phenology of Container-Breeding Mosquitoes in Southwest Virginia

Phenology of living organisms is an important area of study that focuses on the natural events that occur seasonally throughout plant and animal populations. Understanding the phenology of mosquitoes can help us to determine when certain vector-borne diseases may be a greater risk according to trends in local mosquito populations. By looking at the time of year that container breeding mosquitoes are depositing their eggs, we can determine vector seasonality in the New River Valley region. Mosquito eggs were collected weekly across the Montgomery County area from June through October 2021 using oviposition cups lined with seed germination paper. We expect to see three specific mosquito species, Aedes albopictus, Aedes triseriatus, and Aedes japonicus, all container-breeding mosquitoes. We have been rearing the mosquito eggs into adults, then identifying them as one of the three specified species. So far, we have 2,266 Ae. triseriatus adults, 60 Ae. albopictus adults, and 0 Ae. Japonicus adults. We will continue to flood egg mosquito papers tracking the dates we collected them. With 80 papers flooded so far, we still have 390 papers left to flood.

Mentor(s): Gillian Eastwood (Department of Entomology), Virginia Tech
Lindsey Faw (Department of Entomology), Virginia Tech

Charlotte Tury
Virginia Tech/Biological Sciences

Assessing Spatial and Temporal Activity of Native and Invasive Amphibians through Bioacoustic Remote Sensing Technology

Passive acoustic monitoring is a useful remote sensing tool for detecting fine-scale temporal activity of calling animals. In this study, bioacoustic data recorded in southeastern Arizona during the summer and fall of 2021 is being analyzed for two target species: the invasive American bullfrog (Lithobates catesbeainus) and the threatened native Arizona treefrog (Hyla wrightorum). The goal is to uncover information about the location and activity patterns of these two species for broader conservation and management purposes. During the spring and early summer of 2021, adult bullfrogs were removed from several ponds in the study region. The study aims to look for sites in which both species are present and to investigate patterns of bullfrog recolonization after the summer monsoon season. Acoustic data are being analyzed using Wildlife Acoustics's Kaleidoscope Pro software. Manual datasets are being made by scanning through acoustic data files and also using the software's built-in tool that groups similar calls across multiple files. The study is still ongoing, and preliminary results show that both species have occurred at one site so far during the summer of 2021. Additionally, there is evidence that bullfrogs recolonized a site that had been completely drained over the summer of 2021. The acoustic data, as well as ongoing 2022 data collection, will be used to answer questions on how conservation efforts might be improved by adding fine-scale temporal dispersal of the invasive bullfrog and identifying overlap with the threatened Arizona treefrog.

Mentor(s): Meryl Mims (Biological Sciences), Virginia Tech
Grace O'Malley (Department of Biological Sciences), Virginia Tech

Hannah Upson
Virginia Tech/Political Science

"When the Right to Access (Life) Becomes a Burden": Accessibility to Public Health for Disabled People in Virginia during the COVID-19 Pandemic

This study examines two key accessibility issues for disabled people in Virginia during the COVID-19 pandemic: the accessibility of information about COVID-19, and access to vaccinations. Has disabled peoples' legal right to health care services and information been upheld in the time of the COVID-19 pandemic in Virginia?
This study evaluates the accessibility of five web pages created by the Virginia Department of Health, and five web pages created by health districts in Virginia about COVID-19 guidelines and services. The accessibility of websites was determined under the standards of Section 508, a federal law "that requires agencies to provide individuals with disabilities equal access to electronic information and data comparable to those who do not have disabilities, unless an undue burden would be imposed on the agency." The level of compliance to these guidelines was measured by metrics provided by the Trusted Tester Program housed in the Department of Homeland Security. This study used both an accessibility testing tool and manual testing to determine the level of accessibility for each website.
The findings are as follows: (1) Levels of compliance were low (2) Disabled people were overlooked when planning Covid-19 responses (3) They were denied equal access to information necessary for proper care and survival. 4.) Because Section 508 describes responsibility for accessibility as a "burden on agencies" rather than as "a human right," access is not prioritized in times of crisis. This case, I argue, reaffirms the importance of a disability justice framework, because it goes beyond mere compliance.

Mentor(s): Monique Dufour (History), Virginia Tech
Dr. Ashley Shew (Science, Technology, and Society) Virginia Tech

Sameera Vadlamani
Virginia Tech/Cognitive and Behavioral Neuroscience

Does maternal attention facilitation and infant initiated joint attention promote word learning at 2 years of age?

