UNDERGRADUATE RESEARCH & CREATIVE ACHIEVEMENTS FORUM

FALL 2020
DEC 9 - DEC 15

Exhibited online through a collaboration of the
University of Missouri Libraries &
Office of Undergraduate Research

University of Missouri

2020 Fall Undergraduate Research & Creative Achievements Forum

Exhibited online through a collaboration of the University of Missouri Libraries & Office of Undergraduate Research

Join us in celebrating the 31 students presenting scholarship by viewing the forum at: **https://dl.mospace.umsystem.edu/mu/islandora/object/mu%3A424172**. The Forum will go live on Dec 9th and will communicate scholarly projects completed in a variety of disciplines from across the Mizzou campus.

We would like to thank all of the students, mentors, faculty, and administrators for their time and effort in making this digital exhibition of scholarly works possible.

It is our hope, that all involved will find this to be an engaging educational experience.

- Office of Undergraduate Research

2020 Undergraduate Research Advisory Committee

We would like to thank our Advisory Committee for their insight, support and continued engagement with Undergraduate Research and our office.

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Roger Fales, Mechanical Engineering
Jerry Frank, History
Shari Freyermuth, Biochemistry
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Meghan Lawlor, Biological Sciences
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Rebecca Shyu, Computer Science
Lauren Tigner, Speech, Language & Hearing Sciences
Micah Turrell, Biological Sciences

Office of Undergraduate Research

Vision

Mizzou strives to advance a culture where all interested undergraduates engage in a quality research or creative scholarship experience.

Mission

The Mission of the Office of Undergraduate Research is to foster and support mentored undergraduate research, scholarship and creative activity in a premiere research environment.

Goals

- Fostering growth of the practice of undergraduate research and creative scholarship
- Maximizing the student experience and enhancing quality of the experience
- Increasing visibility of the opportunities and outcomes of undergraduate research
- Serving as a central resource for MU students, mentors, programs, and departments

Contact us

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S·T·A·R

STUDENT TRAINING FOR ADVANCING RESEARCH

Student Training for Advancing Research (S.T.A.R.) is a recognition program created by the Office of Undergraduate Research. Started in Fall 2020 when many students may not have access to lab or scholarly activity participation, S.T.A.R. provides students a means to learn and take part in workshops that will inform and enhance their skills for when they are able to get involved with a lab or scholarly group. The students listed have earned their STAR this past semester!

Fall 2020 S.T.A.R. Awardees

Matt Ahn
Hann Albright
Dee Archdekin
Anna Barone
Inbal Barzilay
Nazeema Begam Asaf Khan
Graham Bond
Payton Bradley
Aminah Bradley-Pikes
Madisyn Branch
Emma Bremer
Hannah Burke
Brianna Carman
Grant Coffey
Carrie Coffman
Haylee Crane
Brynn Edwards
Maggie Fitzgerald
Ian Flowers
Alex Fortman
Dylan Fowler
Carson Gaddie
Rosalie Garzia
Emily Groeper
Gabrielle Groves
Elizabeth Gwaltney
Puja Halder
Sarah Hanske
Brooke Hartman
Ellie Henderson
Brooke Hilton
Caleb Hollenbeck
Thomas Holmes
Antonio Hurn
Morgan Hurt
Isabella Janney
Ella Konrad
Brayden Langendorfer
Reese Lavers
Anna Law
Caitlin Lawlor
Sophia Liefer
Emilie Maas
Aubrielle Maginess
Peter Mallett
Bethany Miller
Lindsey Monnig
Ashlyn Morrison
Sage Newton
Eghosa Ogbevoen
Carolyn Parasch
Makenna Parks
Madison Peacock
Liz Ritchey
Jack Roettger
Aleasia Ryan
Emily Schroeder
Gabrielle Scott
Lizzie Sekarski
Kellen Sharpe
Sarah Simmons
Michelle Skroba
Rachel Solverud
Connor Spinelli
Nick Stark
Will Travis
Marie Tweedle
Kathryn Vanden Hoek
Jillian Voskovitch
Mackensie Wagner
Erin Walton
Trace Watkins
Paige Williams
Cole Yager

About the Forum

The Forum is geared towards student research and creative scholarly projects that may be multi-semester projects, senior honors/capstone projects, or other faculty-mentored scholarly activities. At the Spring Forum, approximately 350+ students participate from a variety of disciplines across campus. Projects are typically shared in a 'display' format; however, with the transition to online presentations many students are also choosing to include video presentations for the digital forums. The Forum is not only for STEM students, students in art, humanities and the social sciences are not only invited, they are encouraged to present their projects and scholarly activities.

2020 Fall Undergraduate Research & Creative Achievements Forum

Student Presenters

Jacob Acklin

Sedalia, MO

F20-031

Freshman
Linguistics

Faculty Mentor: Dr. Michael Marlo, English, LInguistics; Dr. Rebecca Grollemund, English, LInguistics

Funding Source:
ASH Scholars

Documenting Luyia Together: the Ganda Talking Wordlist

Jacob Acklin, Rebecca Grollemund, and Michael Marlo

Through its *Luyia-Soga Talking Wordlists* project, the ASH scholars team *Documenting Luyia Together* aims to document and analyze Bantu languages spoken in Kenya and Uganda and to understand the historical relationships between these languages. My research on the team has focused on the analysis of linguistic data on the Ganda language.

Ganda is the most widely spoken language in Uganda; it is the first or second language of approximately 8.5 million people, or 20% of the country's population. Ganda is relatively well-studied compared to most other languages in the region. A list of more than 300 references indexed to Ganda are listed on the *Glottolog* (Hammarström et al. 2020). Despite the comparatively well-documented status of Ganda, it lacks some basic documentation such as a talking dictionary. Our project aims to compare languages using a standard talking wordlist, so we collected new data from a Ganda speaker in 2019.

Our data consist of a 600-item wordlist and accompanying audio recordings. Fellow MU student Sophie Kennedy processed the original interview recordings in spring 2020, creating an archive of audio files with individual sound files of pronunciations of each word in the list. My main research task has been to transcribe the words in the list using the International Phonetic Alphabet. I will later use the transcribed wordlist data to develop a report describing the Ganda sound system and noun class system. My paper will identify the consonants and vowels of the language and the prefixes that are used to mark singular, plural, and gender differences. Later, I will integrate the vocabulary from the Ganda wordlist into a larger database that will allow our research team to compare the Ganda vocabulary and sound system against other languages in the database to develop a new classification of languages in the region.

References

Hammarström, Harald, Robert Forkel, Martin Haspelmath, & Sebastian Bank. 2020. Glottolog 4.3. Jena: Max Planck Institute for the Science of Human History. (Available online at http://glottolog.org, accessed on 2020-11-17.)

Zayd Al Rawi

Columbia, MO

F20-028

Junior
Biological Sciences

Faculty Mentor: Dr. Christian Lorson, Veterinary Pathobiology

Funding Source:
MARC/IMSD - NIH-funded Maximizing Access to Research Careers/ Initiative for Maximizing Student Diversity

Rescue of SMARD1 Mouse Model with use of AAV9-IGHMBP2 Gene Therapy

Zayd M. Al Rawi, Caley E. Smith, Mona Kacher, Sara Ricardez Hernandez, Monir Shababi, and Christian L. Lorson

Spinal muscular atrophy with respiratory distress type 1 (SMARD1) is an infantile autosomal recessive motor neuron disease. SMARD1 is caused by loss-of-function mutations in the ubiquitously expressed immunoglobulin helicase μ-DNA binding protein 2 (IGHMBP2). The lack of functional IGHMBP2 leads to increased vulnerability to motor neuron death which leads to neuromuscular junction (NMJ) denervation and reduced muscle fiber size. There is no effective treatment for SMARD1; patients rely on mechanical ventilators and other palliative care measures. Recently, we have developed a mouse model with the first patient-derived mutation, D564N (Ighmbp2$^{D564N/D564N}$) using the CRISPR/Cas9 System. The D564N mutant mice have severe phenotypic abnormalities including reduced lifespan, weight gain, motor function, and respiratory defects. Additionally, the mice possess selective muscle vulnerability with the gastrocnemius being a severely impacted muscle to denervation and fiber size.

