Patricia Belt Conrades

Summer Science Research Symposium

September 21, 2020

Ohio Wesleyan University

ABBI TURNER '20

Zoology major | Graduate student in the Evolution, Ecology, and Behavior Department, University of Illinois at Urbana-Champaign

"For my project in SSRP, I studied the potential adaptive value of mate switching in house wrens. This experience not only provided me with a valuable introduction to field research, but it inspired my decision to attend graduate school. I learned very quickly that despite the challenges, research is very rewarding and a lot of fun."

THE PATRICIA BELT CONRADES SUMMER SCIENCE RESEARCH SYMPOSIUM

The crises that are upending our world—from the immediate dilemma of the COVID-19 pandemic to the long-term existential threat of global climate change—have boldly reminded us of our reliance on science, mathematics, and technology. We turn to scientists and their research to help us understand and solve such global challenges.

Now in its 28th year at Ohio Wesleyan, the Summer Science Research Program, which culminates in the Patricia Belt Conrades Summer Science Research Symposium, prepares OWU students for careers in science research. The program provides an intensive 10-week opportunity for students to tackle complex research issues by working with seasoned, accomplished mentors at OWU and other universities across the country. In this year of COVID-19, students worked in a variety of locations, frequently connecting with faculty remotely. And the symposium to showcase their work has moved online, where they describe their projects on a 2020 SSRP website and where they will discuss their work in live, interactive video sessions, which also will be recorded and posted on the SSRP website.

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Monday, September 21, 2020
Opening remarks by President Rock Jones
Followed by Live Interactive Video Sessions

owu.edu/ssrp2020

THE MAKING OF A SCIENTIST

While so many things have changed in the past few months, one constant is the talented science students at Ohio Wesleyan and their meaningful contributions to scientific research and connection to their faculty mentors in OWU's Summer Science Research Program (SSRP).

This summer, students had the opportunity to work with OWU faculty mentors both on campus and remotely. Advances in technology allowed for off-campus students to remotely operate the telescope at Perkins Observatory and to analyze data from colleagues in France. Careful preparation and appropriate precautions while on campus—wearing facial coverings and maintaining at least 6 feet of distance—allowed students to collect data at Ohio Wesleyan. In both cases, authentic research is quite different from classroom labs—more challenging, more creative, more frustrating, and ultimately, more rewarding.

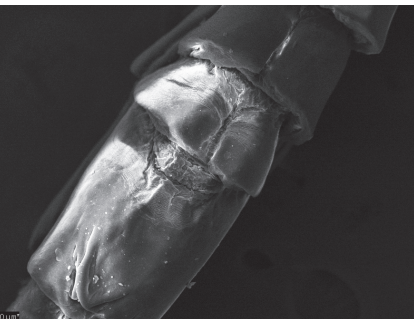
One of the most rewarding parts of SSRP for me is watching the students grow as scientists, seeing them take command of a research project, and knowing they are gaining the confidence to speak and act as scientists. Science cannot be learned solely from a book. Science must be experienced through research. At OWU, we encourage students to plunge in, which prepares them to be successful researchers both at OWU and at other universities. Many first-year students are surprised to learn that they can contribute in substantive scientific research from the moment they arrive on campus. At Ohio Wesleyan, research is not just for the few.

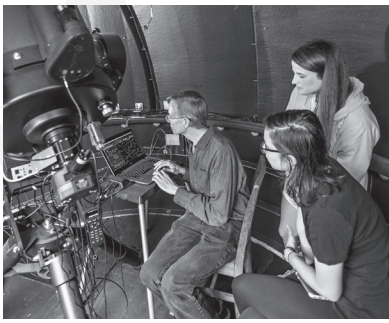
Our 2020 Symposium is taking a different format as well. Groups of student researchers led by their faculty mentors will discuss their research on a virtual platform, then will allow time for attendees to participate and ask questions. Be brave! Ask a question! Our research students are eager to interact with you and answer your questions about their work.

On behalf of the 19 OWU students and 12 OWU faculty mentors whose research will be featured at the 2020 Symposium, thank you for attending. Your virtual presence is greatly appreciated.

Enjoy the Symposium—and be sure to learn something new!

Laura Tuhela-Reuning
Department of Botany-Microbiology
Department of Zoology
Scanning Electron Microscopist
Summer Science Research Program Director



THE PATRICIA BELT CONRADES SUMMER SCIENCE RESEARCH SYMPOSIUM ENDOWMENT

In 2006, Dr. Nancy Reynolds Schneider '64, established an endowment to name the Summer Science Research Symposium after her good friend and fellow OWU alumna, Patricia Belt Conrades '63.