Many toddlers show a word “explosion” between one and two years of age. This means that the number of words said is increasing exponentially. We have found that the 2-year-olds of mothers who were rated high in facilitating attention (MAF) during free play have greater vocabularies (p= <) Attention facilitation is the degree to which caretakers draw and direct attention to objects through responding to and repositioning the infant. This was not true at 12- or 14- months of age. Similar studies with toddlers found that initiated joint attention (IJA) predicts expressive language. IJA is the triangulation of attention to objects between caretakers and infants through the use of eye contact and pointing. Importantly, IJA is infant-initiated and typically begins around the age of 9 months. Does MFA and/or IJA relate to the “word explosion” often seen around the age of 2 years? This study is designed to assess whether IJA mediates the predictive relationship between MAF and expressive language. We measured IJA as the number of infant-initiated gestures during free play videos. Using combined data from two previous projects, this study includes 74 infants ages 12-24 months. We will analyze the correlations between IJA and vocabulary, MAF and vocabulary, and then the correlation between IJA and MAF. These results will illuminate the mediating status of infant initiated joint attention in the relationship between maternal attention facilitation and vocabulary scores in children between the ages of one and two years.

Mentor(s): Robin Panneton (Psychology), Virginia Tech

Omar West
Virginia Tech/Biological Sciences

The effect of pH and symbiont density on outcomes in a cleaning symbiosis

Cleaning symbiosis between crayfish and worms known as ecosymbiotic branchiobdellida annelids have been studied very well in the past in various stress induced environments. The research that has been conducted on these organisms showed that the worms inhabiting the crayfish play a hygienic role for the crayfish that is mutualistic at low and intermediary levels. This relationship can shift to parasitic at high worm levels on the crayfish. This study that has been conducted focuses on the effect of how pH affects the symbiotic relationship between these two organisms. The treatments for this experiment were pH levels of 6,7, and 8, and the worm treatments were 0, 3, and 6. Each treatment had 4 replicants that were averaged together over the course of the study. The results of the study showed that both significantly higher percentage change in carapace length and blotted wet mass for the crayfish in all pH environments and a worm abundance of 3 and 6. This supports the hypothesis that the intermediary worm abundance correlates significantly to the increased blotted wet mass percentage of the crayfish over time.

Mentor(s): Bryan Brown (Biological Sciences), Virginia Tech

Rebecca Wade
Virginia Tech/Public Health

Qualitative Study of Racial Disparities in Maternal Mortality in Virginia

This is a qualitative study designed to reframe the questions being asked surrounding racial disparities in maternal mortality. Using a modified Grounded Theory approach, this research will provide a more complete understanding of maternal morbidity and mortality "near misses" among Black women. This approach will find common elements across the participants' experiences and identify themes related to both positive "health-promoting" experiences and negative "risk enhancing" experiences for Black women utilizing the healthcare system.
Our methodology utilizes interviews of a purposively sampled group, specifically Black women who have experienced pregnancy, labor, and/or delivery. We perform individual, minimally structured, in-depth interviews for data collection. We utilize constant comparative analysis to find and examine identified patterns in the participants' experiences and examine these through Coding as described by Traditional Grounded Theory. Our results will be presented as a set of commonly experienced concepts in the form of a substantive theory grounded within real-life experiences of Black women that provides new insights for the causes of racial disparities in maternal mortality. Our primary outcome is informing areas of likely significant interest for future research into the causes of racial disparities in maternal mortality.

Mentor(s): Cornelia Deagle (Population Health Sciences), Virginia Tech

Julia Wakefield
Virginia Tech/Biomedical Engineering

Go with the Flow: Designing a Biomimetic Fluid-Filled Insect Wing Flapper

Insect wings include a complex system of tubular vessels which circulate hemolymph, or insect blood, to deliver the necessary nutrients and hydration to the wing. Accessory pulsatory organs (APOs) in an insect's body assist in circulating hemolymph through the wing with low pulsing frequencies that range from 1 - 3 Hz. Our research team hypothesizes that the 20 - 500 Hz high wing flapping frequencies in-flight insects aids in circulating the hemolymph. A motorized wing flapping station with 3D printed wings was designed based on the North American locust, Schistocerca americana. To observe flapping-induced circulation, colored water was sealed in the artificial wing's veins and tracked by incremental imaging. Preliminary trials support our hypothesis with water circulating in the leading edge wing veins as expected. Understanding fluid circulation in insect wings will greatly further the field of biomimetic microfluidic robotics and medicine, streamlining machines that use the frequencies it produces to cool and power its movements and drug-delivery devices that use pulsing frequencies to dole out drugs in precise quantities.

