Summer Science Research Program
Ohio Wesleyan University

2024 Research Project Information Sheet
(Faculty information sheet)
Submission Deadline: 26 January 2024

General area of research

Specific title of research project Examining Cognitive and Brain Function through Video Games

Faculty mentor supervising research

Name: Kira Bailey
General area of research:
Department: Psychology & Neuroscience
Email address: kmbailey@owu.edu

Anticipated research dates (10 weeks):

Beginning: 5/20/2024
Ending: 7/26/2024

Requested number of students: Two

Minimum qualifications of student researcher (be as specific as possible)
For this project, the student should have an interest in understanding human cognition through video games. Prior coursework or experience with the coding and/or electroencephalography (measurement of human brain waves) is strongly preferred, but students willing to learn these skills are encouraged to apply. The student should be comfortable learning new computer software. Completion of any of the following courses is strongly recommended, but not necessarily required: Introduction to Neuroscience (NEUR 250), Cognitive Neuroscience (PSYC 342). Students who have taken CS courses or have prior experience with programming in any language are encouraged to apply.

Description of the research project (one page maximum)
A growing body of evidence suggests that action video game (AVG) experience is associated with improvements in visual/spatial attention and executive functioning (Feng, Spence, & Pratt, 2007; Green & Bavelier, 2003, 2006, 2007; Green, Pouget, & Bavelier, 2010; West, Stevens, Pun, & Pratt, 2008) 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), which contrasts with findings from a wealth of training paradigms wherein improvements in performance transfer very

narrowly (to highly similar tasks) or not at all (Ball et al., 2002; Hertzog et al., 2009; Owen et al., 2010).

The seemingly broad transfer of skills from AVGs after little to moderate amounts of training (10 to 50 hours) 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 criticism 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. At this point it is nearly impossible to know what features of a given video game are training which cognitive skills.

The proposed project is designed to address this criticism by developing new video games specifically designed to train cognitive skills and modifying existing commercial games for that purpose. In addition to allowing the researchers greater control over important variables, this approach allows for simultaneous recording of brain activity during game play, which only a few studies have achieved (e.g., Mondejar et al., 2018). We can examine changes in brain activity during, as well as after, video game training, which may provide information about the mechanisms of video game effects that could be used to develop future training protocols.

2024 Research Project Information Sheet
(Faculty information sheet)
Submission Deadline: 26 January 2024

General area of research

Specific title of research project Development in the Context of LGBTQ+ Families

Faculty mentor supervising research

Name: Krystal Cashen
General area of research:
Department: Psychology
Email address: kkcashen@owu.edu

Anticipated research dates (10 weeks):

Beginning: 5/13/2023
Ending: 7/19/2023

Requested number of students: One

Minimum qualifications of student researcher (be as specific as possible)
Required:
Successful completion of PSYC 110
Interpersonal skills necessary for interacting with human participants
Sensitivity to LGBTQ+ identities and openness to continued learning in this area
Detail-oriented and reliable
Preferred:
Successful completion of either PSYC 233, 282, 285, or 333
Familiarity with statistical and survey software

Description of the research project (one page maximum)
The student would have the opportunity to contribute to two projects examining impacts on developmental outcomes within LGBTQ+ families.

Impact of Political Context on Family Formation Decision Making among LGBTQ+ Individuals

In recent decades, scientific advances in assisted reproduction technologies (ART) and changes in legal access to adoption have resulted in greater access to multiple pathways to family

formation for LGBTQ+ individuals. However, each family formation pathway carries unique benefits, risks, and considerations for family functioning and child development (Goldberg, 2023). Previous research has shown that LGBTQ+ individuals often report distinct reasons for choosing a specific family formation pathway in comparison to cisgender heterosexual individuals. However, recent changes in the political and legal landscape within the United States (e.g., the overturning of Roe v. Wade, increasing anti-LGBTQ+ legislation) may shift how LGBTQ+ individuals make decisions about family planning. For example, a recent study of current LGBTQ+ parents in Florida found that many parents had considered or were actively undertaking changes to their own behavior (e.g., not disclosing their LGBTQ+ identity) and/or changes to their family context (e.g., changing their child's school, moving out the state) to cope with growing concerns about the safety of their families following the passage of HB 1557 (Goldberg, 2022).

Using a survey design, this study examines whether LGBTQ+ individuals are similarly making adjustments to their plans for future parenthood (e.g., whether to become a parent, choice of family formation pathway, parenting contexts). Data for this study was collected during SSRP 2023. This year's student would be able to assist with data cleaning and analysis.

LGBTQ+ Family Socialization and Developmental Outcomes in Emerging Adulthood

My previous work has shown that people with LGBTQ+ parents develop unique community connections and identities (Cashen, 2022) and attribute increased feelings of openness and acceptance to their upbringings (Burand et al., 2023). However, we still do not understand which specific processes contribute to these developmental outcomes. One potential parenting practice that may contribute to these outcomes is LGBTQ+ family socialization or the ways in which LGBTQ+ parents talk to their children about what it means to be an LGBTQ+ family (Oakley et al., 2017). This survey study will examine how LGBTQ+ family socialization is associated with important developmental outcomes in emerging adults with LGBTQ+ parents. The SSRP student will be able to contribute to designing and piloting study measures in preparation for data collection this fall.

