2022 CSURF Committee Members

Pikes Peak Community College (Host Campus)

Glenn Rohlfing
Chair and Associate Professor of History
Co-Director of Undergraduate Research
Division of Communications, Humanities, and Technical Division

Jo-Ellen Becco
Professor of English
Director of High Impact Practices

Robin Schofield
Associate Professor of English
Director of High Impact Practices

Tymber Eggers
Technology and Coordinator
Office of High Impact Practices
Office of Equity and Inclusion

Colorado College

Genevieve Love, Ph.D.
Professor of English

John Gould, Ph.D.
Professor of Political Science, Russian & Eurasian Studies

Dan Ellsworth, Ph.D.
Assistant Professor of Mathematics & Computer Science

Lisa Schwartz
Student Opportunities Manager

reduction in tested student linguistic proficiency. Results align with the existing body of literature which posits that racial matching can increase the academic and personal success of students of color. Future research involving larger sample sizes and observational or interview-based qualitative methods could be conducted to further support these preliminary findings and explore the relationship between raciolinguistics and racial matching more extensively.

Characterization of a Fourth-Generation Event-Based Neuromorphic Sensor

Liam Champagne, Kaylee King
Major Daniel O'Keefe, Dr. Matthew McHarg
United States Air Force Academy

This research focuses on investigating the potential of leveraging a high speed and low data rate neuromorphic sensor for space weather and national defense applications. Space-based imaging currently relies on the traditional method of reading out an entire focal plane array at a fixed cadence. Due to size, weight, power, and data constraints for space-based capabilities, relying on this traditional imaging methodology typically requires careful management of a challenging trade space of cost and technical performance (e.g. spatial resolution and temporal resolution). By utilizing neuromorphic (i.e. event-based sensors), which independently record only changes in scene brightness on a pixel-by-pixel basis, many of these limitations can be overcome. Additionally, neuromorphic sensors have high dynamic ranges, suitable for scenes containing both bright and dim objects common to space environments. As a follow-on to analyzing data from our first-generation neuromorphic sensor aboard the International Space Station, we are characterizing a fourth-generation neuromorphic sensor to prepare for spaceflight in 2024. The fourth-generation sensor used in this study boasts a 20-fold increase in the number of pixels, a 100-fold increase in throughput, and a dramatic decrease in noise over the first-generation sensor. To prepare this new sensor for space, we begin with an initial sensor characterization: validating its throughput, measuring its frequency response, and exploring how various bias settings impact its sensitivity to different event types. Afterwards, we test the sensor using computer-simulated events and in the detection and tracking of satellites. These early tests improve our familiarity and understanding of the fourth-generation neuromorphic sensor's use, capabilities, and limitations, findings which will be leveraged when employing this sensor from space to observe lightning, sprites, and other high-altitude phenomenon.

Using a Model Based Enterprise to Improve NASA Facility Maintenance Operations

James Chitika, Ryan Cramer, Jared Dove
Lt Col Brian Lemay, Lt Col Jeffrey Newcamp
United States Air Force Academy

It's been 52 years since NASA has put a human on the moon, so their aging facilities require significant maintenance to do it again. However it is unclear how to prioritize the maintenance schedule given NASA's limited budget. We develop and analyze a model that is based on synthetic data that closely resembles a subsystem that could be found in one of NASA's facilities in order to answer the research question of "How can NASA streamline their facility maintenance operations?" We perform quantitative data analysis to examine what factors in the subsystem predict system failure in terms of operability. This information

is used to build a model that will ultimately assist NASA in reducing the facility maintenance cost by identifying ahead of time when its subsystems will fail. This model informs the decisions of facility managers at NASA to ensure that their facility is assisting in meeting NASA's goal of returning to the moon while not wasting its budget on poor maintenance scheduling practices.

Autonomous Rover via Reinforced Behavioral Learning

Weston Corbeil, Mason Utt , Tanner Todd
Chad Mello
United States Air Force Academy

Our goal is to build a reinforcement learning (RL) package capable of training ground-based autonomous rovers for navigation and mission completion within a variety of environments. We are training in the physical environment, as opposed to virtual environments; this approach is typically constrained by the amount of time it takes to train machine learning (ML) models. We cannot speed up episodes or train in multiple parallel environments in comparison to typical approaches that use virtual environments. Convergence of our RL models while running physical sessions would be nearly impossible using a randomized ML model. Therefore, we combine a pre-trained behavioral cloning model with the Advantage Actor-Critic (A2C) RL approach to significantly reduce the time it takes to train our models in a physical environment. We use dueling networks to converge on some optimum for training a ground-based rover. The actor neural network is our policy network, and is essentially a modified, pre-trained behavioral cloning model (Bojarski CNN) that yields throttle and steering mixture values for our skid steer rover; it yields the actions the rover should take in any state. The state consists of camera images and depth sensor data. The critic uses the same model as the actor. Its output layer and optimizer are modified render the reward "value" of a given state. The goal of this approach is for our two networks to work together to learn a policy that the rover executes against that maximizes its rewards (via the critic model) as well as minimizes the overall loss function (mean squared error). In the end, we have a cheap tech stack with a small footprint able to learn missions in the physical world despite the inherent problems.

Air Force Reserve 15A Billet Optimization

Zach Couper, Taylor Markham, Luke Nolley, Brad Owens
Dr. Dulin, Lt Col Miller
United States Air Force Academy

This project focuses on the recent shift in the Air Force Reserves operations research career field (15A) from primarily supporting acquisition functions to focusing on operations. The team analyzed the Air Force Reserves' 15A billets authorizations. Following Air Force Reserve leadership guidance, the team aimed to align the missions and locations of the Air Forces Reserves with that of the active duty 15A career field. Using the statistical software and surveying 15A reservists, the team analyzed the billets by calculating the percent difference of mission type and location between the reserves and active duty. Reserve billets that differed from active duty billets were given a higher score, indicating a greater need to change/restructure that billet. Types of mission were also taken into account. Billets supporting an

operational mission were classified as more essential and thus there is a less of a need to move them. Survey responses were used to gauge the impact of certain billets and their necessity given the restructuring of the career field. The project team was then able to rank which Air Force Reserves' 15A billets should be moved/restructured to meet the current refocus of the career field.

Confirming Gene Regulation/Expression Modulation as Markers for SARS-CoV2 Infection

Cruz, Antonio
Dr. James J Steel
United States Air Force Academy

SARS-CoV2 infects the respiratory tract of humans, resulting in COVID-19. During infection, the virus takes over the host cell and can result in drastic changes to gene expression. It has been proposed that host cell gene expression modulation may serve as an accurate diagnostic and correlation to SARS-CoV2 infection. We selected six genes (IGKC, DOK-3, IFIT1, HOXA10, MADCAM1, and MIR1-1HG-AS1) and tested them to monitor how SARS-CoV2 infection altered their expression, as compared to uninfected samples. Gene-specific primers were designed for PCR amplification and qPCR detection for our six gene targets. Preliminary findings confirmed the results that IGKC, DOK-3, and IFIT1 experienced up-regulated gene expression during COVID-19 and MADCAM1 exhibited a down-regulated pattern during COVID-19 infection. Host cell gene modulation may serve as an earlier detection and confirmation system to diagnose COVID-19 infection instead of waiting for SARS-CoV2 RNA levels to reach high enough abundance for detection. Further work will investigate the role of these genes and potentially look at how changes to gene expression may correlate with disease outcome in patients. Confirming the gene expression in the presence of SARS-CoV2 allows for a more accurate and subtle system in isolating the infected individuals and withdrawing them from the population to limit the spread of infection amongst others. Additionally, this overall enhances our understanding of basic virology and cell biology by answering the question of why specific genes are turned on or off in the presence of COVID-19.

Improving Inpatient Discharge Processes in Hospitals

Kyle Dane, Staci Davis, Tim Perea, Eddie Ro
Dr. Johnathon Dulin, Lt Col John Miller, and Lt Col Brian Lemay
United States Air Force Academy

As the fear resulting from the Coronavirus outbreak declines, willingness to visit hospitals for non-pandemic related health problems has grown, so hospitals are getting increasingly busy. To get new patients the care they need, beds must be available; reducing the time it takes to discharge patients drives this availability. Through clinical observation, we identified multiple processes causing delays in patient discharge time. We then used data collected from the hospital to quantifiably explain the effects of these delays and determine how changes in these processes could decrease discharge time. Some of the processes found to cause the most delays were communication between floors, availability of patient transportation, and task saturation of staff.