Objective: We wanted to determine if this new model was able to be rescued by gene therapy. We utilized gene replacement therapy by employing an adeno-associated viral vector stereotype 9 (AAV9) carrying full-length IGHMBP2 to see if it will rescue the severity of the D564N mice. Preliminary results of treated D564N mutant mice revealed an extension of lifespan and motor function. AAV9-IGHMBP2 gene therapy also improved important cellular pathology features. By further analyzing the phenotypic and cellular features, we can evaluate the extent the D564N mice are rescued with gene replacement therapy. This will provide a better context to determine if AAV9-IGHMBP2 is a viable treatment option for patients, and can lead to future developments of treatments.

Michael Andrade

Dallas, TX

F20-015

Senior

Health Science (Leadership and Policy)

Faculty Mentor: Dr. Carolyn Orbann, Health Sciences

NPI School Closure Timeline

Michael Andrade and Carolyn Orbann

This poster will examine the impact of non-pharmaceutical interventions (NPIs), such as school closures, on spread of the 1918 influenza pandemic in Missouri Specifically.

Currently, the entire world is dealing the COVID-19 pandemic and over the past 8 months, many governments have tried various strategies to counter the pandemic. The United States, which leads the world in total number of cases ,especially in states such as Texas, Florida, and Wisconsin faces policy decisions on how to best implement protective measures while considering impacts to socioeconomic and educational life. This poster will look back on the efficacy of school-closures during the 1918 Spanish influenza pandemic in selected Missouri counties, representing a variety of sub-populations within the state, including rural communities. Utilizing the Library of Congress newspaper database, announcements of school cancellations and duration of closures were recorded to form an “NPI school-closure timeline” organized by county. The timeline of closures was placed side-by-side with data on county influenza deaths to determine any possible correlation. Death data was utilized at the county level due to absence of incidence reports.

Preliminary Data shows increase of flu mortality after school re-openings.

Much can be learned from the 1918 Influenza pandemic and applied to today’s COVID-19 situation. Policy makers and legislators can learn from the actions of the past on the efficacy of school-closures when making decisions today about the health and safety of students, teachers, faculty, and the community.

Elise Baumann

Hannibal, MO

F20-008

Sophomore
Biological Sciences

Faculty Mentor: Dr. Aaron Stoker, Orthopaedic Surgery

Funding Source:
Thompson Laboratory for Regenerative Orthopaedics

Metabolic Responses of Degenerative Intervertebral Discs from Patients Undergoing Cervical or Lumbar Spinal Fusions

Elise C. Baumann, Jacob S. Kramer, Naomi N. Lee, Don K. Moore, Theodore J. Choma, Muhammad Z. Mirza, James L. Cook, and Aaron Stoker

INTRODUCTION: Intervertebral disc degeneration encompasses a spectrum of biomechanical and cellular changes that are related to neck and back pain. This study was designed to clarify differences in tissue metabolism between cervical and lumbar IVD disc degeneration by examining basal and cytokine stimulated responses of IVD tissues. It was hypothesized that pro-inflammatory and pro-degradative biomarker production from degenerative lumbar discs would be significantly higher than degenerative cervical IVDs while pro-inflammatory and pro-degradative biomarker production would be further escalated by cytokine stimulation of degenerative IVDs from both sites.

METHODS: With IRB approval, IVD tissues were recovered from patients (n=145, mean age 57 years, 92 female) during surgical intervention. Excised tissues were used to make two explants of combined NP and AF per disc segment with a 6 mm diameter biopsy punch. Explants were cultured for 3 days, and media was collected for biomarker analysis. Mann-Whitney u-tests were used to determine differences between cervical and lumbar tissues.

RESULTS: Without IL-1β stimulation, lumbar explants produced higher concentrations of GRO-α, IL-6, IL-8, MIP-1α, MIP-1β, RANTES, MMP-8, MMP-9, MMP activity, PDGF-AB/BB, VEGF, and lower MMP-7 and PDGF-AA compared to cervical explants. With IL-1β stimulation, lumbar IVDs produced higher concentrations of RANTES, MMP activity, MMP-8, MMP-9, and PDGF-AB/BB compared to cervical IVDs.

CONCLUSION: This data expands on previous studies findings indicating degenerative lumbar IVDs have more pro-inflammatory and degradative basal metabolism compared to degenerative cervical IVDs, while degenerative cervical and lumbar IVDs showed similar metabolic responses to pro-inflammatory cytokine stimulation.

Luke Baxter

Columbia, MO

F20-019

Junior

Biological Sciences

Faculty Mentor: Dr. Aaron Stoker, Orthopaedic Surgery

Comparison of Basal and Cytokine Stimulated Metabolism of the Hamstring Tendon

Luke Baxter, Luke Troyer, Richard Ma, Patrick Smith, James Cook, and Aaron Stoker

INTRODUCTION: Anterior cruciate ligament (ACL) tears are a common problem in the United States, affecting over 100,000 people in the United States every year. One option for ACL reconstruction after ACL tear is to use a graft obtained from the patient's Hamstring tendon (HT) to replace the torn ACL. However, it is not clear how the HT responds to the inflammatory environment of the injured knee. Therefore, this study was designed to identify the metabolic responses of the HT to pro-inflammatory stimulation. It was hypothesized that the HT would significantly increase the production of pro-inflammatory and pro-degradative biomarkers in response to cytokine treatment.

METHODS: With IRB approval, HT normally discarded after surgery were collected from 11 patients undergoing ACL reconstruction. Two 4mm explants were created from the HT of each patient, and cultured with or without 10ng/ml rhIL-1β for 3 days. After culture, media was collected for biomarker analysis. Biomarker concentration was standardized to tissue weight. Significant differences between groups were determined using a Mann-Whitey Rank Sum test with significance set at $p<0.05$.

RESULTS: HT explants significantly increased the production of pro-inflammatory (IL-6, MIP-1α, and PGE2), anti-inflammatory (IL-10), but not degradative (MMP or TIMP) biomarkers with cytokine stimulation.

CONCLUSION: Overall, cytokine stimulation appears to increase the inflammatory, but not degradative, metabolic pathways in the HT used for ACL reconstruction. Future studies will compare the HT cytokine response to other common graft tissues, such as Patellar Tendon and Quaternary Tendon.

Allyson Caisley

Danvers, IL

F20-027

Junior
Biological Sciences

Faculty Mentor: Dr. Aaron Stoker, Orthopaedic Surgery

Funding Source:
Thompson Laboratory for Regenerative Orthopaedics

The Effect of Passage on the Metabolic Profile of Osteoarthritic Chondrocytes

Allyson Caisley and Aaron Stoker

INTRODUCTION

Osteoarthritis (OA) of the knee is one of the most common causes for disability in the U.S. The pathogenesis of OA is still lacking. Articular chondrocytes produce different levels of degradative and inflammatory biomarkers as OA progresses. It was hypothesized that the relationship in the production of biomarkers at P0 and P1 chondrocyte cultures are consistent with similar biomarker production levels between each passage.

METHODS

With IRB approval (IRB# 1208392), cartilage from end stage OA patients undergoing total knee arthroplasty (n=74) was collected. Chondrocytes were isolated and grown to confluency in supplemented DMEM. Once confluent (P0), media was changed and collected after three days for biomarker analysis. Cells were split, grown to confluency (P1), and media was collected for analysis after day 3. Data for P0 and P1 were compared for relative biomarker production levels ($p<0.05$) and a correlation was run for each passage ($r=0.5$)

RESULTS

Correlation within passages: A significant positive linear correlation was found in both P_0 and P_1 cells between RANTES, IL-8, MMP-1, MMP-2, MMP-13, MMP-8, MMP activity, and TNF-α. A negative linear correlation was found between TIMP-1 and IL-6.

