STRATEGIC INITIATIVE
Undergraduate Research Funding for
STEM Majors at the University of Idaho
FINAL PROJECT REPORT

FY 2025

Submitted to:
Higher Education Research Council
Idaho State Board of Education
P.O. Box 83720
Boise, Idaho 83720-0037

Submitted by:
University of Idaho Office of Undergraduate Research
875 Perimeter Drive
Moscow, ID 83844
On October 30, 2025

University of Idaho
Office of Undergraduate Research

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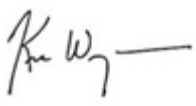
Executive Summary

Undergraduate research (UGR) is recognized as a high-impact educational practice that increases the rates of student retention and engagement. At the University of Idaho, UGR is practiced throughout all units on campus, and it is centrally placed in the institution's strategic plan through the Experiential Learning Pillar. The Office of Undergraduate Research (OUR) is taking the lead in enabling research opportunities for undergraduates at UI as it manages various competitive student grant programs that directly support student research and ensures that students have access to these opportunities.

During AY 2024-25, generous funding from the State Board of Education (SBoE) permitted UI to continue its Semester Awards and Summer Undergraduate Research Fellowship (SURF) Programs. The Semester awards allow for students to submit a proposal to the OUR and, after review, the OUR selects projects for funding. The OUR allocated $4000 to fund four of the twenty-one projects in Spring of 2025 with HERC funding. These projects were from the College of Engineering and the College of Science. The OUR then utilized the remaining $61,000 of SBoE HERC funds to support the Summer 2025 SURF program. This intensive 10-week summer research experience actively engages undergraduates in faculty-mentored, independent research. Over the course of the program, students are mentored toward increased independence on their projects and the OUR provides a series of workshops to help them students prepare for ICUR. Each student was provided with a $5,500 stipend in the form of a fellowship which allows them to devote full time effort to their projects. Each student was also provided with $1,000 to help offset materials and supplies and other project-related expenses. **This year there were 39 applications!** Selection of student participants is a competitive process in which students submit 4-page research proposals to the OUR along with budget justifications and a letter of recommendation from their mentor. The Director utilizes faculty affiliates in each college to review the proposals and provide selections of the top proposals. The Director then makes sure that projects are well-represented across colleges. It is important to note that not all projects for this cycle required a supply budget. This allowed for us to fund additional students with partial SBoE funding. For FY25, the SBoE funding supported **11 of the 15 OUR SURF** awards (some were funded completely or in part by OUR funds). All students supported by SBoE funds attended and presented results of their projects at the 2025 Idaho Conference on Undergraduate Research in Boise, ID on July 15-16, 2025. These students will also be required to present their results at the UI Undergraduate Research Symposium on April 20, 2026. In addition to the projects supported by SBoE funds, the OUR was able to fund **4 additional awards** to allow further participation beyond STEM disciplines.

End of project feedback from students and their mentors was overwhelmingly positive. Significantly, none of the undergraduate research projects described here would have been possible without the support provided by the State Board of Education. We sincerely thank the Higher Education Research Council and the Idaho State Board of Education for making these experiences possible for our students.

Sincerely,



Kristopher V. Waynant
Director, Office of Undergraduate Research
Associate Professor, Chemistry
kwaynant@uidaho.edu

Spring 2025 Awards funded by SBoE

Student: Emily Medema

Project Title: Evaluation of the shrinking core model of iron sulfide weathering in pyritic waste rock, Red Dog mine

Mentor: Jeff Langman, Department of Earth and Spatial Sciences

Abstract: Acid rock drainage (ARD) emanates from the Main Waste Stockpile (MWS) of Teck's Red Dog Mine in northwestern Alaska. The ARD is caused by infiltrated precipitation and weathering of pyrite [FeS2]. The overall project is evaluating future acid generation through weathering experiments with waste rock collected from the MWS. My portion of the project will involve the use of a scanning electron microscope to evaluate the remaining cores (e.g., unweathered portion) of the pyrite minerals and associated iron-bearing rinds. These two sulfide mineral properties are indicative of the mineral weathered state that we describe as the shrinking core model of sulfide weathering. The remaining pyrite cores represent the weathering progression, and the iron-bearing rinds are an indication of the level of acid generation and mobilization or retention of iron during weathering. Using the scanning electron microscope, I will analyze pyrite samples from twenty sampling intervals in the MWS to compare the level of weathering between the intervals and estimate the penetration of infiltrated precipitation. The results of my work will provide insight into the depth of the weathering front and areas of greatest acid generation that will assist with management of infiltrating water into the MWS.

Student: Jasmeen Manshahia

Project Title: Inverted Flag

Mentor: Vibhav Durgesh, Department of Mechanical Engineering

Abstract: This project explores innovative methods for harvesting sustainable and clean energy using an inverted flag design equipped with piezoelectric materials. The study focuses on optimizing the energy production capabilities of piezoelectric flags by varying their thickness-to-length ratios. We plan to conduct experiments in a wind tunnel to investigate the dynamics of the inverted flag and measure the generated electric output. In the second phase, we will perform experiments in a water tunnel using Hydrogen Bubble Flow Visualization to study the flow field around the flag and assess the electricity production. The primary objective is to identify the most efficient configurations for potential commercial applications while gaining deeper insights into the dynamics and performance of the inverted flag system.

Student: John Grundy

Project Title: Improvements to Experimental Fluids Lab

Mentor: Vibhav Durgesh, Mechanical Engineering

Abstract: Interest in small aerial vehicles is increasing. The airfoils in these vehicles operate at low Reynolds number flow regimes. The airfoil aerodynamic characteristics under these conditions are complex. Therefore, one research focus in the Experimental Fluids and Aerodynamics Laboratory (EFAL) is to quantify an airfoil's aerodynamics performance at low-Reynolds numbers. Experimentation is performed in the wind tunnel at EFAL using a high-precision load cell which measures lift and drag forces experienced by airfoils. The load cell and the airfoil are mounted on a stepper motor that allows precise change in the angle of attack. Lift and drag data collected from the load cell are analyzed using Python or Matlab, and researchers iteratively process the data to estimate angle of attack misalignment. The misalignment is due to the challenge of accurately determining flow direction of the wind tunnel relative to the airfoil chord. Therefore, the proposed project's focus is to automatically correct the misalignment. The key deliverable will be data-analysis software developed in Matlab that analyzes loadcell data and identifies misalignment using basic principles of airfoil aerodynamics. If successful, this will significantly reduce analysis time and would provide a robust method for identifying the angle of attack misalignment using data analysis techniques.

Student: Nishan Thapa

Project Title: Improve Head Loss Calculations for Laminar Pipe Flow and its fitting

Mentor: Tao Xing, Department of Mechanical Engineering

Abstract: Elbows are a common type of fitting in piping systems to transport fluid, but they introduce challenges by causing head loss due to directional changes in flow. Accurate head loss estimation in elbows is crucial for selecting the right pumps for the given pipeline to ensure energy efficiency so that the pump operates close to its best efficiency performance. Current methods largely focus on fully developed, steady flow conditions, neglecting the developing flow regions and effect of Reynolds number on head losses for pipe fittings. This research addresses this gap by analyzing head loss in a laminar pipe system including developing and developed flows and a 90-degree elbow using high-fidelity computational fluid dynamics (CFD) simulations and experimental studies. The project will generate more accurate correlations to estimate head loss for laminar pipe flow system under various Reynolds numbers, which will help select the right pump to achieve the best efficiency point during operation.

Summer Undergraduate Research Fellowships 2025 funded by SBoE HERC

STUDENT: Brodie Becker **College:** Engineering

TITLE: LoRa Bands for Virtual Fencing

Mentor: Dev Shrestha, Department of Biological Engineering

Abstract: Virtual fence is an emerging tool for livestock management that can determine an animal's location on the landscape, compare that location to preset boundaries and implement stimuli to encourage animal movement as needed. An ongoing project at the University of Idaho is working to develop a virtual fence system that leverages radio communication to determine location. This research will evaluate the suitability of two different radios for usage in virtual fencing technology. The radios being compared will operate in the 2400 and 915 MHz bands, both common for LoRa networks. They will be compared based on several factors relevant to their performance in virtual fencing applications. The desired outcome of this project is to provide information to enable informed decision-making for teams selecting radios to be used in rangeland networks.

Virtual Fence LoRa Band Comparison

A comparison of radio effectiveness in rangeland virtual fencing applications

Presenter: Brodie Becker

University of Idaho

Abstract

The goal of this research is to evaluate the suitability of two different radio frequencies for usage in Virtual Fencing technology. The radios being compared operate in the 2400 and 915 MHz bands, both common for LoRa networks. They are being compared based on several factors relevant to their performance in Virtual Fencing applications. We are measuring straight line performance as well as obstructions from terrain, foliage, and other obstacles that are likely to be encountered in this application. We aim to measure and quantify the performance advantage of the 915mHz radio in these scenarios. Both radios perform exceptionally well in a line-of-sight scenario with minimal obstructions. However, the 915mHz radio demonstrates a significantly reduced rate of signal integrity decrease with distance.

Virtual Fence

Virtual fencing technologies encompass a variety of systems for enforcing livestock locations using a boundary deterrence system to prevent the animal(s) from violating a geographic region defined by the user. These systems operate one or several digital locating systems, such as GPS or ToF(time of flight) ranging. The UI Unfencing Range project uses ToF ranging to evaluate animal positions and sx1280 radios to communicate between devices in the system. This research was inspired by questions that arose in the course of the devlopment of their system.

Virtual fencing technologies offer a promising solution to many problems in the cattle industry, including lower costs than traditional fencing and easier management of grazing animals, rangeland, and the grazing environment as a whole. Radios are a critical part of any Virtual Fence system, and their performance has a direct and drastic impact on the performance of the system as a whole. They are also central to the development process, and once a radio has been selected it is difficult to alter that selection.

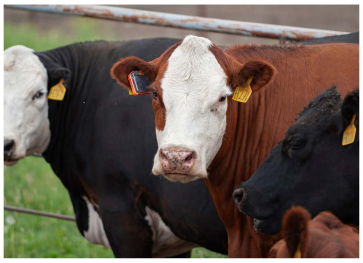
Research & Methodology

This project aims to compare the performance decrease of two different radios, the sx1280 and sx1260(selected as representative for their respective frequency bands) in rangeland environments and scenarios that will be commonly found in a Virtual Fencing application.

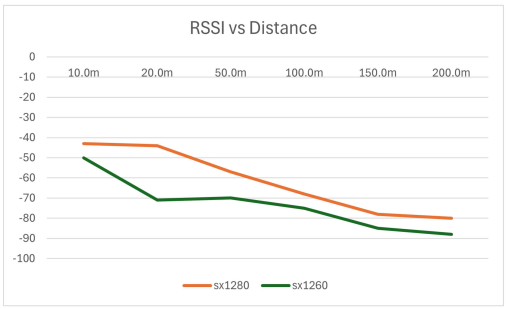
Both radios used are products of Semtech, who produce a variety of LoRa radios. LoRa is a standard intended for long range-low power communication for embedded devices. They are well-suited to Virtual Fencing applications, and very commonly used in many industries.