Mrs. Conrades is a volunteer registered nurse and homemaker, and a member of Ohio Wesleyan's Board of Trustees. She regularly assists in the operating room of Boston's Mount Auburn Hospital and is also a nurse with Volunteers in Medicine, assisting the poor in Stuart, Florida. Dr. Schneider is a highly regarded Professor of Pathology and Director of the Cytogenetics Laboratory on the faculty of the University of Texas Southwestern Medical Center in Dallas. She also has served on the Ohio Wesleyan Board of Trustees.

Mrs. Conrades and Dr. Schneider share a commitment to the sciences, and are both examples of individuals who have enjoyed successful careers in science. The support of Mrs. Conrades and her husband, George Conrades '61, a member of the OWU Board of Trustees, and Dr. Schneider and her husband, John Schneider, continues to strengthen the science and mathematics programs at OWU.

THE C. PATRICIA FERRY SUMMER SCIENCE RESEARCH PROGRAM ENDOWMENT

In 2008, Patricia Ferry '53 established the C. Patricia Ferry Summer Science Research Endowment in recognition of the program's value as an integral part of the liberal arts experience. The endowment that will fund the program in perpetuity follows Ms. Ferry's support of the program through gifts she has made annually for several years.

Through her contacts with SSRP participants, Ms. Ferry has observed how the program introduces students to the excitement of science and original research and provides familiarity with the many career options available in the disciplines.

Ms. Ferry's interest in the sciences is longstanding, including her years at Case Western Reserve University, where she worked in the medical school directing its medical education program. She graduated from Ohio Wesleyan with majors in psychology and sociology and as a member of Alpha Xi Delta sorority.


Abercrombie
& Fitch

EMMA BLACKBURN

Research Mentor: Bethany Rudd
Department of Chemistry

A windy day at the beach or lake produces a mist of spray. It so happens that these sea spray and lake spray particles actually have an important impact on the climate due to their complex chemical composition. Our study examined the effect that high (ocean) and low (lake) salt concentrations have on the organization of molecules at the surface of these spray particles.

PROBING MOLECULAR ORGANIZATION OF ATMOSPHERICALLY-RELEVANT INTERFACES USING SURFACE TENSION TECHNIQUES

Wind action on lakes and oceans releases aerosols to the atmosphere. These lake spray aerosols (LSA) and sea spray aerosols (SSA) are coated with a complex mixture of organic surface-active species (surfactants), and can scatter solar radiation, act as cloud condensation nuclei (CCN), and participate in multiphase chemical reactions. Surfactants can alter the physical and chemical properties of the air-aqueous interfaces of these aerosol particles thus impacting how they participate in various climate processes. One factor that dictates the molecular organization of surfactants is the critical micelle concentration (CMC). In this work, sodium dodecyl sulfate (SDS, $NaC_{12}H_{25}SO_4$) was used as a model LSA and SSA surfactant system. The CMC of SDS under various ionic conditions representative of different aerosol systems was determined via two techniques, surface tension and conductivity. As the concentration sodium ions in the subphase increased, the CMC of the SDS decreased. Using the CMC data obtained here, global climate models can be improved to more accurately account for the impact of organic-coated lake and sea spray aerosols.

ALYSSA BLAKE

Research Mentor: Shala Hankinson
Department of Zoology

Everyone including animals needs new experiences to make sure they don't get bored and depressed. For captive animal species, certain negative behaviors can be created with the lack of stimulation in life and will develop negative behaviors that affect their well being. My study observes the different behaviors that are influenced by different types of enrichment and how the selected tiger interacts with the chosen items.

THE EFFECTS OF ENRICHMENT ON A SELECTED CAPTIVE TIGER

All animal species require psychological, physical, and emotional stimulus in order to maintain a healthy way of life, especially wild animals in captivity. In places such as zoos and sanctuaries, enrichment programs are especially important in maintaining a healthy environment. The stimulation these programs provide have been widely studied and continuously proven to reduce the possibilities of abnormal, aggressive behaviors and provide an enriching environment. If a captive animal's needs are not met and instead animals are provided with only a monotonous routine, the animals may develop certain negative characteristics and behavioral changes and negatively impact their health. One such stereotypical behavior that is affected is pacing, especially in large cats, such as tigers (*Panthera tigris*). The negative effects of captivity have been widely acknowledged in the literature and there is a general consensus that the limitations of a captive environment can lead to the performance of stereotypic behavior in many species. There are several different types of enrichment including, food, sensory, and physical. Each of these types of enrichment is a way for the animals to have new experiences and increase their well being while in captivity. While working at the Wild Animal Sanctuary in Texas, I implemented an enrichment program of different activities for each day of the week. The overall results of most of the activities were positive, showing active, playful engagement with the enrichment items.