Relationship between passages: P1 samples were grouped based on P0 production. There were not strong positive correlations between biomarker production at P_0 and P_1. A significant positive linear correlation was found in both P_0 and P_1 cells between RANTES and IL-8, MMP-1 and MMP-2, MMP-13 and MMP-8, MMP ACT and TNF-α. A negative linear correlation was found between TIMP-1 and IL-6.

CONCLUSIONS

The results suggest that there may be a relation in biomarker production level between passages for chondrocytes for some biomarkers, but this conclusion cannot be drawn for all biomarkers.

Brianna Carman

Eldon, MO

F20-018

Senior
Psychology; Chemistry

Faculty Mentor: Dr. Shawn Christ, Psychological Sciences

Funding Source:
A&S Undergraduate Research & Creative Activity Mentorship Program

Cortical Atrophy Evidenced by Increased Extra-Axial Cerebrospinal Fluid in individuals with Early-Treated Phenylketonuria

Brianna D. Carman, Alex Brown, and Shawn E. Christ

Main Purpose: Phenylketonuria (PKU) is a rare autosomal recessive disorder characterized by a deficiency in the inability to metabolize the amino acid phenylalanine. Even if treated, individuals with PKU are at risk for neurologic problems (e.g., white matter abnormalities, disruptions in protein synthesis). The majority of past research has focused on children with PKU. Much less is known regarding neurologic outcomes in adults with PKU. In the present study, we examined whether adults with early-treated PKU (ETPKU) experienced cortical atrophy as evidenced by an increased volume of extra axial-cerebrospinal fluid.

Procedure: A sample of 36 individuals with early-treated PKU (18-35 years of age) and a demographically-matched group of 32 individuals without PKU underwent structural MRI scanning in a 3T Siemens Trio Scanner. Data processing is presently underway, and the examiner (B.C.) is blind to the group status of participants. First the MRI data is being processed through SPM12 software in MatLab to acquire 3D masks of cerebrospinal fluid tissue segmentations for each of the individuals. Next, Freesurfer software will be used to manually edit the masks to remove any non-cerebrospinal fluid that SPM12 did not remove. After the editing of the cerebrospinal fluid tissue segmentations is finished, the brains will then be processed through Freesurfer for a statistical analysis on the voxels.

Anticipated Findings: Data processing is still underway. Resulting data will be analyzed using a standard random effects general linear model (GLM) approach. Based on previous findings of cortical atrophy in ETPKU, we anticipate increased volumes of extra-axial cerebrospinal fluid in adults with ETPKU compared to the adults without ETPKU.

Priyanka Chaudhary

St. Louis, MO

F20-022

Junior

Linguistics; International Studies (Peace Studies)

Faculty Mentor: Dr. Michael Marlo, English, LInguistics; Dr. Rebecca Grollemund, English, LInguistics

Documenting Luyia Together: the Lamogi Talking Wordlist

Priyanka Chaudhary, Rebecca Grollemund, and Michael Marlo

This presentation is about my research in Fall 2020 as part of the *Luyia-Soga Talking Wordlists* project of the *Documenting Luyia Together* ASH Scholars research team. The overall goals of this project are to document the many linguistic varieties of the Luyia and Soga language clusters in western Kenya and eastern Uganda and to produce a new classification of the languages in the region. For each individual language, we want to study the sound system and the structure of words.

My work involves an understudied language spoken in eastern Uganda called Lamogi. As far as we know, there are only three prior studies of Lamogi, carry out by Prof. Larry Hyman at UC-Berkeley (Hyman 2014, 2017, Hyman & Merrill 2016). My research is focused on transcribing and analyzing over 600 sound files of Lamogi words collected by fellow MU student Sarah Pribe in Uganda in 2019. I am going word-by-word in the list and transcribing the pronunciations of each word using the International Phonetic Alphabet. On the basis of these transcriptions, I am also writing a report about the sound system of Lamogi. In this report, I identify and exemplify each of the consonants and vowels in Lamogi, and I also study the structure of nouns, identifying the prefixes that signal singular, plural, and gender. Later, I will integrate the Lamogi wordlist into a larger database that will allow for a new classification of the languages in the region based on a comparison of their vocabulary and sounds.

References

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Hyman, Larry M. & John Merrill. 2016. Morphology, irregularity, and Bantu frication: The case of Lulamogi. In Jean-Léo Léonard & Daniel Petit (eds.), *Actualité des Néogrammariens, Mémoires de la Société de Linguistique de Paris*, 139-157. Paris: Peeters.

Nicholas Choma

Columbia, MO

F20-014

Senior
Biological Sciences

Faculty Mentor: Dr. Aaron Stoker, Orthopaedic Surgery

Funding Source:
Thompson Laboratory for Regenerative Orthopaedics

Metabolic Responses of ACL Explants to Estradiol and Pro-inflammatory Cytokine Stimulation

Nicholas Choma, Richard Ma, James Cook, and Aaron Stoker

INTRODUCTION: Anterior cruciate ligament (ACL) injury in females are almost ten times more common than in males. Estrogen levels present during the menstrual cycle have been associated with increased ACL injury rates. Therefore, this study was designed to assess the responses of ACL explants to estrogen and pro-inflammatory cytokine stimulation. It was hypothesized that 17-β estradiol and IL-1β stimulation, individually or in combination, will significantly increase production of inflammatory biomarkers when compared to controls.

METHODS: With ACUC approval, the ACL was collected from female dogs (n=12). Four 6mm-explants were taken from each ACL. Explants (n=12/group) were randomly assigned to groups: (1) Control (ACL-N), (2) IL-1β (1ng/ml) stimulated (ACL-I), (3) Estrogen (300ng/mL) stimulated (ACL-E), or (4) Cytokine and estrogen stimulated (ACL-IE). The explants were cultured for 12 days with consistent media changes. Media were assessed for inflammatory biomarkers using commercially available assays.

RESULTS: The ACL-I and ACL-IE groups produced significantly higher inflammatory biomarkers compared to the ACL-N and ACL-E groups across time points. There were no significant differences between the ACL-I and ACL-IE groups or the ACL-N and ACL-E groups.

CONCLUSION: The data from this study indicate that estrogen does not have direct inflammatory or degradative effects on the ACL even in the presence of a pro-inflammatory stimulus. Our laboratory is working to better understand sex disparities with ACL injury and treatment failure.

Della Cox

University City, MO

F20-029

Junior
Sociology, Statistics

Faculty Mentor: Dr. Joan Hermsen, Sociology

Popularity and Variation of Risk-Reducing Behaviors in Response to COVID-19

Della Cox and Joan Hermsen

Twenty-five weekly cross-sectional surveys of US adults, conducted by Ipsos and sponsored by Axios, are used to assess the behaviors and risk-assessment of the public. Risk-reducing behaviors such as not dining in at restaurants and only visiting with people in one's household have been recommended to the public to limit the spread of COVID-19. Public compliance with these recommendations has changed over time. Since April, social distancing has decreased and mask wearing has increased. Eating out and visiting friends and family have also increased while the perceived severity of the risk of dining in and visiting friends and family has decreased.

Josh Fajardo
Saint Charles, MO

F20-001
Senior
Nutrition and Exercise Physiology
(Human Physiology & Translational Sciences)

Faculty Mentor: Dr. Kevin Middleton, Pathology and Anatomical Sciences

Comparison of Methods for Analyzing Mouse Locomotion with Free Software

Joshua Fajardo and Kevin Middleton

INTRODUCTION: Mouse locomotion is commonly studied in models of human musculoskeletal disease and exercise physiology. Traditional methods for tracking joint movements for the study of locomotor kinematics is labor intensive and requires expensive hardware. We sought to speed up the process with Deep Learning using free software and consumer grade hardware.

METHODS: Nine mice were filmed prior to and after one week of voluntary wheel locomotion. We filmed 174 trials using two GoPro cameras operating at 120 FPS. Trials were digitized separately for each camera using both DeepLabCut (Deep Learning) and DLTdv8 (manual). Cameras were 3D calibrated and coordinates tracked for 6 lower limb landmarks. We compared rigid body error by digitizing a wand of known length and compared locomotor kinematics after 1 week of wheel access.