The sx1280 operates at 2.4gHz, and the sx1260 at 915mHz. 915mHz is broadly known to be better suited to this sort of application, but there are challenges in implementing it for a virtual fencing system. We are evaluating sx1260 performance relative to the sx1280 in 5 key areas that will allow for informed decisions on virtual fencing implementations by quantifying the advantage of the lower frequency radio in pertinent scenarios.

It is important to note that the sx1280, while being very powerful for an unlicensed 2.4gHz radio, is still capable of a significantly lower maximum transmission power. When making implementation decisions and weighing the merits of these two radios, this must be taken into account.



Results



In line of sight testing, both radios exhibit a similar rate of decrease for RSSI. This is our key metric for evaluating the relative performance. The testing results indicate that both radios are well suited for this application when deployed in an open field. This data was collected by averaging several minutes of data collected from continuous communication at each distance listed for each radio. This information provides a useful baseline for our comparisons in all future testing. We will be able to evaluate the rate of attenuation of both radios in different scenarios, and use this to make informed decisions about their performance and extrapolate out to consider performance with different antennae and transmission power levels.

Acknowledgements:

Funded by the UI Office of Undergraduate Research SURF program

Support and hardware provided by UI Unfencing Range project

STUDENT: Minigna Lama **COLLEGE:** Engineering

TITLE: Analysis of C2C12 myoblast secretome for enhanced muscle regulation

Mentor: Nathan Schiele, Department of Biological Engineering

Abstract: Skeletal muscle repair is a complex process involving cellular proliferation, differentiation, and remodeling of the extracellular matrix, all of which are required for tissue repair as well as tissue engineering. The C2C12 myoblast secretome is involved in the process since proteins secreted into the medium and signaling factors mediate intercellular communication and control muscle differentiation. This study aims to characterize the dynamic modulation of the C2C12 secretome during different stages of myogenic differentiation and with varying serum concentrations and mechanical loads. The significant factors involved in the muscle regeneration process will be quantified by enzyme-linked immunosorbent assay (ELISA) to determine the impact of environmental conditions on the composition of the secretome. Elucidation of such regulatory processes will provide valuable information on muscle tissue communication and adaptation, allowing biomaterial and therapeutic strategy design for muscle tissue engineering and regenerative medicine.

Analysis of IGF-1 production by C2C12 myoblasts during engineered muscle formation

University of Idaho College of Engineering
Minigna Lama, Alonna G. Clair, and Nathan R. Schiele
Department of Chemical & Biological Engineering, University of Idaho, Moscow, ID
University of Idaho Office of Undergraduate Research

Background

- C2C12 myoblasts are used to study skeletal muscle repair and regeneration.
- Secreted proteins act as signaling factors for intercellular communication and regulation of myogenesis.
- This study analyzes secretome changes during different differentiation stages and serum levels.
- Enzyme-linked immunosorbent assay (ELISA) used to quantify the secreted proteins (IGF-1) in the culture media.

Objective

- Evaluation of IGF-1 production during myogenesis of C2C12 cells.

Cell Seeding and Secretome Collection

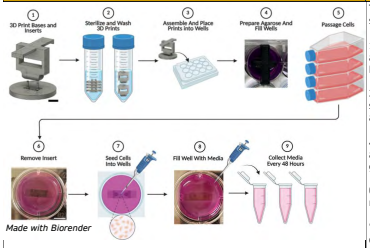


Fig. 1) C2C12 scaffold free self assembly 3D culture overview

Neo Muscle seeding protocol steps:

- 3D-printed PLA inserts were sterilized in 70% ethanol for 24 hours, rinsed with sterile water, and assembled into standard 12-well plates.
- 2% agarose was poured into each well to create molds; after solidification, inserts were removed to form defined agarose wells.
- Cells were cultured under standard conditions and passaged when confluency reached 75%.
- C2C12 line continuation was seeded at 1500cells/cm², and Neo Muscles were seeded with 5 million cells per mold.
- Neo Muscles treated with 10% FBS till Day 7 and changed to 2% horse serum Day 8 onwards in every 48 hours interval.
- Macro images were taken of Neo Muscles daily, media was collected for secretome evaluation and stored in -80℃.

Macroscopic Progression of Neo Muscle Constructs

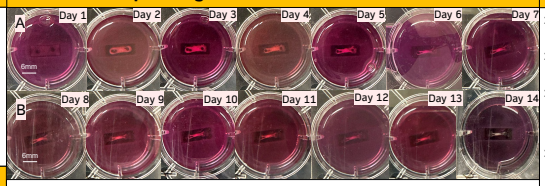


Fig. 2) Representative **A)** macroscopic images of Neo Muscle D0-D7, 10% Fetal Bovine Serum Media **B)** macroscopic images of Neo Muscle D8-D14, 2% Horse Serum Media

ELISA Quantification of IGF-1 Secretion

The ELISA protocol followed standard steps:

1-2) Plate coating with capture antibodies and blocked with blocking buffer.

3.) Sample addition and IGF1 serial dilution, incubate for antigen binding.

4-5.) Addition of HRP Conjugate antibodies and substrate to generate a colorimetric signal.

6.) Optical density was measured at 450 nm & 650 nm.

7.) IGF-1 concentration was determined using a standard curve generated from known IGF-1 concentrations.

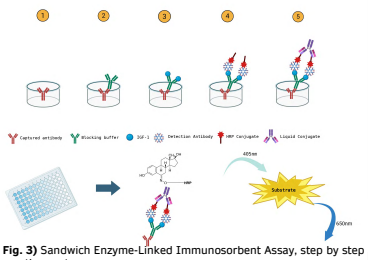
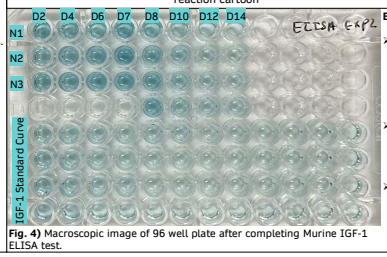


Fig. 3) Sandwich Enzyme-Linked Immunosorbent Assay, step by step reaction cartoon



ELISA Plate Setup:

- The standard curve was prepared by performing serial dilutions of IGF-1, starting from 6000 *pg/mL* (100 *µL* per well) diluting down to 0 *pg/mL*.
- For experimental samples, Up to Day 7, each 100 µL sample consisted 3 biological replicates.
- From Day 8 to Day 14, the samples consisted of 2 biological replicates.

Fig. 4) Macroscopic image of 96 well plate after completing Murine IGF-1 ELISA test.

IGF-1 concentration peaked on Day 7

- IGF-1 concentration peaked between Day 2–7, with the highest recorded IGF-1 quantified approx. on Day 7.
- Sharp decline post-Day 7 suggests possible reduction in secretion, protein degradation, or cell stress.
- IGF-1 secretion pattern aligns with published findings, showing peak expression around Day 7 during active myogenic differentiation, followed by a decline as regeneration stabilizes (Charge & Rudnicki, 2004).
- Day 7 identified as a key window for collecting large quantities of secreted IGF-1, for use as conditioned media in cell differentiation studies.

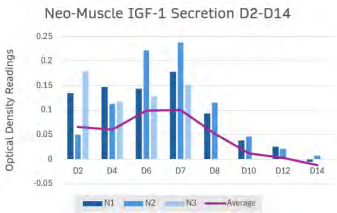


Fig. 5) IGF-1 curve of OD read for the conditioned media from D2-D14 set to 405nm-650nm.

Future Work

- Re-run IGF-1 ELISA with a higher concentration standard curve for accurate quantification.
- Analyze macroscopic images of Neo Muscles and cell line growth to elucidate possible correlations in IGF-1 secretion.
- Continue analyzing secretome samples for additional myogenesis biomarkers.
- Continue collecting secretome samples and testing to identify other secreted factors that may affect other musculoskeletal Neo constructs seeded in the lab, when used as conditioned media.

Acknowledgments

- This project was funded through Summer Undergraduate Research Fellowship (SURF) by Office of Undergraduate Research (OUR), University of Idaho.

STUDENT: Jiaxin Liu **COLLEGE:** Engineering

TITLE: The Attack on AI

MENTOR: Min Xian, Department of Computer Science

Abstract: Adversarial attacks pose critical challenges to the deployment and adoption of artificial intelligence (AI) and Machine Learning (ML) systems, as they exploit vulnerabilities in AI models to cause incorrect predictions through carefully crafted perturbations. This research explores the mechanisms, implications, and defenses associated with adversarial attacks, with a focus on understanding their impact on deep learning models. Over a 10-week period, foundational concepts in AI and adversarial attacks are studied, followed by hands-on experimentation with state-of-the-art attack methods such as the Fast Gradient Sign Method (FGSM), Projected Gradient Descent (PGD), Carlini & Wagner (C&W), Sign-OPT, and RayS attacks. Defense strategies, including adversarial training, defensive distillation, and input preprocessing, are implemented and evaluated for their effectiveness in mitigating adversarial threats. A small-scale research project is conducted to investigate a specific aspect of adversarial attacks, such as their performance on real-world datasets or the robustness of different model architectures. The findings will highlight the fragility of AI systems to adversarial manipulations and underscore the importance of developing robust models to ensure their reliability and security in critical applications. This research contributes to the growing body of knowledge in adversarial learning and provides insights into the ongoing efforts to build trustworthy AI systems.

Lance and Shield: Benchmarking Adversarial Attacks and Defenses of AI

University of Idaho

DEPARTMENT OF COMPUTER SCIENCE, UNIVERSITY OF IDAHO

Jiaxin Liu, Kyle Lucke, Min Xian

University of Idaho

Abstract

As deep learning (DL) reshapes the future of image-based applications, from handwritten digit recognition to autonomous driving, one unsettling question persists: just how trustworthy are these celebrated models when faced with real-world adversaries? Our study investigates the mechanisms and consequences of hard-label black-box adversarial attacks that exploit blind spots in state-of-the-art architectures (ResNet-50, DenseNet-121, VGG-16) trained on MNIST, CIFAR-10, and ImageNet. We implement and benchmark three leading methods such as RayS, OPT, and Sign-OPT, and counter them with three advanced defenses: adversarial training, robust self-training, and multi-instance robust self-training. By measuring attack success rates, query efficiency, and perturbation subtlety, our findings expose critical vulnerabilities in vision systems and guide the design of more resilient defenses for practical deployment.

Background

1. **Problem**: DL can now be used for critical applications like cancer classification, but are susceptible to adversarial attacks.
2. **Goal**: Evaluate three state-of-the-art adversarial attacks against popular DL approaches and defenses.
3. **Approach**: Benchmark RayS, OPT, and Sign-OPT vs. ResNet50, DenseNet121, and VGG16 using breast-cancer dataset plus CIFAR-10, MNIST, and ImageNet. Then apply three advanced defenses and repeat.
4. **Outcome**: Reveal which defenses hold up, why others fail, and guide safer AI, whether diagnosing tumors or classifying traffic signs.

Figure 1: Study workflow. **Input data** (CIFAR-10/MNIST/ImageNet). **Model** (ResNet50, DenseNet121, and VGG16). **Hard-label black-box attacks** (OPT, Sign-OPT, and RayS). **Defense strategies** (adversarial training, robust self-training, and multi-instance RST). **Evaluation metrics** (success rate, queries, and perturbation)

Results

Table 1. Attack ResNet-50 [12] using the CIFAR-10 [9] dataset (ε = 0.031).