YILUN (HANNA) CAO

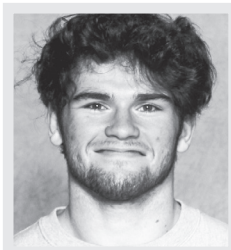
Research Mentor: Scott Linder
Department of Mathematics and Computer Science

In real applications, population correlation is unknown and must be estimated from a sample. For full samples, researchers are well able to estimate this parameter and make statements about the likely error of estimation (margin of error). However, many clinical settings force researchers to use data that has been subjected to censoring. In these settings, conventional methods may not perform well. We explore a method for modifying a full-sample method for estimating correlation to the setting in which data have been censored.

ESTIMATION AND INFERENCE FOR CORRELATION UNDER CENSORING

In many clinical and industrial settings, data are subjected to censoring. However, widely used and conventional statistical methods (t-tests, linear regression, etc.) are based on underpinning sampling distributions which typically become mathematically intractable when censoring occurs. Our study examines the effect of censoring on the accuracy of the method for estimating correlation due to the Fisher transformation. This method is seen to be quite accurate for full samples as small as 8 or 10. We use simulation to generate random samples from a bivariate Normal population, and simulate the sampling distribution of the sample correlation coefficient. When censoring of the sample is imposed, we observe that actual coverage rates of confidence intervals for the population correlation coefficient constructed through the Fisher Transformation method degrade very rapidly, rendering this method inappropriate when data has been subjected to censoring. Again using simulation, we propose a shift and scale modification to the approximate normality of the sampling distribution of the Fisher transformed sample correlation. The scale and location shifts are functions of the degree of censoring the data was impacted by. This allows us to proposed “modified” confidence intervals for the population correlation under censoring, and we observe that these modified intervals offer slight improvement in coverage rates over the unmodified version.

ALEJANDRA CORONEL-ZEGARRA
BRYCE WITTMAN



Research Mentor:
Allen Pistner
Department of Chemistry

Dipyrrin is an organic scaffold with the potential to form metal complexes. These complexes will be explored for oxygen activation for uses in fuel cells or photodynamic therapy. In this research, dipyrrin was synthesized and coordinated with various metals to investigate its photochemical and electrochemical properties

INVESTIGATION OF DIPYRRIN LIGANDS FOR THE ACTIVATION OF OXYGEN

A redox active ligand scaffold, dipyrrin, was synthesized for the purpose of activating oxygen. The pathway of focus entailed a Negishi coupling followed by condensation with a phenyl aldehyde using pyrrole and di-tert-butyl phenol, using either methyl or silyl protecting groups. The use of these groups was investigated to explore a more efficient synthesis; as expected, the results indicated that the methyl protecting group was more effective due to sterics. Complexes were formed with the phenyl ligand derivative using aluminum (III) and boron coordinations. These organometallic compounds were analyzed using proton NMR, UV-Vis spectroscopy and electrochemistry.

ROSS EGGLESTON

Research Mentor: Dustin Reichard
Department of Zoology

This project aimed to study how nest defense behaviors of house wrens are similar against predators that commonly feed on house wren eggs and nestlings and whether the strength of their defense relates to reproductive success. We used plastic predator models of an eastern chipmunk and black rat snake to simulate an attack on the nest box to get the parents to perform nest defense behaviors, and counted the number of times that the parents performed certain behaviors, such as flying over and attacking the fake predator. We then used statistical tests to determine if there was consistency in the bird's anti-predator behavior, and if there was a significant relationship between those behaviors and reproductive success. Interestingly, there was no significant difference in responses of individual parents even though the predator models were very different from each other.

PREDATOR DEFENSE AND REPRODUCTIVE SUCCESS IN HOUSE WRENS (*TROGLODYTES AEDON*)

Offspring predation is one of the greatest obstacles to an organism's reproductive success. Individual parents vary greatly in their risk-taking behavior in response to a predator, as investing more energy while defending current offspring has the potential to lower future reproductive success if the predator is also capable of injuring or killing the parent as well as the nestlings. House Wrens (*Troglodytes aedon*) are small, cavity-nesting songbirds that have clutches of up to 8 offspring. Common nest predators include rodents, predatory birds, and snakes. Here, we used two different predator decoys, an eastern chipmunk (*Tamias striatus*) and a black rat snake (*Pantherophis alleghaniensis*), to elicit nest defense behavior and test whether parents are consistent in their anti-predator response and whether that response affects fitness. We hypothesized that parents would respond consistently to each predator model, as previous research has shown that birds are able to assess predation risk in known predators. Interestingly, even though the predator models were very different animals, anti-predator behaviors were not significantly different between the models. However, there was a significant weak negative correlation between time spent within five meters of the model and the number of offspring produced. This result contradicts our prediction that greater investment in anti-predator behavior should yield higher reproductive success.