RESULTS: DeepLabCut has significant hardware requirements compared to DLTdv8, and setup for the former is more challenging in comparison. Once configured, DeepLabCut was efficient in video processing and accurate in marker tracking (50% lower mean error). We found significant kinematic differences after one week of wheel activity, including increased mean speed, stride frequency, stride length as well as lower duty factor.

CONCLUSION: We found that consumer grade hardware and free software is a viable solution to the challenges of studying locomotor kinematics in mice. Inexpensive hardware coupled with deep learning yields both increases in video throughput and marker accuracy. Finally, we found significant locomotor differences after only one week of wheel acclimation, suggesting a non-invasive approach to altering gait kinematics.

Elizabeth Fletcher

St. Louis, MO

F20-016

Senior

Biological Sciences; Psychology

Faculty Mentor: Dr. Aaron Stoker, Orthopaedic Surgery

Funding Source:
Thompson Laboratory for Regenerative Orthopaedics

Intervertebral Disc Metabolic Responses to Sustained IL-10 Stimulation using a Rat-Tail Whole Organ Explant Model

Elizabeth Fletcher, Emma LePage, and Aaron Stoker

INTRODUCTION: This study was designed to assess the pathologic and metabolic changes that occur after injury and IL-10 stimulation to a rat tail whole organ IVD during long term culture. It was hypothesized that there will be a significant decrease in the production of inflammatory and degradative biomarkers in response to stimulation with IL-10 in injured and uninjured IVDs. Further, the production of inflammatory and degradative biomarkers in response to IL-10 stimulation will be significantly higher in injured IVDs compared to uninjured IVDs.

METHODS: Tails were collected from 6 skeletally mature Sprague Dawley rats euthanatized for reasons unrelated to this study. IVD Explants (n=24) were created and assigned to either the Injured or Uninjured group with or without IL-10 at 10.0 or 0.0ng/ml. Explants were cultured for 12 days, and media were changed every 3 days and collected for biomarker analysis. On day 12 tissues were processed for cell viability using a resazurin assay.

RESULTS: On day 3 of culture, groups treated with IL-10 produced significantly lower levels of media GAG, PGE2, and MMP Activity. Injured IVDs treated with IL-10 produced significantly higher levels of GROKC, and uninjured samples treated with IL-10 produced significantly lower levels of VEGF.

DISCUSSION: This study uses a whole organ model of disc disease to uncover pathways activated by IL-10 stimulation with and without injury to provide potential diagnostic biomarkers and therapeutic targets for IVD degeneration. The results suggest that IL-10 shows protective and antidegradative effects, and in uninjured samples IL-10 may decrease vascularization.

Matthew Gao

Joplin, MO

F20-009

Senior
Biological Sciences

Faculty Mentor: Dr. Aaron Stoker, Orthopaedic Surgery

Funding Source:
Thompson Laboratory for Regenerative Orthopaedics

Relationships among Degradation-Related Biomarkers Released by Subchondral Bone from Osteoarthritic Knees

Matthew Gao, Hayley Ockerhausen, Ashwin Garlapaty, James Keeney, James Cook, and Aaron Stoker

INTRODUCTION: Osteoarthritis (OA) is a multifactorial whole-joint disease progressing from thinning of the cartilage to complete loss of cartilage. OA progression can be variable, resulting in regional variation in architecture and metabolic responses of affected tissues. This study was designed to determine relationships in the production of degradation-related biomarkers by subchondral bone of patients undergoing total knee arthroplasty (TKA). It was hypothesized that patterns could be identified that indicate non-linear co-expression patterns between biomarkers.

METHODS: With IRB approval (#1208392), tissues were obtained from OA patients undergoing TKA surgery. Explants (6mm) were samples across the joint. The cartilage was separated from the bone, and the bone was cultured for 3 days. Day 3 media was assessed for relevant OA biomarkers. Data was ranked and Kruskal-Wallis test with a Bonferroni correction was performed to identify production patterns.

RESULTS: The data analysis from this study identified novel positive, negative, and complex associations between degradation related biomarkers produced by subchondral bone from OA patients not observed with linear correlation analysis.

CONCLUSION: Data from this study indicates that there are several relationships between degradation related biomarkers produced by osteoarthritic subchondral bone. This suggests that key degradative mechanisms of disease in knee OA may share common regulatory pathways and signaling cues.

Ashwin Garlapaty

Eureka, MO

F20-020

Junior
Biological Sciences

Faculty Mentor: Dr. Aaron Stoker, Orthopaedic Surgery

Funding Source:
Thompson Laboratory for Regenerative Orthopaedics

Relationships among Pro-Inflammatory and Degradation-Related Biomarkers released by Articular Cartilage from Osteoarthritic Knees

Ashwin Garlapaty, Hayley Ockerhausen, Matthew Gao, James Keeney, James Cook, and Aaron Stoker

INTRODUCTION: Osteoarthritis (OA) is a multifactorial disease progressing to whole-joint inflammation and degeneration causing pain and dysfunction. Previous studies found weak to moderate correlations between inflammatory biomarkers and degradation related biomarkers. This study was designed to find non-linear relationships between inflammatory biomarker and degradation related biomarkers to better understand how OA development and progression.

METHODS: With IRB approval (#1208392), cartilage was collected from TKA (n=8). 6mm diameter cartilage explants were created and cultured in supplemented DMEM with a 3-day media sample analyzed for biomarkers. The data was placed into evenly distributed quartiles. A Kruskal Wallace with post-hoc analysis and Bonferroni correction were used to determine significant differences between groups ($p<0.05$).

RESULTS: This analysis of the data found numerous biomarker production relationships not found using standard linear correlation analysis, and provided insight into the dynamics of biomarker production for biomarkers with a weak moderate linear correlation.

CONCLUSION: The results of this study uncover relationships between inflammatory and degradation related biomarkers. Ongoing studies are aimed at further characterization of these interactions during development and progression of OA towards better defining disease mechanism and targets for effective interventions.

Aaron Harmon

Aurora, CO

F20-023

Senior

Health Science (Health and Wellness Services)

Faculty Mentor: Dr. Carolyn Orbann, Health Sciences

Jasper County 1918 Influenza Case Study

Aaron Harmon and Carolyn Orbann

This poster describes a case study looking at the impact of the 1918 influenza pandemic in Jasper County, Missouri. The data used was collected from the Missouri Digital History Project and the Jasper News. This new variant of influenza, known as H1N1, was unusual because it was more deadly than a typical flu, especially in the young and middle-adulthood age group. Jasper County felt the full force of the pandemic by October, 1918. Deaths from influenza and pneumonia increased significantly toward the end of October and began to slowly decline until the first week in December. Using newspaper data from the Jasper News, I created a timeline to help us understand why we see peaks and valleys in the mortality curve. Public health restrictions, as reported in the newspaper, seem to correlate with changes in mortality. Jasper County was notable due to its uneven mortality by sex. More men (569) than women (452) died, likely due to the high population of miners that worked within the county. At the time, Jasper County was the center of the Tri-State Mining District, a world-class producer of zinc and lead. Working conditions that miners experienced caused them to be more at risk for lung diseases such as silicosis and tuberculosis. By 1910, Jasper County experienced so many cases of these diseases that a hospital was built and opened in September of 1918 to directly fight this problem. Of the 569 men that died due to the influenza and pneumonia, 121 were miners The combination of these two diseases along with the 1918 influenza could have affected the mortality rate, which could be the reason why we see the difference in the sex ratio.