Attack	Success Rate ↑	Avg Queries ↓	Med Queries ↓	Avg L_2 ↓	Avg L_∞ ↓	Avg PSNR ↑
OPT [3]	4.39%	**376.7**	**208.0**	**0.232**	**0.015**	50.266
Sign-OPT [4]	53.20%	2944.8	2040.0	0.446	0.027	42.463
RayS [5]	**99.40%**	1341.3	719.5	1.593	0.029	**31.101**

Table 2. Attack ResNet-50 [12] using the MNIST [10] dataset (ε = 0.30).

Attack	Success Rate ↑	Avg Queries ↓	Med Queries ↓	Avg L_2 ↓	Avg L_∞ ↓	Avg PSNR ↑
OPT [3]	78.92%	481.57	433.00	**2.234**	**0.152**	28.290
Sign-OPT [4]	89.20%	427.78	287.00	2.972	0.215	25.181
RayS [5]	**100.00%**	**280.24**	**166.00**	8.118	0.232	**16.300**

Table 3. Attack ResNet-50 [12] using the ImageNet [11] dataset (ε = 0.05)

Attack	Success Rate ↑	Avg Queries ↓	Med Queries ↓	Avg L_2 ↓	Avg L_∞ ↓	Avg PSNR ↑
OPT [3]	3.00%	**273.33**	**167.50**	**2.099**	**0.025**	48.133
Sign-OPT [4]	31.10%	3569.47	2626.00	3.901	0.044	40.400
RayS [5]	**98.40%**	1339.02	748.00	17.465	0.046	**27.257**

Attack success scales directly with perturbation magnitude (**ε**):

- OPT finds adversarial samples with the smallest mean L_2 distances but only a low success rate* (SR).
- Sign-OPT achieves a higher SR with a larger mean L_2 distances.
- RayS achieves a high SR across all three datasets at the cost of a larger mean L_2 value with roughly 1,300 queries per sample.

Success rate: the percentage of examples that have obtained and adversary within a query budget

Acknowledgements

I gratefully acknowledge Kyle Lucke for dedicated research assistance and Dr. Min Xian for expert mentorship. This work was supported by a University of Idaho Office of Undergraduate Research (OUR) Semester/SURF Award 2025.

Figure 2. Adversarial samples on ImageNet [11] using a ResNet-50 model [12]. Columns show (1) clean image, (2) RayS [5], (3) Sign-OPT [4], (4) OPT [3] examples.

Conclusions and Future Directions

Our experiments confirm that ResNet-50, DenseNet-121 and VGG-16 remain highly vulnerable to hard-label black-box attacks, with the SR rising alongside allowed perturbation magnitude. On CIFAR-10, OPT achieves a 4.39 % SR with an average L_2 of 0.2320, whereas RayS achieved a 99.40 % SR with an L_2 of 1.5930. On MNIST, the SR increases from 78.92 % to 100.00 %. On ImageNet, the SR of OPT falls to 3.00 %, Sign-OPT to 31.10 %, while RayS maintains 98.40 % success. Next, we will re-evaluate these models after implementing training-based defense techniques like adversarial training, robust self-training and multi-instance robust self-training, quantifying how they affect SR, query efficiency and perturbation norms. We will also incorporate a distortion threshold for human perceptual evaluation to align the detection results with actual image quality standards.

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STUDENT: Dristanta Silwal **COLLEGE:** Engineering

TITLE: Benchmarking Uncertainty Quantification for Deep Learning

MENTOR: Min Xian, Department of Computer Science

Abstract: Uncertainty quantification (UQ) plays a pivotal role in ensuring the reliability and robustness of predictive models, particularly in deep learning models where uncertainties arise from many sources, e.g., incomplete data, model approximations, and inherent variability. Ensuring the reliability of predictions is critical to patient safety in medical AI applications. Most work on Uncertainty Quantification (UQ) focuses on out-of-domain (OOD) samples, how it identifies misclassification has yet to be comprehensively explored (1). This research evaluates the existing UQ methods to detect misclassification, and their accuracy based on the publicly available natural image classification dataset. We will then explore how UQ works in different misclassification detections with a detailed comparison of each method evaluated (3, 5). Besides, we will develop a publicly accessible website to report where and how we obtained our datasets and research results with a list of other feasible tasks.

Benchmarking Uncertainty Quantification for Deep Learning

University of Idaho
DEPARTMENT OF COMPUTER SCIENCE, UNIVERSITY OF IDAHO
Dristanta Silwal, Kyle Lucke, Min Xian
University of Idaho Office of Undergraduate Research

Abstract
One of the most significant developments in the last decade has been the heights Artificial Intelligence (AI) has reached in our daily lives. However, many advanced AI models have proved to be over-confident in their predictions, which makes it a challenge to apply them to critical applications such as healthcare, finance, and nuclear power and creates pressing needs for quantitatively understanding the uncertainties of AI predictions. In this project, We benchmark uncertainty quantification (UQ) methods for state-of-the art deep learning-based image classification models. The UQ methods focus on identifying misclassification in natural image datasets. We benchmark state-of-the-art UQ methods: Deep Ensembles (DE), Monte Carlo Dropout (MCD), LP-BNN, Dirichlet, and MAPLE. Performance was assessed on publicly available datasets, using DenseNet and WideResNet as backbone architectures. By analyzing epistemic uncertainty across these methods, architectures, and dataset, this research seeks to provide critical insight into UQ's effectiveness for misclassification detection, ultimately enhancing AI reliability and reducing risks associated with confident mistakes.

Problem
DNNs are increasingly popular due to their state-of-the-art performance on various tasks such as image classification, and natural language processing.
Even well-trained models produce confidently incorrect outputs, but cannot detect when this happens

Solution
UQ is a newly emerging subfield of deep learning that can mitigate this issue.
UQ methods provide uncertainty about the model's prediction, allowing the identification of confidently incorrect predictions.

References
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[2] Gal, Y., & Ghahramani, Z. (2016). Dropout as a Bayesian Approximation. ICML.
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[7] Venkataramanan, A., et al. (2023). Gaussian Latent Representations for Uncertainty Estimation. ICCV.
[8] Zagoruyko, S., & Komodakis, N. (2016). Wide Residual Networks. BMVC.

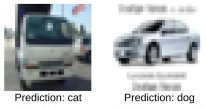
High Uncertainty Misclassified Images


Prediction: cat
GT Label: deer
Uncertainty: 0.06
Prediction: airplane
GT Label: cat
Uncertainty: 0.06
Deep Ensembles (WRN28-10)


Prediction: deer
GT Label: frog
Uncertainty: 0.04
Prediction: deer
GT Label: bird
Uncertainty: 0.04
MC Dropout (WRN28-10)


Prediction: automobile
GT Label: truck
Uncertainty: 0.05
Prediction: horse
GT Label: bird
Uncertainty: 0.05
LP-BNN (WRN28-10)


Prediction: dog
GT Label: horse
Uncertainty: 5.68
Prediction: airplane
GT Label: ship
Uncertainty: 4.55
MAPLE (WRN28-10)


Prediction: cat
GT Label: truck
Uncertainty: 8.04
Prediction: dog
GT Label: automobile
Uncertainty: 7.13
Dirichlet (WRN28-10)

Results Summary

Method	Accuracy (%) ⬆	AUGRC (x1000) ⬇
Deep Ensembles [3]	91.00	**9.90**
MC-Dropout [2]	91.60	40.70
LP-BNN [1]	90.95	13.20
MAPLE [7]	90.01	51.10
Dirichlet [6]	91.40	15.80

Table 1: Misclassification detection performance for CIFAR10 [4] dataset using WRN28-10 [8] backbone

Method	Accuracy (%) ⬆	AUGRC (x1000) ⬇
Deep Ensembles [3]	95.30	**4.20**
MC-Dropout [2]	93.99	6.60
LP-BNN [1]	93.809	7.10
MAPLE [7]	84.28	94.00
Dirichlet [6]	93.98	35.79

Table 2: Misclassification detection performance for CIFAR10 [4] dataset using DenseNet100 [3] backbone

Conclusions and Future Directions
We benchmark misclassification detection performance of five UQ methods on the CIFAR10 dataset using WideResNet and DenseNet models. Overall, we find that Deep Ensembles significantly outperforms other methods according to the AUGRC metric. Additionally, we have created a website which discusses the outcome of the research in detail. Our code will be available on github, allowing researchers to evaluate other UQ methods, backbone models and datasets. In the future, we plan to implement more UQ methods and evaluation metrics, and expand the benchmark to more datasets and backbone models.

Acknowledgements
This research was funded as a Summer Undergraduate Research Fellowship from the Office of Undergraduate Research at the University of Idaho which supportsundergraduate student engagement in research and creative activities. Also, I would like to extend my gratitude to Dr. Min Xian and Kyle Lucke for their incredible support and guidance during this research.

Learn more about me and my research project at the following website:

STUDENT: Claire Shelton **COLLEGE:** Science

TITLE: Investigating the Mechanisms driving regenerative responses in the Zebrafish retina

MENTOR: Diana Mitchell, Department of Biological Sciences

Abstract: Humans have limited ability to regenerate damaged tissues in the central nervous system (CNS; brain, spinal cord, and retina). Injury to the CNS can lead to permanent loss of function due to the inability for new neurons to be born or to regrow damaged projections from surviving neurons, which are necessary for neural communication. However, zebrafish show spontaneous regeneration of the CNS in most, but not all, experimental systems of acute damage. By probing the triggers of the regenerative response of this species, we can better understand the distinct characteristics and unique cellular processes that allow CNS regeneration. Understanding these processes will help develop our understanding of tissue regeneration and inflammatory processes. To address this gap, I will examine the regenerative responses of the zebrafish retina at different ages and with different levels of neuron death (Objective 1). I will also investigate if microglia, the innate immune cells of the CNS, are required for this response (Objective 2). By achieving these objectives, I will contribute valuable insights into zebrafish's ability to regenerate the CNS, specifically the retina, paving the way for future research.

University of Idaho
Department of Biological Sciences

Investigating the Mechanisms Driving Regenerative Responses in the Zebrafish Retina

DEPARTMENT OF BIOLOGICAL SCIENCES, UNIVERSITY OF IDAHO

Claire Shelton, Jordan Rumford, Ashley Farre PhD, Justin Mai, and Diana Mitchell PhD

University of Idaho
Department of Biological Sciences

Abstract

Humans cannot regenerate damaged retinal tissue, leading to permanent loss of vision. However, zebrafish show spontaneous regeneration of the retina following acute damage. By studying the regenerative response of this species, we can understand the cellular processes that allow retinal regeneration. In this project, we examine the role of microglia, the resident macrophages of the retina, to understand how they may support retinal regeneration. To date, there has been mixed evidence on whether microglia are required for retinal regeneration; this may be related to different experimental models used by different researchers. To trigger regeneration in the zebrafish retina, we used a zebrafish line that allows cone photoreceptor ablation upon drug exposure, which is then followed by regeneration. Cones are a specialized retinal neuron that responds to light in the vertebrate retina. We crossed the "cone ablation" zebrafish with a line that lacks a functional *irf8* gene, leading to microglia deficiency because the *irf8* gene is essential for the development of microglia. Our experiments will compare the regeneration of cones in microglia-deficient *irf8* mutant zebrafish to their microglia-sufficient siblings. This will potentially open new avenues for retinal regeneration research in humans.