2024 Research Project Information Sheet
(Faculty information sheet)
Submission Deadline: 26 January 2024

General area of research

Specific title of research project Studying Foreign Policy Preferences Using Relative Choice Survey Methods

Faculty mentor supervising research

Name: Nick Dietrich
General area of research:
Department: Math/CS
Email address: nmdietrich@owu.edu

Anticipated research dates (10 weeks):

Beginning: 5/13/2024
Ending: 7/19/2024

Requested number of students: One

Minimum qualifications of student researcher (be as specific as possible)
Experience manipulating data in R, Python, or another programmatic data software;
Experience conducting and interpreting statistical analyses;
An interest in social science or public opinion research, broadly defined.

Description of the research project (one page maximum)
This research project aims to investigate the relative importance of different factors in the formation of foreign policy preferences related to international intervention. Existing literature has identified a number of predictors of support for international intervention, usually among American audiences. These predictors include governance (e.g., intervening on behalf of democracies), cost (e.g., the number of casualties sustained during intervention), partisanship (e.g., whether the respondent considers themselves a Republican or Democrat), and moral justification (e.g., the specific circumstances of the situation requiring intervention as they relate to international norms). A pervasive weakness of this body of literature is the inability to draw conclusions about the relative importance of different predictors.

In this study, we will use survey methods in which respondents are required to choose the best and worst options from a list of alternatives. This methodology (sometimes called “MaxDiff” or

“Best-Worst”) allows for internally valid estimation of relative utility in a set of alternative choices. This methodology is often used in market research. The student researcher will work with the faculty mentor to recruit a sample of survey respondents, field the survey, clean and format the data, analyze the survey results, and analyze/visualize those results in a manner suitable for publication in a peer-reviewed journal.

Summer Science Research Program
Ohio Wesleyan University

2024 Research Project Information Sheet
(Faculty information sheet)
Submission Deadline: 26 January 2024

General area of research

Specific title of research project Testing Spacetime Symmetries with Spin Precession

Faculty mentor supervising research

Name: Yunhua Ding
General area of research:
Department: Department of Physics and Astronomy
Email address: yding@owu.edu

Anticipated research dates (10 weeks):
Beginning: 5/13/2024
Ending: 7/19/2024

Requested number of students: One

Minimum qualifications of student researcher (be as specific as possible)
Completion of PHYS 280 Contemporary Physics. Some experience in Mathematica coding is preferred, but not required.

Description of the research project (one page maximum)
General Relativity (GR) and the Standard Model (SM) of particle physics are the two most successful theories describing our nature so far. Among the important foundations of both theories, Lorentz and CPT symmetries play a crucial role. The former states that physical laws are unchanged when transforming between two inertial frames, while the latter is the symmetry of physical laws under the simultaneous transformations of charge conjugation (C), parity inversion (P), and time reversal (T). Although many of the predictions from GR and the SM have been testified by experiments, these two theories are not unified, and they are believed as low-energy limits of a more fundamental theory. Recent analysis indicates that tiny violations of Lorentz and CPT symmetries could appear theoretically as natural features of models unifying gravity with quantum physics. Such tiny deviations from these symmetries could produce interesting observable effects, such as modifications to the spin motion of particles under electromagnetic fields.

This theoretical project focuses on studying interesting signals arising from the violation of

Lorentz and CPT symmetries in experiments searching for nonzero Electron Dipole Moments (EDMs). By exploring both theoretical and experimental prospects for Lorentz and CPT violation related to the spin motion under electromagnetic fields, the project aims to identify interesting experimental signals, study their properties, and use published results to set limits on the sizes of these signals.

In this project, by collaborating with the mentor, the student will

1. Apply the general framework, the Standard-Model Extension, to calculate the corrections to the energy levels of a confined particle in electromagnetic fields.
2. Derive the Lorentz- and CPT-violating contributions to the spin precession of the confined particle.
3. Relate the measured EDM signal to the coefficients in the SME.
4. Study the time variations of the signals due to the Earth's rotation.
5. Apply published experimental results for EDM measurements to constrain the sizes of Lorentz- and CPT-violating effects.

(Depending on the progress, a paper draft could be ready for submission to a peer-reviewed journal after completing the project.)

Summer Science Research Program
Ohio Wesleyan University

2024 Research Project Information Sheet
(Faculty information sheet)
Submission Deadline: 26 January 2024

General area of research

Specific title of research project Traffic modeling: the impact of lane-changing

Faculty mentor supervising research

Name: Han Guo
General area of research:
Department: Math and CS
Email address: hguo@owu.edu

Anticipated research dates (10 weeks):

Beginning: 5/13/2024
Ending: 7/19/2024

Requested number of students: One

Minimum qualifications of student researcher (be as specific as possible)
The successful candidate should

1. have taken Math 111 (calc II) and possess equivalent knowledge of CS110 (basic knowledge for programming) by the end of the Spring semester (more math and CS classes are helpful, but not required);
2. not be afraid of programming;
3. be curious about the traffic jams;
4. be hardworking and embrace challenges.

Description of the research project (one page maximum)
Research on traffic dynamics began as early as the 1930s, and a surge in the number of publications on the topic was seen in the 1950s. These papers introduced the fundamental diagram showing the relation between traffic flow and vehicle density or the instability of traffic flow, which are critical elements of understanding traffic.

In 1959, Harold Greenberg wrote that "The volume of vehicular traffic in the past several years has rapidly outstripped the capacities of the nation's highways. It has become increasingly necessary to understand the dynamics of traffic flow and obtain a mathematical description of the process." [Greenberg, Harold. Operations research (1959)]

He was not wrong. In fact, the situation has greatly deteriorated since then. Highways in big cities like Los Angeles and San Francisco have practically become giant parking lots. Heavy traffic congestion also leads to environmental pollution, and harms human health both physically and mentally.