Behirah Hartranft

St. Louis, MO

F20-010

Senior
Biological Engineering

Faculty Mentor: Dr. Kiruba Krishnaswamy, Biomedical, Biological & Chemical Engineering

Funding Source:
Engineering for Change (E4C) Fellowship in partnership with University of Missouri and Institute of Food Technologists (IFT)

Upcycling of Mango Processing Waste to Support Circular Economy in East Africa

Behirah Hartranft and Kiruba Krishnaswamy

Kenya is a leading producer of mangoes in Africa; however, it is estimated that 45-50% of mangoes grown in East Africa are lost between the point of harvest and the point of sale leading to food loss. Mango by-products (such as skin, seed kernel) make up about 39% of the mass of a mango. These by-products can be upcycled and processed into value added foods, nutraceuticals and cosmetic products. This research explores upcycled mango by-products, such as mangiferin (polyphenols), pectin, mango peel powder, mango kernel oil, kernel flour, and odor-active compounds. Mango peel powder, kernel oil, and kernel flour present the largest opportunities for mango processors in East Africa due to efficient utilization of existing food processing infrastructure, incorporating low-cost manufacturing processes, and potential marketability of upcycled products. By developing zero waste food processing systems we can reduces food loss, support circular economy and sustainability.

Bridget Holterman

Westphalia, MO

F20-012

Sophomore
Communication Sciences and Disorders

Faculty Mentor: Dr. Nicholas Smith, Speech, Language and Hearing Sciences

Funding Source:
Richard Wallace Faculty Incentive grant to N. Smith

Vocal Timing in Mother-Child Dialogue: Effects of Maternal Depression

Bridget Holterman and Nicholas Smith

Objective: As a research team, we are studying speech production in the context of caregiver-child interaction, by looking at the time differences of utterances and responses in dialogue between mothers and their children. In our lab we are focusing on how both maternal depression can affect this time gap within Early Head Start families. We hypothesize that mothers who suffer from maternal depression, will also have longer gaps between utterances and responses with their child.

Method: Our analysis makes use of existing sample of video recordings from about 1000 families from the Early Head Start Research and Evaluation Project (EHSRE). In these videos mothers and child are interacting through play with specified toys. We extract the audio from each recording, and use Praat software to identify what each utterance says as well as the time gap between the mother and child. From this we can obtain a variety of temporal measure, including the exact time between the utterances and responses between the mother and child as well as language sample analysis. Next, we look specifically into the mother's mental health history, determining if she suffers from depression, using a CESD scale. We use this knowledge to compare mother's with depression and mother's without depression. .

Results/Conclusion: Our preliminary results show a significant effect of maternal depression, with mothers with higher CESD scores showing slower and more variably timed responses than mothers with lower depression scores.

Morgan Kluge
Cape Girardeau, MO

F20-021

Junior
Biochemistry

Faculty Mentor: Dr. Aaron Stoker, Orthopaedic Surgery

Funding Source:
Thompson Laboratory for Regenerative Orthopaedics

Effects of Glucose and Insulin Levels on Intervertebral Disc Metabolic Responses in an In Vitro Rat Tail Model

Morgan Kluge, Emma LePage, and Aaron Stoker

INTRODUCTION: Intervertebral disc degeneration (IVDD) is associated with debilitating low back pain and is a major cause of disability in the U.S. Diabetes is a comorbidity for IVDD and is associated with chronic systemic inflammation. However, the effect of diabetes on IVDD is not fully understood. This *in vitro* study was designed to test the effects of high or low glucose with low or normal insulin levels on the metabolic responses of the IVD using a whole organ culture rat tail model. It was hypothesized that IVDs cultured in high glucose would produce significantly increased inflammatory biomarkers compared to low glucose, and IVDs cultured in low insulin would produce significantly increased inflammatory biomarkers compared to normal insulin.

METHODS: With IACUC (ACUC#9435) approval, tails were harvested from skeletally mature Sprague Dawley rats (n=6) euthanized for reasons unrelated to this study. IVD explants (n=24) were created and assigned to 4500 μg/ml high glucose or 1000 μg/ml low glucose and 1 μg/ml low insulin or 10 μg/ml normal insulin (n=6/group). Explants were cultured for 12 days with media changed and collected every 3 days for biomarker analyses.

RESULTS: Data analyses are ongoing but will be presented on the poster.

CONCLUSION: This study uses a whole organ model to measure the IVD metabolic response when exposed to varying glucose and insulin levels to better understand the relationship between diabetic inflammation in the realm of IVDD. Data analysis is still ongoing, and conclusions will be made on the poster following complete analysis.

Elizabeth Kujath

Kansas City, MO

F20-013

Senior
Linguistics; Religious Studies

Faculty Mentor: Dr. Michael Marlo, Linguistics; Dr. Rebecca Grollemund, LInguistics

Funding Source:
ASH Scholars

Documenting Luyia Together: Tone in Kabarasi

Elizabeth Kujath, Miya Russell, Rebecca Grollemund, and Michael R Marlo

The ASH Scholars project *Documenting Luyia Together* was started in 2016 for the purpose of describing understudied languages of the Luyia cluster in western Kenya and eastern Uganda. Kabarasi is an understudied member of Kenyan Luyia, spoken by a community of approximately 250,000 members (2009 Kenya Census). This presentation discusses the research of Elizabeth Kujath and Miya Russell on Kabarasi during the Fall 2020 semester, building on previous research done by Kujath in 2018, by Russell in 2020, and by former MU postdoctoral fellow Kristopher Ebarb in 2016.

The focus of this presentation is the analysis of research materials collected on Kabarasi in 2019 as part of the *Luyia-Soga Talking Wordlists* subproject of Documenting Luyia Together. This subproject has the goal of collecting comparative 600+-item wordlists with accompanying audio recordings for the 30+ members of the Luyia and Soga language clusters and their neighboring Bantu languages. This work will allow for a new classification and investigation into the linguistic history of the languages of this region, while also generating new linguistic documentation and description of several understudied languages.

We created an archive of audio files for each of the words in the wordlist, processing the original interview recordings using Audacity. We then transcribed each of the words in the list using the International Phonetic Alphabet, which allowed for a preliminary study of the Kabarasi sound system, along with the identification of the consonants and vowels of the language. Subsequent research has emphasized the tonal patterns of nouns and verbs in the language, which we intend tot continue studying in future research as we extend the dataset to include additional vocabulary and phrases.

Eric Lis

Chicago, IL

F20-005

Junior

Biological Sciences; Psychology

Faculty Mentor: Dr. Jacqueline Limberg, Nutrition and Exercise Physiology

Funding Source:
University of Missouri Department of Nutrition & Exercise Physiology

Sympathetic Discharge Patterns in Human Type 2 Diabetes

Eric C. Lis, Elizabeth P. Ott, Jennifer L. Harper, Camila M. Manrique-Acevedo, and Jacqueline K. Limberg

Objective: Sympathetic nervous system activity is predictive of cardiovascular morbidity and mortality. Muscle sympathetic nerve activity (MSNA) can be directly measured in humans and has been previously shown to be elevated in individuals with type 2 diabetes. Sympathetic neural recordings are often rectified and integrated to give multi-unit MSNA that represents activity of several axons recorded simultaneously. Unfortunately, multi-unit MSNA does not account for firing patterns of single action potentials (AP). AP firing patterns provide unique information about central neural processing and may have implications for end organ responses. With this, we hypothesized individuals with type 2 diabetes would display augmented AP firing patterns compared to non-diabetic controls. We further hypothesized these AP firing patterns would be associated with end organ responses (i.e., blood pressure, BP).

Methods: Heart rate (HR, ECG), arterial BP (finger photoplethysmography), and multi-unit MSNA (microneurography) were measured in 5 non-diabetic adults (59±4 yrs, HbA1c 5.6±0.1%) and 6 adults with type 2 diabetes (51±2 yrs, HbA1c 7.6±0.7%). Sympathetic AP firing patterns were assessed using matched wavelet-based methodology.

Results: No differences in multi-unit MSNA were observed between healthy controls and individuals with type 2 diabetes (26±2 vs 23±3 bursts/min; p=0.65). The firing probability of sympathetic APs (167±47 vs 177±57 AP/min; p=0.80) and the components of an integrated burst (6±2 vs 7±1, p=0.58 AP/burst; 4±1 vs 4±1 clusters/burst, p=0.45) did not differ between control and type 2 diabetes. An association between firing patterns of sympathetic AP and diastolic BP were observed, such that those individuals with greater sympathetic neural discharge (clusters/burst) exhibited higher diastolic BP (R=0.628, p=0.05).