Methods

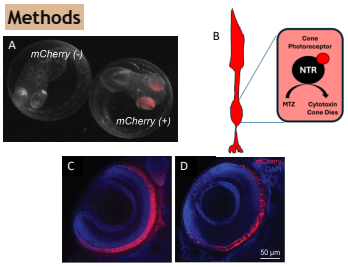


Figure 1. Transgene expression and MTZ-induced cone ablation in *gnat2:nfsb-mCherry* zebrafish.
(A) Larvae expressing the *gnat2:nfsb-mCherry* transgene. The transgenic larva (+) has red fluorescent cone photoreceptors, while the non-transgenic (-) does not.
(B) Diagram showing that Metronidazole (MTZ) selectively ablates cone photoreceptors. Zebrafish at 4.5 days post fertilization (dpf) are given a 48 hour MTZ treatment leading to ablation of cones.
(C and D) Whole-mount retina from zebrafish 6.5 dpf. Zebrafish are collected 48 hours into treatment with dimethyl sulfoxide (DMSO) (Vehicle/solvent) (C) and MTZ (D).

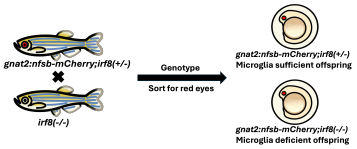


Figure 2. Breeding Scheme for microglia response.
This diagram illustrates the cross between *gnat2: nfsb-mCherry; irf8 (+/-)* to *irf8 (-/-)*. Offspring were sorted 4 dpf for red mCherry eyes, indicating transgene expression. Genotyping occurred after collection.

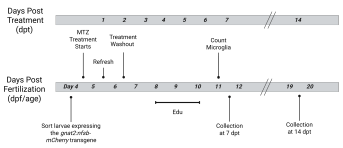


Figure 3. Age (dpf) and treatment schedule (dpt) for ablation and regeneration of cones.
EdU is a nucleotide analog incorporated into DNA as it is copied and is used to mark cones regenerated from dividing neuronal progenitor cells.

Results

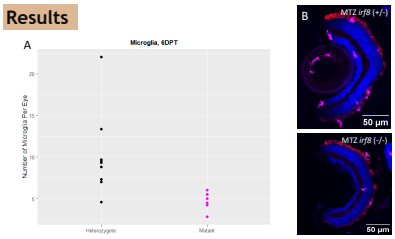


Figure 4. Microglia counts in heterozygote and *irf8* mutant zebrafish retinas at 6 dpt. (A) Quantification of microglia in heterozygote (black) and *irf8* mutant (magenta) zebrafish using an antibody to stain zebrafish microglia. At 6 dpt, *irf8* mutants show significantly fewer microglia compared to heterozygote, consistent with microglial deficiency. (B) Image of retinal cryosections stained with DAPI (cell nuclei, blue), 4C4 (magenta) and mCherry cones (red).

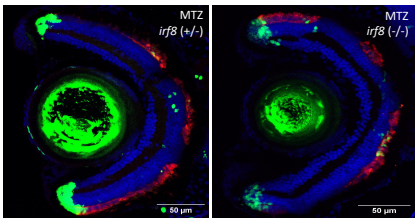


Figure 5. Detection of Regenerated Cones at 7 dpt.
Image of retinal cryosections stained with DAPI (cell nuclei, blue), Edu (Green) and mCherry cones (red). Edu can be seen colocalized with mCherry + cones, indicating cone regeneration.

Conclusions and Future Directions

- Regenerated cones are seen by 7 days post Mtz treatment of *gnat2:nfsb-mCherry* larval zebrafish
- *irf8* mutant zebrafish have reduced numbers of microglia but whether regeneration of cones is different remains to be determined
- Ongoing/future work will include quantifying numbers of regenerated cones and microglia at 7 dpt and 14 dpt

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Shiau et al. (2015) PLoS One. DOI: 10.1371/journal.pone.0117513

Acknowledgements

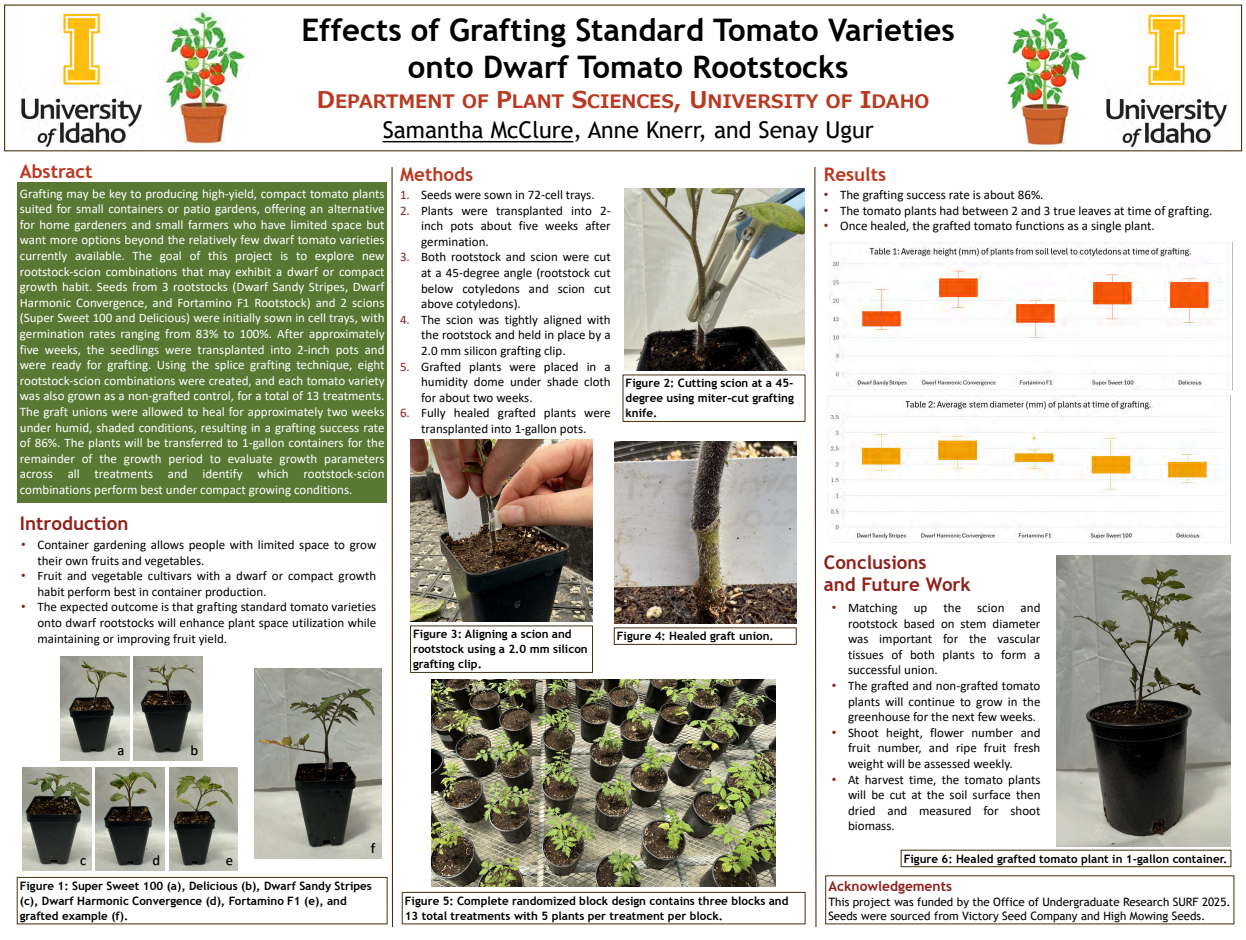
Funding for this work: Award R01EY030467 from National Institutes of Health granted to Diana Mitchell. We thank the University of Idaho IDAC Optical Imaging Core for their support. Thank you to Dr. Mikko Nagashima (University of Michigan) for gifting us the *gnat2:nfsb-mCherry* fish line made in Rachel Wong's lab (University of Washington; see D'Orazi et al. for more details). Thank you to the University of Idaho Laboratory Animal Research Facility (LARF). Lastly, thank you to the University of Idaho Office of Undergraduate Research for granting me the Summer Undergraduate Research Fellowship (SURF) Award.

STUDENT: Samantha McClure **COLLEGE:** Agricultural and Life Sciences

TITLE: Effects of Grafting Standard Tomato Varieties onto Dwarf Tomato Rootstocks

MENTOR: Senay Ugur, Department of Plant Sciences

Abstract: Grafting is an important horticultural tool for both ornamental plants and food crops. Grafted plants are the best of both worlds, as producers can select desirable traits in both the rootstock and scion and combine them to create a composite organism. Grafting may be key to producing high yield plants suited to small containers or patio gardens. Tomato (*Solanum lycopersicum*) is one of the most important and valuable vegetable crops in the world. There are hundreds of tomato varieties, each with unique sizes, shapes, colors, taste, texture, growth habits, etc. In recent years, tomato breeding programs have produced dwarf varieties which have a more compact growth habit. These varieties are ideal for home gardeners and small farmers who have limited growing space; however, the options are still limited when compared to the wide diversity of standard tomato varieties. The goal of this project is to explore new rootstock-variety combinations to develop alternative solutions for tomato producers with limited growing spaces.



STUDENT: Mary Schwartz **COLLEGE:** Agricultural and Life Sciences

TITLE: The Relationship of the Mediterranean Diet Adherence and Pregnancy/Postpartum

MENTOR: Yimin Chen

Abstract: This study's goal is to analyze the relationship between Mediterranean Diet adherence and perinatal maternal health. Weight management during the perinatal period is a critical life stage that may influence later risks for chronic diseases. The Mediterranean Diet is associated with reduced risk of many weight-associated chronic diseases in various populations. This will be a sub-analysis of an ongoing study to investigate associations between perinatal weight during baseline (2-3 weeks before the due date) as well as 4-week and 8-week postnatal appointments to monitor for gestational diabetes and postnatal glucose homeostasis.

Adherence to Mediterranean Diet & Perinatal Health

Mary Schwartz, College of Agricultural and Life Sciences, Professor Yimin Chen, PhD, RD

Project funded in part by an Institutional Development Award (IDeA) from the National Institute of General Medical Sciences of the National Institutes of Health (NIH), the NIH Office of Women's Health and the NIH Office of Nutrition Research under grant #P20GM152304, and an Undergraduate Research Grant from the Office of Undergraduate Research at the University of Idaho.

