

2022

UNDERGRADUATE
RESEARCH FORUM

Thursday, April 14, 2022



THE OHIO STATE UNIVERSITY

LIMA

PURPOSE

The **Lima Campus Undergraduate Research Forum** is designed to encourage students to actively engage in research. Beyond the Lima Campus Forum, participation in the Denman Undergraduate Research Forum, the Spring Undergraduate Research Festival, the University Libraries Research Prize or publication in JUROS are all strongly encouraged, although faculty and students are welcome to pursue any appropriate forum for their discipline that will showcase undergraduate research.

THANK YOU

We thank the Dean's Office for supporting the Research Forum.

2022 UNDERGRADUATE RESEARCH AND MENTORING COMMITTEE

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The Ohio State University at Lima Undergraduate Research
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ABSTRACTS

Leah Beraki

Research Advisor: Ryan W. Norris

Evolutionary history of root rats (*Tachyoryctes*) reveals some alignment with Ethiopia's diverse lingual populations

African root rats, *Tachyoryctes*, are distributed in a condensed portion of Eastern Africa. Researchers dispute their classification into species, and recent studies suggest a particularly rich diversity in Ethiopia. Ethiopia also has rich linguistic diversity, and methods for analyzing language evolution overlap with biological phylogenetic diversity. We compared the evolutionary history of root rats with the locations of the abundant Ethiopian tribes and their linguistic evolution in order to test for similar patterns in their geographic distribution. I mapped the precise location of the root rat samples from a recent genetic study and determined the local dialect, language, and language lineage (Cushitic, Semitic, Omotic, and Nilo-Saharan) common to the area. The Cushitic Oromo and Semitic Amharas comprised the majority of the data. We constructed phylogenetic trees for each of the local languages and compared them to the existing tree of the root rats. The Omotic and Nilo-Saharan lineages were disregarded in this case due to insufficient samples ($n=1$ and $n=0$ respectively). We found a significant association between the two trees using the program TreeMap and a chi square test. The Semitic language regions, Amharas and Gurages, perfectly align with the root rat data. Less matching was observed in the Cushitic lineage with the exception of the eastern Oromo that aligns with an isolated root rat clade. We used ecological niche modeling to look for isolating barriers and compared regions of poor root rat habitat to linguistic separations.

Ariba Fatima

Research Advisor: Robin K. Bagley

Impact of host use on sawfly ovipositor shape and size

Plant-feeding insects are one of the most diverse groups organisms on Earth. This has generated a lot of interest in why this group is so vast, and many hypotheses have been proposed to explain this. One hypothesis that has gathered a lot of support in recent years is that shifts and adaptation to new host plants may directly drive speciation in insects. One group where this may occur is *Neodiprion*, a pine-feeding genus of sawflies. Like many other plant-feeding insects, these sawflies associate with, and are highly specialized to, a limited number of host plants. For example, sawflies typically spend their entire lifecycle closely associated with their pine hosts, with larvae feeding on the needles, pupae spinning cocoons in the nearby soil, and adults mating on the tree. Females even lay their eggs within the needle tissue, using their ovipositor (or egg-laying organ) to cut pockets that eggs are placed into. Since pines vary in their needle shape and structure, we predict that ovipositor shape may change in response to a host shift. In this study, we evaluate this hypothesis using ovipositors from several locations where sawflies are found on both jack pine (*Pinus banksiana*) and/or red pine (*P. resinosa*) using a combination of landmark-based geometric morphometric analysis of shape and statistical evaluation of ovipositor length and width.

Addison Gray

Research Advisor: Ryan W. Norris

Coevolution of Cannabinoid Receptors and Ligand Enzymes in Primates

Cannabinoid Receptors, CB1 and CB2, coevolved with their ligand, 2-arachidonyl glycerol (2-AG), synthesized by DAGL α , DAGL β , and at least 8 other enzymes. In a 2007 study, the evolutionary history of CB1 and CB2 and their ten corresponding enzymes were examined across seven animal species. This study found that enzyme diacylglycerol lipase alpha (DAGL α) and the receptor CB1 exhibited a strong signal of coevolution in these seven species. Many more full genomes have been published since 2007, which presents an opportunity to examine coevolution of these proteins across more species at a finer evolutionary scale. Here we examine CB1, CB2, and their corresponding enzymes, DAGL α and DAGL β , in animals from the order Primates and a single tree shrew outgroup. Nucleotides and their corresponding protein sequences for each receptor and enzyme from a total of 28 species were examined and aligned within the program PAUP* to create 8 phylograms to compare branch lengths of both the amino acid sequences and nucleotide sequences. I divided the number of amino acid substitutions by the number of nucleotide substitutions along each branch and compared the value for each receptor – synthetic enzyme pairing using linear regression. The results may provide evidence of compensatory changes due to coevolution.