Campus Race to Zero Waste: Game-Day Basketball Recycling at USAFA

Shahana Gray, Boreth Pech, Morgan Ustick, Justin Wilmoth
Dr. Amelie Davis, Ms. Daniela Lawrence
United States Air Force Academy

Campus Race to Zero Waste is a competition among colleges and universities across the United States that aims to promote recycling. The United States Air Force Academy (USAFA) competed in the game day basketball category, where the goal is to collect the largest amount of recycling per capita at a single game. We also wanted to greatly reduce or try to eliminate contamination of the recycling waste stream given disposing non-recyclable items in recycling bins often leads to that collection being sent to the landfill. We conducted an experiment to answer the following research question: how does the location of the recycling bins in relation to the trash bins affect people's ability to recycle properly? Half the trash-recycling bin pairs in the basketball arena were placed directly next to each other; the other half were placed five meters apart from each other on either side of a walkway. We hypothesized that placing the trash and recycling bins five meters apart from each other will result in more contamination. We counted instances of attempts to recycle properly and improperly during half time and through the second half of the USAFA versus NM Lobos February 5 2022 men's basketball game. Overall, when the bins were placed together, more people attempted to recycle compared to when the bins were placed apart (237 instances versus 76 instances, respectively.) Interestingly, 25% of people placed a non-recyclable item in a recycling bin when the bins were part, while 32% did so when the bins were placed together. The percentage of contamination attempts however did not differ statistically between the two treatments ($X2(1, N=13)=0.91$, $p=0.34$.). We do find that the location of bins matters and that abutting the recycling and trash bins yields more recycling attempts, but education and signage are greatly needed to reduce contamination rates.

Internet of Things Lightweight Encryption Evaluation

William Duran, Bryson Fraelich, Andrew Lee, Augustin Sullivan
Major Bobby Bierer
Untied States Air Force Academy

Internet of things (IOT) devices with limited processing power and memory have introduced significant security vulnerabilities and challenges. These systems often sacrifice critical security features such as encryption due to the high demand these features would place on the system. To address this issue, NIST (National Institute of Standards and Technology) published a call for new lightweight symmetric encryption techniques for use with embedded devices such as IOT devices. These lightweight techniques would require significantly fewer resources than traditional encryption mechanisms such as AES, allowing them to be used on even the most constrained devices. From the 56 original submissions, 10 algorithms were chosen as finalists to be evaluated for their overall security and performance impacts. This study tested the performance of Ascon, one of the algorithm finalists on IOT devices. The study measured the performance of Ascon on real-world systems, including a weather station and e-ink display. These measurements included CPU usage, RAM usage, power consumption and packet captures of the communications traffic. The results of these measurements confirmed that Ascon performs well in resource-limited systems and would add much-needed security to IOT devices.

Silicon Laser Spectroscopy and Cooling for the Construction of a Quantum Computer

Noah Everett, Carson McLaughlin
Dr. Jerry Sell, Dr. Alina Gearba,Captain Anita Dunsmore, Dr. Randy Knize
United States Air Force Academy

We are in the preliminary stages of constructing a silicon-based quantum computer. Using a 252 nm laser and a silicon atomic beam, we perform laser spectroscopy of the Si $3s^2 3p^2 ^{3}P_1 \rightarrow 3s^2 3p 4s ^{3}P_0$ transition to measure the hyperfine structure and calculate the isotope shift between Si, Si, and Si. We use these measurements to design a Zeeman slower which laser cools and traps Si.

The Detection and Generalization of Quaternary Amines by Canine Olfaction

Ciara Gavin
Kristin Rowan
Pikes Peak Community College

For decades, canines have been used to detect classes of chemical compounds, such as the nitrogen or chlorine compounds found in bombs. As anaphylactic reactions increase worldwide, allergies to the class of compounds known as quaternary amines have developed. Quaternary amines are permanently positively charged molecules derived from ammonium, and may have any or all of the hydrogen atoms replaced by alkyl or aryl groups. They are surface-active agents used primarily as disinfectants and cleaning products. This research attempted to discover if dogs could be trained to detect specific quaternary amines, and if so, whether or not they would spontaneously alert to other types of quaternary amines they were not specifically trained to detect, a skill known as generalization. Generalization indicates that some detectable fragment of the odor remains the same between the molecules, despite the structure changing. If canines are able to generalize between quaternary amines, they may be used to alert allergic individuals to the presence of quaternary amines in an area. Initial research indicates that canines can detect and alert to specifically trained quaternary amines, but no generalization between compounds has yet been observed.

Development and Characterization of Perflouropyridine Pendant Polymers

Ian Geniza
Abby R. Jennings
United States Air Force Academy

Fluorinated polymers remain of interest due to their implementation in high performance applications, such as the aerospace and automotive industries. Recently, our group and others have shown that perflouropyridine (PFPy) can be utilized to make fluorinated polymers and materials. In this work, a new PFPy containing monomer was synthesized via nucleophilic aromatic substation. The monomer was then combined in varying mass ratios with methyl methacrylate and co-polymers were prepared via radical initiated chain growth polymerization techniques. The resulting polymers were characterized using TGA, DSC, GPC, and multinuclear NMR spectroscopy. The results of these studies will be further discussed.

Machine Learning Applications for Synthetic Aperture Radar

Grady Gills, James McGoldrick
James Maher
United States Air Force Academy

Illegal, unreported, and unregulated (IUU) fishing threatens ocean ecosystems globally and jeopardizes U.S. Economic security. Additionally, IUU Fishing has been shown to increase climate change, as well as increase the likelihood of military conflict over maritime resources. Synthetic Aperture Radar (SAR) can be used to locate and identify IUU vessels regardless of light levels or cloud cover, but a limited number of trained SAR analysts can interpret the data. In participation with the Defense Innovation Unit Xview3 Challenge, cadets from the United States Air Force Academy Department of Computer Science tackled data storage and space complexity problems to store 10TB of imaging data, and then trained a Convolutional Neural Network using the stored data. The resulting inference model is able autonomously classify maritime objects in SAR imagery as vessels, and additionally to determine if the identified vessels were fishing. By combining current fishing vessel detections and locations with Naval transponder data, authorities can determine if an identified fishing vessel is engaging in IUU fishing activities.

USAFA Utilizing Highly Motile Genetically Engineered Bacteria to

David Hatfield
Dr. Jordan Steel, and Dr. Chia Hung
United States Air Force Academy

Biocementation presents a unique method for creating structural material. The microbial enzyme, Urease, catalyzes the formation of the product calcium carbonate, which helps bind soil/sand particles together. We hypothesize that if bacterial motility can be enhanced, the penetration depth of the microbes may be greater and result in thicker Biocementation. Current techniques are able to solidify sand substrates into cement-like material, but after a topical application, the hardened cement is only a few inches thick. A simple transformation of the Urease plasmid into a bacterial species with a mechanism for motility maintains the function of this critical enzyme. Subsequently, assays at different soil depths will reveal bacterial motility's effectiveness, and structural strength tests can identify relative cementation strength at these depths. Biocementation has been of particular interest for its unique ability to solve complex structural problems. The demand for optimized yet structurally effective Biocementation treatment is rising. Getting deeper penetration and a thicker layer of hardening would be critical for applying this technology, especially in the context of airfield operating platforms (i.e. runways or aprons) and extra-terrestrial uses (i.e. lunar structural foundations).

Utilization of Wearable Fitness Tracking Devices to Predict Airman Health

Madison Hofmann, Scott Kinross
Lt Col Lemay, Capt Forbes
United States Air Force Academy

Currently all military members in the United States Air Force are required to take biannual physical fitness assessments (PFA) that are known to be significant stress inducers. As a potential alternative to the PFA, we analyzed the data obtained from wearable fitness devices to predict an individual's level of fitness and health outcomes. To accomplish this, we performed descriptive analysis to illustrate wearable fitness tracking abilities and accuracy based on a predictive model of health metrics. We developed mathematical models to predict the fitness level of individuals from their wearable fitness data and describe how these predictions may be used by Air Force leaders as an alternative to the current biannual fitness assessments for all Airman.

Totally Tubular: Determination of the Effect of Sonication on the Length and Purification of Single Walled Carbon Nanotubes

Laurique Hughes
Dr. Kevin Tvrdy
University of Colorado Colorado Springs

Single walled carbon nanotubes (SWNT) are purified by passing individual aqueous suspensions through a Sephacryl, S-200 gel bed in the presence of 2 wt% (70mM) sodium dodecyl sulfate (SDS). Different lengths and chiralities of SWNT adsorb to the surface of the hydrogel beads and are then eluted with 5 wt% (170 mM) SDS. Suspensions of individualized SWNT in 2 wt% (70 mM) SDS are generated through tip-horn sonication, which unbundles as-produced carbon nanotubes. During sonication scissioning of individual tubes occur, shortening SWNT lengths present in solution. It is hypothesized that shorter SWNT length will lead to greater interactions with hydrogel bead surface(s) due to a greater surface area of the tube can bind to the hydrogel surface. The effect of physical SWNT length on the ability and efficiency of different chirality SWNT to adsorb to Sephacryl, S-200 microspheres was determined using “underloaded” column conditions. During underloaded conditions there are more hydrogel binding sites than SWNT introduced. Increased sonication time showed an increase in overall abundance of individual SWNT present in solution. The absorption spectra pre- and post-interaction with the hydrogel beds indicated that despite having an overabundance of adsorption sites for the SWNT, there was a lack of complete SWNT uptake. SWNT uptake efficiency and elution efficiency data of aqueous suspensions were collected and correlated with length-of-sonication. Future work includes measuring the length of individual SWNT sonicated for varying time intervals before and after hydrogel interactions through atomic force microscopy (AFM) and scanning electron microscopy (SEM) to determine the effect of SWNT length of purification.