MARK FRAWLEY

Research Mentor: Nathan Rowley
Department of Geology and Geography

The summer melt season in West Greenland begins in late April lasting until September. On the Greenland ice sheet, are supraglacial lakes which form in depressions, where melt runoff accumulates. We use satellite and topographic data in our study area. We use three different volume estimation methodologies to estimate volume, depth, and area of 230 melt lakes on the Sermeq Kujalleq glacier.

ESTIMATING SUPRAGLACIAL MELT LAKE VOLUME USING REMOTE-SENSING IN WESTERN GREENLAND

During the 2018 summer melt season, the Greenland Ice Sheet (GrIS) lost an estimated 300 billion tons of ice (Fettweis, 2019), which contributed between 0.03-0.08 mm (Hock et al., 2019) of sea-level equivalent. Located on the western coast of the GrIS is the Sermeq Kujalleq Ablation Region (SKAR) — a region of significant melt and belonging to the fastest flowing outlet glacier in the world. Western Greenland has an abundance of supraglacial melt-lakes (SGL) which form in the same location annually. The ablation (or melt) region, along the ice sheet's periphery, is where summertime melt supersedes wintertime snow accumulation (Rowley et al., 2019), and is the source of overland runoff (King et al., 2018) or localized hydrofracturing (Krawczynski et al., 2009). SGLs are driven by increased surface air temperature and net radiation values (incoming sunlight minus outgoing reflective light), causing an acceleration in glacial melt. The glacial melt finds its way into topographic depressions, where the meltwater collects. We estimate melt-lake depth and volume, and measure area of SGLs within the drainage basin of the SKAR by applying three different remote-sensing volume estimation techniques with data acquired from Landsat-8 satellite imagery and a surface digital elevation model (DEM). Methods used in this study include Sneed and Hamilton depth reflectance (2007), Pope Landsat band ratio (2016), and our novel DEM-based approach. We collected values from 230 lakes for July 30, 2018, and compared the different volume calculation methods for accuracy and precision of lake depth, volume, and area.

DAVIS GRAHAM

Research Mentors: David Lonard and Bert O'Malley
Department of Molecular and Cellular Biology
Baylor College of Medicine

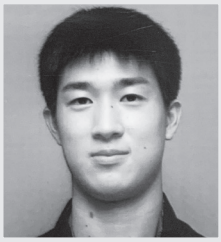
Steroid receptor coactivators (SRCs) are proteins that have strong links to cancer. Since SRCs are present in numerous cell types, including immune cells, they should correlate with the presence of immune cells in primary tumors. Knowing the immune cell composition of tumors can help to improve immunotherapies. This study suggests the CD93 protein may have a translational issue in prostate cancer, and that it is worth pursuing further.

RELATIONSHIP BETWEEN STEROID RECEPTOR COACTIVATORS AND TUMOR TISSUE COMPOSITION

Steroid receptor coactivators (SRCs) are linked to cancer. Cancers related to SRC-3 alone account for at least 733,000 new cases and 319,000 deaths yearly in the United States. SRCs are expressed in all kinds of cells, including immune cells. Given that primary tumors are composed of immune cells, vascular endothelial cells, fibroblasts, and cancer cells themselves, immunotherapies are an emerging approach for treating cancers. A key part of improving immunotherapies is knowing what kind of immune cells are present in tumors. Using cellular markers, SRC mRNA co-expression with various immune cell types was evaluated in breast, prostate, and renal cancers. A transitional B cell marker (CD93) showed correlation with SRC-1, SRC-2, and SRC-3 in prostate cancer and SRC-1 and SRC-3 in renal cancer. Since CD93 is also highly expressed in endothelial cells in addition to immune cells, a second round of co-expression analysis was done with new cell type markers of cells that CD93 is expressed in to determine more precisely what type(s) cells CD93 was being expressed in for the prostate and renal cancers. Immunohistochemistry images for prostate and renal cancers were analyzed, ultimately revealing that CD93 protein was not expressed at high levels in prostate cancer. The lack of protein expression despite significant mRNA expression suggests a possible translational issue with CD93 protein in prostate cancer.

SAKSHI GUPTA
KAITO IWASAKI

Research Mentor: Robert Harmon
Department of Physics and Astronomy



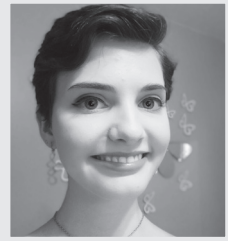
Starspots are a feature of a star's surface where the temperature is lower than the rest of the surface due to magnetic activity, causing them to be darker. Studying them provides a better understanding behind the physics of the magnetic fields of the Sun and other stars. We took digital images of LO Pegasi, a star located 79 light years from Earth, using a telescope at Perkins Observatory, and used a program called Light-curve Inversion to map its starspots. We compared the series of model surfaces from the years 2014 to 2020 to study the changes in starspot configuration.