Traffic modeling is a complex system problem in which everyone's driving decisions affect the overall traffic flow. In this project, we aim to explore the connections between individual's driving decisions and the overall traffic flow rate. We will model the traffic flow mathematically and write computer programs to run simulations. We will simulate each car and study how individual driver's behaviors affect the overall traffic flows.

Last year's SSRP project adopted a classic car-following model for single-lane dynamics and experimented with various lane-changing rules for multi-lane dynamics, mostly in a homogeneous setting (all cars obey the same rule). Building on the encouraging results from last year, this year's project will focus on either or both of the following (1) test the lane-changing rules under heterogeneous settings; (2) incorporate finite reaction time for the driver. Students are also HIGHLY encouraged to propose interesting ideas!

Summer Science Research Program
Ohio Wesleyan University

2024 Research Project Information Sheet
(Faculty information sheet)
Submission Deadline: 26 January 2024

General area of research

Specific title of research project Investigating Starspots via Light-curve Inversion

Faculty mentor supervising research

Name: Robert Harmon
General area of research:
Department: Physics and Astronomy
Email address: roharmon@owu.edu

Anticipated research dates (10 weeks):
Beginning: 5/27/2024
Ending: 7/26/2024

Requested number of students: Two

Minimum qualifications of student researcher (be as specific as possible)
Completion of PHYS 111 L

Description of the research project (one page maximum)
Even as imaged by the Hubble Space Telescope, stars appear to be featureless pinpoints. As a result, it is necessary to use indirect techniques in order to obtain information about their surface features. This project uses a particular technique for doing that called Light-curve Inversion (LI). Of particular interest are “starspots,” which are analogous to sunspots on the Sun, and are known to be present on certain classes of stars. Like sunspots, starspots are believed to be manifestations of stellar magnetic fields. The study of starspots can thus provide valuable insights into the physics of the magnetic dynamos operating in the Sun and other stars.

If there is a dark spot on the surface, then every time the star’s rotation carries the spot into view from Earth, there will be a dip in the star’s brightness. If we knew in detail the appearance of the star’s surface, a relatively straightforward calculation would allow us to predict the star’s brightness as a function of time, i.e., its light curve. With LI we attempt to go in the other direction: knowing the light curve, determine the appearance of the star’s surface.

There are two projects that students might work on during the summer. The first is to use a

telescope at Perkins Observatory to obtain light curves of a particular star, LO Pegasi, that is particularly well-suited for a summer research project: It is well-placed for observation in June and July, and it has a short 10.153-hour rotation period, making it relatively easy to gather enough data for analysis of its starspots. Images of a star field surrounding LO Pegasi will be obtained using a QSI 632 CCD camera and V, R and I photometric filters. The light curves will then be analyzed via LI to produce maps of the stellar surface.

The other potential project involves participating in the analysis of light curve data obtained for a large set of stars observed by NASA's Kepler satellite mission. The Kepler telescope was designed to search for exoplanets orbiting other stars by observing the decreases in brightness caused when an exoplanet transits, i.e., passes in front of, its host star, thus blocking some of the star's light. Because starspots also cause changes in a star's brightness, Kepler data can be used to study starspots as well as exoplanets. I am collaborating with Dr. Rachael Roettenbacher OWU '08 on this project, and we are looking to involve undergraduates at OWU and the University of Michigan in it.

2024 Research Project Information Sheet
(Faculty information sheet)
Submission Deadline: 26 January 2024

General area of research

Specific title of research project Generative Textile Design and Production

Faculty mentor supervising research

Name: Craig Jackson and Jeff Nilan
General area of research:
Department: Math/CS and Fine Arts
Email address: chjackso@owu.edu

Anticipated research dates (10 weeks):

Beginning: 5/13/2024
Ending: 7/19/2024

Requested number of students: One

Minimum qualifications of student researcher (be as specific as possible)
A prospective student should have taken a foundational 2D art course (either Intro to 2D Design or one of Digital or Materials Foundations). For the rest, it depends on what specific parts of the project the student is interested in. If they are interested in the hardware/software side of it, then at least CS 110. If interested more in the production side of the project, then an upper level studio art course.

Description of the research project (one page maximum)
The term “generative art” describes art in which the artist relinquishes some significant aspect of control over the final piece to an external agent. Often, this external agent is machine driven randomness. The proposing faculty are interested in developing generative algorithms for textile design with a focus on rugs due to their long history of use across cultures as both utilitarian pieces and aesthetic objects. This is a newer area of inquiry since generative designs are historically impractical for use in textiles: implementing irregular/generative designs on a traditional loom requires time consuming manual intervention by the artist. As a remedy for this, we have constructed a Jacquard loom that allows rugs to be woven up to 40 inches wide at 4-8 ends per inch. Our loom uses 320 individual microprocessor-driven servo motors and is capable of producing literally any weaving pattern.

Complete access to all possible weaving patterns is not strictly necessary for producing generative textiles, however. Shaft switching is a technique that represents a middle ground between a traditional floor loom and a full Jacquard loom. Equipping a loom with a computer-controlled shaft switching device would allow the weaving of generative designs without the need for full Jacquard functionality. So far as we know, digital shaft switching is an unexplored area of generative textile design.

The student(s) selected for this summer research experience could work on one or more of the following projects according to their interests and expertise:

1) Develop generative algorithms for textile design with a focus on rugs. It is important to note that weaving designs are heavily constrained by the material reality of the underlying woven medium. Hence, designs that look good on paper can easily result in poorly woven pieces.

2) Redesign the graphical user interface for our computer-controlled Jacquard loom to make it usable for weavers without extensive programming background.