Introduction

- The Mediterranean Diet is associated with reducing the risk of many chronic diseases. And its adherence is also associated with lower odds of excessive gestational weight gain and postpartum weight retention.[1]
- After giving birth, many women struggle to lose weight due to low thyroid function, sleeplessness, and stress hormones.[2]
- Data from randomized clinical trials suggest the Mediterranean Diet has a beneficial effect on the primary and secondary prevention of cardiovascular disease, type 2 diabetes, atrial fibrillation, and breast cancer.[3]

Stocker, J. (n.d.). Greek salad or horiatiki with large pieces of tomatoes, cucumbers, onion, feta cheese and olives in white bowl isolated top view. village salad with sliced mozzarella, arugula, parsley and olive oil. Freepik. Retrieved July 8, 2025.

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(2) Parker Jones, K. (2023, August 15). *Why am I Gaining Weight After Giving Birth?*. University of Utah Health | University of Utah Health. https://healthcare.utah.edu/the-scope/health-library/all/2018/06/why-am-i-gaining-weight-after-giving-birth
(3) Tosti, V., Bertozzi, B., & Fontana, L. (2017). Health Benefits of the Mediterranean Diet: Metabolic and Molecular Mechanisms. *National Library of Medicine*, *3*(73), 318–326. https://doi.org/10.1093/gerona/glx227

Hypothesis

- Higher adherence to the Mediterranean Diet will be associated with a lower Body Mass Index and Hemoglobin A1C level in perinatal women.
- Higher adherence to the Mediterranean Diet will be associated with lower maternal stress via Perceived Stress Scale scores in perinatal women.

Methods

- Data is currently being collected from pregnant and postpartum (<3 months postpartum) women who are being recruited in Moscow, ID and the surrounding areas of the Palouse.
- Mothers will complete a 72-hour diet recall using the ASA24® dietary assessment tool at 4-week and 8-week time points. Raw data collected from the ASA24 will be directly inputted into the versatile R package dietary index, and the output will be used to determine a score (aMed) based on adherence to the Mediterranean diet.
- Mothers will be weighed on the same stand-on scales at baseline, 4-week and 8-week postnatal appointments.
- Maternal perceived stress will be measured at baseline, 4-week and 8-week time points using the validated Perceived Stress Scale.
- Maternal glycemic control will be assessed by quantifying HgbA1C concentrations using blood samples collected at baseline and 8-week postnatal appointments.
- Data will first be assessed for normality. If the data is normally distributed, Pearson correlation will be conducted. If the data is not normally distributed, Spearman's rank correlation coefficient will be used.

Project Design

- The parent study is a double-blind randomized control study.
  - The control group will receive a prenatal vitamin and 2,000 IU/day of Vitamin D gummies.
  - The placebo group will receive a prenatal vitamin and placebo gummies.
- A secondary analysis of the parent study will be conducted looking at the following relationships:
  - Adherence to the Mediterranean Diet and BMI
  - Adherence to the Mediterranean Diet and HbA1c levels
  - Adherence to the Mediterranean Diet and the Perceived Stress Scale
- Blood will be collected at baseline and 8-week and stored in -80°C and then analyzed at the same time.

Unknown, U. (2020). Pregnancy, Baby belly, Woman image. Pixabay. Retrieved July 8, 2025.

University of Idaho

MIMI

STUDENT: Callie Schmidt **COLLEGE:** Agricultural and Life Sciences

TITLE: Exploring Innovative Approaches to micropropagate North American Cloudberry

MENTOR: Senay Ugur

Abstract: The Cloudberry (*Rubus chamaemorus)* is a hidden northern gem, one of nature's remarkable gifts, yet is largely unknown to many people. Commercial cloudberry products (fresh fruit, jelly and wines) fetch a premium price, while cloudberries cultivated in Norway and Sweden are considered a national delicacy. However, demand greatly exceeds the supply available from wild plants. Traditional propagation methods, such as using seeds or rhizomes, have proven to be inefficient, labor intensive, and time consuming. Micropropagation, an asexual method wherein plants are multiplied using controlled levels of nutrients and light on an artificial media, has potential for cloudberry propagation. Four cloudberry cultivars have been developed using micropropagation in Norway but are unavailable to interested US buyers. The goal of my proposed research is to develop a micropropagation procedure for North American cloudberry. I will compare the effects of different growth media on the development and overall health of cloudberry plants. Media to be compared will include Murashige and Skoog, which has been used previously, against the effects of two new media, woody plant and Driver Kuniyuki Walnut. I hope my research will serve as the first step to introduce and produce this unique fruit in North America.

STUDENT: Jared Hanchey **COLLEGE:** Education and Human Health Sciences

TITLE: Effects of Isometric and Generalized Warm-Ups on Deadlift performance

MENTOR: Joshua Baliey, Department of Movement Sciences

Abstract: Isometric pulls before testing/performance have been associated with an increased athletic performance, such as countermovement jump (CMJ) testing **(1)**. However, there is no research about the effect of isometric pulls, used during a warm-up, on deadlift performance. The purpose of this project is to help determine the best type of warm-up to maximize deadlift performance. It is hypothesized that the isometric pull will improve performance in deadlifting and jump performance. Methods to observe differences between generalized warmups and a warmup utilizing isometric pulls will be as follows. Participants will participate in 3 sessions: session 1 will be consent and intake, followed by a 3RM test; sessions 2 and 3 will be either a deadlift specific warm-up or an isometric mid-thigh high-pull warm-up followed by CMJ and 90% 1RM deadlifts. Young healthy adults (18-30) with resistance training experience, specifically deadlifting, will perform the CMJ and deadlifts on dual force platforms with motion capture and electromyography (EMG). Specific warm-ups will be counterbalanced, to remove order effect of condition. Dependent variables [peak force and power, rate of force development (RFD), and muscle activation (EMG RMSE)] will be analyzed using paired *t*-test.

University of Idaho Department of Movement Sciences

Effects of Isometric and Deadlift Specific Warm-Ups on Deadlift Performance

University of Idaho Integrated Sports Medicine Movement Analysis Laboratory

J. Hanchey, L. Collett, S.E. Schlittler, & J.P. Bailey

BACKGROUND

- **Post Activation Potentiation:** Previous research has shown that isometrics can boost performance by increasing Post-Activation Potentiation (PAP). PAP is a temporary increase in muscle force and rate of force development (RFD) following a high-load, non-fatiguing contraction.
- **Mechanism:** PAP may occur through two proposed mechanisms: phosphorylation of myosin regulatory light chains, making muscles more sensitive to calcium or an increased synaptic excitation in the spinal cord, leading to greater force production and increased recruitment of higher-order motor units.
- **Focus:** In addition to examining the effect of PAP on strength, measured through peak force production in the deadlift, this study also examined its effect on counter movement jump (CMJ) performance, as PAP has been shown to influence both strength and power.
- **Hypothesis**: Isometric pulls (figure 1) will result in an increased propulsive RFD in the CMJ (figure 2) as well as an increase of peak force production and muscle activation in the deadlift.

PURPOSE

Identify the effect of incorporating an isometric pull into the warm-up of a deadlift. The findings of this project may cast new light on how warming up for the deadlift and potentially other compound lifts is practiced.

METHODS

Experimental Protocol

- 6 apparently healthy college students participated in three sessions
- Prior to session 1, participants completed a self-selected warm-up routine.
- **Session one**: 3-repetition maximum (RM) conventional barbell deadlift test. 1RM was estimated from 3RM load.
- **Sessions two and three**: Participants performed a designed dynamic warm-up then performed 2 CMJ. Then participants performed the designated deadlift warm-up (isometric pull or deadlift specific) followed by 2 CMJ then deadlifted their 3RM load for 3 individual repetitions.
- Sessions two and three alternated in sequence for each participant

Data Analysis

- Peak propulsive RFD of the delta of CMJ pre/post
- Peak Bar speed and max force in the deadlift

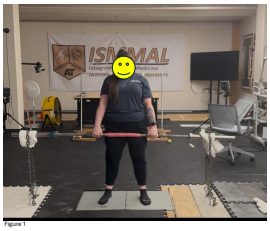
Statistical Analysis

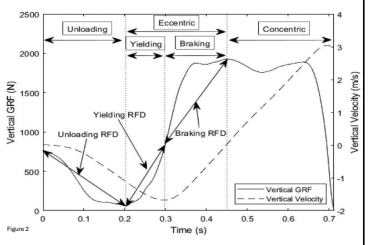
- Differences between conditions, will be analyzed using a paired *t-test*.

Table 1. Participant Demographics (n = 6)

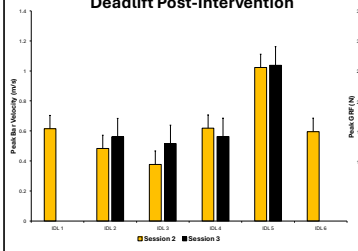
Age (yr)	Height (m)	Mass (kg)	3-RM Load (kg)
20.8±0.8	1.79±0.1	82.4±11.7	146.6±35.2

RESULTS

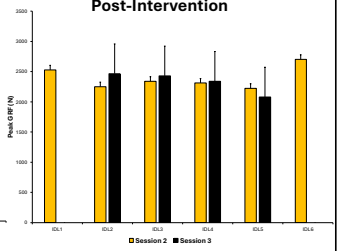




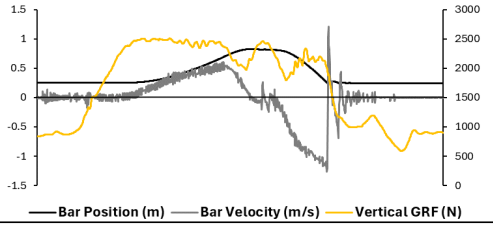
Peak Barbell Velocity During The Deadlift Post-Intervention



Peak GRF During The Deadlift Post-Intervention



Deadlift Exemplar Plot



STUDENT: Ash Moghadam **COLLEGE:** Art and Architecture

TITLE: Enhancing Architectural History Education with AI-generated imagery

MENTOR: Lori Smithey

Abstract: This research project aims to revolutionize the teaching of architectural history by integrating Heinrich Wölfflin's comparative method with the innovative capabilities of AI-generated imagery. As an architecture student passionate about teaching, I propose to enhance traditional educational methods by leveraging AI to create visually stimulating and thought-provoking images. The methodology involves gathering a comprehensive data set from architectural history and training three AI programs (Midjourney, DALL-E 3, and Stable Diffusion) on selected structures. Various prompts will be tested to combine images of architectural examples often used for comparing and contrasting discussions. By training AI software on specific historical data sets and generating hybrid images that merge architectural precedents, the project seeks to develop a powerful pedagogical tool. These AI-generated images will not only aid in teaching visual literacy but also serve as compelling design constructs. This early study aims to inspire future explorations and advancements.

Enhancing Architectural History Education with AI-Generated Imagery

College of Art & Architecture, UNIVERSITY OF IDAHO, Moscow, Idaho, 83844

Ash Alizadeh Moghadam, Prof. Lori Smithey

Abstract

Leveraging generative AI to enrich established pedagogy, this project reimagines architectural-history instruction through purpose-built, visually provocative imagery. Guided by Wölfflin's comparative binaries, Venturi's dialectic of complexity, and Davis's visual-culture analytics, we curate supervised, citation-rich datasets of canonical buildings and fine-tune Midjourney, DALL-E 3, and Stable Diffusion to produce hybrid renderings that fuse—yet never obscure—their source precedents. Targeted prompt engineering and model-specific control nets enable deliberate manipulation of massing, proportion, and ornament, foregrounding formal parallels and cultural divergences to sharpen comparative discussion. Pilot studio workshops show marked gains in students' visual-literacy scores and catalyze livelier debate, while faculty report the images' utility as springboards for speculative design.