STARSPOTS ON LO PEGASI, 2014-2020

Starspots, like sunspots on the Sun, are regions on a star's surface where the temperature is lower than the rest of the surface due to magnetic activity, causing them to be dark in comparison to the rest of the surface. LO Pegasi is a spectral class K8 V star located 79 light years from Earth. Its short rotation period of 10.153 hours gives it a strong magnetic dynamo, producing large starspots on the surface. As the dark starspots are carried into and out of view from Earth by the star's rotation, the star's brightness varies. Digital CCD camera images of LO Pegasi were acquired through B, V, R, and I photometric filters at Perkins Observatory using a 0.35-m aperture telescope. After performing standard bias and dark subtraction and flat fielding, differential aperture photometry was performed to generate plots of the star's brightness as a function of time. We used a program called Light-curve Inversion that uses the brightness variation caused by the spots to map the surface of the star and visualize the appearance of surface structures. We compare a series of model surfaces from the years 2014 to 2020 to study the changes in spot configuration.

HOLLY KEATING

Research Mentors: Dustin Reichard and Elizabeth Schultz
Department of Zoology



Most birds in northern climates only sing during the breeding season to attract mates. Carolina wrens however sing all year round, though almost no research has been done on them. Our study uses Carolina wren songs collected from online databases to compare the melodies during the breeding and nonbreeding seasons, as well as looks at the effects location and year might have on how the songs change. We found that songs were longer and slower during the breeding season than in the nonbreeding season, but not more complicated. This may be because singing longer and slower songs during the breeding season helps males increase their chances of being heard by females.

SEASONAL SONG VARIATION IN CAROLINA WRENS (*THRYOTHORUS LUDOVICIANUS*)

Temperate songbirds typically sing to attract mates and repel rivals during the breeding season (spring/summer), but most species rarely sing during the nonbreeding season (fall/winter). Carolina wrens (*Thryothorus ludovicianus*) are North American songbirds that are an exception to this rule as they sing year-round. Despite this unique behavior, very little research has been done into their song structure, variation, or evolution. In this study, we hypothesized that wren songs during the breeding season would be more complex and longer in length than nonbreeding songs in order for males to more effectively attract potential mates. We compared breeding and nonbreeding Carolina wren songs that were recorded and deposited into public databases including eBird, the Macaulay Library, the Florida Museum of Natural History, and Xeno Canto over multiple decades (1950-2020). Over 600 songs were measured for length, complexity, frequency range, and the number of notes and syllables using Raven Pro analysis software. We found that year of recording did not influence the data, though latitude minimally did. When controlling for latitude, breeding songs were significantly longer, slower, and had more syllables than nonbreeding songs, but the two did not differ in complexity. These results suggest that Carolina wren males may sing longer and with more syllables during the breeding season to increase their chances of being heard by a potential partner. However, future research should also investigate why males do not also increase song complexity when potentially attracting mates and determine the exact function of their song during the nonbreeding season.

CHASE PATTON

Research Mentor: Ashley Allen
Department of Geography and Geology

With growing concern regarding unsustainable lifestyle all over the world we decided to take a deeper look into the ways an average citizen can combat unsustainable living in an urban and suburban area. By using three different composting methods to collect and breakdown household food waste we concluded that among the three different methods there was not one "superior" way of composting food waste. We found that the choice of composting is dependent on the lifestyle in which an individual lives and their everyday habits.

MEASURING HOUSEHOLD URBAN AND SUBURBAN SUSTAINABILITY INITIATIVES

Food waste has been a problem all over the world for many years, however recently it has become a growing issue which many individuals are trying to combat in their day-to-day lives. Many people are attempting to reduce their environmental footprint by living more sustainably. This research took a closer look into at-home sustainability efforts regarding food waste in urban and suburban areas, specifically Columbus and Delaware, Ohio. We used three types of indoor composters: electric, manual (tumble), and vermicompost to collect and breakdown our household food waste. We then used the product of each composting method in the growing of a raised garden bed located in Columbus. Each week, we measured the pH, moisture, and temperature of the soil, along with the height of each plant in the garden. The ease of use and "smell test" of each compost method were also noted each week to conclude which method of composting was most user-friendly for the average person. Each method was unique its own way, and each came with its own learning curve. We found that all three composting methods were effective in the reduction of food waste in a household environment, and all are sufficient forms of reducing ones environmental footprint in an everyday setting, leading us to conclude that individuals should choose their preferred method depending on their lifestyle habits.

HANH PHAN

Research Mentor:
Sean T. McCulloch
Department of Mathematics and Computer Science

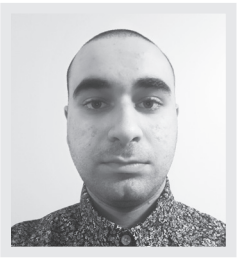
Scotland Yard is a board game in which five detectives are trying to catch a player named Mr. X. Mr. X's job is to move around the map of London using taxis, buses or underground tickets while his exact location is sometimes revealed. Our study created the game and built a bot who plays the detectives and does his best to catch Mr. X.