3) Design and build the hardware and software necessary to add digital shaft switching functionality to a 200+ year old barn frame loom that we have recently acquired.

4) Validate the work done on any/all of the previous projects by actually producing full-sized woven pieces. This entire project is premised on using math and computing in the production of art and craft. Hence, to be successful, it is important to test the work done in service of this goal. It can take many hours to produce a finished piece. Students who apply must be willing and able to spend significant time at the loom.

For more information, please consult the following paper:

C. Jackson, J. Nilan, Generative Design in Textiles: Overcoming Problems of Production, Proceedings of the 26th International Conference on Generative Art, Rome, 2023. https://generativeart.com/GA2023/papersDOC/OK/44_CRAIG_Jackson_Nilan3.pdf

2024 Research Project Information Sheet
(Faculty information sheet)
Submission Deadline: 26 January 2024

General area of research

Specific title of research project The influence of urban and forested habitat on physiology and population dynamics of wall lizards in Ohio

Faculty mentor supervising research

Name: Allison Litmer
General area of research:
Department: Biological Sciences
Email address: arlitmer@owu.edu

Anticipated research dates (10 weeks):

Beginning: 5/13/2024
Ending: 7/19/2024

Requested number of students: Two

Minimum qualifications of student researcher (be as specific as possible)
Students should have the following qualifications:
1. Willingness to learn to handle live animals (or former experience working with live animals)
2. Experience with meticulous record keeping and/or data collection
3. Students with an interest in ecology and/or physiology are preferred
4. Ability and willingness to work flexible hours, sometimes including uncomfortable conditions such as long, consecutive, field days
5. Willingness to travel for 3 - 4 days at a time to Cincinnati, OH

Description of the research project (one page maximum)
The student researchers will be part of a team working on a project funded by the National Science Foundation titled “BRC-BIO: Success in the Anthropocene: Evolutionary Ecology of the Common Wall Lizard in Ohio”.

Project Summary:
Common wall lizards (Podarcis muralis) in Cincinnati, OH, are urban invaders with successful establishment in many locations worldwide, providing an ideal system of asking how organisms

invade urban settings. Habitat, and the resulting thermal landscape, influence the ability of an introduced species to persist. Temperatures are often comparatively warmer in cities, potentially resulting in higher body temperatures and faster rates of physiological processes. However, few studies examine methods of establishment with consideration for physiological performance in terrestrial invaders. If novel, urban environments promote efficient performance in introduced species (in contrast to forested habitat), the result may be subsequently high rates of survival and reproduction promoting population growth. Additionally, prey type may vary in the new location, and in particular between urban and forested settings, influencing the gut microbiome of invaders. Gut microbiomes may promote invasion success, with effects on the flexibility in digesting novel diets, physiological performance, thermal sensitivity, pathogen susceptibility, and overall health. Thus, we propose a comparative study quantifying differences in temperature profiles, population demographics, physiology, and gut microbiome between wall lizards living on human-made structures versus forested parks. Determining how animals invade urban habitat is important for understanding how human-disturbed areas influence organismal performance and predicting future invasion success of potential harmful species.

Standard Protocol for Researchers:
We will conduct surveys at pre-established urban and forested sites in Cincinnati, OH throughout the summer. Lizards will be captured using a safe, established method of looping with a string, followed by data collection on body size, mass, sex, reproductive status, and temperature. Lizards often voluntarily defecate upon capture, and feces will be stored in tubes for microbiome extraction at OWU in the lab. We will mark lizards and release them for recapture at a later point to quantify changes in body dimensions and reproductive status. Additional temperature data will be assessed via data loggers or thermal imaging camera. Some lizards will be returned to the lab for additional studies on physiological performance related to food consumption and digestion, where we determine how much lizards voluntarily eat under given environmental conditions, digestion time, and energy assimilation. The specific components of the study will vary based on student interest.

Summer Science Research Program
Ohio Wesleyan University

2024 Research Project Information Sheet
(Faculty information sheet)
Submission Deadline: 26 January 2024

General area of research

Specific title of research project Artificial Intelligence of Modern Board Games

Faculty mentor supervising research

Name: Sean McCulloch
General area of research:
Department: Math/CS
Email address: stmccull@owu.edu

Anticipated research dates (10 weeks):

Beginning: 5/13/2024
Ending: 7/19/2024

Requested number of students: One

Minimum qualifications of student researcher (be as specific as possible)
Successful completion of CS210 by the end of this spring. More CS classes (especially CS360) is helpful.

Description of the research project (one page maximum)
Much work has been done in the past on designing Artificial Intelligence (AI) programs to play "classic" board games, such as Chess, Checkers, Othello, and Go. Many of these games have programs that are sufficiently advanced that they beat the best human players. In the last ten to twenty years, however, there has been a rise in "abstract" or "European-style" board games. These differ from the board games many of us have played as children (such as Monopoly or Life) in several areas: (1) the games are typically short, many finishing in 90 minutes or less; (2) the games usually emphasize player interaction in some way (components such as bidding, competing for scarce resources, or trading/negotiation are commonly seen); and (3) the games often are based around hidden information, so that nobody can know the whole state of the game. These factors, especially the last two, make designing an AI for these games a challenge, and so much less has been done analyzing these games, and what has been done has much room for improvement (some people have made "toy" programs to play against, while other game companies have been developing AI programs for sale, usually as mobile apps). I have personally created a game-theoretic agent to play the game Football Strategy, and past

summer students have created an agent for the game Battle Line that is based on probability].