Ongoing analysis is cataloguing prompt–image–learning correlations to establish replicable best practices and to build an open-access repository of annotated AI visuals. By uniting historiographic theory with supervised machine creativity, the study delivers a scalable toolset for architecture educators and a transferable model for humanities-centered AI scholarship.

Introduction

Architectural-history courses still rely on a narrow corpus of photographs and plans, leaving students with few opportunities to practice deep visual reading across time, style, and context. This project asks: How can generative AI enrich architectural-history pedagogy and sharpen students' visual literacy? Leveraging Wölfflin's comparative method, Venturi's dialectic of complexity and contradiction, and Davis's focus on the physical and metaphysical resonances of images, we curate a supervised dataset drawn from seminal texts (I.e. Kostof, Ching, Ingersoll, et al.). Fine-tuned Midjourney and Dzine AI models then synthesize "Multi-structurel" renderings: mash-ups that fuse signature elements of paired precedents and re-illuminate canonical buildings from fresh vantage points. This supervised workflow—unique in architecture education—serves as both research probe and classroom assignment, inviting students to generate, analyze, and debate their own AI-aided visuals.

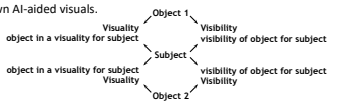


Figure 1.1: Bivisibility Diagram - Whitney Davis

Conclusively the future implementation of this method hopes to see measurable gains in comparative accuracy and descriptive precision, underscoring AI's potential to transform even the most tradition-bound corners of the curriculum.

Results

Figure 1.2: Hybrid-structure generation (Midjourney)

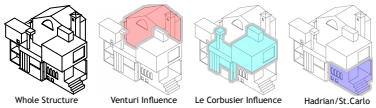
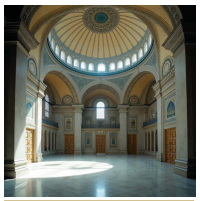


Figure 1.3: Isometric breakdown diagram

The outcomes of our image-generation experiments have clarified how the software responds to both the initial training dataset and to the incremental introduction of additional architectural structures. Continuous, rigorously documented testing—combined with an explicit engagement with the theoretical underpinnings of our visual-production strategy—has enabled us to iteratively calibrate the model's parameters. As a result, we have achieved demonstrable improvements in the fidelity, stylistic nuance, and pedagogical value of the generated imagery, thereby bringing the outputs into closer alignment with the project's overarching objectives.



(Top) Figure 1.4: Generation of Suleymaniye Mosque (Midjourney)

(Bottom) Figure 1.5: Generation of Hybrid Sinan-Palladio

Data Sets

By synthesizing Kostof's panoramic chronology, Fazio's typological matrix, Venturi's dialectic of complexity, Davis's scalar "bivisibility," Wölfflin's comparative binaries, and Ching-Ingersoll graphic manuals, the training corpus combined breadth and analytical precision. These sources diversified visual inputs, framed theoretically rigorous prompts, and supplied nuanced evaluation rubrics, enabling iterative fine-tuning. The resulting AI outputs—pedagogically annotated architectural mash-ups—balance historical authenticity with inventive recombination, offering a visually coherent, theoretically grounded tool that augments visual-literacy instruction and stimulates contemporary design inquiry within studios and history classrooms.

Figures1.6-1.8: Example images from datasets

Conclusions and Future Directions

Moving forward, the project will concentrate on three practical goals. First, we will broaden the supervised image set by systematically adding peer-reviewed exemplars from core architectural-history texts. Second, we will convert the AI workflow into repeatable studio and lecture assignments that ask students to generate, annotate, and debate hybrid-structural images. Finally, we will compile the best outputs—along with accompanying prompts and discussion guides—into a modular teaching pack for use across our history sequence. By steadily enlarging the dataset and embedding AI-mediated visual inquiry into everyday coursework, we aim to create richer material for instructors and a more active, image-literate learning experience for students.

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Acknowledgements

Thank you to the OUR, and SURF offices for support and funding for the project.
Thank you to Prof. Lori Smithey for the opportunitiy and boundless support

STUDENT: Kaitlyn Vilgos **COLLEGE:** Letters, Arts, and Social Sciences

TITLE: Missing and Murdered Indigenous Women and Two-Spirit Individuals

MENTOR: Omi Hodwitz, Criminal Justice

Abstract: North America's history of systemic oppression against Indigenous people has contributed to a tragic epidemic of Missing and Murdered Indigenous Women, Girls, and Two-Spirit people (MMIWG2). These individuals suffer disproportionately high rates of violence, this disturbing imbalance is emphasized by Hodwitz and King, stating that, “when compared to the national average, Indigenous women are two and a half times more likely to experience violent crime, twice as likely to be victims of sexual assault, and ten times more likely to be murdered than non-Indigenous women” (2021, p. 319). This statistic highlights the severity of the violence that Indigenous women and Two-Spirit’s face, but official estimates still do not show the full scope of the problem. Data collection of MMIWG2 cases remains inconsistent and inaccurate, leaving many cases undetected and unacknowledged. This lack of data affects the development of preventative measures and effective government responses to this issue. This research project, conducted at the University of Idaho, aims to improve our understanding of the MMIWG2 crisis by verifying existing case information (through public media sources) and compiling all known data into one database. This will help address discrepancies in current data and provide a more complete picture of the issue, supporting efforts to bring justice and healing to affected communities.

The MMIWG2 Database: Addressing Canada's Missing and Murdered Indigenous Women, Girls, & Two Spirit People Crisis

University of Idaho

Department of Culture, Society, and Justice, University of Idaho

Kaitlyn Vilgos, Omi Hodwitz, Ph.D, Steff King, M.S., Olivia Michelson

University of Idaho

Abstract

North America has a history of systemic oppression against Indigenous people that has contributed to a tragic epidemic of Missing and Murdered Indigenous Women, Girls, and Two Spirit people. While Canada has recently begun to keep track of reported cases, there is a sufficient lack in research and attention to this crisis. Indigenous people suffer disproportionately high rates of violence and mistreatment, and official estimates cannot show the full scope of this issue. The data being inaccurate leaves many cases undetected and unacknowledged. To address this problem, the MMIWG2 project actively collects and compiles all known information about Indigenous cases into a comprehensive database. This process clears up data discrepancies to improve government responses and prevent future violence for MMIWG2 individuals and their families. This research is ongoing and the MMIWG2 database needs continuous collaboration. These efforts will provide a more complete picture of this crisis and support bringing justice and closure to affected communities.

Research Questions

- To what extent do Indigenous youths, under the age of 18, make up the majority of direct victims of the MMIWG2 crisis compared to Indigenous adults in Canada?
- What are the primary geographic locations with the highest numbers of recorded cases of Indigenous youths across Canada?

Acknowledgements
Thank you to University of Idaho's Office of Undergraduate Research (OUR) and the College of Letters, Arts, and Social Sciences for funding this research. Thank you to research advisors Omi Hodwitz and Steff King.

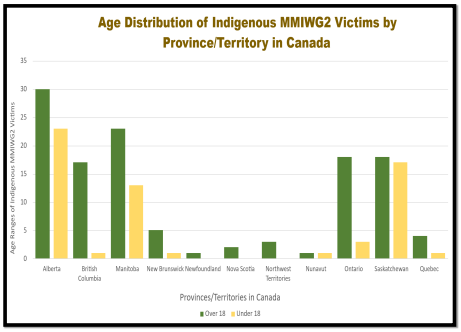
INTRODUCTION

The Missing and Murdered Indigenous Women, Girls, and Two-Spirit (MMIWG2) individuals crisis puts tremendous heartbreak and frustration upon affected families. Beyond the immediate concerns for health and wellness, Indigenous families also endure the stress of wondering whether a family member will vanish without proper justice or attention. This tragic reality is worsened by the lack of research and depth of knowledge given to it, creating a limited understanding of these cases. Amplifying this issue, media coverage alienates Indigenous communities through insufficient reporting and inadequate representation of these events. In direct response to the urgent need for improved data collection and research, the MMIWG2 project, conducted at the University of Idaho, was established in 1980. This ongoing project requires continuous collaboration to ensure the database remains current with the unceasing volume of reported cases. While the full scope of the crisis remains vast and obscured, the MMIWG2 database serves as a vital source of consolidated and clear information. Analysis of the data allows for identification of the key descriptors associated with MMIWG2 cases, offering crucial insights into the demographics of those affected. While the complexity of the crisis means that definitive conclusions cannot be drawn, the data within the MMIWG2 database provides visible trends regarding age ranges and geographic locations.

Methodology

The MMIWG2 database requires three phases:
1) Gathering details and reading reports of MMIWG2 cases.
2) Coding the collected case information and conducting quality control.
3) Preliminary data analysis.

In this specific research study, a total of 200 cases were fully coded for analysis.



Results

- Out of the 200 cases, there were **63 total** reported MMIWG2 cases where the victim was **under the age of 18.**
- Out of the 200 cases, there were **119 total** reported MMIWG2 cases where the victim was **over the age of 18.**
- **Alberta, Canada** had the highest number of recorded cases of Indigenous youths: **23**.
- **Saskatchewan, Canada,** had the second highest number: **17,** and **Manitoba, Canada,** had the third highest number: **13**.

Conclusion

These findings suggest that Indigenous adults (those over 18) made up the majority of direct MMIWG2 victims, significantly outnumbering Indigenous youth. However, there were three concerning provinces within this specific dataset that had alarming numbers of Indigenous youth being direct victims; Alberta, Saskatchewan, and Manitoba, which is crucial to acknowledge for this research. These research questions represent only a fraction of the MMIWG2 project. There has been significant work accomplished, but there remains much more to be done. This adapting database has been a tool to provide clear, sufficient statistics. The ongoing efforts are vital for a complete understanding of the MMIWG2 crisis, which is important for informing effective policies + strategies to achieve justice and prevent further violence for all Indigenous peoples.

STUDENT: Maximillian Wood **COLLEGE:** Letters, Arts, and Social Sciences

TITLE: Sharing Idaho's History - Visually

MENTOR: Mark Warner, Anthropology

Abstract: For 12 years anthropologists at the University of Idaho have actively engaged the citizens of the state through a series of public archaeology projects in locations such as Coeur d'Alene, Moscow, and Boise. The projects have generally been successful from a research perspective and somewhat successful from an outreach perspective, reaching thousands of the state's citizens during the excavation. The shortcoming with the projects has been the ability to continue to engage communities after excavations are completed (a typical project is two to four weeks). The proposed project is intended to address this issue by producing at least three documentary videos on two recent excavations and one upcoming excavation. The excavations were conducted in Moscow, near Riggins and the upcoming excavation will be in Boise. The resulting videos provide opportunities to continue to share archaeological work for years after excavations are complete as well as the ability to reach audiences who may not otherwise be able to visit archaeological sites. Furthermore, it provides a significant opportunity for professional development for the student researcher enabling them to create multiple videos that will be shared throughout the state.

https://www.youtube.com/watch?v=nZzBiUeo-r4

Boise Assay Office – Field School Documentary.