ARTIFICIAL INTELLIGENCE OF MODERN BOARD GAMES

Board games have always played an important role on kids' growth; they bring a lot of fun when friends or families play together. Scotland Yard is a board game that depicts the hunt for Mr. X through the streets of London. There are six players (five detectives and Mr. X) whose jobs are to move from point to point around the map of London using taxis, buses, and underground tickets. The five detectives would try their best to catch Mr. X. Mr. X's transportation is mostly revealed every round while his exact location is known sometimes through the game. The game ends when either it reaches round 24 or Mr. X is caught by any detective. Our study created a computer version of Scotland Yard that allows six players to play in turn. We also created a bot who plays as five detectives and makes the best moves to catch Mr. X. Using breadth first search algorithm for the map, a detective knows his shortest path to reach Mr. X. For every round, each detective gets updated about Mr. X based on his transportation or his last revealed location. A detective could choose to move towards Mr. X's current possible locations, Mr. X's predicted locations next round or an Underground station where it would be easy to get to a distant location in one move. Before any detective makes a move, they all communicate and decide which move is the best for all.

NADAV SHAIBE

Research Mentor: Brad Trees
Department of Physics and Astronomy

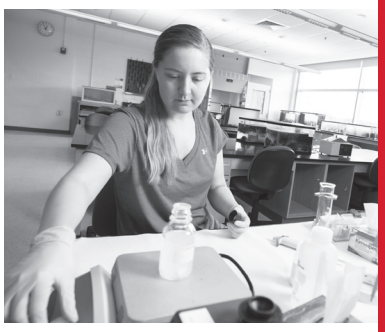


The synchronization of coupled oscillators is a well-studied phenomenon. For example, metronomes can be made to synchronize their ticking by putting them on a rocking platform. Similarly, the oscillating magnetic fields of little loops of superconducting wire with a small section removed can also be made to synchronize by driving them with an external magnetic field. Such loops are called rf SQUIDs. Using computer programs and mathematical models, we could see the degree of SQUID synchronization and its resistance to disturbances. For example, and perhaps counterintuitively, we found that the stronger the coupling between the SQUIDs, the more susceptible the system was to falling out of synchronization.

SYNCHRONIZATION OF LOCALLY-COUPLED JOSEPHSON JUNCTION SQUID ARRAYS IN AN EXTERNAL MAGNETIC FIELD

The entrainment of nonlinear oscillators to a driving sinusoidal wave is a subject of much investigation as the behaviors and the mathematics used to describe them are nontrivial. We study an array of one type of nonlinear oscillator called an rf SQUID, or Superconducting QUantum Interference Device, which can be placed within an AC magnetic field that acts as the driving wave. The inductance of each SQUID creates a magnetic field in response, and the resultant flux within each SQUID is tracked as the oscillating quantity. Neighboring SQUIDs are affected by each other's fields, effectively coupling neighbors. We model the array behavior numerically, which allows us to test a wide range of parameter values. By comparing the amplitudes and phases of the fluxes, we can get a value for the Kuramoto order parameter, a measure of the synchronicity of the oscillations with a value of one indicating perfect synchronization. Preliminary results for the order parameter show that only in the limit of very weak SQUID damping does the value decrease below one as either the frequency of the AC magnetic field or the strength of the SQUID coupling is varied. It is also possible to use Floquet analysis to test the stability of the synchronization by modeling a small perturbation to each SQUID, one at a time, and seeing whether the perturbations shrink or grow over time. We found, through both numerical computation and analytic calculations, that stronger coupling weakened the stability of the synchronization, while the damping of the SQUIDs initially had a positive effect on the stability until the system was critically damped after which further damping decreased stability. The frequency of the external field had no effect on the stability except when very small. We found that the self-inductance of the SQUIDs was inversely proportional to the stability of the synchronization. The next step would be to test the effect of disorder in the critical current values on our findings, as that would be more realistic.