Previous summer students have also begun work on agents for the games Modern Art (a multiplayer auction game), Euro Rails (a game where players create rail lines and deliver goods), Pandemic (a cooperative game where players work together to cure diseases before it outbreaks across the world), Lost Cities (a two-player game where people compete to make increasing sequences of cards) and Scotland Yard (a semi-cooperative where a team of detectives work together to find the hidden “Mr. X”). This summer’s SSRP student can either extend the work in these programs, refine the Football Strategy or Battle Line programs, or begin work on an entirely new game.

2024 Research Project Information Sheet
(Faculty information sheet)
Submission Deadline: 26 January 2024

General area of research

Specific title of research project Exploring Self-Grading in Mathematics: A pedagogical approach to foster metacognition in a college mathematics class

Faculty mentor supervising research

Name: Matthew McCurdy
General area of research:
Department: Math/CS
Email address: mtmccurdy@owu.edu

Anticipated research dates (10 weeks):
Beginning: 6/10/2024
Ending: 8/9/2024

Requested number of students: One

Minimum qualifications of student researcher (be as specific as possible)
Must have taken Differential Equations (or other math course we agree on), and be interested in something education-related

Description of the research project (one page maximum)
A student and I will collaborate to prepare for implementing self-grading in a college-level Ordinary Differential Equations course (or another math class that we agree on!). Three/four weeks of this project will take place at OWU, and six/seven weeks will take place on the campus of Amherst College while serving as a TA in a seven-week math class for Thrive Scholar's Summer Academy (with more information at the end of this proposal).

Our preparatory tasks include:

1. Research and Literature Review: We will review existing literature on self-grading methodologies in mathematics education to inform our project design.
2. Development of Assignment Structures and Rubrics: Together, we will design assignment structures and rubrics aligned with course objectives, fostering clear guidelines for student self-evaluation.

3. Pilot Testing and Refinement: We will conduct pilot testing of assignments and rubrics with a summer Calculus course, gathering feedback to refine our assessment tools.
4. Training and Professional Development: Engaging in workshops with the program at Amherst College, we will enhance our understanding of self-grading practices and student-centered learning approaches.
5. Technology Integration and Resource Preparation: We may explore software tools and prepare instructional materials to support students in the self-grading process.
6. Documentation and Evaluation Framework: We will document our progress and establish an evaluation framework to assess the impact of self-grading on student learning outcomes.

By engaging in these collaborative activities, the student and I will lay a foundation for implementing self-grading in ODEs (or other course!), fostering a student-centered learning environment conducive to academic growth. Our tools would be implemented the next academic year and we would aim to publish our results in a journal focused on math education.

Thrive Scholars (https://www.thrivescholars.org) is a non-profit aimed at helping high-achieving, low-income underrepresented students get into and graduate from top colleges to achieve their full career potential. You would be a TA for a calculus course during our time there. Food, lodging, and an additional (modest) stipend would be provided.

Please feel free to chat with me about this if you're at all interested!

2024 Research Project Information Sheet
(Faculty information sheet)
Submission Deadline: 26 January 2024

General area of research

Specific title of research project Behavior, physiology, and reproductive success in two species of North American wrens

Faculty mentor supervising research

Name: Dustin Reichard
General area of research:
Department: Biological Sciences
Email address: dgreicha@owu.edu

Anticipated research dates (10 weeks):

Beginning: 5/8/2024
Ending: 7/26/2024

Requested number of students: Two

Minimum qualifications of student researcher (be as specific as possible)

1. Must be able to wake up early (pre-dawn) and hike on uneven terrain in hot, humid conditions in the presence of biting insects such as ticks, mosquitos, and flies.
2. Must be able to use binoculars to observe small birds and identify individuals based on combinations of colored leg bands (no previous experience necessary, training will be provided!).
3. Must be willing to handle live birds (adults and nestlings) and collect blood samples (no previous experience necessary, training will be provided!).
4. Completed BIOL 122 (preferred) or BIOL 120.

Description of the research project (one page maximum)

Research in my lab focuses broadly on the evolution of animal behavior and the hormonal mechanisms of behavior. We investigate these topics in free-living (wild) songbird species, but our primary focus is two closely related species of wrens that nest in bird boxes. House and Carolina Wrens differ in multiple life history characteristics, which makes them a compelling comparative study system. House wrens are migratory, experience a shorter breeding season, and coexist at much higher densities than Carolina Wrens, which are sedentary and found in

central Ohio year-round. My lab studies both species using a collection of 200 nest boxes in the Delaware area. Students that work in the lab gain skills in handling and extracting birds from mist nets, bird banding, blood sampling and processing, behavioral observation, audio recording, and field data collection and management. In the summer of 2022, there is one ongoing research project that we will undertake and the possibility for additional projects depending on the number of students recruited and their interests.

Our primary project will investigate what determines the strength of nest defense behavior in House Wrens. Previous SSRP students found that female House Wrens respond less aggressively to a simulated hawk at their nest box than to a snake or chipmunk. This result indicates that wrens use risk assessment to guide their antipredator behavior, which means that they don't treat all predators equally. Because hawks pose a larger threat to adults than offspring, cautious parents are more likely to survive and reproduce again in the future, which makes weaker nest defense the best strategy. This summer we will expand on these results to test whether wrens use a size-based threshold to determine their antipredator response. Basically, do wrens only attack predators below a certain size? We will 3D print three identical plastic chipmunk models that differ only in size and present them to wrens at their nest boxes on consecutive days. Consistent with the size-based threshold hypothesis, we predict that wrens will respond less aggressively to the larger models.