Morgan Henschen

Research Advisor: Robin K. Bagley

Describing Hymenopteran diversity on the Ohio State Lima campus

The importance of biodiversity is generally widely accepted today. Despite this understanding, biologists do not have a solid number for how many species there actually are on the planet. Current estimates range from two million species on the low end to trillions of species on the high end. In recent years, however, estimates for the total number of insects have settled around six million species. Within insects, recent work suggests that the largest order of insects is Hymenoptera, which includes sawflies, bees, ants, and wasps. Within this group, parasitic wasps are particularly diverse and likely outnumber even other insect orders. In this project, we describe our initial efforts to categorize the diversity of the order Hymenoptera on the Ohio State Lima campus. We particularly focus on insects captured in a passive Malaise trap set alongside a farm plot maintained with regenerative agriculture techniques. This work involves finding Hymenopteran specimens amongst the large number of collected insects, as well as using keys and other tools to identify them to lower taxonomic designations (e.g., family, genus, species, etc.). We also discuss some challenges we have faced in this endeavor, including the frequent mimicry of flies and other insects of wasps.

Waseq MohammedResearch Advisor: Robin K. Bagley

**Mirroring divergence?
Evaluating speciation of parasitic
wasps alongside their sawfly hosts**

A major goal of evolutionary biology is to understand what generated our current biodiversity, and how new species form, especially within diverse groups such as plant-feeding insects and parasitoid wasps. One thing that is thought to generate new insect species are shifts to new host plants. Because insects spend their entire life cycle closely associated with their host plant, any changes to their host are likely to require adaptations to maximize their performance on the new host. These adaptations may directly promote the development of new species. This is an example of ecological speciation, where adaptation to divergent environments produces reproductive isolation as a by-product. Because parasites are also closely associated with their hosts (typically other insects), they may follow ecological divergence of their hosts, forming new groups specializing on each diverging host species. In this way, divergence in host insects could also result in divergence of their parasites. One system where this may be occurring, but has not yet been tested, are *Neodiprion* sawflies. *Perilampus hyalinus*, a parasite of the redheaded pine sawfly, *Neodiprion lecontei*, is one species where this sequential divergence may be occurring. This parasite is proposed to be a generalist that attacks many host insects, although no molecular work has confirmed this hypothesis. Here, we describe the initial sorting and selection of *P. hyalinus* specimens for a population genetic study.

Anna Walker

Research Advisor: Ryan W. Norris

Substantial unrecognized diversity exists among the burrowing voles (*Hyperacrius*) of Northern Pakistan

The high elevation mountain ranges of Northern Pakistan have contributed to the speciation of mammal species. Northern Pakistan is home to the greatest topography on Earth; the world's three highest mountain ranges converge here. Burrowing voles (genus *Hyperacrius*) are found only in this part of the world. Within the genus, two species, *Hyperacrius fertilis* and *Hyperacrius wynnei*, are recognized based on morphological differences. We hypothesized that the high elevation mountain ranges which these species inhabit have presented the opportunity for additional allopatric speciation. I sequenced the Cytochrome b gene and used the results to construct a phylogenetic tree. My results showed that some samples in the field are not from *Hyperacrius*, but are in the genus *Microtus*, subgenus *Blanfordimys*. The genus *Hyperacrius* is very diverse. Our findings demonstrate that there are numerous lineages separated by large genetic differences. Resolving *Hyperacrius* taxonomy will be challenging, but it is evident that numerous species exist.

Macy Wiktorowski

Research Advisor: Robin K. Bagley

Evaluating mite abundance and diversity on the Ohio State Lima campus

Biodiversity is an essential part of functioning ecosystems that help to support all life on Earth. While it is known there are many species on Earth, the exact number is unknown, as are the relative ratios of diversity between groups. One group that has traditionally been thought to be a candidate for the largest insect order are beetles. These insects are large and charismatic, making detection and formal species descriptions relatively simple. However, other, less-charismatic groups of organisms with smaller bodies are harder to find and may appear to have similar morphologies to the naked eye. Consequently, these groups are under-described. A good example of this phenomenon are parasitic wasps. Their small size and the relative lack of information on their ecology made historical investigation and formal description challenging. Recent work, however, suggests that parasitic wasps actually far outnumber beetles, highlighting the importance of closely evaluating groups. One group of organisms with similar issues are mites, a poorly-defined taxon of parasitic arachnids. It has been proposed that mites could be highly specialized, with most species of animals and plants having their own unique infecting mite, but little ecological or molecular data is available to support or refute this idea. Here we describe the beginning stages of a project explicitly evaluating this hypothesis. We collected insects using a passive Malaise trap in the Tecumseh Interpretive Nature Preserve. The collected insects were surveyed for the presence of external mites, with the goal of identifying what mites attack which hosts, and how diverse these attacking mites are. Although this work is still in progress, thus far mite abundance seems low and their diversity limited, refuting the hypothesis of high mite diversity.