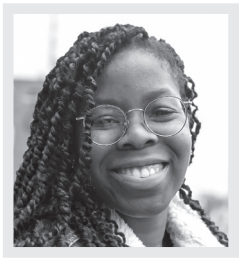



NAVAMI SHENOY
ISABELLE RODRIGUEZ
JOY BURAIMA

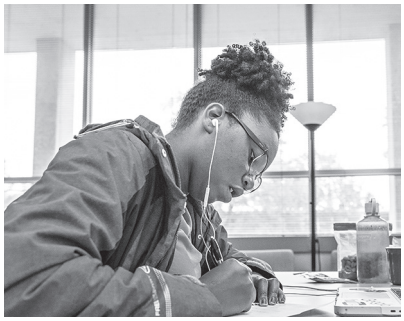
Research Mentor: Kira Bailey
Department of Psychology, Neuroscience Program

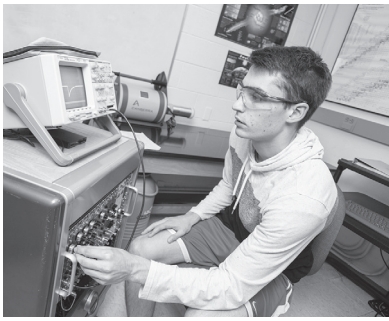
Commercial video game consumption has been linked to changes in cognitive control, the processes that allows us to plan and execute our goal-directed behavior. Some studies identify positive changes in cognitive control, while others demonstrate negative changes. Commercial video games are not specifically designed to train cognitive abilities, so it is difficult to know which aspects of the games are causing the various effects. By designing video games that replicate cognitive control tasks and allow the researcher to manipulate individual variables, we are better able to ascertain the effects of specific game features on brain activity and behavior.

EXAMINING COGNITIVE AND BRAIN FUNCTIONS THROUGH VIDEO GAMES



A growing body of evidence suggests that action video game (AVG) experience is associated with improvements in visual/spatial attention and cognitive control (Green & Bavelier, 2003, 2006, 2007; Green, Pouget, & Bavelier, 2010) and changes in brain function (Knols et al., 2017). The significance of this finding lies in the implication that the skills acquired in an AVG might be transferred to other contexts (Boot, Blakely, & Simons, 2011; Green & Bavelier, 2003). This has led some researchers (Bavelier et al., 2012; Green & Bavelier, 2008) to recommend the use of AVGs in training protocols among populations that would benefit from enhanced visual attention and cognition (e.g., older adults, pilots, military personnel). These recommendations may be premature, however; there are several methodological criticisms of the past research (Boot, Blakely, & Simons, 2011; Bisoglio et al., 2014), one of which is that the use of readily available commercial video games does not allow for strong experimental control over the numerous variables that could influence cognitive skills. Unreal Engine 4 was used to create three video games that simulate standard laboratory assessments of cognitive control; two simulate the Flanker task (Ericksen & Ericksen 1974) while the third video game simulates the N-back task. Two benefits of this approach are 1) greater ecological validity in measuring cognitive control, and 2) the ability to control numerous variables in the video game in order to directly test hypotheses. The realistic video games should provide behavioral data comparable to behavioral data obtained from the standard psychological tasks, while also providing insight into the mechanisms for video game effects on cognition.





SIERRA SPEARS

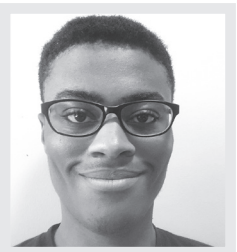
Research Mentor: Eric Gangloff
Department of Zoology

Every organism on this planet must adapt to Earth's ever-changing environments to survive. However, as climate change worsens, this adaptability becomes harder to maintain for Earth's ectothermic (cold-blooded) inhabitants, who depend on the surrounding environment to help regulate their body temperature. Our study looked at how lizards, specifically Pyrenean rock lizards (an endangered species specializing in high-elevation environments), handled changing temperatures at both high and low elevations, and looked for evidence of specific physiological adaptations that could have a hand in ectothermic thermoregulation.

OXYGEN'S EFFECT ON THERMAL PHYSIOLOGY IN *PODARCIS MURALIS*

As climate change worsens and temperatures rise, the ability to respond to novel environments is becoming essential for all life on Earth. Ectotherms, or "cold-blooded" animals, are particularly vulnerable to environmental changes, as they rely on environmental temperatures to maintain their body temperature. Ectotherms that reside at higher elevations are facing warmer temperatures while also dealing with high-elevation hypoxia (oxygen deprivation). To study the effect oxygen availability has on ectothermic thermal physiology, we collected Pyrenean rock lizards (*Iberolacerta bonnali*) from high-elevation habitats. These lizards were then split into two treatments: one group was maintained at the same high elevation environment and one group was transplanted to lower elevation. We then conducted thermal preference trials on both groups in thermal arenas with a gradient of 20-60°. We predicted that lizards transplanted from high to low elevations would prefer a warmer environment, as the increased oxygen availability would aid in maintaining a higher metabolism. While inside these arenas, thermal imaging cameras (FLIR C3 models) were used to take thermographs of each lizard every five minutes. From these thermographs, I extracted both body and head temperature data, and then analyzed it to test the effects of oxygen availability on the thermal preferences for each lizard. This data was also analyzed to test for the presence of regional heterothermy (a physiological strategy wherein ectotherms keep different regions of their bodies at different temperatures) in *I. bonnali*. These results are important because they can give insight into unknown mechanisms of the *I. bonnali's* thermal physiology and help in understanding the mechanisms of how they adapt and respond to the novel environments created by climate change.