Kinematic Analysis of Maneuvering Flight in Bats

Chris Joiner, Armon Ranjbar, Abigail Shultz
Jonas Håkansson and Aaron Corcoran
University of Colorado Colorado Springs

Flight has only evolved three times in living animals—bats, birds and insects. Bats are unique among these flyers in that they have heavy, many-jointed wings that are highly compliant. Most research on flight has been conducted in highly controlled conditions such as wind tunnels where animals exhibit steady, controlled flight. We conducted research to determine flight turning kinematic patterns in bats flying in a large flight arena to determine unique flight techniques and differences in patterns between species. Bats were filmed with high-speed infrared cameras flying in a large flight arena in Austin, TX in 2020 and in Arizona in 2021. The video data of three species of bats were chosen for turning flight analysis: Lasiurus borealis and Nycticeus humeralis from the Austin recordings and Myotis ciliolabrum from the Arizona recordings. The videos were digitized by identifying 16 anatomical points of interest on the bats which were then used to train a deep learning computer program (DeepLabCut) to automatically place the points frame by frame in each video. These points are used to measure the motion of the anatomy for each flight path. Views from three cameras were used to convert two-dimensional detections into three-dimensional real-world coordinates. When average kinematic parameters are analyzed for each species of bat observed, the patterns and techniques used for each species can be further analyzed and compared to determine significant differences in flight patterns between species. These data will be used to test long-standing hypotheses regarding the mechanics and evolution of bat flight that have yet to be tested with empirical data.

Overestimation of Self-evaluation of One's Performance

Amy Kang, Maya Thorson
Dr. Silz-Carson and Lt Col Tucholski
United States Air Force Academy

Competition tied in with self-evaluation can trigger dishonesty in even the most honest person. In many professional settings, including in some parts of the United States military, subordinates are required to provide significant input about their work performance to their superiors as a part of the performance appraisal process. In some cases, subordinates are expected to draft their own performance appraisals. These appraisals may then be used to rank-order subordinates to determine who receives a limited number of rewards, such as a "Definitely Promote" (DP) rating of an officer in the United States military. The research question under investigation in this experiment is whether this form of competition for a limited number of rewards induces individuals to overstate the quality of their performance, something which could be considered a mild form of lying. We are planning to conduct this research through a matrix solving game through an Amazon program called Amazon Mechanical Turk (MTurk). In the game, participants will be given 20 matrices of 12 numbers and will be asked to select the two numbers in each matrix that add up to 10.The participants will report two statistics: (1) the number of matrices that they believe that they solved correctly; and (2) the average time that they think it took them to solve each matrix. We hypothesize that under a competition-based compensation scheme, one is more likely to overstate the quality of their performance.

Direct Carbon Capture Future Outlook in Cities

Jackson Kenney
Dr. Beauregard, Dr. Ashtiani
United States Air Force Academy

Carbon Capture Technology is seen as an important aspect of meeting global climate agreements. This will allow the world more time to switch to renewable resources. The captured carbon can be used in a variety of functions to include increase oil drilling operations, carbon products, and being stored underground. Carbon Capture Technologies can be highly energy intensive and is beneficial to be placed closer to renewable energy sources. This article will explore the scalability of Direct Air Carbon Capture Technology in cities. The benefit of such a system is in the air quality improvement in cities as well as decrease the growing impact that cities have on the environment. The advantages and disadvantages of these systems will be presented and how they can be implemented into city infrastructure planning. The paper will expand on the recent government actions in the United States to increase research and development in the field to meet current climate goals. The goal of this paper will be to show the cost effectiveness of direct air carbon capture technology and the market feasibility of captured carbon in consumer products. The best outcome for direct air carbon capture is significant investments in research to develop cost effective systems. The emphasis of this paper is not that direct air carbon capture is the solution to climate change but is an important part of meeting global climate goals in conjunction with renewable sourcing of materials and energy.

Analysis of Efficacy and Efficiency of CRISPR Gene Editing in Fission Yeast

Hadeel Khammash
Dr. Amy Klocko
University of Colorado Colorado Springs

CRISPR gene editing has the potential to make precise genome changes. However, the efficacy of this approach can vary. A goal of our work is to evaluate CRISPR targeting one gene in fission yeast. Yeast with changes to the AVT5 gene should gain the ability to grow on salt, a condition that normally kills the cells. Data from a lab experiment with unexpected results was used as a basis for this study. Yeast had been transformed with a CRISPR construct targeting the AVT5 gene and were being tested with salt plates to identify salt-tolerant yeast. Oddly, all yeast grew on the salt, even yeast that did not receive the CRISPR construct. Sequencing the AVT5 gene showed that there was no genetic changes, which mean the amount of salt was too low and that the targeting did not work. Therefore, we decided to identify a lethal dose of salt and to repeat the yeast transformation to gain more colonies for testing. In brief, competent yeast are transformed with the CRISPR plasmid and grown for colonies before testing on salt. Salt-tolerant colonies are isolated, DNA purified, and sent out for genetic analysis. Experimental yeast samples are compared to WT DNA, and success is indicated by genetic changes in the AVT5 gene. Success with such experiments can be seen in large scale medical experiments on diseases like muscular dystrophy and the work that is being done to aid in advance the research done to potentially treat diseases like this in the future.

Determination of the Change in Molecular Volume of an Aqueous Alcohol Solution and its Implications on Hydrogen Bond Length

Michaell Koogle
Dr. Kristin Rowan
Pikes Peak Community College

The observation that led to this investigation was as follows: when two miscible liquids formed a homogeneous solution their volumes were not additive. In layman's terms when 1.0 mL of water and 1.0 mL of ethanol were combined the resulting homogeneous solution's overall volume was less than the expected 2.0 mL. The use of this phenomenon was to investigate the intermolecular interactions between the two liquids, particularly their hydrogen bonding, which became the focus of this investigation. The deviation of the expected volume of a solution of ethanol and water at varying mole fractions was measured. This experiment was replicated using a solution of methanol and water, with particular attention paid to the mole fraction at which the solution volume reached its lowest value, the point at which the maximum deviation from the expected volume was reached. The ethanol solution reached this point at a mole fraction of 0.264 moles of ethanol with a maximum deviation of -2.55 mL, whereas the solution of methanol and water reached this point at a mole fraction of 0.314 moles of methanol with a maximum deviation of -4.10 mL. The volume per molecule at which the ethanol had reached its maximum deviation was 4.57E-23 ml/mlc and the volume per molecule at which the methanol had reached its maximum deviation was 3.95E-23 ml/mlc. The results seem to imply that the
discrepancy in the volume per molecule is due to the differing lengths of the hydrogen bonds between the alcohol and water, the shorter carbon chain of the methanol made it so that the bond between its oxygen and hydrogen was more polar, allowing it to get closer to the water molecules.

Evaluating the Extent of Inquiry Occurring in Colorado College Classrooms

Cat Krupka
Michael Taber, Ph. D.
Colorado College

The purpose of this study was to evaluate the extent to which inquiry-based learning is occurring in classrooms at the liberal arts college Colorado College. The study sought to gain insight into the relationship between occurrence of inquiry and the class environment. In determining what inquiry looks like at the college, another research objective was to instigate further research into improving inquiry-based learning. The research consisted of a phenomenological, case-study, non-experimental, mixed-methods study in which classroom observations were structurally coded to the McGill Classroom Level of Inquiry Checklist (Oppong-Nuako et al., 2015). The observed students completed a questionnaire on their perception of inquiry occurring in their classroom and their class environment. The results showed that levels of inquiry-based learning at the college are not as high as possible, with one of the four classes observed exhibiting Most inquiry, while two exhibited Middle inquiry and one exhibited Least inquiry. Data produced from the questionnaire was limited by the number of participants but demonstrated a strong positive correlation between classroom inquiry and positive class environments. This suggests further research is required on the creation of a classroom culture that promotes high inquiry learning.

Quantification of 1-Dodecanol in Single Walled Carbon Nanotube Solution

Natasha Mastalka-Tatro
Dr. Kevin Tvrdy
University of Colorado Colorado Springs

Single walled carbon nanotube purification can be realized by passing surfactant suspended single walled carbon nanotubes (SWNT) through a multicolumn system containing Sephacryl Gel, S-200. Sodium dodecyl sulfate (SDS) is a commonly used surfactant in the suspension of single walled carbon nanotubes for chiral purification. Carbon nanotubes are suspended in 2 wt% SDS through tip horn sonication and it is suspected that SDS is converted to 1-dodecanol (dodecanol) during sonication. The presence of dodecanol in carbon nanotube solutions has shown to prevent carbon nanotube adsorption to Sephacryl S-200 gel. To improve the SWNT purification process, the precise quantity of dodecanol in sonicated SDS was investigated. The conversion of SDS to dodecanol during sonication was quantified by the method of dodecanol extraction and gas chromatography (GC). SDS was purified by recrystallization to contain zero dodecanol concentration, prior to experimentation. A liquid-liquid extraction method with hexanes and recrystallized 2 wt% SDS was validated with spike and recovery, yielding percent recoveries above 80%. Concentrations of dodecanol were quantified by an external calibration curve. The rate of conversion of SDS to dodecanol during sonication was studied by sonicating recrystallized SDS in progressive time intervals, followed by extracting dodecanol for GC analysis. The next steps in this research include, defining new methods of SWNT suspension, that inhibit the conversion of SDS to dodecanol. We expect findings from this project to improve SWNT gel adsorption during the loading stage of purification and allow for improved SWNT purification.