Mentor(s): Anne Staples (Biomedical Engineering and Mechanics), Virginia Tech
Jake Socha (Biomedical Engineering and Mechanics), Virginia Tech
Sevak Tahmasian (Biomedical Engineering and Mechanics), Virginia Tech
Mary Salcedo (Biomedical Engineering and Mechanics), Virginia Tech

Kathleen Walker
Virginia Tech/Creative Writing

"The Ability to Speak Does Not Make You Intelligent": Dialect, Stereotypes, and Othering in Star Wars Episode I - The Phantom Menace

This project investigates the use of standard versus non-standard dialects in Star Wars: Episode I - The Phantom Menace. I draw upon Rosina Lippi-Green's (2012) previous work focusing on the use of accented speech in Disney films to assist in my analysis of similar trends in The Phantom Menace. All speaking characters within the film were organized in terms of their species, dialect, voice actor demographics, and other factors. Certain characters or groups that stood out as particularly interesting linguistic cases–such as Jar Jar Binks' Caribbean English, the Jedi's British English, the Neimoidians' Thai English, and Watto's Middle Eastern English–serve as case studies. My analyses suggest that the film overwhelmingly employs nonstandard dialects in alien characters as a tool to indicate otherness. This otherness is emphasized by the fact that the majority of these selected dialects are associated with communities of color. Characters using these dialects often reflect harmful stereotypes. I argue that standard and nonstandard dialects are used within The Phantom Menace as characterization shortcuts and assist in the creation of social hierarchies within the Star Wars universe. Ultimately, I discuss the harmful impacts of utilizing nonstandard dialects to invite stereotyping and push for greater awareness of dialect use amongst filmmakers, participating in current conversations about avoiding "vocal blackface" within the voice acting community.

Mentor(s): Abby Walker (English), Virginia Tech

Jennie Weitzenhofer
Virginia Tech/Wildlife Conservation

Beary Active Cubs? - Quantifying American Black Bear Mother and Cub Behavioral Changes Surrounding Hibernation Emergence

American black bear (Ursus americanus) behaviors change surrounding hibernation. Thus, understanding hibernation patterns can lead to more effective wildlife management. However, it is challenging to study wild bear behavior, resulting in little research systematically assessing behavioral changes associated with hibernation onset and emergence. Utilizing a unique 24/7 video monitoring dataset collected at Virginia Tech's Black Bear Research Center, we cataloged 38 behaviors exhibited by a mother and cubs, quantifying the proportion of time spent exhibiting behaviors from February-April 2016. We found that both mother and cubs exhibited mostly passive behaviors pre-emergence, 0.96 and 1.0, respectively. Active behavior increased as bears emerged from the den 43 days after birth, but passive behaviors were still high into April (0.91) for mother and cubs. As the cubs gained weight, the proportion of active behaviors rose by 0.09 for mother and cubs. Active behaviors increased dramatically through April as we documented cubs beginning to engage in play behavior. Ongoing analyses have isolated daily trends in behaviors (e.g., playing, climbing). We have seen that cubs were generally more active than the mother but exhibited similar numbers of active behavior types post-emergence. This research is important to the Virginia Department of Wildlife Resources, providing insight into emergence times and activity levels increase, which is relevant to potential human-bear interactions.

Mentor(s): Marcella Kelly (Fish and Wildlife Conservation), Virginia Tech
Brogan Holcombe (Fish and Wildlife Conservation), Virginia Tech

Joseph White
Virginia Tech/Wildlife Conservation

Getting Along Like Cats and Dogs: Examining Interactions between Bobcats (Lynx rufus) and Coyotes (Canis latrans) in the Central Appalachian Mountains.