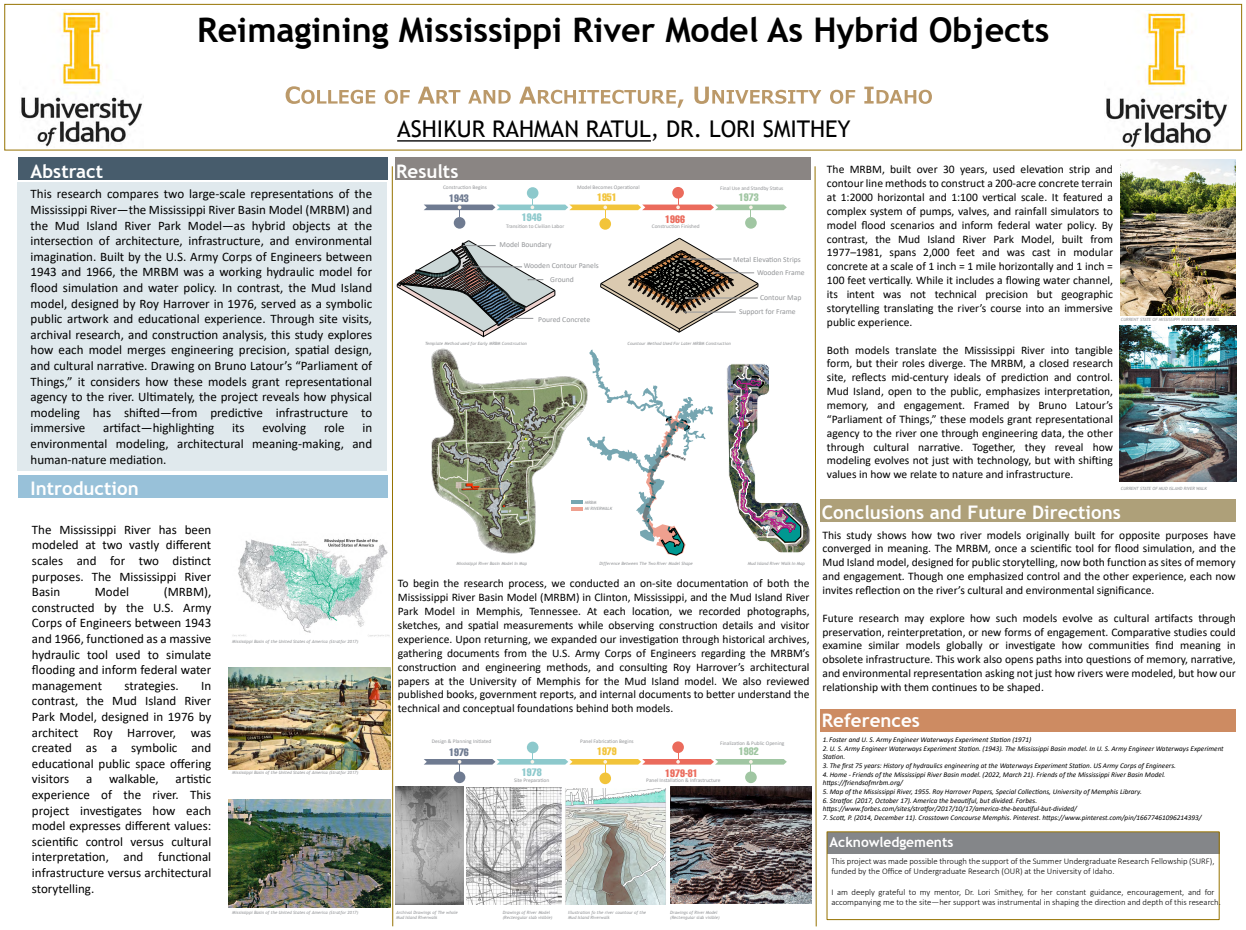
Max also created a video for an Archeology project at Moscow High School and presented his work at a regional archeology conference.

STUDENT: Rahman Ratul **COLLEGE:** Art and Architecture

TITLE: Exploring Mississippi River Models as Hybrid objects

MENTOR: Lori Smithey

Abstract: This research project explores the two models of the Mississippi River, the Mississippi River Basin Model and the Mud Island Park River Model, as hybrid objects that bridge the gap between nature and society. Built by the US Army Corps of Engineers between 1943 and 1965, the Mississippi River Basin Model was designed to visualize the Lower Mississippi and predict flooding, reflecting early 20th-century technological optimism. In contrast, the Mud Island Park River Model, designed by architect Roy Harrover in 1976, emerged during a period of growing environmental awareness and serves as a cultural and educational attraction. This study examines these models through the lens of Bruno Latour's concept of the "Parliament of Things," which advocates for giving non-human entities a voice in decision-making processes. By employing site visits, documentation, archival research, and literature analysis, this project aims to highlight the limitations of modernist approaches to environmental management and suggest alternative frameworks for understanding human-environment interactions. This research contributes to broader discussions on environmental stewardship and the role of physical models in fostering public engagement and understanding.

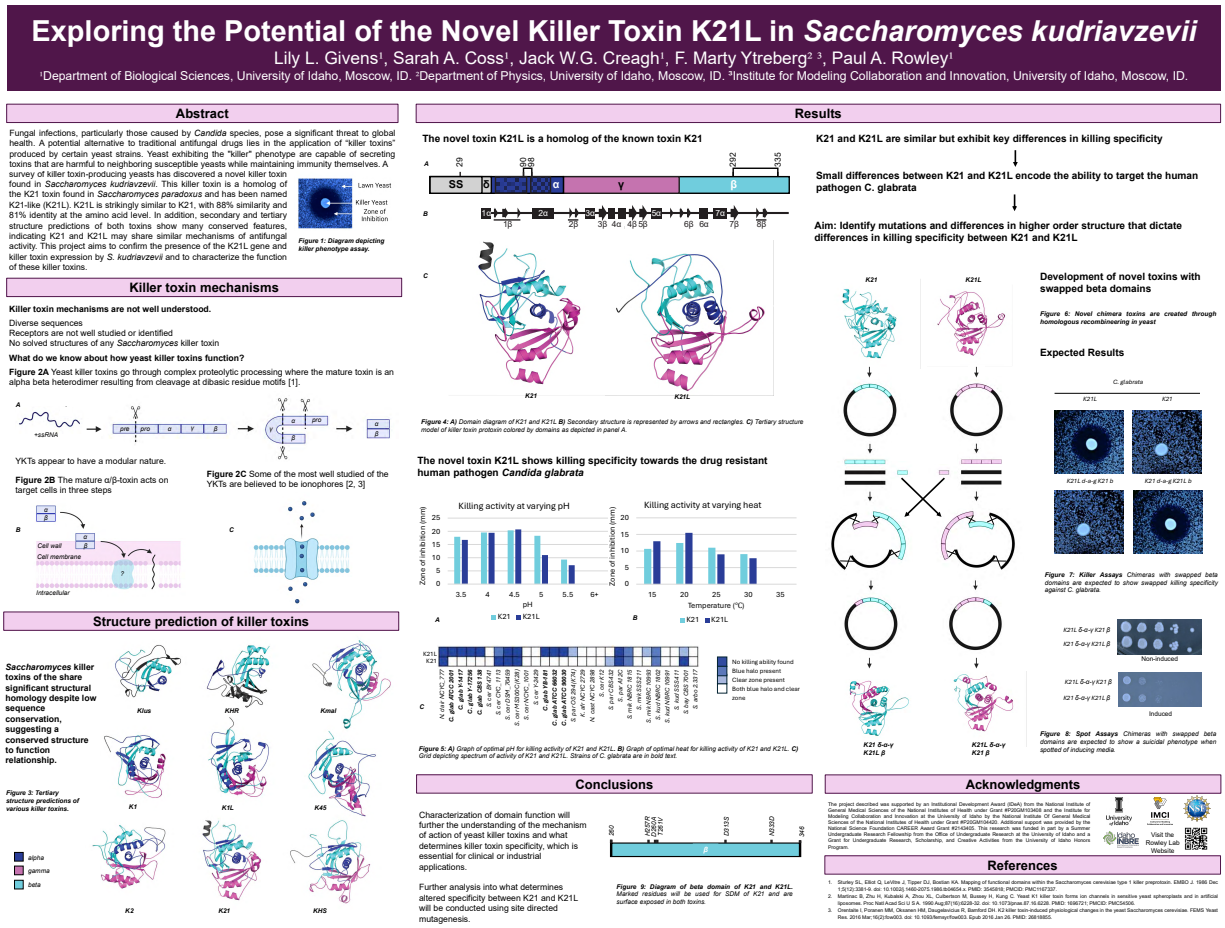


STUDENT: Lily Givens **COLLEGE:** Science

TITLE: Exploring the potential of the novel killer K21L in *Saccharomyces kudriavzevii*

MENTOR: Paul Rowley, Department of Biological Sciences

Abstract: Fungal infections, particularly those caused by *Candida* species, pose a significant threat to global health. A potential alternative to traditional antifungal drugs lies in the application of “killer toxins” produced by certain yeast strains. Yeast exhibiting the "killer" phenotype are capable of secreting toxins that are harmful to neighboring susceptible yeasts while maintaining immunity themselves. A survey of killer toxin-producing yeasts has discovered a novel killer toxin found in *Saccharomyces kudriavzevii*. This killer toxin is a homolog of the K21 toxin found in *Saccharomyces paradoxus* and has been named K21-like (K21L). K21L is strikingly similar to K21, with 88% similarity and 81% identity at the amino acid level. In addition, secondary and tertiary structure predictions of both toxins show many conserved features, indicating K21 and K21L may share similar mechanisms of antifungal activity. This project aims to confirm the presence of the K21L gene and killer toxin expression by *S. kudriavzevii* and to characterize the function of these killer toxins.



STUDENT: Sebastian Herrera-Allegre **COLLEGE:** Science

TITLE: Development of a modular thumb support with multi-directional locking to improve post-stroke thumb opening and positioning

MENTOR: Joel Perry, Mechanical Engineering

Abstract: Stroke is a leading cause of long-term adult disability and frequently impairs voluntary control of the hand. Disruption to the brain's motor pathways weakens the muscles responsible for finger extension while also increasing involuntary tone in the finger flexors. This imbalance makes it difficult to extend or release the hand, hindering daily activities and slowing rehabilitation. Although dysfunction affects the entire upper limb, effective thumb positioning—particularly in abduction, extension, and opposition—is essential for functional hand use. Most orthotic devices focus on supporting grasp but offer little assistance for controlled hand opening or repeatable thumb positioning. To address this gap, a modular thumb support attachment was developed for a lab-designed hand orthosis. The design includes a multi-layered spherical joint with a position-locking cam handle, allowing for manual locking and multi-directional adjustment. The attachment was designed to align with natural thumb movement and provide support for abduction and extension without interfering with grasp. It remains low-profile and lightweight for user comfort and integrates directly into the existing hand orthosis framework. Preliminary self-testing demonstrated improved comfort, positioning, and ease of use during repeated motions. This early-stage prototype presents a promising direction for adaptable, user-centered orthotic tools that support functional hand rehabilitation.