Conclusions: These data support a role for augmented sympathetic neural firing in the development of higher resting diastolic BP; however, this relationship does not differ between controls and individuals with type 2 diabetes.

Bobby Love

Versailles, MO

F20-004

Junior
Computer Engineering

Faculty Mentor: Dr. Michael Marlo, English, LInguistics; Dr. Rebecca Grollemund, English, LInguistics

Funding Source:
ASH Scholars

Documenting Luyia Together: the Swadesh Wordlist, Siginyi Talking Wordlist

Bobby Love, Rebecca Grollemund, and Michael R. Marlo

The purpose of this project is to document the Siginyi language, presenting newly collected linguistic data about an understudied Bantu language spoken in Namutumba District in eastern Uganda. Very little is known about the language, which is not even listed in the *Glottolog*, one of the leading authorities on languages of the world (Hammarström et al. 2020). We are aware of only one prior study that provides any insight into the linguistic properties of Siginyi: Nabirye's (2016) survey of languages of the Busoga kingdom, which compared languages based on a 100-item wordlist.

The present project builds on Nabirye's prior research, providing additional documentation of Siginyi and further comparison of its vocabulary, sounds, and basic aspects of grammar to other languages in the region. The data were collected by fellow MU student Sarah Pribe in 2019 as part of the ASH Scholars project, *Documenting Luyia Together*. The data include an audio-recorded wordlist of about 600 words. Early stages of the research by Pribe created individual sound files of each word in the list and produced a preliminary written transcription of each word. My work picks up where Pribe left off when she graduated in Spring 2020, checking and updating the transcriptions using the International Phonetic Alphabet.

My next task is to compile a report about the Siginyi sound system, identifying and illustrating its consonants and vowels, and its noun class system (the prefixes that mark singular, plural, and gender on Siginyi nouns). In the future, I will incorporate Siginyi vocabulary into our team's comparative database to test to see whether we agree with Nabirye's classification of Siginyi among the Bantu languages of eastern Uganda. This research represents an initial attempt to better understand the linguistic properties and sociolinguistic status of the Siginyi language.

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Lukas McGuire

Camdenton, MO

F20-011

Senior

Environmental Sciences (Atmosphere)

Faculty Mentor: Dr. Anthony Lupo, School of Natural Resources

The Interannual and Interdecadal Variability of Soil Moisture and Recent Tornado Activity (EF2 or greater) in the Central USA

Lukas J. McGuire, Corey E. Clay, and Anthony R. Lupo

Previous studies have demonstrated that El Nino and Southern Oscillation (ENSO) have a distinct impact on the occurrence of severe weather and the attendant environment in the eastern two thirds of the USA. Typically, La Nina years have been shown to be more active in the central USA. Here, a previous study of tornado activity in Missouri from 1948 – 1999, as well as the neighboring states of Iowa, Nebraska, and Kansas, is updated to included the most recent two decades. The datasets used in this study were the National Centers for Environmental Prediction / National Center for Atmospheric Research (NCEP / NCAR) re-analyses and the National Oceanic and Atmospheric Administration (NOAA) Storm Prediction Center (SPC) event archive were used. The results demonstrated that recently tornado activity in this region was higher than that of the late 20th century suggesting interdecadal variability in the time series. The interannual variability for the latest two decades is similar to that of the last half of the 20th century. Finally, these results will show that there is a correlation between the in-season soil moisture and tornado activity, but it is not clear whether the correlation was a lead or lag.

Austin McLain

Kansas City, MO

F20-026

Sophomore
Biochemistry

Faculty Mentor: Dr. Susan McKarns, Surgery

Funding Source:
NIH R01 ES022966 grant to S. McKarns

Bile Acids: A New Therapeutic Target for Central Nervous System Neurodegeneration

Austin McLain, Benjamin Schroeder, Grant Abkemeier, and Susan C. McKarns

Abstract withheld due to proprietary permissions.

Caleb Ridings

Blue Springs, MO

F20-003

Sophomore
Philosophy

Faculty Mentor: Dr. Michael Marlo, English, LInguistics; Dr. Rebecca Grollemund, English, LInguistics

Funding Source:
ASH Scholars

Documenting Luyia Together: The Gwere Talking Wordlist

Caleb Ridings, Rebecca Grollemund, and Michael R. Marlo

This presentation describes my research activities for the ASH Scholars team *Documenting Luyia Together* in 2020. My work is part of the *Luyia-Soga Talking Wordlists* subproject, which studies the vocabulary, sound patterns, and basics of grammar of the 30+ Bantu language varieties in the Luyia and Soga language clusters spoken in western Kenya and eastern Uganda.

My project focuses on the development and analysis of Gwere linguistic materials. Gwere is spoken in eastern Uganda near several other Bantu languages, including Masaaba, Nyole, Kenyi, Lamogi, Siginyi, and Soga. The 621,000 members of the Gwere ethnic community (2014 Uganda Census) are said to use Gwere "vigorously" (Eberhard et al. 2020). Like many languages in the region, Gwere is underdocumented, with few published works describing its linguistic properties.

The research materials for the Gwere Talking Wordlist were collected in January 2020 and include 650 sound files representing about 400 Gwere words, which I extracted from the original interview recordings using Audacity. I then transcribed the words in the list using the International Phonetic Alphabet, which provides essential phonetic detail for further analysis.

Using the transcribed wordlist as a database, I am analyzing the Gwere sound system and the morphological structure of words. I have identified the phonetic inventory of consonants and vowels in the language, I have identified prefixes that mark the noun class (singular, plural, and gender) of each noun, and I have begun to study how the pronunciations of words change as different types of sounds combine. Soon, I will prepare a questionnaire for the collection of around 200 additional Gwere words for the list. This preliminary work will provide greater insights into the linguistic structure of Gwere and will allow us to compare its features with other languages in the region to better classify them and study their history.

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Matthew Rockey

Chicago, IL

F20-030

Senior
Information Technology

Faculty Mentor: Dr. Prasad Calyam, Electrical Engineering & Computer Science

Funding Source:
NSF REU grant to P. Calyam

Blockchain-based Financial Information Sharing System with Intelligent Threat Detection

Matthew Rockey, Ramya Bhamidipati, Varsha Vakkavanthula, and Prasad Calyam

Abstract withheld due to proprietary permissions.

Miya Russell

O'Fallon, MO

F20-024

Junior
Linguistics; Anthropology

Faculty Mentor: Dr. Michael Marlo, English, LInguistics; Dr. Rebecca Grollemund, English, LInguistics

Funding Source:
ASH Scholars

Documenting Luyia Together: Tone in Kabaras

Miya Russell, Elizabeth Kujath, Rebecca Grollemund, and Michael Marlo

The ASH Scholars: Documenting Luyia Together project was started in 2016 for the purpose of describing understudied languages in Kenya and Uganda, most of which fall into the same cluster. Kabaras is an understudied member of the Luyia language cluster of western Kenya, spoken by approximately 250,000 native speakers as according to the 2009 Kenya census. This poster presents the work of Elizabeth Kujath and Miya Russell, two student researchers on the ASH: Documenting Luyia Together team, during the Fall 2020 semester, building off of previous research done in 2018 by Kujath and 2020 by Russell as well as previous data collection by Kristopher Ebarb in 2016.

The current documentation of Kabaras began in the Spring Semester of 2020 and was based off the ASH Talking Wordlist project. The Talking Wordlist project is a collection of audio pronunciations of written words in a language, with each language composing of a set of 600+ words that require processing to create what is essentially an audio dictionary. After processing the full list of Kabaras words that were available, a sound inventory of the language was established, and Russell and Kujath began work on identifying and creating categories for tone in Kabaras verbs and nouns. The tonal categories found have been presented with examples. Further study would explore words from these categories in differing contexts, I.e. paired with modifiers of different tonal patterns.