The Mountain Lake Biological Station (MLBS) camera trapping survey is a long-term study (18 years) run by the Wildlife Habitat and Population Analysis Lab and The Student Chapter of the Wildlife Society at Virginia Tech (VT). The objective is to provide VT undergraduates with experience running camera trap surveys while collecting valuable data on large mammals. Each station consists of two cameras per station located on Jefferson National Forest and MLBS with the number of stations ranging from 13 (2004) to 25 (2021). Two common species captured were coyotes (Canis latrans) and bobcats (Lynx rufus). Because these species are similar in size and overlap in habitat use and diet, we investigated niche partitioning through examining activity rates and space use over time. Preliminary trapping rates from the first 10 days of each year, show that bobcats have remained relatively stable, with an average trapping rate of 2.33 captures per 100 trap nights (TN). In contrast, coyotes varied annually with 0.09 captures per 100TN in 2011 to 7.83 captures per 100TN in 2017. We will expand our analysis to the entire 3-month period and will incorporate human and habitat covariates as predictor variables. We will analyze annual percent overlap between the species across the landscape. Results will be important to determine if coyotes have stabilized in their eastward expansion and whether there are seasonal trends in trap rates, especially into the hunting season. Our findings will aid wildlife managers in better understanding interactions between established and returning carnivores on the landscape.

Mentor(s): Marcella Kelly (Fish and Wildlife Conservation), Virginia Tech
Brogan Holcombe - grad student (Fish and Wildlife Conservation), Virginia Tech

Cheyenne Williams
Virginia Tech/Psychology

Predictive factors of social efficacy during middle childhood

To thrive in multiple social domains, children must be able to reconcile their own goals and those of the people with whom they are interacting. A child's ability to both effectively identify these separate goals and implement a socially acceptable response can be defined as social efficacy. Several child factors such as temperament, emotionality, and emotion regulation predict social efficacy (Lengua, 2003).We hypothesized, therefore, that child emotionality, emotion regulation, and temperament will predict social awareness and motivation in one model of social efficacy with others; and supportive and non-supportive parenting in another model of social efficacy with parents.
Data of 145 9-year-old participants were analyzed with two multiple regression models. Emotion expression behaviors expressed during frustrating tasks emotion regulation behaviors expressed during the same tasks, two temperament scales (affiliativeness and negative affectivity), and two scales of parenting (Supportive and Non-Supportive), both assessed by a mother-report questionnaire. Outcomes of the models were social awareness and motivation to interact with others also measured by questionnaire. Preliminary findings indicate that both models fit data well, and explain a respectable amount of variance (R2 ~0.15). Regarding specific predictors, only temperament factors were significant predictors of outcomes in the first model, contrary to our hypothesis. In the other non-supportive parenting predicted both social awareness and motivation. We will discuss why child temperament and not emotionality and emotion regulation behaviors predicted social efficacy.

Mentor(s): Martha Ann Bell (Department of Psychology), Virginia Tech
J. Douglas Harrison Jr., (Department of Psychology), Virginia Tech

Béla Williams
Virginia Tech/Advanced Studies

Effect of Biochar on Bioavailable Nitrogen and Phosphorus in Food Waste Compost

In response to global environmental degradation, composting is becoming more important as a sustainable waste management practice, as well as a nitrogen and phosphorus source for crops. However, there is a higher nitrogen/phosphorus demand ratio among common crops, and finished compost tends to have a lower nitrogen/phosphorus supply ratio. This results in excess water-soluble (bioavailable) phosphorus leaching into the environment. Biochar has already been shown to reduce nitrogen losses during decomposition, but its effects on phosphorus are largely unknown. My lab-study revealed that water-soluble nitrate and phosphate decreased as biochar/compost dry weight ratios increased. My field-study combined food waste and wood chips to form compost, which was then divided into two portions. Biochar was mixed with one portion (wet weight ratio: 3:20) while the other portion remained as a control without biochar. During the 55-day decomposition process, it was observed that the biochar-compost mixture had consistently higher temperatures (up to 10°C) but 4-9% lower water content than the control. The biochar-compost mixture resulted in a larger decrease of both water-soluble (bioavailable) nitrate and phosphate concentrations over time. My lab-study demonstrated that higher biochar/compost ratios resulted in less water-soluble nitrate and phosphate. More research is necessary to determine the cause of this relationship, but the laboratory results suggest biochar is capable of adsorbing both nitrate and phosphate. If biochar's ability to reduce nitrate and phosphate loss to the environment is confirmed, this technology has the potential to improve compost's viability as an alternative to synthetic fertilizers.