Sex Identification of Vanessa cardui Through PCR Testing

Katheryn McIntyre
Dr.Hollis-Brown
University of Colorado Colorado Springs

In painted lady butterflies (Vaness cardui), the most commonly used technique for distinguishing sexes is by observing differences in the shape of the abdomen. The objective of this research was to develop a genetic test to identify accurately male and female painted lady butterflies, using a small portion of the wing as a sample. We identified a sequence unique to the W chromosome in females that could be amplified using polymerase chain reaction (PCR). Dried butterfly specimens were identified as male or female through consensus of two observers based on abdomen shape, and samples of the wings and abdomens were taken for testing. Results of the PCR showed that both the wing and abdomen samples yielded sequences of the expected size. This indicates that wing sampling can provide a nonlethal means of tissue sampling in these butterflies. We also found that several individuals that were initially identified by both observers as one sex were identified as the other sex through PCR testing. This suggests that identifying sexes solely based on abdominal shape is unreliable and cannot be used as a definitive method of sex identification.

Understanding the Immune System – Epstein Barr Virus Interaction

Kyrie Milliron
Dr. James Kovacs
University of Colorado Colorado Springs

Complement Receptor 2 (CR2) is the obligate human host receptor for the Epstein Barr virus (EBV). The viral surface glycoprotein 350 (gp350) is known to interact with CR2 on human immune cells, resulting in viral infection. EBV infection results in either an asymptomatic response as a result of infant infection or a symptomatic response clinically known as infectious mono resulting from infection later in life. Regardless of when the initial infection occurs, the virus will remain latent in the body until the immune system becomes compromised. This latency has been suggested to be related to many different cancers and diseases. Currently there are no therapies or vaccines against EBV. The results we present are the first steps in understanding the molecular interactions required for the infection of immune cells by the EBV. To date, we have preliminary binding data, protein crystals, and preliminary diffraction data. In order to continue working towards determining the three dimensional co-structure of CR2 and gp350, we have completed and confirmed the required cloning to express the proteins in human cells. We have also completed the production of the DNA needed to start human cell expression of the proteins.

Psychological and Somatoform Dissociation in Binge Eating:
Development of the Dissociative Eating Scale

Julia Nolan
Tricia Waters
Colorado College

Binge eating is very common in the general population, with U.S. prevalence rate estimates reaching up to fifty percent, and binge eating disorder (BED) is the most common eating disorder. Dissociation is associated with disordered eating tendencies that involve binge eating behaviors. Dissociation can be a maladaptive emotional regulation strategy utilized to distract oneself from negative affect, and, when paired with a food stimulus, dissociation can lead to overeating or binge eating. The Dissociative Eating Scale (DISS-EAT) was constructed to assess the dissociative phenomena one may experience when overeating. The DISS-EAT scale demonstrated good reliability and construct validity. Somatoform dissociation (which regards one's experience of their own body), rather than cognitive dissociation, more strongly predicted DISS-EAT scores, suggesting a need for a shift towards more embodied, integrative treatments for disordered eating.

Analysis on the Mathematical Principals of the Game Go

Quinn Popielarczyk
Professor Mahan
Pikes Peak Community College

The game Go (also known as Baduk, Weiqui and Igo) is a 4000 year old Chinese game that has been a brilliant testing ground for both computer science and mathematics in the recent years. The game consists of two players placing black and white stones on the intersection of lines of an n x n grid, with n=19 being the standard. Using fundamental principals of graph theory and John Nash's non-cooperative game theory, this research attempts to establish the foundations for a predictive model of the game using algorithmic reasoning. Binary values that represent unique conditions of the stones can be plugged into a series of graph theory applications. When these applications are then altered into the appropriate format, they can fit into a variation of Nash's theorems to yield a result. This defined subset could then, in theory, be used to determine the strengths and weaknesses within group structures especially for opening moves.

The effect initial mass of copper has when calculating the empirical formula for copper sulfide

Evan Schaible
Kristin Rowan
Pikes Peak Community College

This research was conducted due to discrepancies in a class experiment when trying to find the empirical formula for copper sulfide. Based on the data observed in class we assumed that the starting mass of copper would impact the resulting empirical formula. To test this theory we took multiple different masses of copper ranging from 1 gram to 2.5 grams and heated them in a crucible with excess sulfur repeatedly. Following the completion of the heating cycles the empirical formula was calculated for the created copper sulfide. During the experiment the data we found suggested that the starting mass of copper does not matter as if you continue to heat the copper with excess sulfide the empirical formula you will always get eventually is copper (II) sulfide.

Orthorexia: When disordered eating becomes a moral good

Maya Sikora
Dr. Tricia Waters
Colorado College

This study examined the morality of disordered eating particularly as it relates to orthorexia nervosa and self-critical perfectionism. A new scale was developed to measure concerns specifically about Moral Purity of Food and Eating (MPFE). The research aimed to discover whether and to what extent the MPFE was related to general concerns of moral purity using the Moral Foundations Questionnaire (MFQ), disordered eating attitudes using the Disordered Eating Attitudes Scale (DEAS), Self-Critical Perfectionism (SCP) using the subscale of the Big Three Perfectionism Scale (BTPS) , and orthorexia split into two subscales of healthy (HO) and unhealthy (ON) using the Teruel Orthorexia Scale (TOS). Adult female participants were recruited from Amazon mTurk to complete the surveys along with the new scale and some demographic questions.

The MPFE showed excellent reliability and good content validity because it was correlated with the other scales, as it was predicted to be conceptually related. The MPFE was the strongest significant predictor of ON, followed by the DEAS and SCP. The MPFE also moderated the relationship between SCP and ON. Future studies should further examine the MPFE and test it with male and non-binary populations.

Objective and Subjective Help Seeking Behaviors in Children

Alisha Silkey
Michelle Shields and Diana Selmeczy PhD
University of Colorado Colorado Springs

Help-seeking is a strategy that can promote learning. However, previous research has measured help-seeking using different methods. Some research has used objective measures of help-seeking during a cognitive task while other research has used subjective self-reports of help-seeking through questionnaires. Therefore, we do not have a strong understanding of how help-seeking develops in children using the same methods and whether these two methods yield similar conclusions. This current study examined the relationship between objective measures of help-seeking measured during a memory task and self-reported help-seeking measured through a questionnaire in children ages 8 to 13-years-old, (N=42). Results showed that children who self-reported engaging in less adaptive help-seeking behaviors also self-reported avoiding seeking help. Additionally, we found a positive association between self-reported help-seeking and objective help-seeking such that children who asked for help more frequently in the memory task were also the ones who self-reported more adaptive help-seeking. Overall, these results suggest that children can self-reflect about their general help-seeking intentions. However, the relation between objective and self-reported measures were only moderate, suggesting these measures may capture different aspects of help-seeking.

Curcumin diminishes oligomeric Aβ binding to a model lipid membrane

Daniel Soto
Dr. Crystal Vander Zanden
University of Colorado Colorado Springs

Alzheimer's disease (AD) is the 6th leading cause of death in the US, affecting more than 6 million Americans. In AD, the protein Amyloid Beta (Aβ) aggregates from disordered monomers, to intermediate fibrillar oligomers (FO-Aβ), to β-sheet rich fibrils and plaques. FO-Aβ is neurotoxic and is known to disrupt cell membrane structure. Alongside its antioxidant and anti-inflammatory benefits, the polyphenol curcumin has received attention for its ability to reduce Aβ's toxicity in cell culture and AD animal models. In this study, we propose an in vitro approach to determine curcumin's role in soliciting FO-Aβ interaction in a DMPG monolayer, which serves as a model cell membrane. Protein-lipid interaction was assessed via Langmuir trough assays by observing changes in membrane surface pressure (π). FO-Aβ was injected beneath a DMPG monolayer, and π was monitored to determine protein interactions. To assess curcumin impacts, curcumin was co-incubated with DMPG at various times (30 min or 2 hrs), followed by FO injection. In absence of curcumin, FO-Aβ insertion increased membrane surface pressure by ~2 mN/m,

Antibiotic Characterization of Marine Algal Extracts

Taryn Cates-Beier
Dr. Anthony Arment
United States Air Force Academy

The increasing antibiotic resistance from bacterial pathogens has created a strong need for new antibiotics. We tested six different marine algal extracts for antibiotic characteristics and differences in effectiveness against gram positive and gram negative bacteria. The disc diffusion assay was used to assess the effectiveness of these six extracts against 13 gram negative bacteria and seven gram positive bacteria. The extracts were solvated in methanol, ethanol and water. Precipitates were noticed when using alcohol as a solvent, these precipitates were then re-solvated in water and tested using Mueller-Hinton agar. Although the onset of the COVID-19 pandemic halted research, obtained results indicated no significant difference between the two different types of bacteria and the effectiveness of the extracts. There was also no significant difference between the effectiveness of the different tested solutions. Future research intentions were to use paper chromatography and Chromobacterium violaceum as the bacterial focus. If continued, the discovery of a novel antibiotic capable of quorum sensing inhibition could have potential microbe or cancer treatment implications regarding tumor cell signaling.