Additional unrelated projects could involve investigating territorial behavior, circulating hormone levels, song structure and function, or nest architecture in either wren species. Although not required or expected, I am hoping to recruit students that are interested in continuing their research as an independent study during the next academic year. The independent study would likely focus on data analysis and writing a manuscript for publication.

2024 Research Project Information Sheet
(Faculty information sheet)
Submission Deadline: 26 January 2024

General area of research

Specific title of research project Environmental Mapping and Analysis using Unoccupied Aerial Vehicles (UAVs)

Faculty mentor supervising research

Name: Dr. Nathan Rowley
General area of research:
Department: Department of Environment and Sustainability
Email address: nrowley@owu.edu

Anticipated research dates (10 weeks):

Beginning: 5/14/2024
Ending: 7/19/2024

Requested number of students: One

Minimum qualifications of student researcher (be as specific as possible)
Intro GIS (GEOG 291 or GEOG 292) (required), GEOG 369: Remote sensing (very much preferred), ability to work with limited supervision, motivated and looking forward to problem-solving.

Description of the research project (one page maximum)
Since the beginning of the 21st Century, there has been rapid, and significant change in the remote sensing of the global environment. Remote Sensing is the ability to understand a surface (e.g., water, forest, urban area, different planetary bodies) without direct contact; unlike weather stations that provide data about our atmosphere while being in the atmosphere. The sensors associated with remotely sensed data mainly rely on freely available satellite imagery and, more recently, the professional use of UAVs, or unoccupied aerial vehicles.
To date, the work in the Remote Sensing Lab (RSL) has captured and analyzed data in the visible portion of the electromagnetic (EM) spectrum, that is, in red (0.70 μm), green (0.55 μm), and blue (0.48 μm) wavelengths. This has allowed us to generate two-dimensional orthomosaics and high-resolution digital surface models (DSMs). We will use the RSL's Micasense Dual RedEdge cameras and the Zenmuse L1 LiDAR sensors for this study.
The Dual RedEdge camera has a total of 10 bands in which it captures data and has been

designed to distinguish between various plant species, while the Zenmuse L1 LiDAR sensor will allow us to generate a very accurate 3-D representations of objects (like a forest, or shallow water bodies).

This summer's work is a collaboration with Methodist Theological School of Ohio (MTSO) – a campus partner – where we address environmental questions and concerns on their campus, including vegetation mapping of the campus' forest, monitoring of farm fields during the growing season, bathymetric (below water surface elevation) mapping of the pond, and hydrologic water routing across the campus to monitor and mitigate flooding hazard.

This will require a hybrid lab experience where meetings and data collection will take place outdoors, while data processing and analysis will take place in the lab, using GIS software.

Summer Science Research Program
Ohio Wesleyan University

2024 Research Project Information Sheet
(Faculty information sheet)
Submission Deadline: 26 January 2024

General area of research

Specific title of research project Interactions between monolayer membrane mimics and cell-penetrating peptides

Faculty mentor supervising research

Name: Bethany Rudd
General area of research:
Department: Chemistry
Email address: barudd@owu.edu

Anticipated research dates (10 weeks):

Beginning: 5/13/2024
Ending: 7/19/2024

Requested number of students: One

Minimum qualifications of student researcher (be as specific as possible)
The student should have successfully completed the organic chemistry sequence. Ideal candidates have proficiency in basic laboratory skills such as solution preparation. This project will also involve data analysis using graphing software and a large amount of literature review.

Description of the research project (one page maximum)
Biological membranes are significant contributors to transmembrane protein function and localization. Additionally, membrane fluidity and dynamics is influenced directly by its composition. In this project, students will study Langmuir monolayers of sphingolipids, phospholipids and cholesterol as simple model systems representing human biological membranes. Two-dimensional Langmuir monolayers have long been used as simplified model systems to study the interactions that occur within cell membranes (bilayers). Using simple Langmuir model systems allows us to obtain molecular-level information on the interactions between these lipids and various small molecules (i.e. drugs, hormones, peptides, etc.) which can be correlated to their physiological activity. The glycine receptor (GlyR), a pentameric ligand gated ion channel (pLGIC) protein, is responsible for inhibitory neurotransmission by facilitating the influx of chloride ions. GlyR is a therapeutic target as it is linked to chronic pain and hereditary hyperekplexia. A large intracellular loop within GlyR, the M3-M4 loop, is not well

characterized structurally, though it is known that receptors that have truncated or missing loops do not function. Crosslinking-mass spectrometry (CXMS) studies have shown that attaching a crosslinker to mutated Cys residues in the extracellular domain of GlyR can crosslink to residues in the M3-M4 loop region, though these residues are located beyond the reach of the crosslinker. One explanation of the results could be due to poly-Arg/Lys regions, located in the M3-M4 loop. Studies have shown that peptides containing Arg and Lys residues have the ability to penetrate the membrane and act as cell-penetrating peptides (CPPs). By studying the effects CPPs have on the structural organization of various Langmuir monolayers, the M3-M4 loop can be better understood. Through this project, students will get a unique opportunity to use specialized surface-science instrumentation. Students will utilize a Langmuir trough to collect surface pressure-area isotherms and Brewster angle microscopy to image the aqueous interfaces of interest.