Mentor(s): Gregory Evanylo (Crop and Soil Environmental Sciences), Virginia Tech
Katharine Davis, Blacksburg High School

Nicole Wilson
Virginia Tech/Health Science
Rhen Blake
Virginia Tech/Psychology
Meredith Beaver
Virginia Tech/Health Science

Examining the relationship between academic burnout, mental health and student perceptions of impact of COVID-19 on student learning

Background: Burnout, depression, and anxiety are common among health professional students. However, few studies assess burnout at the undergraduate level. Given the impact of COVID-19 on mental health and learning, it is vital to assess burnout among pre-health undergraduates. As unaddressed burnout can carry over into clinical practice, understanding and creating early intervention may mitigate the future negative impacts. The purpose of the study is to: (1) assess burnout, depression, and anxiety among pre-health undergraduates (2) examine student perceptions on the impact of COVID-19 on their pre-health education and training. Methods: This descriptive study utilized an anonymous, cross-sectional survey in a sample of JMU undergraduate pre-health students. Participants completed the Maslach Burnout Inventory (MBI-SS), Generalized Anxiety Disorder Screener (GAD-7), Patient Health Questionnaire (PHQ-2), and five open-ended questions regarding the impact of COVID on their health education and training. Results: The sample consisted of 223 undergraduate pre-health students. Burnout was prevalent with 75.6% reporting emotional exhaustion, 46.5% reporting high cynicism, 76.6% were at risk for depression and 68.6% met criteria for moderate to severe anxiety. Of open-ended responses, 159 participants reported COVID having a negative impact on their education and training. Major qualitative themes included decrease in applied learning, motivation, quality of education, retention of material, and reduction in pre-health opportunities. Discussion: This is one of the first studies examining depression, anxiety, and burnout in undergraduate pre-health students following the COVID pandemic. Our findings are similar to those from studies among medical students indicating these issues warrant early intervention at the undergraduate level.

Mentor(s): Aimee Johnson (Health Science), Virginia Tech

Mackenzie Woolls
Virginia Tech/Public Health

Identifying Genetic Associations for Methionine Content in Soybeans using a Genome-wide Association Study

Global animal agriculture is the primary consumer of U.S. grown soybeans. Soybeans are high in protein content and contain all nine essential amino acids, i.e., those required in livestock diets, however they are low in methionine content. Methionine is essential for the growth and development of livestock because it initiates protein synthesis. Animals cannot synthesize methionine on their own and require it to be included in their diet. Preliminary data and genomic association studies from 2019 analyzed by the Virginia Tech Soybean Breeding Program have identified promising genetic regions with associations to higher methionine. A genome-wide association study (GWAS) can help find genes associated with high protein and methionine content to help benefit animal nutrition and minimize the cost of supplementation. The methionine content for each sample was determined using an Agilent 1200 series High Performance Liquid Chromatography (HPLC) model with the Agilent Advance Bio AAA column. Using soybean samples taken from maturity groups IV, we performed a GWAS to test for associations between methionine content and known single nucleotide polymorphisms (SNPs) on Tassel. Significant SNPs were deemed as any SNP with a -log10(p-value) above 4.91. Suggestive SNPs had a -log10(p-value) above 4.16. All SNPs with a significant p-value were found on chromosome five. Chromosomes 7 and 13 contained suggested SNPs with a potential difference in environmental factors. Samples grown in Warsaw, Virginia had the strongest SNP associations and contained multiple SNP repeats. Upon further research these SNPs have the potential to increase methionine content through breeding efforts.

Mentor(s): Bo Zhang (Plant and Environmental Sciences), Virginia Tech
William Singer (Plant and Environmental Sciences), Virginia Tech

Jacob Wynne
Virginia Tech/Biological Sciences

Quantifying uncertainty contributions for lake thermal dynamics under future climate scenarios

Healthy freshwater ecosystems are vital to both human society and the natural world, yet are facing increasing risks from climate change. While current lake management focuses on retroactive approaches, there is an increasing need for proactive management tools such as accurate projections of future ecosystem states due to a changing climate. One generally unexplored area that we targeted in this study was projection uncertainty. We used four General Circulation Models (GCMs) with three Representative Concentration Pathways (RCPs) to drive five vertical one-dimensional (1-D) hydrodynamic lake models, producing projections of multiple lake thermal metrics to 2100 (n = 60). We grouped projections by lake model and GCM and examined distributions across these groupings to determine model interactions over mid- and end-century. We also partitioned lake model and GCM uncertainty over time for all thermal metrics across the paired RCP, GCM and lake model combinations. Using an ensemble modeling approach, we found that almost all lake thermal metrics are projected to change over the next century, especially under more severe RCP scenarios. Additionally, we found that certain metrics had greater model consensus than others. Lastly, we found that the dominant source of uncertainty is dependent on the metric modeled, reflecting the dominant processes which drive variability in each metric. We were also able to show that the impact of climate change is wide ranging, dependent on the socioeconomic and climate mitigation strategies taken over the next century. Through our ensemble modeling approach, our study shows important information on future lake thermal dynamics, providing insights for proactively managing lake water quality.