PRINCETON VAUGHN



Research Mentor: Eric Gangloff
Department of Zoology

Morphology, how an organism's body is shaped, affects its performance, or how effectively it carries out tasks like sprinting and climbing. Our study examines this relationship in the common wall lizard. Specifically, we tested how fast lizards sprint under different conditions and how their morphology determines this performance.

HOW MORPHOLOGICAL MECHANISMS AFFECT THE PERFORMANCE OF THE COMMON WALL LIZARD (*PODARCIS MURALIS*)

An organism's morphology (how its body is shaped) affects its performance (how effectively it carries out tasks like sprinting and climbing). This relationship can change in different contexts. Therefore, we might expect to find trade-offs whereby beneficial morphology in one environment can be detrimental in another environment. Understanding how morphology affects performance in novel environments is necessary to understand how invaders can be successful. We tested this relationship in the common wall lizard (*Podarcis muralis*) by measuring their sprint speed under a variety of conditions with a full-factorial design of substrate type (cork bark, artificial grass, and sandpaper), sprinting elevation (level, incline), and obstacles (presence, absence). We also measured the size of various body dimensions important for locomotion including tail length and limb dimensions. We analyzed these data to answer three questions, (1) on what condition do lizards best perform? (2) Are there any within individual performance trade-offs (do lizards who run faster on one substrate run slower on another)? (3) How does morphology affect sprint performance? Our results show that lizards perform best on artificial grass without obstacles, but on cork with obstacles. Surprisingly, lizards consistently perform better on an incline compared to a flat track on all substrates. We also found significant negative correlations between sandpaper and the other two substrates. Larger lizards ran faster than smaller lizards, but only without obstacles. This research will allow us to see how these lizards can respond to different environments and provide insight into how invasive species colonize novel environments.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Student Name	Mentor	Department	Title
Amanda Hays	Richard Spall	History	Tolstoy and Gandhi: How Tolstoy's Philosophy Influenced the Movement for Indian Independence
Anthony Padget-Gettys	Mark Allison	English Literature Writing	Tabletop Role-Playing Games: A Unique & Deserving Narrative Form
Michaela Rice	Kira Bailey	Psychology	Shooting your Accuracy in the Foot? Examining the Short-Term Effect of an Action Video Game on Cognitive Control
Alex Sanchez	Sean Kay	International Studies	Exploring the Case of Puerto Rico: The Century-Old Philosophy in Augustine
Megan Sievers	Andrew Busch	HHK Exercise Science	Comparison of Jump Performance, Balance, Lower Extremity Range of Motion, and Interlimb Asymmetries in Different Levels of Dancers
Emma Tarawally	Blake Michael	Religion	The Practice of Ayurveda and African Traditional Healing

SPECIAL ACKNOWLEDGEMENTS

Sources of Support for the 2020 Summer Science Research Program

American Electric Power Foundation
Harry Phillip Bahrick Summer Research Fund
Joseph H. ’30 and Elizabeth Brant Collaborative Research Fund
Eleanor Brown Summer Science Research Endowment
Jack E. ’52 and Joyce A. Cornett Summer Science Research Fund
Anne E. Donnelly ’75
Herbert L. ’61 and Margaret Wright ’61 DuPont Collaborative Summer Research Fund
Ferry Family Foundation
Dr. James B. Hoy ’57 Endowment
Robert V. and Alice C. Kail Summer Science Research Internship
Marcia Kunstel ’69
The Frank McKinney P ’71 and Donalda McKinney P ’71 Endowed Fund
Albert A. Mills Jr. Summer Science Research Program Fund
National Science Foundation
Bruce R. Roberts Research Endowment for The OWU Connection
The David O. and Janice S. Robbins Summer Science Research Endowment
David H. Smith ’53 Fund for the Sciences
The Student-Faculty Endowed Research Fund in Chemistry
Ohio Wesleyan University Provost and Academic Affairs Office

Support for the Patricia Belt Conrades Summer Science Research Symposium

Dr. Nancy Reynolds Schneider ’64

Campus Researchers

Special Thanks

Rock Jones
Charles L. Stinemetz
Karen McNeal
Sue Haidle
Chuck DellaLana
Allie Hausfeld
Lindsay Mauter
Barb Wiehe
Ohio Wesleyan University Buildings and Grounds Staff
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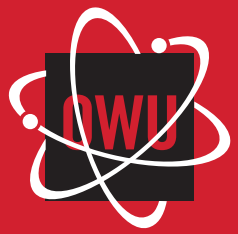

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