Rakan Roda, Regan Swisshelm and Evan Wint

Research Advisor: Sabine Jeschonnek

Networks and Epidemics

In light of the outbreak of COVID-19, we built a network modeling a randomly spreading pandemic. This network is made up of nodes, representing humans susceptible to infection, and edges, representing contact between two nodes. The network contains a virus which has a chance to spread from node to node if they are connected.

Last year we examined the spread of our simulated disease during holidays and business days, the impact of highly connected nodes, and the effect of changing parameters such as connection probability and transmission probability.

This year, we seek to observe our model's results on two major topics. First, how transmission probability affects the R-naught value of the disease and thus its effect on the herd immunity threshold. Second, what is the effect of social distancing and if it is comparable to the effect to vaccination without distancing. We are currently collecting data by running the simulation code.

Lauren Chatman-Wright

Research Advisor: John Hellmann

The Godgame in Black and White: Race in John Fowles' Novel *The Magus*

Many scholars have analyzed the post-colonial and psychoanalytic nature of *The Magus* by John Fowles, as the 1966 novel invokes the memory of colonialism and highlights the psychological nature of its main character, Nicholas Urfe. However, explicit racial content plays a prominent role in the novel that literary critics have not discussed. This project explores the theme of race in the novel by applying African-American literary criticism and post-colonial criticism to explain the significance of the racial content found in *The Magus*. Close reading of the text and historical evidence help to identify the purpose of the racial content and to expose the connection it has to Nicholas. He enacts a veiled prejudice in the novel, mimicking the prejudice found throughout the west and the British Empire he comes to represent. Nicholas represents the quintessential western man of privilege whom Conchis—the orchestrator of the psychological godgame to which Nicholas falls victim—identifies as a representative ‘type’ that must change in order for western society to advance past pretentiousness, nationalism, and racist thinking. The idea of the godgame, in part, is that Nicholas can change, and if he can change, so can other westerners, resulting in the western world rising above its prejudiced behavior toward the racial “other.” However, as demonstrated in the novel, change is easier said than done, especially for Nicholas, who arguably remains prejudiced until the end. This failure to change is significant, as it foretells the difficulty of the western world to shed its prejudice.

Chloe Simmons

Research Advisor: John Hellmann

The War Against British Identity in *The Magus* and the Beatles Discography in Postwar Era Britain

Both John Fowles' novel *The Magus* and the Beatles' *Sgt. Pepper's Lonely Hearts Club Band* are postmodern works of art that employ strategies of self-conscious play with traditional forms and with fantasy. Appearing within approximately one year of each other, both works were responding to the disconnect of youth in postwar Britain from their Victorian heritage. Fowles' 1966 novel *The Magus* explores the dissatisfaction of English youth with their British identity by exposing the conventional Victorian ideas that still dominated the country. The novel follows Nicholas Urfe, son of a brigadier general who epitomizes the Victorian values of hierarchy and duty. As a young adult coming of age in a postwar Britain that has lost its empire, Nicholas flees to a Greek island to get away from the antiquated and pompous ideals that still dominate in Britain even after Britain has lost its former status. There the owner of the island puts Nicholas through a living theatre that confuses fantasy and reality, even presenting Nicholas with the "ghost" of a woman from the Victorian era. One year after the publication of *The Magus*, the Beatles also challenged traditional British identity through their 1967 album *Sgt. Pepper's Lonely Hearts Club Band*. By pretending to be a Victorian military band, they create a musical journey that mixes history and fantasy. Both Fowles in *The Magus* and the Beatles in *Sgt. Pepper's Lonely Hearts Club Band* play with nostalgic images from the Victorian era to challenge traditional ideals and fantasize new ways of being English. Both *The Magus* and *Sgt. Pepper's Lonely Hearts Club Band* put their English characters through experiences of play, theater, and fantasy as they search for new identities.