Mentor(s): Cayelan Carey (Biological Sciences), Virginia Tech
Quinn Thomas (Forest Resources and Environmental Conservation), Virginia Tech

Samuel Xiang
Highschool

Understanding the Exact Mechanisms of SARS-CoV-2 Binding to the Human ACE2 Receptor

In the era of coronavirus, it has become imperative to develop new avenues of drug research and advance epidemiology prevention. Understanding the exact mechanisms by which SARS-CoV-2 binds to the human ACE2 receptor is key to providing new opportunities to understand viruses and for further vaccine development. Residues that undergo significant changes in pK and protonation state upon binding are integral to the binding of SARS-CoV-2 to the human ACE2 receptor. Identifying these residues allows them to be disrupted by new drug treatments, reducing the virality and severity of coronavirus.

To determine shifts in pK upon ligand binding, the computational server H++ was used. Analyzing the SARS-CoV-2 spike receptor binding domain and the Human ACE2 receptor before binding and complexed together allowed analysis of important residues. These residues were identified by undergoing a significant shift in pK (a change greater than 1). The ACE2 Receptor has 23 residues that experienced a significant change in pK, with LYS-476, HID-373, and ASP-38 experiencing the most drastic pK shifts. The SARS-CoV-2 Spike protein's receptor binding domain has 16 residues that experienced a significant change in pK, with TYR-508, GLU-406, ASP-398, and GLU-516 experiencing the most drastic pK shifts.

Because these residues experience large shifts in pK, new drugs should target these residue bonds and attempt to disrupt them to prevent the transfer of viral genetic information. This procedure can also be replicated for new viruses in the future, to quickly identify key residues and create drug treatments.

Mentor(s): Ramu Anandakrishnan (Bioinformatics), Virginia Tech
Alexey Onufriev (Computer Science and Physics), Virginia Tech

Danny Yessayan
Virginia Tech/Mechanical Engineering

A Microfluidic Platform for High Throughput Screening of Multicellular Tumor Spheroids

Multicellular tumor spheroids (MCTS) resemble essential structural function and mass transport properties of avascular tumor tissue; thus, they are widely utilized for in vitro screening of novel anticancer therapeutics. MCTs are typically cultured and maintained in multi-well plates. Lack of fluid flow in well-plates leads to a build-up of waste and spatiotemporal variation in the concentration of metabolizable therapeutics, which constrain the experiment duration and may adversely affect the repeatability in the results. The goal of this research is to develop a microfluidic platform that captures MCTS at designated locations and supports long-term experiments by providing fresh nutrients, removing waste, and administrating therapeutic compounds at well-defined and repeatable concentrations. The microfluidic device design was inspired by a high-efficiency single cell (diameter, 10 μm) trapping device [1]. The device's geometrical design of the channels and trapping sites were modified to be appropriate for MCTS (diameter, 600-800 μm). A theoretical model was developed and used to design the device such that MCTS will be directed to the trapping sites. Multiple devices with different channel lengths and gap sizes were 3D printed using a clear resin. Our preliminary experimental results with breast cancer MCTS showed great promise as it was 66% effective in trapping the MCTS. We identified that the closure of trapping sites in some areas of the device contributed to less than 100% capture. We are currently optimizing the device design and exploring higher resolution 3D printers to produce high fidelity microfluidic devices.