The Belt and Road Initiative in the Pacific:
Implications of Infrastructure Investment in Fiji and Papua New Guinea

Phoenix Chang Roper
Vibha Kapuria-Foreman
Colorado College

In 2013, Chinese President Xi Jinping announced the Belt and Road Initiative (BRI), a global infrastructure investment plan to connect Asia with Africa and Europe. While the initial focus of the Belt and Road Initiative was to increase Afro-Eurasia connectivity, it has expanded to encompass other regions to become the world's largest development finance initiative. This expansion included the addition of the Pacific Islands to the Maritime Silk Road (MSR) beginning in 2017, including the Cook Islands, Micronesia, Fiji, Niue, Papua New Guinea, Samoa, Tonga, and Vanuatu. I provide a qualitative analysis of the two primary recipients of BRI-related investments in the region: Fiji and Papua New Guinea. Through a review of macroeconomic data and local news coverage on Chinese construction since 2017, I seek to understand how the initiative has economically and politically impacted these two countries and what has determined these outcomes. I hypothesize that BRI impact in the Pacific Islands depends on institutional quality and capacity, which will determine the ability of local governments to utilize funds effectively and repay outstanding debts.

The effect of cannabis on older adults' processing speed

Katrina Cooley
Rachel Thayer and Adrianna Gallegos
University of Colorado Colorado Springs

In the United States, cannabis use is rising across populations, including older adults (OA), raising questions about the possible effects of cannabis on OA cognition. Namely, the impact of use and age on processing speed and inhibition and implications on driving. This study recruited OA aged 60+ (N = 11, M = 69.00, SD = 5.12) via community flyers and online ads. Participants completed four weekly brief timeline follow-back (TLFB) surveys, capturing the quantity and frequency of cannabis use. Week four also included an interview and cognitive battery, containing the Color-Word Interference (CWI) subtest of the Delis-Kaplan Executive Function System. Two participants were excluded for incomplete participation. A bivariate Pearson correlation was conducted to analyze the sample's (n = 9, male = 5) relationships among age (M = 67.89, SD = 4.82,), weekly use frequency (M = 5.22, SD = 2.44), and CWI average scores (M = 11.22, SD = 1.50) . The analysis revealed a statistically significant negative correlation between age and CWI scores (r = -0.74; p = 0.022), such that increased age was associated with slower performance. No correlations were observed with days of cannabis use within the last week. It is expected that processing speed will slow with increased age. Frequency was not associated with processing speed, but future studies can examine other measures of cannabis such as potency and use within the day that the tests are given. Does this mean you made a composite of all of the scores? "Processing speed" would be color naming and word reading alone, while "inhibition" would just be the inhibition and inhibition/switching trials.

Adaptive Tutoring System: An Application in an Introduction to Computer Science Course

Cameron Cubra, Cameron Estep, Jacob Hall, Thomas Kyle, Evan Marrone
Lt Col Justin Wilson, Captain Kevin Cardenas
United States Air Force Academy

In this project, we explore a new approach to an online tutoring system which attempts to minimize the time to learn a concept or skill through maximizing the users time in the zone of proximal development. We leveraged concepts from past academic studies which were able to show improved performance in an online tutoring system through adaptive weighting of question difficulty and question ordering for users. We modified and applied this approach to the CS110 Introduction to Computer Science Course at the United States Air Force Academy. Using the CS110 Database, which uses scores and records results on every code submission throughout, we were able to evaluate question difficulty through the features of time between attempts, number of attempts, and score. Our tutor links a Graphical User Interface to the CS110 Database and the user's python file which contains the question and autograder. Leveraging historical question difficulty, our tutor enables a user practice topics and questions in an order which minimizes learning time, updating continuously as the user completes problems. We are currently finalizing our tutor and beginning to test on current CS110 students to validate our assumptions and approach.

Leveraging Data To Improve Urban Farming Operations

Kelly Dang, Colin Douglas, Jacob Waltermire, Rex Yee
Lt Col Brian Lemay, Lt Col John Miller & Dr. Gerry Gonzalez
United States Air Force Academy

Urban farming offers numerous benefits over traditional farming, to include reducing the need to transport crops long distances, but is often more expensive due to space limitations and the cost of urban real estate. In order to be successful, urban farms need to operate and use their space efficiently. To identify opportunities to improve the profitability of an urban farm, we conducted a thorough analysis of data from a local urban farm. From our analysis, we identified multiple opportunities in the farm's food development processes and distribution operations that can be altered to increase profit. By implementing data wrangling, comparative analysis, and profit maximization, we explain our analysis methods and show how they were used to inform farming decisions and increase profit.

Effective Intervention: Perspectives of Title I elementary school teachers on most significant inhibiting factors to effective literacy interventions

Psalm Delaney
Mike Taber, PhD
Colorado College

The purpose of this study was to investigate Title I elementary school teachers' perceptions of the most significant inhibitors to effective reading interventions and to describe teachers' solutions to such inhibitors. The research followed a phenomenological, non-experimental, mixed-methods design centered from a metaphysical orientation. The data analysis concluded five significant inhibitors to effective reading interventions: (1) incomprehensive curricula, (2) high teacher shortages, (3) insufficient collaboration time, (4) low student attendance, and (5) student home life factors. Teachers suggest that increased professional development for curriculum implementation, "protected collaboration time" within the school day, and efforts for increased parent involvement in student literacy may reduce the severity of these inhibitors. Many teachers deem home life factors to be outside of their control. Further research may be conducted to investigate parent perspectives on inhibitors to engaging in their child's literacy development.

Seeking Justice: The Jewish Volunteers of Offenbach Archival Depot, 1945-1949

Eisert-Wlodarczyk
Meredith Scott
United States Air Force Academy

In addition to being perhaps the greatest attempt at the mechanized destruction of an entire people in history,, the Holocaust was also the largest organized theft in history, and the end of the war revealed the massive problem that had come with peace: what to do with the millions of items stolen by the Nazis? The prevailing historical narrative which surrounds post Second World War restitution efforts places American service men at the forefront of restoring Jewish belongings, culture, and literature. In reality, Jews of all different backgrounds came together and worked to restore what they had lost. Many of these volunteers flocked to the Offenbach ARchival Depot located in the American occupied zone of Germany. The depot was under military command but the epertise and labor were provided by Jewish volunteers coming from international organizations, academia, religious groups, and much more. This story of Jewish volunteers at Offenbach Archival Depot is one of determination, bravery in the face of near complete destruction, and one that rights the historic misplacement of credit in saving Jewish artifacts and books.

Regression Analysis for Predicting URT Student Performance

Jonathan Farmer, Robert Martin, Sung O, Eve Schoenrock
Lt Col John Miller, Capt Ethan Salgado
United States Air Force Academy

The 558th Flying Training Squadron, the only Undergraduate RPA Training (URT) squadron is currently seeing a trainee failure rate of approximately 6%. The project team aims to predict student performance at URT using econometric regression strategies analyzing initial student data for selected trainees and identifying at-risk students early in the training timeline. The 558th seeks to enhance the performance of their trainees by identifying student trends indicative of success and failure prior to URT, enabling them to provide attention and resources to students in need. The team's goal is to provide the 558th with information that will help them reduce the failure rate at URT without requiring additional funding. We find GPA, PCSM, STEM, and PPL status to be significant indicators of student success.

USAFA Telescopes Limiting Magnitude Study

Seth Finley
Dr. Devin Della-Rose, Dr. Tim Giblin, Dr. Francis Chun
United States Air Force Academy

The United States Air Force Academy (USAFA) operates a wide range of telescope systems including a 1-meter, 0.4-meter, and a global network of eleven 0.5-meter telescopes (Falcon Telescope Network) for cadet and faculty space science research. We conduct a limiting magnitude study for these instruments using Landolt Photometric Standard star fields to determine the faintest apparent brightness detectable with a specific exposure time and filter. Following data collection and processing, two plots are generated: 1) magnitude histogram, and 2) magnitude versus magnitude uncertainty. This establishes the limiting magnitude of a specified signal-to-noise threshold for the USAFA telescopes, thus defining their observational capabilities (e.g., duty cycle) for space situational awareness and the study of celestial transient events.