This is a collaborative project between Drs. Bethany Rudd & Kayce Tomcho. Two students will work on the following parallel projects:
1) Interaction of Sphingomyelin-dipalmitoylphosphatidylcholine-cholesterol monolayers with the following potential CPPs in the M3-M4 loop: 310QHKELLR316 and 317FRRKRRHHK325

2) Interaction of Sphingomyelin-dipalmitoylphosphatidylcholine-cholesterol monolayers with the following potential CPPs in the M3-M4 loop: 372SPEEMR377, 378KLFIQRAK385 and 386KIDKISR392

2024 Research Project Information Sheet
(Faculty information sheet)
Submission Deadline: 26 January 2024

General area of research

Specific title of research project Characterizing the competitive mechanisms of symbiotic squid bacteria

Faculty mentor supervising research

Name: Andrea Suria
General area of research:
Department: Biological Sciences
Email address: amsuria@owu.edu

Anticipated research dates (10 weeks):

Beginning: 5/13/2024
Ending: 7/19/2024

Requested number of students: One

Minimum qualifications of student researcher (be as specific as possible)
The student researcher should be comfortable learning how to culture non-pathogenic bacteria. They should be willing to work with live squid eggs, including maintaining a saltwater aquarium and learning how to inject eggs with a syringe. Attention to detail will be important for maintaining multiple different egg treatments in the same experiment.

Description of the research project (one page maximum)
All animals establish life-long symbiotic relationships with bacteria, which play crucial roles in the animal's health. While pathogenic bacteria can cause disease, beneficial bacteria can aid in digestion, foster development of the immune system, or prevent infections. However, these benefits depend on the type of bacteria that successfully outcompete other bacteria to colonize the animal. Although bacteria have evolved many different methods of competition, the exact molecular mechanisms are not well understood.

In the Suria lab, we use symbiotic bacteria isolated from the Hawaiian bobtail squid as a model to study the mechanisms of bacterial competition. Female squid deposit bacteria into a jelly layer that surrounds the embryo of their eggs, which protects them from lethal fungal infections. In this project, we will create gene mutations in the egg bacteria and screen for their ability to

compete with other bacteria. If a mutant can no longer outcompete other bacteria, then the mutated gene may be necessary for colonizing the squid and that mutant will be tested in the eggs.

The student researcher will be taught a combination of culture-based microbiology and molecular biology techniques (PCR, cloning, and DNA sequencing) to determine the genes involved in competition. The student will first conduct bacterial competition assays in vitro on agar plates, and then in vivo, by injecting mutant bacteria into the squid eggs and sampling over the course of egg development.

Summer Science Research Program
Ohio Wesleyan University

2024 Research Project Information Sheet
(Faculty information sheet)
Submission Deadline: 26 January 2024

General area of research

Specific title of research project Interactions between monolayer membrane mimics and cell-penetrating peptides

Faculty mentor supervising research

Name: Kayce Tomcho
General area of research:
Department: Chemistry
Email address: katomcho@owu.edu

Anticipated research dates (10 weeks):

Beginning: 5/13/2024
Ending: 7/19/2024

Requested number of students: One

Minimum qualifications of student researcher (be as specific as possible)
The student should have successfully completed the organic chemistry sequence. Ideal candidates have proficiency in basic laboratory skills such as solution preparation. This project will also involve data analysis using graphing software and a large amount of literature review.

Description of the research project (one page maximum)
Biological membranes are significant contributors to transmembrane protein function and localization. Additionally, membrane fluidity and dynamics is influenced directly by its composition. In this project, students will study Langmuir monolayers of sphingolipids, phospholipids and cholesterol as simple model systems representing human biological membranes. Two-dimensional Langmuir monolayers have long been used as simplified model systems to study the interactions that occur within cell membranes (bilayers). Using simple Langmuir model systems allows us to obtain molecular-level information on the interactions between these lipids and various small molecules (i.e. drugs, hormones, peptides, etc.) which can be correlated to their physiological activity. The glycine receptor (GlyR), a pentameric ligand gated ion channel (pLGIC) protein, is responsible for inhibitory neurotransmission by facilitating the influx of chloride ions. GlyR is a therapeutic target as it is linked to chronic pain and hereditary hyperekplexia. A large intracellular loop within GlyR, the M3-M4 loop, is not well

characterized structurally, though it is known that receptors that have truncated or missing loops do not function. Crosslinking-mass spectrometry (CXMS) studies have shown that attaching a crosslinker to mutated Cys residues in the extracellular domain of GlyR can crosslink to residues in the M3-M4 loop region, though these residues are located beyond the reach of the crosslinker. One explanation of the results could be due to poly-Arg/Lys regions, located in the M3-M4 loop. Studies have shown that peptides containing Arg and Lys residues have the ability to penetrate the membrane and act as cell-penetrating peptides (CPPs). By studying the effects CPPs have on the structural organization of various Langmuir monolayers, the M3-M4 loop can be better understood. Through this project, students will get a unique opportunity to use specialized surface-science instrumentation. Students will utilize a Langmuir trough to collect surface pressure-area isotherms and Brewster angle microscopy to image the aqueous interfaces of interest.