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Mentor(s): Bahareh Behkam (Mechanical Engineering), Virginia Tech
Ying Zhan, PhD (Mechanical Engineering), Virginia Tech

Jessie Yu
Virginia Tech/Psychology
Claudia Hilton
Virginia Tech/Psychology
Julia Coron
Virginia Tech/Public Health
Leila Pruscino
Virginia Tech/Human Nutrition Foods and Exercise
Chris Pereira
Virginia Tech/Cognitive and Behavioral Neuroscience
Loralee Hoffer
Virginia Tech/Psychology
Mackenzie Davis
Virginia Tech/Psychology

Bus Behavior: Gratitude in the Community

Decision-making in social situations is influenced by a number of contextual and interpersonal variables. Two notable psychological theories that attempt to predict human behavior in social situations are observational learning and diffusion of responsibility. Observational learning predicts that people will take cues from the actions of others. Diffusion of responsibility, on the other hand, predicts that people will be less likely to act in the presence of others. The present behavioral observation field study focuses on evaluating the frequency of interpersonal gratitude on Blacksburg Transit buses. Specifically, undergraduate researchers have been recording whether passengers thank drivers as they disembark, and whether this is influenced by drivers exhibiting prosocial behavior (e.g., saying “Have a nice day!”). Current analysis is ongoing and centered on whether passengers more frequently exhibit observational learning or diffusion of responsibility. The anticipated results are that passengers engage in the former–when one passenger thanks the driver when disembarking, subsequent passengers will follow suit. This study is part of a project that seeks to understand what contextual variables in a social situation may affect whether one theory predominates over the other. The results will inform future interventions to promote gratitude around campus, enhancing the subjective well-being for both benefactors and beneficiaries, as outlined in the extant gratitude literature.

Mentor(s): Scott Geller (Psychology), Virginia Tech
Jack Wardale (Psychology), Virginia Tech

Jessie Yu
Virginia Tech/Psychology
Sara Carter
Virginia Tech/International Relations

Ideologies of Intelligibility in Subtitling

Intralingual subtitling,ÄîspecifIcally, translation of audio in one language into non-optional text of the same language,ÄîIs used when a speaker,Äôs dialect is considered difficult for target audiences to understand. Thus, these subtitles and the commentary surrounding them offer insights into ideologies of within-language intelligibility. In the present study, we investigate such ideologies from two approaches: by documenting how intralingual subtitles are being used in practice in 3 reality-based cooking shows, and by analyzing common themes in published complaints about intralingual subtitles. Our results suggest that productions are comfortable using subtitles for L2-accented (non-native) English, but more reluctant for L1 English; any use of subtitles for L1 English appears to be limited to certain varieties, such as Indian English. Our commentary analysis shows that people generally respond to intralingual subtitles in one of four ways: that it,Äôs offensive to subtitle someone,Äôs English; that in the instance they are complaining about, subtitling was unnecessary and/or motivated by racist or ableist biases; that subtitles allow audiences to be lazy; or that they,Äôre actually helpful. The purpose of intralingual subtitles is ostensibly to facilitate communication, and they have been framed in the literature as tools for breaking down boundaries. However, both the practice and commentary around them highlight largely negative connotations of marking someone as unintelligible.

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Potential Drug Targets; The Effect of Mutagenesis on Sphingosine Kinase 1 Ligand Binding

Modern technology has made great strides in using software such as PyMOL to computationally manipulate molecular interactions to investigate potential pharmaceutical drug targets. The target of interest that we researched was Sphingosine Kinase 1 (SphK1) because of its role in regulating the generation of the signaling molecule S1P. There is evidence showing that increased levels of S1P in the body are connected to diseases such as cancer and fibrosis. We aimed to study possible methods inhibitors could use to fit into a rotational isomer (rotamer) of SphK1 and outcompete substrates that typically bind to SphK1 to activate it. Preventing SphK1 from being activated will shut down one of the biological pathways that generates the S1P molecule that may be a factor in several detrimental diseases that affect millions of people. To conduct this study, we used the software PyMOL to model SphK1 and alter the ligand's binding site. The software allows for hypothetical interactions to be visualized and for the distances between the kinase and the ligand to be measured. This visualization allowed us to determine how mutations could possibly prevent ligand binding. We compared the unaltered binding sites of SphK1 to several of the mutagenesis rotamers to determine the effect on binding efficiency to the ligand. We found that the different rotamers had an increased distance between the ligand and the SphK1's binding sites. Therefore, mutating the ligand binding site (ASP-264) decreased the binding efficiency of the ligand, making it a possible method of inhibiting SphK1 activity.