Exploring the Epistemic Mechanisms of Threat: Comparing the Effects of Mortality Salience and Incongruity on Cognitive Performance

Brian Foster
Dr. Tom Pyszczynski
University of Colordao Colorado Springs

Whereas terror management theory posits that the awareness of one's mortality triggers distinctive defensive processes, the Process Model of Threat and Defense posits that diverse threats trigger the same defensive processes. The present study investigated how exposing people to tasks that triggered incongruent or death-related cognitions affects performance on a logic test that is sensitive to political bias. 468 participants were randomly assigned to one of four tasks containing one of the following stimuli: death word pairs, a death-related short answer question, incongruent word pairs, or congruent words pairs. It was hypothesized that death reminders increase logical errors in the direction of support for one's worldview, whilst incongruity reduces logical errors by triggering more careful consideration. Pairwise comparisons revealed significant differences in cross-party composite bias scores between the incongruent experience condition ($M = -.28$), and both the implicit ($M = .18$) and explicit ($M = .05$) death conditions, $p < .05$; were a lower score equals greater conservative bias, and a higher score, greater liberal bias. Consistent with the direction of change in cross-party bias, conservatives in the incongruent condition demonstrated significantly more bias ($M = -.63$) when compared to the implicit ($M = .05$) and explicit ($M = .05$) death conditions. While these results are contrary to the hypothesis, they demonstrate that responses to death and incongruity are dissimilar, which is inconsistent with the Process Model of Threat and Defense. I speculate that death reminders reduced political bias among conservatives by triggering a need to bolster stimuli related self-esteem.

surveillance system, and to discovery the field test's sensitivity compared to sophisticated lab tests. The field-based test indicates when a major outbreak will or is occurring, but not to the same detail of data analysis of a sophisticated test. The field-based test still shows proportionality in the values given, meaning it can be used to monitor the beginning, height, and end of an outbreak cycle, meaning it can still acts as a useful and simple tool to help predict outbreak cycles without the specificity of a sophisticated test.

Abuse Towards Healthcare Workers

Rebekah Gomez
Robin Schofield
Pikes Peak Community College

I hope to discover a way to help bring some light and maybe help alleviate the problem surrounding the abuse on healthcare workers. I want people to realize that this is a common problem and happens all the time, from healthcare workers to other healthcare workers or more commonly patient abusing healthcare workers. This has happened to most every healthcare worker. I hope to show that these people all have a love to help people and should not have to deal with all the abuse they receive. A study that shows the trends of the abuse and such on healthcare workers should be completed as it would shine a light on this subject. This will be hard because it is a very taboo subject in healthcare. The healthcare workers are expected to care for the population in their darkest hours. It is expected that they can deal with all of the horrible things they see with little reaction. This is also true for the factor of patients abusing the healthcare personnel. It is expected that they do not retaliate or defend themselves when attacked. This expectation needs to change.

Investigation of Curcumin's Ability to Inhibit Amyloid Beta's Toxicity and Cell Membrane Interactions

Wendt Griffin
Crystal Vander Zanden
University of Colordao Colorado Springs

Amyloid beta (Aβ) has been experimentally shown to permeabilize membranes, resulting in cell death, due to its ability to aggregate creating toxic oligomers and fibrils found in Alzheimer's disease. An outstanding question is whether curcumin can inhibit Aβ interactions with the membrane. Curcumin has been shown to reduce Aβ toxicity and its ability to interact with monolayer membrane systems. To gain greater insight into Aβ's ability to penetrate phospholipid bilayers, liposomes were created to perform a fluorescence leakage assay. It is hypothesized that treatments such as curcumin work to either prevent interactions, help form non-toxic oligomers, or de-toxify oligomers. Aβ interacts with negatively charged phospholipids; therefore the liposomes were made with anionic POPG and a 7:3 molar ratio of POPG:POPC (POPC is zwitterionic) to mimic the inner leaflet of the plasma membrane. The vesicles were filled with the self-quenching fluorophore calcein to ensure no fluorescence would be recorded unless the membrane had been compromised. Our fluorescence data showed that monomeric Aβ caused dose-

dependent membrane leakage indicated by calcein presence outside the vesicles. Furthermore, the fibrillar and non-fibrillar oligomeric forms showed membrane disruption. Preliminary data showed curcumin had an effect on liposome fluorescence, although more testing is necessary for further evaluation.

Isolation, Extraction, and Identification of Fluorescent Unknown in Friedel-Crafts Acylation of Biphenyl

Nicholai Hagemann
Dr. Kristin Rowan
Pikes Peak Community College

Acylation of biphenyl with acetyl chloride is a commonly used Friedel- Crafts reaction. Side products observed between the reactant and the acetylating agent are often due to incorrect stoichiometric quantities. Fluorescent complexes were observed and made the focus of this project, while a lack of interest and funding in these byproducts by traditional industries was the motivation. Isolating, extracting, and identifying these develops a methodology to separate compounds with comparable properties.

Determination of Anisotropy Factors of Nanomagnets

Victoria Martinez
Ezio Iacocca
University of Colorado Colorado Springs

Magnets are common materials that exhibit north and south poles, no matter the size. As magnets are shrunken down to the nanoscale, (a thousandth of human hair width) their shape induces a symmetry breaking called anisotropy [1]. Because of anisotropy, nanomagnets have a well-defined north pole orientation. Nanomagnets can be ordered in arrays that produce new materials with unique functionalities call artificial spin ices (ASIs) [2]. ASIs support magnetic waves which are potential candidates for future energy-efficient information and computation carriers [3]. However, ASI magnetic wave research remains predominantly experimental, and analytical methods are required to accurately model these materials. A crucial factor for an analytical model is the determination of anisotropy for realistic shapes. We aim to determine the anisotropy of nanomagnets for a variety of shapes. We take advantage of the natural dynamic response of magnetic materials, ferromagnetic resonance (FMR). We theoretically derive FMR for a general case that describes any nanomagnet shape. Then we will use a modeling program MuMax3[4] to compute the FMR numerically. Our derivation allows fitting the simulated FMR and recovery of the parameters that describe the anisotropy. We will first model an analytically exact ellipsoid [5], and then explore realistic shapes. Our results will contribute to describe magnetic waves in ASI and model devices for spin-based information technologies.

Use of Artificial Reproductive Technologies in the Conservation of Endangered Species

Tara Matula
Jennifer Wawrzonek
Pikes Peak Community College

More than 7000 species are listed as critically endangered across the globe. Many of these species are animals, including familiar high profile species such as Pongo pygmaeus (Bornean orangutan), Elephas maximus sumatranus (Sumatran elephant), Panthera tigris (tiger), and Ailuropoda melanoleuca (giant panda). Conservationists have explored many methods to attempt to preserve and protect these species with varying levels of success. One such method that has been utilized is artificial reproductive technologies (ARTs). These technologies include techniques such as intrauterine insemination (IUI) using fresh or frozen sperm and in vitro fertilization (IVF). Experts analyze lineages and determine ideal pairings to maintain genetic diversity in these endangered species. When numbers are critically low, it becomes even more important to pay close attention to such pairings to avoid the risk of dangerous genetic defects resulting from inbreeding. With the use of ARTs, gametes can be collected from anesthetized animals then shipped to a suitable match and reproduction can occur even when the pairing itself may be risky (such as when introducing tigers or when mixing gametes of animals in the wild and those in captivity) or after the death of a male with a valuable bloodline. A rich field of study to further this technology is the introduction of newer technology such as microfluidics to make ARTs more accessible in work with wild animals.

Near-field microwave scanning microscope for magnonics applications

McAllister, Kaitlin McAllister
Dmytro A. Bozhko
University of Colorado Colorado Springs

Modern magnonics requires tools for the investigation of spin-wave dynamics in frequency, time, and space domains. One of the most critical features is the ability to probe spin waves in out-of-plane magnetized materials. We report the design and performance of a near-field microwave scanning microscope capable of providing all these features. It uses a broadband microwave loop antenna as a probe, which can be positioned over a sample surface with nanometer resolution using a piezo-driven platform. The microwave signal is recorded by a fast oscilloscope. As an example of system performance, we will show the dynamics of spin waves in a Yttrium Iron Garnet ring. Research using the microscope is ongoing and will aid the study of new magnetic materials, with applications in data processing and computing.

Optimization of Collaborative Autonomous Small Unmanned Aircraft Systems (SUAS)

Austin Patel
Lt Col John Miller, Lt Col Kevin Treat
United States Air Force Academy

With increasingly complex combat zones and advancing adversaries, developing large swarms of cost-effective Unmanned Aerial Systems may provide compelling capabilities for US (United States) Forces. Therefore, the research question concerns the optimal combination of existing UAVs that maximizes the probability of success while operating within time requirements, of being an effective component of the US military kill chain. Requirements for these sUAS were a flight time of at least 1.5 hours, a 2ms or better delay in sensing capability, and minimizing cost to less than $150,000 a unit. A python simulation was used to gather performance data on different combinations of UAVs and a randomized target set in a 5nm radius. The results suggest that an Altius-900, Voly M20, and Matrice 100 drone are the most optimal. The combined cost is 1.25 million dollars. Using insights from the simulation, the team was also able to recommend what attributes were the most important to a successful mission, saving time and money in the development processes.