This is a collaborative project between Drs. Bethany Rudd & Kayce Tomcho. Two students will work on the following parallel projects:
1) Interaction of Sphingomyelin-dipalmitoylphosphatidylcholine-cholesterol monolayers with the following potential CPPs in the M3-M4 loop: 310QHKELLR316 and 317FRRKRRHHK325

2) Interaction of Sphingomyelin-dipalmitoylphosphatidylcholine-cholesterol monolayers with the following potential CPPs in the M3-M4 loop: 372SPEEMR377, 378KLFIQRAK385 and 386KIDKISR392

Summer Science Research Program
Ohio Wesleyan University

2024 Research Project Information Sheet
(Faculty information sheet)
Submission Deadline: 26 January 2024

General area of research

Specific title of research project Studying the Behavior of SQUID Arrays

Faculty mentor supervising research

Name: Brad Trees
General area of research:
Department: Physics and Astronomy
Email address: brtrees@owu.edu

Anticipated research dates (10 weeks):
Beginning: 5/20/2024
Ending: 7/26/2024

Requested number of students: One

Minimum qualifications of student researcher (be as specific as possible)
Completion of PHYS 111 and MATH 111

Description of the research project (one page maximum)
My research concerns superconductive devices known as the Josephson junction (JJ) and the superconducting quantum interference device (SQUID). A JJ is a tunnel junction formed from two bulk superconductors with a narrow non-superconducting material sandwiched between them. The physics of a JJ has been well studied since it was first proposed in 1963. It is, in effect, a nonlinear, electromagnetic oscillator whose behavior in the classical regime is well described by a model called the resistively and capacitively-shunted junction model. Two JJs combined in parallel constitute a so-called DC SQUID. The behavior of a DC SQUID is more challenging to describe than that of a JJ, because it is a more complicated structure, but such SQUIDS have been fabricated and studied (both experimentally and theoretically) since the late 1960s. For example, it is well established that DC SQUIDs are the most sensitive detectors of magnetic fields currently known. More recently, researchers have been studying multiple DC SQUIDs combined in particular geometries (SQUID arrays) in the hope of obtaining even more sensitive field measurements. Our project would study such SQUID arrays theoretically in a combination of analytic and numerical work. We will first study the underlying physics of a SQUID array so as to write down the system of coupled differential equations that should

describe the array's behavior. We will then solve the system of equations numerically (coding in Python and Mathematica) to study the behavior of the model. This project is ideal for any student interested in learning about condensed matter physics (which includes the physics of the solid state). It is preferred that the student working on this project has completed physics through the level of at least PHYS 280 (Contemporary Physics) and math through the level of MATH 280 (Differential Equations), as well as having had a course in computer science. Strong students who have completed both PHYS 111 and MATH 111 will also be considered.

2024 Research Project Information Sheet
(Faculty information sheet)
Submission Deadline: 26 January 2024

General area of research

Specific title of research project Identifying treatments for jet lag and psychiatric disorders through manipulations of the suprachiasmatic nucleus and administration of novel compounds

Faculty mentor supervising research

Name: Chelsea Vadnie
General area of research:
Department: Psychology
Email address: cavadnie@owu.edu

Anticipated research dates (10 weeks):

Beginning: 5/13/2024
Ending: 7/19/2024

Requested number of students: One

Minimum qualifications of student researcher (be as specific as possible)
The selected student should have interest in neuroscience research using animal models. It is strongly recommended to have completed Introduction to Neuroscience (NEUR 110, previously NEUR 250). The student must be willing to learn to handle mice and work with mouse brain tissue. Completion of the Behavioral Neuroscience Lab (PSYC/NEUR 343L) or prior experience working with rodents is preferred. The selected student must be detail-oriented and reliable. The student must be willing to live and work in Pittsburgh this summer to participate. The student will be asked to register for the University of Pittsburgh Schools of Health Sciences Research Training Program. I will help the student remotely complete the necessary paperwork and environmental health and safety training prior to the start date. The student should expect to need to find and pay for housing in Pittsburgh. We will work with the student to explore options to defray the housing cost although we cannot guarantee that the student will receive additional funds beyond the OWU SSRP stipend. Pitt students commonly sublet apartments or rooms on campus during the summer. A free shuttle is available from campus to Dr. Colleen McClung's lab on Technology Drive.

Description of the research project (one page maximum)

Travel and variable schedules result in many individuals suffering from jet lag symptoms. The symptoms of jet lag are largely due to mistimed 24-hour bodily rhythms, called circadian rhythms. Acute circadian rhythm disruption produces increased symptoms in susceptible individuals. Chronic circadian rhythm disruption is thought to increase risk for disorders and diseases. Currently there are few therapeutic options for preventing jet lag and the mechanisms by which circadian rhythm disruption can cause symptoms of disorders and diseases are unclear. The McClung lab and I previously showed that directly manipulating the suprachiasmatic nucleus (SCN), the central pacemaker in the mammalian brain, with optogenetics (tool to control neuron firing with light-sensitive channels) disrupted the circadian activity of mice. Mice with more disrupted rhythms exhibited increased anxiety-like behavior. Thus, we have demonstrated that we can manipulate the SCN to mess up rhythms and cause a behavior that is translationally relevant. What if we could manipulate the SCN in another way to produce therapeutic-like effects? We are currently using different cutting-edge neuroscience tools in mice to determine how we can optimally manipulate the SCN to overcome various insults.

Although brain stimulation tools in humans continue to advance, pharmacology remains a relatively safe and powerful approach to treat disorders and diseases. The McClung lab is currently working with a team of scientists to identify promising compounds that could be used to target circadian rhythms and treat disorders and diseases.

The selected student will work with me in the McClung lab at the University of Pittsburgh on both of these projects. Project 1 involves studying the behavioral effects of SCN manipulations and project 2 involves studying the behavioral effects of novel compounds that are hypothesized to affect circadian rhythms. Our goal is to determine if these interventions affect how rapidly mice adapt to a new light/dark schedule (i.e. “treat jet lag”). We are also interested in determining the effects of these interventions on mouse behaviors that are translationally relevant to psychiatric disorders in humans. The selected student will have the opportunity to be involved in all aspects of the projects from assisting with mouse surgeries and behavior testing to tissue processing and data analysis. The work is supported by a WoodNext Foundation Grant awarded to Drs. Colleen McClung and Stephen Chan.