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Q&A on Zoom for preschoolers: The impact of on-screen partner's questions on preschoolers' word learning and memory of content from shared book reading over video chat

During the pandemic, video chat has been a vital educational tool for all, including young children (Dore et al., 2021). Although preschoolers have been shown to benefit from reading over video chat with an on-screen partner (Gaudreau et al., 2020), what type of experience would maximize its instructional impact over time remains to be tested. In this study, we examined whether on-screen partner's questions (compared to statements) during shared book reading would improve preschoolers' novel word learning and memory of the content over two reading phases. The preliminary analyses were based on 20% of the final sample: 16 children (3-5 years; 37.5% female) participated in a 30-min Zoom session where an on-screen adult read a storybook two times. The book included 5 novel objects and 5 hiding locations. Children were randomly assigned to read the book with either questions (n = 8) or statements (n = 8). For both groups, each reading phase was followed by a word learning test and a location memory test. There was no difference between the two reading phases in the test scores; thus, the scores were combined. Children's word learning performance was higher in the question group than the statement group, $t = -2.57$, $p = .023$. However, location memory performance did not differ between the two groups, $t = -0.421$, $p = .680$. The results suggest that asking questions can be an effective tool for teachers to support preschoolers' word learning in an online learning environment.

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Sing, act, and dance with robots: A child-robot musical theater afterschool program for STEAM education.

Although “robotics for all” efforts have been initiated to emphasize a cohesive learning paradigm based on real-world applications, major challenges remain in finding diverse approaches for young learners. We designed a 13-week long afterschool program focused on child-robot musical theater, combining child-friendly humanoid and animal robots and familiar activities (acting, music, dancing, drawing) to engage children in Science, Technology, Engineering, Arts, and Math (STEAM) education. A sample of 16 children (8-10 years; 37% girls) from a Title 1 elementary school (with a high proportion of low-income students) participated in the program, and nine of them consented for research. Children completed 4 surveys to periodically report their engagement in the program in addition to pre- and post-surveys about their interest and confidence in STEAM and curiosity in robots. Children reported a high level of engagement throughout the program (*Ms* = 3.5 out of 4). Following the program, all children reported increased interest in STEAM. Children’s confidence in STEAM (*Mpre* = 3.02, *Mpost* = 3.09; out of 4) and curiosity in robots (*Mpre* = 3.7, *Mpost* = 3.6; out of 4) were high pre- and post-program. The findings suggest that our program effectively maintained children’s engagement and improved their interest in STEAM. Further research is needed to increase sample size, identify ways to enhance children’s curiosity and confidence, and take into account children’s demographic diversity.

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Poison Ivy Urushiol Trait-Trait Allometric Relationships Do Not Reveal A Consistent Pattern Of Purifying Natural Selection.

Urushiols are C15- and C17-alk(en)yl-catechol (urushiol) congeners presumed to be chemical defense compounds against herbivores. They are secreted by the native American plant poison ivy, and people who are allergic to contact may develop a skin rash. Further research on the genetic variation of urushiol production in different poison ivy origins will better explain the evolutionary process of this chemical defense. The current study focused on the tradeoffs and/or benefits between leaflet biomass and urushiol concentration, as well as the allometric relationships between C15- and C17-urushiol congeners. Extracted C15- and C17- urushiol levels showed no consistent patterns with leaf dry weight collected from six states cultivated in controlled environments. The allometric relationships of drupe C15- and C17-urushiol differed between the three counties in VA as well. Plants at the MI and VA-Augusta County site demonstrated urushiol levels positively correlated with leaf or drupe biomass (respectively). Overall, there was no significant evidence showing a consistent pattern of purifying natural selection acting on urushiol levels.

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Design and Testing of a Novel Household Anaerobic Digester

Large-scale anaerobic digesters have been employed to treat food waste for some time, and more recently smaller models are being designed at the household scale in response to recent regulations on the disposal of food waste. However, there is little research to guide the evolution of household designs intended for the U.S. market. These household digesters are based on designs originally meant for processing manure. A study of these digester designs indicates high levels of maintenance for the end-user. The largest issue is the accumulation of unprocessed lignin that clogs outlet pipes. The aim of this project is to build and test a novel design that offers a two-stage treatment process where undigested materials are delivered to a secondary vessel where they can be removed by the end-user. Clear vessels and piping are utilized to aid in the visualization of solid movement within the digester system. Gas mixing is employed to aid in the mixing and moving of accumulated solids. The design is tested for proper flow of solids through feeding of chopped straw, which is largely composed of lignin. Flow volume, solids delivery, and frequency of clogging are evaluated to validate the design and test several configuration options. The results of this project will inform the future of household digester development in the U.S., as well as potential applications at larger scales for manure-fed systems in both the developed and developing worlds.

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