Alisa Sivapiromrat

O' Fallon, MO

F20-006

Sophomore
Biological Sciences; Economics

Faculty Mentor: Dr. Aaron Stoker, Orthopaedic Surgery

Funding Source:
MARC/IMSD NIH-funded Maximizing Access to Research Careers/ Initiative for Maximizing Student Diversity; Thompson Laboratory for Regenerative Orthopaedics

Investigation of the Effect of IL-1Œ≤, RANTES, and MMP-1 Injection into Nucleus Pulposus (NP) of Intervertebral Disc (IVD)

Alisa Sivapiromrat and Aaron Stoker

INTRODUCTION: Back pain can originate from Intervertebral Disc (IVD) degeneration (IVDD). Inflammatory stimulation and degradative enzyme activity contribute to this disease. IVDD often develops through changes in nucleus pulposus (NP) structure, compromising the function of the IVD. However, the metabolic effects of injury and localized inflammation, and degradative enzyme activity on the NP is poorly understood. This study was designed to determine the effects of NP stimulation with IL-1β, RANTES, and MMP-1. It was hypothesized that localized IVD stimulation would result in significant increases in the proinflammatory and degradative metabolism and decreases in physical properties.

METHODS: With ACUC approval, rat tail IVD explants were created, and assigned to MMP-1 (Injury+injection), IL-1β (Injury+injection), RANTES (Injury+injection), PBS (Injury+injection), injury only, or uninjured control groups. A 25g needle was used to create an injury and inject 10ul of solution based on group. Explants were cultured for 6 days, media was collected for biomarker analysis, and IVDs were tested biomechanically. RESULTS: The IL-1β and injury only groups had a higher inflammatory and degradative metabolism compared to other injection groups. The biomechanical properties of the IL-1 β, RANTES, and MMP-1 groups were significantly lower than the uninjured control.

CONCLUSION: IL-1β was the most inflammatory treatment applied to the IVD and produced significantly higher biomarker levels compared to other injection groups. Injury alone was more inflammatory than injury+injection, as the PBS, RANTES, and MMP-1 groups produced significantly lower inflammatory biomarkers compared to the injury only control. The IL-1β, RANTES, and MMP-1 resulted in physical changes to the IVD based on decreased creep modulus and higher histology scores. In conclusion, IL-1β elicited an inflammatory metabolic response, contributing to pain and inflammation in IVD degeneration and physical changes within the IVD, while RANTES and MMP-1 elicit physical changes in IVD degeneration but not a metabolic inflammatory response.

Anna Sullentrup

Washington, MO

F20-007

Junior
Biochemistry

Faculty Mentor: Dr. Aaron Stoker, Orthopaedic Surgery

Influences of Patient Medication Use on Osteoarthritic Chondrocyte Metabolism

Anna N. Sullentrup, Spencer E. DeLucia, Nicole T. Greco, Eli L. Pratte, Allyson B. Caisley, James L. Cook, and Aaron Stoker

INTRODUCTION: Osteoarthritis (OA) is the most prevalent cause of musculoskeletal disability in the United States. Vast patient-to-patient variability exists in the clinical development and progression of knee OA, and knee OA is often managed using medication for many years prior to surgical intervention. Previous studies have indicated that OA chondrocytes maintain key phenotypic characteristics during initial in vitro culture. However, it is not clear if medications commonly prescribed to treat comorbidities (thyroid medications, thiazide diuretics, proton-pump inhibitors, angiotensin-converting enzyme [ACE] inhibitors, cyclooxygenase [COX]-2 inhibitors, non-steroidal anti-inflammatory drugs [NSAIDs], corticosteroids, opioid analgesics, and statins) impact chondrocyte metabolism during initial culture. Therefore, this study was designed to identify significant differences in production of distinct biomarkers based on patient medication use prior to surgery.

METHODS: With IRB approval and informed patient consent, cartilage tissue normally discarded during surgery was collected from patients undergoing total knee arthroplasty. Chondrocytes from these tissues were grown to confluence, media were changed, and the cells were cultured for three days. After three days, a media sample was collected. Media were analyzed for cytokines, degradative enzymes, inflammatory indicators, and matrix molecules. A Mann-Whitney U Test was utilized to identify significant differences between treated and untreated patient groups for each medication type, with significance set at $p<0.05$.

RESULTS: Assays and data analysis for this study are ongoing and will be presented on the poster.

CONCLUSION: Assays and data analysis for this study are ongoing and will be presented on the poster.

Kristina Todd

Elk Grove, CA

F20-002

Senior
Health Science

Faculty Mentor: Dr. Carolyn Orbann, Health Sciences

The 1919 Flu In Missouri

Kristina Todd and Carolyn Orbann

For my research I have been collecting information from death records during the 1919 pandemic in St. Louis Missouri. I am focusing solely on records with flu or pneumonia related deaths. See database: https://s1.sos.mo.gov/records/Archives/ArchivesMvc/DeathCertificates/ For my project I want to prepare a poster out of word documents with varying texts and images. I will gather more information to paint the picture of what life looked like from an overall perspective during this time. In order to accomplish this, I will be looking at different newspapers and other sources local to the city of St. Louis. I will be looking at factors that impacted the quality of life during this time period such as the: unemployment rate, wars, healthcare, and what measures were implemented for the pandemic. This will beneficial by providing insight into how the pandemic affected life and how it was either worsened or lessened by the actions of society.

This will contribute to the project "1918 flu in Missouri" by helping to complete data collection from primary sources. The focus on 1919 is important because the 3rd wave of the pandemic happened in early 1919, but we don't know that much about the non-pharmaceutical interventions put in place during that period.

Historical society website: https://shsmo.org/

Olivia Watt

Rolla, MO

F20-017

Sophomore
Environmental Sciences

Faculty Mentor: Dr. Michael Marlo, English, LInguistics; Dr. Rebecca Grollemund, English, LInguistics

Funding Source:
ASH Scholars

Documenting Luyia Together: Tsootso Talking Wordlist

Olivia Watt, Carrick O'Bleness, Rebecca Grollemund, and Michael Marlo

This presentation describes research to develop the first talking dictionary of the Tsootso language as part of the ASH Scholars team *Documenting Luyia Together* in 2020. Our efforts contribute to the documentation of Tsootso, a variety of the Luyia language cluster spoken in Kakamega County in western Kenya. Tsootso is much less commonly spoken compared to the largest Luyia languages such as Bukusu and Logoori. Moreover, Tsootso is underdocumented language, with very few prior publications on the language, aside from a handful of publications by Gerard Dalgish in the 1970s, and no published dictionary to date.

Our research builds on a collection of approximately 700 Tsootso words collected in 2019 from two Tsootso speakers as part of the *Luyia-Soga Talking Wordlists* subproject of the ASH Scholars program. The larger aims of this project tare to collect comparative vocabulary and information about the sound systems and grammatical systems of the 30+ language varieties of the Luyia and Soga clusters of Bantu languages in western Kenya and eastern Uganda.

Our work focused on the audio recordings collected from two Tsootso speakers. We processed the original interview recordings and created individual sound files for each of the words in the list. In Fall 2020, we have been working to transcribe all of the words in the collection using the International Phonetic Alphabet (IPA). This process includes listening to the speaker's pronunciation and identifying the appropriate phonetic symbols to identify the consonants, vowels, and tones in the word. Once the transcription work is complete, we will produce a preliminary study of the Tsootso sound system and the structure of nouns, identifying the different prefixes that mark singular, plural, and gender. Later we will integrate the Tsootso data into a larger database to produce a new classification of languages in the Luyia-Soga region.