40-year Changes in Lipid Storage Differ Between an Endemic Moth (Euxoa lewisi) and a Migratory Moth (Euxoa auxiliaris)

Pease, Sydney Pease
Dr. Emily Mooney
University of Colorado Colorado Springs

Moths are some of the most diverse insects in the world, playing integral roles as pollinators and as food sources in different ecosystems. Interestingly, alpine moths have been seldom studied, even with pressures of global change taking place. The aim of this study was to recreate a 1981 experiment from the UCCS Biology Department, tracking abundance and lipid storage of alpine moths. Alpine moths feed from nectar of high elevation plants, adding lipids to their body mass for reproduction. Our prior research showed that the widespread migratory miller moth (Euxoa auxiliaris) no longer gains lipids while feeding at high elevation. In this project, we tested for this same pattern in the endemic moth, Euxoa lewisi. Results indicate no significant change in lipid percentage over the sampling year; however, abundance of moths in 2021 were notably higher than in the 1981 samples. These results suggest that endemic moths may be faring better with global change than migratory moth species. Migration can expose species to a variety of threats associated with global change, making migratory species vulnerable to population declines.

Characterizing Blood Marker Proteins for the Development of mRBCs

Nathan Scheidt
Dr. Jordan Steel, Dr. Orion Furmanski, Dr. Armando Estrada, Dr. Kristin Heitman, Dr. Vincent Ho
United States Air Force Academy

Blood transfusions save countless lives every year. Despite their utility in treating severe trauma wounds and illnesses, the availability of donated blood is extremely limited. The imbalance between supply and demand of blood is intensified not only by the requirements of scrupulous testing for diseases but also by the need for compatibility between donor and recipients, which severely reduces the opportunity for life-saving blood transfusions. The present project is a literature review performed to compare and gain additional information for various techniques being used for the expression of antigens on manufactured red blood cells (mRBCs). While producing red blood cells from hematopoietic stem cells to yield mRBCs has become a viable solution in combatting the blood shortage, mRBCs must likewise exhibit the proper antigens to avoid or reduce hemolytic transfusion reactions. Future in vitro and ex vivo experimentation of the reviewed methodologies will be required to confirm specific antigen expression on mRBCs. Overall, the ability to add various antigens to mRBCs will provide more compatible blood transfusions, reducing the occurrence of hemolytic transfusion amongst patients, and provide critical life-saving blood to those most in need.

Club Basketball in Colorado Springs: Shaping Success and Failure

Holly Siu
Dr. Eddie Portillos, Dr. Jeff Montez de Oca, Alexandra Hood
University of Colorado Colorado Springs

The purpose of this research is to explore how club basketball, specifically in Colorado Springs, shaped many aspects of a participant's life and investigate why youth and parents decide to partake in club basketball. The project also looks at the challenges and the benefits of being involved in a club sport. In addition, we explore how participation in club sports shapes relationships with parents and the community, and participation in delinquency. This study has been conducted via zoom with volunteers who are former players, parents, and coaches over 18 years old. Thus far, there is a full analysis of twelve interviews. The recording and transcription feature has been applied in order to further examine similarities and differences among the perspectives of our participants. From there, NVIVO has been utilized in order to code these transcripts and further inspect a few key findings that revolve around racial treatment on the court, sexuality and basketball, as well as delinquency/police and basketball.

Replicating PLATYPUS Findings & Analyzing MUNGE Encryptions

Jessica Hannebert
Dan Ellsworth
Colorado College

PLATYPUS attacks use power measurements to steal cryptographic keys (such as the ones we use in e-commerce). We set out to replicate the findings from the original PLATYPUS paper in a less controlled environment and find out whether the attack could be applied to a High-Performance Computing network. We found that, as the paper reported, different instructions in the x86 assembly language can easily be distinguished by their power consumption. Along the way, we also discovered some peculiar behavior in Intel RAPL counters. However, we were unable to replicate the paper's findings on distinguishing between operands of assembly instructions based on Hamming weight. Based on our experiments so far, using this attack against an HPC system would be difficult and fairly easy to prevent.

Perceived Stress and Aerobic Performance

Alli Kearns
Lt Col Odaro J. Huckstep DPhil, MSc
United States Air Force Academy

Stress is linked to cardiovascular risk and many adverse health outcomes. Elevated life stress and anxiety have climbed in recent years with markedly higher prevalence in young adults. In the UK, unmanageable stress affected nearly 74% of the adult population in 2018, and new research indicates a surge in global stress since the onset of the COVID-19 pandemic. Physical activity is frequently prescribed for stress reduction, with benefits largely mediated through improved sympathetic function. However, the inverse relationship, how stress may impact aerobic performance, is poorly understood. The hypothesis that perceived stress is inversely related to aerobic performance was tested in a pilot study in conjunction with research investigating the relationship between nasal obstruction and aerobic performance. Perceived stress was measured with a validated 10-question perceived stress survey (PSS-10) and analyzed for relationships to aerobic performance assessed by maximal effort 1-mile run times. Study recruitment is approximately 30% complete which limits statistical power for this investigation. However early trends suggest that perceived stress is inversely correlated with 1-mile run performance. Once completed, this study will offer clues regarding how stress impacts aerobic performance. These data will be useful in guiding future research, particularly in populations such as military and first responder communities that demand high physical performance under stressful conditions.

Guideline Adherence During COVID-19:
Changes in Individual Willingness to Adhere or Vaccinate After Exposure to Falsified Data

Scout Rhodes
Dr. Laith Al-Shawaf
University of Colorado Colorado Springs

The outbreak of the 2019 Coronavirus led to profound changes in social, behavioral, and psychological domains of functioning. As Coronavirus variants mutate and evolve, adherence to guidelines such as social distancing and wearing masks are critical in mitigating the pandemic's detrimental effects. Previous non-causal research found significant positive associations between individual's perceptions of others' adherence to Centers for Disease Control (CDC) recommended guidelines and their own willingness to adhere (Norton, et. al, 2021). These findings suggest that witnessing social conformity plays a significant role in one's adherence during a public health crisis. The present study expands upon this research by experimentally manipulating the percentage of the population participants believe to be adhering to guidelines using doctored graphs and poll results from the CDC. We predict that because people are significantly more likely to mimic normative behaviors, viewing messages indicating a greater percentage of the population are adhering to guidelines will cause participants to increase their own willingness to adhere. Study 1 was a randomized between-subjects design with one independent variable and four levels. Each image depicted different levels of mask adherence (i.e., 40%, 70% and 100%) and an empty city control. Study 2 was a randomized between-subjects design with one independent variable and four levels consisting of statistically doctored polls with varying levels of guideline adherence (i.e., 23%, 67%, and 92%). The National Highway Traffic Safety Administration graph served as the control. We will conduct a one-way ANOVA on the results of both studies. For Study 1, we expect that guideline adherence will be higher in conditions showing more masking. For Study 2, we also predict that guideline adherence will increase in conditions showing a higher percentage of the public adhering to guidelines.

An Analysis of Yasser Arafat's 1976 Speech to the UN General Assembly

Annalise Webber
Dr. Meredith Scott
United States Air Force Academy

In 1974, Yasser Arafat addressed the United Nations General Assembly. As head of the Palestine Liberation Organization (PLO), Arafat approached the council and advocated for peace, stating that he wanted an end to the conflict tearing apart his country. This presentation will provide historical context for understanding the Arab-Israeli conflict and examine specific events in the year leading up to Arafat's speech and why they are important context for Arafat's speech. In addition, it will consider why those events were important influences on his address. Finally, it will analyze Arafat's words and evaluate the motives for his famous speech. He needed to explain why the PLO rejected the UN's partitioned state solution while also diverting attention from the violence that Palestinians committed in response to Israeli strike, seeking the General Assembly's sympathy. Furthermore, Arafat called for peace to further gain sympathy and build credibility with the General Assembly. His call for peace, however, was a thinly veiled threat, with the intention of forcing the General Assembly to give the PLO what they wanted.

North Korean Nuclear Proliferation

Blake Bautch
Dr. Lynne Chandler-Garcia
United States Air Force Academy

Before North Korea renews its resolve to develop nuclear missiles capable of reaching U.S. mainland, the U.S. must take an unprecedented, aggressive, and threatening stance against Kim-Jong-Un's regime. Negotiations between the Trump administration and Kim-Jong-Un failed to yield significant North Korean cessions due to a lack of credible, threatening U.S. threats. The liberal security approach of the previous administrations has continued to fail to coerce North Korea nuclear and missile tests, therefore, the U.S. needs to shift to a stronger realist security approach with the intent of creating a security dilemma for Kim-Jong-Un. The dilemma must no longer be for North Korea to cease nuclear proliferation or face sanctions, but rather to cease nuclear proliferation or face harsh internal and external military, political, and soft-power pressure. The policy I am proposing consists of a two-pronged approach to coercing Kim-Jong-Un to cease nuclear and missile testing: provide internal pressure via information and influencing campaigns and provide external pressure by openly denouncing Kim's nuclear developments, threatening the use of covert military force, and increasing international pressure in violation of North Korea's anti-leaflet laws. Ensuring the stability of the Korean Peninsula is of utmost importance to the United States. The U.S. must take renewed decisive action against the Kim regime in order to force Kim in line so that the U.S. can focus its resources on its peer great power threats such as Russia and China. Additionally, the U.S. has a principle interest in protecting the security of its South Korean allies, as well as disarming a nuclear threat to the homeland.