Development of a Modular Thumb Support With Multi-Directional Locking to Improve Post-Stroke Thumb Opening and Positioning

Sebastian Herrera Alegre[1]; Joel Perry[2]
[1]Department of Chemical and Biological Engineering and [2]Department of Mechanical Engineering, University of Idaho, Moscow ID

Abstract

- **Background:**
  - Stroke often impairs voluntary hand control by weakening extensors and increasing involuntary flexor tone.
  - This limits hand opening, delaying recovery and complicating tasks where thumb positioning—especially in abduction, extension, and opposition—is critical.
- **Problem Statement:**
  - Few orthotic devices provide targeted, adjustable support for the thumb that enables functional hand opening after stroke.
- **Solution Design:**
  - A modular thumb support was developed for a modified hand orthosis, featuring a low-profile, lightweight structure that integrates directly into the device and uses a multi-layered spherical joint with a position-locking cam handle to support thumb abduction and extension without interfering with grasp.

Objectives

- Design a modular thumb support attachment that approximates the natural range of motion in a non-stroke-affected thumb.
- Develop a mechanical system that provides assistive force for thumb extension to support controlled hand opening.
- Incorporate a position-locking mechanism that enables repeatable, user-defined thumb orientation for functional tasks or therapy.
- Ensure compatibility with both daily use and clinical settings, prioritizing ease of adjustment, comfort, and integration with existing orthoses.

Methods

- **Design Requirements:**
  - Replicate the functional range of motion of the thumb, with emphasis on abduction, extension, and opposition with manual locking.
  - Ensure integration with a lab orthosis and maintain a lightweight, low-profile design.
- **Design Implementation:**
  - A multi-layered spherical joint was selected for secure, multi-directional adjustment and manual position locking.
  - Components were modeled in CAD and 3D printed using a combination of rigid and flexible materials to balance support and comfort.
- **Testing:**
  - Self-testing assessed comfort, anatomical alignment, and grasp compatibility across repeated-motion trials.
  - Assisted extension and locking stability were evaluated, with qualitative observations informing refinement and future user testing.

Mechanical Design and Components

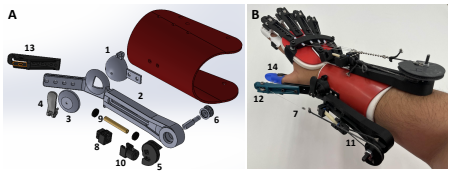


Figure 1. Modular Thumb Support Design – Exploded and Assembled Views. (A) Exploded view displaying internal structure: base (1), central (2), and top (3) spherical joint layers; cam handle (4); series cam piece (5); ball bearings (6); fixed spring mount (8); rubber spring with end caps (9); floating spring mount (10); and pulley support arm (13). (B) Assembled device mounted on the hand orthosis, also showing Cable A (7), Cable B (11), pulley (12), and thumb cap with Velcro straps (14).

Functional Capabilities and Use

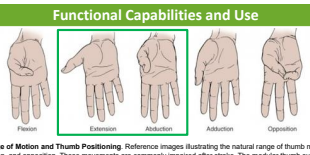


Figure 2. Range of Motion and Thumb Positioning. Reference images illustrating the natural range of thumb motion, including abduction, extension, and opposition. These movements are commonly impaired after stroke. The modular thumb support was designed to assist in restoring these motions, particularly extension and abduction, to improve functional hand use.

Figure 3. Adjustment sequence of the position-locking mechanism. (A) Thumb support secured in a neutral position with the cam handle locked. (B) The cam handle is disengaged, allowing the user to reposition the support by rotating the middle layer of the multi-layered spherical joint. (C) A new thumb position is secured by re-engaging the cam handle, demonstrating ease of repositioning and repeatability.

Comparison to Existing Orthotic Solutions

Feature	Proposed Thumb Support	SaeboFlex	SoftPro Orthosis
Thumb Adjustability	Multi-directional, manual locking	Limited (via Allen wrench)	Minimal (pre-shaped splints)
Locking Mechanism	Cam handle for secure positioning	Screws	None
Extension Assistance	Nonlinear force via cam + spring	Linear spring assistance	Passive/stretch-based support
Grasp Compatibility	Maintains open grasp	Designed for flexion tasks	Supports resting or grip
Integration	Modular	Full splint	Pre-molded resting orthoses
Adjustability	High (mechanical + length tunable)	Medium (adjust w/ tools)	Low (fixed shape, bend-to-fit)
User Setup	Designed for single-user operation	May need assistance	Simple; straps or Velcro

Table 1. Comparative features of the proposed thumb support and two commonly used orthotic systems in post-stroke hand rehabilitation.

Discussion

- Designed to support thumb extension and positioning often impaired post-stroke.
- Multi-layered spherical joint and locking cam allow flexible, repeatable adjustment.
- Nonlinear spring and dual-cable system offer graded assistance but require tuning.
- Manual locking supports consistent use, though may be difficult to adjust unassisted.
- Future refinement will target compactness, ease of use, and clinical evaluation.

Conclusions

- Preliminary self-testing showed improved thumb comfort, positioning, and ease of use during repeated motions.
- This early-stage prototype presents a promising direction for adaptable, user-centered orthotic tools that support functional hand rehabilitation.

Acknowledgments

- Supported by an Institutional Development Award (IDeA) from the National Institute of General Medical Sciences of the National Institutes of Health under Grant #P20GM103408.
- For further questions please contact Dr. Perry by email at jperry@uidaho.edu.

IdahoINBRE IDeA Network of Biomedical Research Excellence

University of Idaho

BUDGET:

$65,000 – spent $64,869

Budget Justification:

A. Spring Semester Awards **$4,000** but $3,369 spent
In December of 2024 it was determined that SBoE earmarked STEM funding could apply to four of the Spring 2025 semester awards. Each of these projects requested $1,000 and the students and faculty mentors utilized internal departmental budget codes (that we monitored) to purchase supplies for the projects. Attached to this document is a itemized list of materials purchased ($3,369)

B. Summer Undergraduate Research Fellowship (SURF) awards $**50,500**
For Summer of 2025 the OUR was able to award 8 full scholarships at $5,500 to STEM students using SBoE HERC funding and one partial scholarship of $1,500 and another partial scholarship of $5,000. The rest of the funding – specifically for their projects – was supported from the OUR.

C. SURF-INBRE Stipends **$11,000**
The OUR has partnered with the Idaho INBRE program to help students that were meritorious enough to earn INBRE in their Sophomore year summer and reapplied for INBRE for their Junior year summer. In this partnership – the OUR is secured a high-quality STEM related research project and motivated student and INBRE can offer a second summer for students with limited other options. This year – the two students in the SURF-INBRE program were Lily Givens and Sebastian Herrera Allegre. Each was paid a $5500 stipend and the remaining stipend and supplies budget was furnished by INBRE.

D. **Total: $64,869**

University of Idaho

Itemized Expenditures

From 7/1/2024 through 6/30/2025

Grant: SC8081 - ISBOE HERC OUR FY25

Index: -

Fund: 228081 - ISBOE HERC OUR FY25

Operating Expenses

E5025 Printing & Binding

4/28/2025	J1376225	Tckt#1640778591 Iron Weathering tg	$59.40
4/30/2025	J1376510	Tckt#1642813919 J Manshahia Pstr tg	$67.20
4/30/2025	J1376520	Tckt#1643474785 John Grundy Pstr tg	$43.20
4/30/2025	J1376764	Tckt#1644130351 Thapa Symp Pstr tg	$43.20
6/11/2025	J1379362	jlr/To 917998 SURF Medema Doc Ref: J1376225	($56.45)
6/11/2025	J1379364	jlr/To 917998 SURF Manshashia Doc Ref: J1376510	($42.58)

E5080 Licensing/Certificates

4/21/2025	Z1094191	Renewal of Tecplot research softwar Doc Ref:	$608.00

E5307 Analytical Services

4/11/2025	J1375504	March 2025 EM Center Langman; jdg	$590.00
4/15/2025	J1375614	RJH / CT 804776 to 887854 / ESS Doc Ref:	$60.00

E5671 Refreshments & Meals - Internal

6/20/2025	Z1098189	This was for lunch for the ME Exter Doc Ref:	$92.39

E5710 Tools

5/5/2025	Z1094957	This was ordered for Jasmeen Mansha Doc Ref:	$496.58
5/5/2025	Z1094957	This was ordered for Jasmeen Mansha Doc Ref:	$35.44

E5724 Research Supplies

3/11/2025	Q0103445	Amazon Capital WEST SYSTEM 105A Epoxy Resin	$104.98
3/14/2025	Q0104016	Amazon Capital 13 Pieces Set of 5 gram Diamond	$49.00
3/14/2025	Q0104016	Amazon Capital shipping	$11.28
3/18/2025	Z1091947	Seeding fluid for Vibhav Durgesh's Doc Ref:	$310.00
3/31/2025	!0577344	Amazon Capital Services Inc	$0.00
4/2/2025	Z1093029	Research supplies: thin section mat Doc Ref:	$181.79
4/3/2025	!0577760	Amazon Capital Services Inc	$0.00
5/8/2025	Z1095331	Differential pressure transducer fo Doc Ref:	$133.36
5/8/2025	Z1095331	Differential pressure transducer fo Doc Ref:	$210.00
6/20/2025	Z1098189	Reimbursement from PayPal correspon Doc Ref:	($133.36)
6/20/2025	Z1098189	Reimbursement from PayPal correspon Doc Ref:	($210.00)
6/20/2025	Z1098189	This is for Dr. Durgesh and John Gr Doc Ref:	$715.45
			$3,368.88

Trustee/Benefits

E7060 Prizes & Awards

5/12/2025	J1377283	SPAP for V00809589	$2,750.00
5/12/2025	J1377283	SPAP for V00877197	$2,750.00
5/12/2025	J1377283	SPAP for V00938253	$2,750.00
5/12/2025	J1377283	SPAP for V00959435	$2,750.00
5/12/2025	J1377287	SPAP for V00910800	$2,750.00
5/12/2025	J1377292	SPAP for V00924845	$5,000.00

5/13/2025	J1377285	SPAP for V00888970		$2,750.00
5/13/2025	J1377290	SPAP for V00898620		$1,500.00
5/13/2025	J1377289	SPAP for V00927644		$2,750.00
5/13/2025	J1377288	SPAP for V00975945		$2,750.00
6/11/2025	J1379337	SPAP for V00809589		$2,750.00
6/11/2025	J1379337	SPAP for V00877197		$2,750.00
6/11/2025	J1379339	SPAP for V00888970		$2,750.00
6/11/2025	J1379341	SPAP for V00910800		$2,750.00
6/11/2025	J1379343	SPAP for V00927644		$2,750.00
6/11/2025	J1379337	SPAP for V00938253		$2,750.00
6/11/2025	J1379337	SPAP for V00959435		$2,750.00
6/11/2025	J1379342	SPAP for V00975945		$2,750.00
6/18/2025	J1379957	jlr/FR 917999 SURF Stipends	Doc Ref: J1379345	$11,000.00
				$61,500.00
		Totals for 228081		$64,868.88
		Totals for SC8081		$64,868.88