Ariba Fatima and Agapè Anderson

Research Advisor: Fábio Leite

Evaluation of Individual differences in spatial and cognitive abilities within the general population, artists, and athletes

Broadly, we are interested in individual differences in spatial and cognitive abilities. Spatial and cognitive abilities have been focal points of many studies (e.g., Hedge, Powell, & Sumner, 2018; Leite, 2009). The purpose of this study is to examine the relationship between spatial and cognitive abilities and athletic and artistic inclinations. We initially reviewed tasks that have been reported to be robust and time-effective methods. In our study, two adapted inventories will be used to identify participants by their level of expertise (fluency) in athletics and art. Participants will be Psych 1100 students who volunteer to participate for approximately 45 to 60 minutes. The involvement of all participants is tested through a card rotation task, Stroop interference task, an inspection time task, and a matrix reasoning. Performance in these tasks will be compared to athletic and artistic inventory classifications, exploring individual differences. We predict that there will be some observable differences between athletic individuals, artistic individuals, and the general population. For example, athletic individuals are expected to have an advantage in card rotation and inspection time over the general population. We will examine whether that advantage carries over to the interference and reasoning tasks. On the other hand, artistic individuals may have an advantage in reasoning and card rotation. We will examine whether that advantage, if present, carries over to inspection time and interference tasks.

Hedge, C., Powell, G., & Sumner, P. (2018). The reliability paradox: Why robust cognitive tasks do not produce reliable individual differences. 50(3), 1166-1186. <https://link-springer-com.proxy.lib.ohio-state.edu/article/10.3758/s13428-017-0935-1>

Leite, F. P. (2009). Should IQ, perceptual speed, or both be used to explain response time? *The American Journal of Psychology*, 122(4), 517-526. <http://www.jstor.org/stable/27784426>

Lauren Grothaus

Research Advisor: Virginia Tompkins

Parents' Stress and Children's Screen Time During the COVID-19 Pandemic

The COVID-19 pandemic has altered the home life of many families with young children. It is unclear what role parenting stress has played in the amount of time children spend on screens. The current study examined parenting stress in relation to children's screen time over one year during the COVID-19 pandemic. We examined the relative role of parents' COVID-19 stress (e.g., difficulty completing work remotely) and daily parenting stressors (e.g., cleaning up after children). Parents (81% mothers) from across the U.S. responded to online surveys; participants included 172 parents and their 4-to 6-year-old children ($M_{\text{age}} = 5.43$). Parents (78% working) reported their children's time spent on screens (including TV, smartphones, tablets, computers, and gaming consoles), parents' stress, and several covariates (e.g., child age, parent education). Parents completed the same survey in Spring 2020 and Spring 2021. Based on prior research, we hypothesized that 1) parents' stress would be related to children's screen time cross-sectionally and 2) parents' stress would predict children's later screen time but not the reverse. Novel to this study, we explored how both COVID-19 and typical parenting stressors related to screen time. Average weekly screen time was 701.05 minutes (11.69 hours) and ranged from 60 minutes to 3570 minutes (59.5 hours) per week. We found that daily parenting stressors and COVID-19 stress were significantly correlated. However, daily parenting stressors, but not COVID-19 stress, was related to total screen time at Time 1. We will also examine parents' stress as a predictor of children's later screen time controlling for the covariates. The current work shows that greater parental stress is linked to children's increased screen time, which has practical importance given potentially negative effects of screen time on children's behavioral (e.g., inattention) and cognitive (e.g., language) outcomes.

Isabella M. Torsell and Shivani BhattResearch Advisor: Joseph P. Green

**Political Leanings of Students Predict COVID-19
Attitudes and Compliance Behaviors**

As of March 2022, the death toll from coronavirus disease 2019 (COVID-19) surpassed 6 million people worldwide (CBS News, 2022). Perceptions of risk and mitigation responses to this devastating disease appear to fall along political lines (Joslyn et al., 2021). In an online survey of N=215 university students, we explored whether emotional intelligence and dimensions of attachment predicted attitudes and behaviors protective of COVID-19 (e.g., wear masks, socially distance) beyond political leaning. Measures included three dimensions of the Adult Attachment Scale – close, depend, anxiety (AAS; Collins & Read, 1990; Collins, 1996); Trait Emotional Intelligence Questionnaire (TEIQue-SF; Petrides, 2009); self-reported biological sex at birth; and a novel, 12-item scale assessing concerns and compliance behaviors associated with COVID-19. Using standard regression, our measures accounted for 40% of the variance in scores on our COVID-19 scale. Political leaning was the only variable statistically related to COVID-19 scores ($r = .63$). Students reporting to lean Democratic expressed greater concern about COVID-19 and willingness to comply with risk-reduction behaviors than students leaning Republican and those without a single-party preference. Across the sample, female students scored higher than male students on our COVID-19 scale and on the anxiety dimension of the AAS. Male students scored higher on emotional intelligence. We discuss the implications of our work in light of other findings.



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