Why Nations Abandon Conscription

Jonathan Farrell
John Gould
Colorado College

The world's militaries are currently undergoing a structural shift in response to a change in military purpose. Since 1970 the number of recorded nations not employing a conscription-based recruitment model has risen from 20% to 55% in 2009. This paper engages scholars' political, social, and economic reasoning for this reformation in a case study comparing India and South Korea. The existing academic arguments of removal of external threat, proliferation of military alliances and economic factors contradict the reality observed in South Korea and India as each determinant should have led to South Korea adopting AVF and India maintaining a conscription force. The opposite of what is true. Instead, this rise of all-volunteer-forces is a response to the evolving function of militaries as tools to respond to overseas terrorism and smaller conflicts. Military policymakers recognize the need to change outdated military structures and envision a smaller, elite, long-term, technologically superior force.

diplomatic efforts in 2003 Iraq must not be repeated; the American military lost 4,431 soldiers and spent $757.8 billion trying to undo the effects of the policy. This research aims to comprehensively understand the American policy and its faults, all of which lead to the prolonged US presence in the nation, and will identify the major shortcomings of de-Ba'athification. It will elucidate de-Ba'athification's origins, objectives, implementation and finally its aftermath. The presentation will highlight interviews, government documents and books to obtain empirical information on this policy. Finally, further study will show that the policy was fundamentally at fault by assuming all members of the Ba'ath Party were as evil as its oppressive leader, Saddam Hussein. However, association with the party was the only way to get and keep any government jobs, including service in the military, since the 1960s. Therefore, by indiscriminately removing all 400,000 members of the party working in the government, Iraq could no longer function as a state.

An Uphill Battle:
The Integration of Women into the United States Military and Service Academies

Hoffmeister, Haley Hoffmeister
Dr. Brian Laslie
United States Air Force Academy

Throughout history, women consistently contributed or held some role in the United States' wartime effort and military conflicts. Women served in unofficial capacities until 1901 when the military willingly employed women as civilians. However, with the onset of World War I, military service needed to adapt. With the breakthrough of civilian women flying for the military, various organizations and individuals began to fight against gender norms and discrimination to provide women with the opportunity to serve. President Harry S. Truman signed the Women's Armed Services Integration Act into law in 1948, which formally allowed women in active duty. In March 1972, congressional debates began on the Equal Rights Amendment to address the possibility of women at military service academies. After continued debates, the bill reached President Gerald Ford, who signed the Department of Defense Appropriation Authorization Act into law on 7 October 1975. Individuals across the country displayed continuous opposition to the inclusion of women after the decisions from congressional litigation. The transformation of female experiences, representation, and recognition in the military is a direct result of decades worth of activism following the ratification of the Nineteenth Amendment. However, gender inequality still exists in the U.S. military. All combat positions, including ground forces, only opened to women in January 2013. While the U.S. military remains one of America's most progressive institutions, it is still necessary to encourage the participation of women in the military and ensure their experiences/opportunities are equitable to their male counterparts.

The war with Russia and its Direct Effects on the Economy

Yusuf Khan
Tahira Ahmad
Pikes Peak Community College

My main purpose is mainly to inform people what can happen if we go into a war with Russia. I am personally interested in learning how the business cycle can be affected by the actions of congress: involving the US economy in foreign affairs. This is something I believe is very important to learn as the economy can take a hit from a war which in turn effects everyone's life. I would love to teach people the importance of economics and how just learning a brief amount of economics can change your life and allow you to be prepared for any changes in the business cycle.

Humanities
Room A259

The Morality of Don Quijote

Latsis, Elizabeth Latsis
Dr. Ismenia De Souza
United States Air Force Academy

Hace más que cuatrocientos años, un hombre nombrado Miguel de Cervantes decidió escribir una sátira de las caballerías de España, y por una consecuencia involuntaria, escribió uno de los libros más influyentes en la historia del ser humano. La historia es más que un cuento sobre un loco que imagina que es un caballero, más que una combinación de todos los estilos de la literatura, y más que un resumen de la situación actual de España. Es la historia de un hombre que quiere más que todo encontrar un propósito en su vida, que se lleva al punto de la manía. Don Quijote de La Mancha encapsula la esencia del ser humano, el malvado, el bueno, todas las emociones, las intenciones, la hipocresía, y las motivaciones. Tras la perspectiva de un hombre loco, Miguel de Cervantes crea un mundo en lo cual el lector se conecta con su imaginación y con la pureza del ser humano. Debido a la manera en que Don Quijote como un personaje captura la necesidad humana de sentirse importante, en que la historia inspira la imaginación, y en que el lector se siente la profundidad de las emociones, Don Quijote de La Mancha tiene su fama. El propósito del trabajo es analizar las motivaciones y valores de Don Quijote en sus aventuras para mostrar como su carácter hace que Don Quijote de La Mancha es un libro tan famoso.

Un análisis de la representación de la iglesia católica desde de la percepción y perspectivas del protagonista Lázaro en la obra obra La vida de Lazarillo de Tormes y de sus fortunas y adversidades.

Renee Montaz
Dr. Ismenia De Souza
United States Air Force Academy

Se ha escrito mucho sobre el poder y la influencia de la iglesia católica en España. En realidad, a través de la literatura se puede ver millares de trabajos sobre el papel de la iglesia y, en algunos casos sobre la hipocresía, la corrupción y los abusos de la iglesia en España. Sin embargo, se hace falta un análisis detallado de la representación de la iglesia desde de la percepción y los ojos del protagonista Lázaro en la obra La vida de Lazarillo de Tormes y de sus fortunas y adversidades. En este papel, se analisará en particular las experiencias y abusos que sufre Lázaro bajo la tutela de los amos: el clérigo, el Fraile de la Merced, el buldero, el capellán y el arcipreste. Por fin, se analisará las influencias negativas en la vida de Lázaro y, la falta de la enseñanza de los valores morales y religiosos por parte de los amos de Lázaro.

The Use and Effects of Romanticism in the Poetry of José Martí

Allison Langenburg
Dr. Ismenia De Souza
United States Air Force Academy

This paper analyze how the poet and revolucionary used romanticismo in his writing both to express his own tragic story and to rouse patriotic sentiment in Cuba during a time of revolution. Martí wrote in a time of great social upheaval in Latin America, when many countries began to reject the colonization of the conquistadores and reinvigorate their national identity. While controverisal, José Martí roused the nation and incited public fury with his strong patriotism and anti-Spanish sentiment, as expressed in the poems Poema XXV and Dos Patrias. Still, the man was more than the ideals he fought for, as evidinced by Martí's heartbroken and sentimental poems Yo Soy un Hombre Sincero and Cultivo una Rosa Blanca. This paper will analyze the style and devices used in both the personal and revolutionary poems of José Martí, and how these common methods are effective in conveying both messages.

An analysis of the Spanish perspective on the subject of death in Coplas by the death of the master of Santiago Don Rodrigo Manrique

Adam Broshkevitch
Dr. Ismenia De Souza
United States Air Force Academy

Much has been written on the subject of death, however, an analysis of the Spanish perspective is needed as regards the issue of death and the legacy of each one when dying. Human beings wonder, what happens when a person dies? What will be my legacy as I leave? The writer tries to answer some of those questions in Coplas for the death of the master of Santiago Don Rodrigo. In addition, the writer shows us some Spanish perspectives on the subject of death and Spanish culture. Jorge Manrique shows us through Ubi sunt, and other literary devices such as personification and metaphors to form his characteristic of death and the legacy of each person at death. Therefore, the purpose of this work is to analyze the Spanish

Gram Positive / Gram Negative Bacteria Versus Household and Name Brand Disinfectants

Joseph Ponce de Leon, Alvin Syquia, Hero Vernon
Jennifer Wawrzonek
Pikes Peak Community College

E. coli and Staphylococcus Aureus are two types of bacteria commonly found, that although are mostly harmless, contain a few strains that have a possibility of causing illness. While both of these types of bacteria contribute a multitude of health related issues one difference between the two is their gram stain positivity. Over a period of forty eight hours various disinfectants, household and name brand, were applied on these bacteria to test overall resistance to everyday cleaning products through growth in a controlled environment. This presentation aims to educate on the effects of gram positive and negative bacteria and their resistance to these everyday cleaning agents. The results conclude whether or not gram stain affects the overall resistance to these cleaning agents and clarifies which agents are the most effective.