Matthew DeHass

Kansas City, MO

F20-032

Junior

Ancient Mediterranean Studies (Classical Languages)

Faculty Mentor: Dr. Dr. Michael Marlo, English, LInguistics

Documenting Luyia Together: the Nyole Talking Wordlist

Matthew DeHass and Michael R. Marlo

As an affiliate of the ASH Scholars *Documenting Luyia Together* team, I have carried out research on an understudied language in the Luyia cluster, Upper Nyole. My written report has been developed on the basis of a 600-item wordlist collected on Upper Nyole in 2019, which includes the orthography of the words on the list and audio pronunciations of each word. The recording was done by Kevin Alulu with Nyole speaker Higenyi Stephen in Uganda. The audio has already been processed, so I have listened to each word, providing and refining a phonetic transcription of the language. From this wordlist, I have carried out phonological analysis on the language, identifying the phonetic inventory and describing the phonemic inventory. The phonetic transcriptions are a work-in-progress, and more data will be necessary to more thoroughly analyze the morphology and phonological rules of the language. In the final version of my project, I plan to describe the inventory of vowels and consonants in Nyole and the phonological rules applying to them in this data set. I will not be addressing tone in this analysis but will briefly look at word structure and syllable structure since this is important to the analysis of some rules specifying the phonemic inventory in this language. This work is intended to be an introduction to Nyole that can be further refined and developed in the future.

Caroline Topham

Louisville, KY

F20-033

Freshman
Linguistics

Faculty Mentor: Dr. Michael Marlo, English, LInguistics; Dr. Rebecca Grollemund, English, LInguistics

Documenting Luyia Together: Soba Talking Wordlist

Caroline Topham, Rebecca Grollemund, and Michael Marlo

The purpose of this project is to provide linguistic documentation of Soba, a language spoken in Eastern Uganda and a part of Masaba/Gisu cluster. This work has been conducted as part of the ASH Scholars research team under the guidance of Drs. Grollemund and Marlo. Soba is an understudied language; little research or documentation of it exists. This means that its long-term stability is threatened. This project aims to provide transcriptions and a talking wordlist to contribute to the preservation of Soba.

Throughout this semester, I have worked to create a database of transcriptions of vocabulary in the Soba language. At first, my work consisted primarily of renaming and organizing audio files of interviews with a native Soba speaker. Many of the files had previously been named incorrectly or were inconsistent in format, making them difficult to work with. I standardized and organized the files to facilitate more efficient use of them in the future. The next portion of my work involved creating phonetic transcriptions of the audio files. This process involved practicing and improving my skills in transcription by comparing my work against that of Dr. Marlo, before moving on to creating transcriptions of my own in the International Phonetic Alphabet. My process of transcription for Soba should be complete by the end of the semester.

The work in this project will be a base for future research and analysis. I intend to create a phonemic inventory of Soba, as well as morphological analysis involving identifying affixes of the language relating to different parts of speech. This work will contribute to the long-term stability and vitality of Soba by providing documentation and analysis of a severely understudied language.

Quinn Cunningham

Columbia, MO

F20-034

Junior
Linguistics; Physics

Faculty Mentor: Dr. Dr. Michael Marlo, English, LInguistics

Funding Source:
ASH Scholars

Documenting Luyia Together: A Study of Tiriki Tone

Matthew DeHass and Michael R. Marlo

The research I am presenting is on the tone system of Tiriki, a language variety of Luhya that is spoken in Western Kenya. I have done this research as part of the ASH Project: *Documenting Luhya Together*, and with continued guidance and help from Associate Professor, Michael Marlo. The first and largest part of this research has included the segmentation and transcription of Tiriki sound files, and the tonal transcriptions of Tiriki word lists. The data cleaning and transcription process has been facilitated greatly by the use of the software Audacity. Most data collection was completed previously by Michael Marlo and Tiriki-speaking associates including Kelvin Alulu, though this is still an ongoing process. Tone patterns of Tiriki nouns were compared with those of other languages, as well as tone shifts when in various phono-syntactic environments, including before adjectives and possessives. Nouns were assigned tone labels in order to group them together based on their tonal patterns in more than one context. The analysis of tone was aided by using Python to process and visualize tone data. I have been writing various scripts using Python and relevant libraries such as Numpy, Pandas and Plotly in order to great graphs showing the frequency of different tone patterns. Additionally, I have created algorithms in order to convert columns of tonally-transcribed excel data into tonal codes such as HHL (for high-high-low toned words) and converted into a data format compatible with data visualization. In the near-term future, I plan to formally compare the results of this Tiriki noun tone study with the results of noun tone studies of other Luhya varieties such as Logoori and Bukusu. In my presentation, both the methods and results of this Tiriki noun tone study will be showcased in-depth. Relevant Python code and any other related work will be included as links for further inquiry by viewers.

Zoe Bowman

Lee's Summit, MO

F20-035

Senior
Biomedical Engineering

Faculty Mentor: Dr. Shramik Sengupta, Biomedical, Biological & Chemical Engineering

Detection of Lactic Acid Bacteria (LAB) in Yeast Fermentations

Zoe Bowman, Amandeep Sharma, Yongqiang Yang, and Shramik Sengupta

This project aims to develop a new diagnostic method which one can use to detect contamination of yeast fermentations by lactic acid bacteria at an early stage (at low bacterial numbers).

Yeast fermentations are involved in a number of applications such as fermentation of beer, wine and other foods and production of ethanol and other chemicals. Typically, it is desired that chosen strain(s) of yeasts alone be present in the fermentation broth, either to ensure highest productivity and/or to prevent by-products such as off-flavors. A problem often encountered is "infection" by undesired microbes, particularly lactic acid bacteria (LAB) that survive at low pH. Such infection is most consequential if present in the original inoculum. So, the inoculums into production fermenters (themselves generated smaller fermenters) are checked for the presence of LAB before loading. Current technology to detect LAB is indirect: and relies on detecting the presence of lactic acid using High Performance Liquid Chromatography (HPLC). Typical limits of detection for lactic acid are ~0.2 g/L, which corresponds to a LAB level of ~ 107 Colony Forming Units (CFU)/ml. Such high levels often result in lower productivity and in some cases "stuck fermentations". So, in some cases (presumably those with loads of ~10 6 CFU/ml, or lower of LAB present), adverse outcomes (lower productivity / stuck fermentations) are obtained despite the inoculums passing the quality control (check for presence of lactic acid). Industrial production units can consist of up to 1 million gallons of fluid, which is a large waste of resources and can be very costly.

The Sengupta lab plans to adapt an existing technology for detecting low levels of bacteria in blood cultures to this application, with a targeted limit of detection of ~ 102-3 CFU of LAB/ml. The adaptation involves developing a protocol to separate yeasts from bacteria in the aliquots collected from the fermentation and using microchannel Electrical Impedance Spectroscopy (m-EIS) to monitor the effects of antibiotics (which kill bacteria but not yeasts) on processed samples.

I will be involved in developing a prototype of the device to be used, designing and conducting both separation and m-EIS experiments using this prototype, and analyzing data generated to optimize the detection method.

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A Model of Physician Clinical Burnout based on Electronic Medical Record Use Metrics

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Healthcare provider “burnout” is a personal risk to both behavioral and physical health and seriously threatens the critical need for dramatically improved healthcare in the United States. In the past forty years, Electronic Medical Records (EMRs) have been implemented to simplify routine healthcare provider tasks. However, recent studies suggest that although EMRs are designed to efficiently execute routine tasks, they have not always achieved that objective. The long-term objective of this study is to develop a model of physician EMR use interaction that will longitudinally monitor key EMR metrics that are tied to routine and specialized EMR tasks. Thereafter, this data will be used to create a mathematical model of the correlation of which metrics are associated with burnout risk as measured by the Single Question Burnout Survey (SQBS). We hypothesize that some EMR metrics correlate to burnout risk, therefore remodeling the EMR workflows provides an interventional method to reduce the burnout risk factors, thus reducing physician burnout risk.

We have conducted a retrospective analysis of EMR metrics collected over one month (February, 2020) for 1554 physicians, including 75 EMR metrics. Consequently, a rigorous quality assessment (QA) process led to the removal of 44 variables and 492 physician records, revealing that 31 variables are potentially important. Our preliminary results suggest that the EMR metrics available to us are a rich source of information regarding physician EMR use patterns.

Currently, we are conducting a prospective study that is designed to capture all EMR metrics (by month) and collect the physician self-reported stress level using the SQBS. When we receive this study’s data, we will assess all data and seek to identify the longitudinal relationship between physician EMR metrics and self-reported fatigue. We anticipate that our future analysis will identify key elements in the EMR that reflect physician burnout risk.