



OFFICE OF UNDERGRADUATE RESEARCH
LAMAR UNIVERSITY

April 13th, 2022

8:45 a.m. to 6:45 p.m.

**WELCOME TO
EXPO 2022**



**The Ninth
Annual
Exhibition of
Undergraduate
Research and
Creative
Activities**

**Setzer Student Center
Live Oak Ballroom**



LAMAR UNIVERSITY
MEMBER THE TEXAS STATE UNIVERSITY SYSTEM™

YOUR
Moment
IS HERE

The co-Chairs of the Ninth Annual Exhibit of Undergraduate Research and Creative Activities

EXPO 2022

Dr. Kelley Bradley and Dr. Mamta Singh

Welcome to EXPO 2022!

Lamar University

April 13, 2022

Setzer Center



**Director of O.U.R.
Dr. Cristian Bahrim**

Welcome to the Ninth Annual Exhibition of the Undergraduate Research and Creative Activity! EXPO event is Lamar’s annual showcase of undergraduate research. EXPO 2022 proudly welcomes more than 60 graduate and undergraduate students from Lamar University and other schools from Texas: UT Arlington, UT Austin, and Tarleton University. In addition to 15 sponsored research presented by OUR grant winners, cohort 2021-22, we welcome research done by students in Aerospace Engineering, Audiology, Biology, Chemistry, Communication and Media, Construction Management, History, Industrial and Environmental Engineering, Mechanical Engineering, Nursing, Physics, and Political Science, presented in 24 posters and 33 talks. Also, we warmly welcome our five special guests from academia and industry: Dr. Wei Chen (UT Arlington), Dr. William Miller (Baker Univ.), Dr. Lauren Richardson (UTMB – Galveston), Dr. Paul Rizk (Univ. of Florida), and Mr. John Shrader (EH Specialties) for joining our EXPO.

**Advisory Board of O.U.R.
Spring 2022**

Dr. Robert Kelley Bradley
College of Engineering

Dr. Bianca Easterly
College of Arts & Sciences

Dr. Gina Hale
College of Arts & Sciences

Dr. Matthew Hoch
College of Arts & Sciences

Dr. Alyse Jordan
Mary and John Gray Library

Dr. Xiangyang (Sunny) Lei
College of Arts & Sciences

Dr. Lekeitha Morris
College of Fine Arts & Communication

Dr. Nicki Michalski
College of Fine Arts & Communication

Dr. Gevorg Sargsyan
College of Business

Dr. Thinesh Selvaratnam
College of Engineering

Dr. Mamta Singh
College of Education & Human Development

Dr. Robert Worley
College of Arts & Sciences

Mr. Juan Zabala
University Advancement

Office Information:

Chemistry Suite 115 – P.O. Box 10052

**Dr. Cristian Bahrim – Chem 115B / Ms. Jenna Erwin – Chem 115A
cbahrim@lamar.edu - ext. 8290 / jerwin6@lamar.edu - ext. 8430**



Message from The President of Lamar University Dr. Jaime Taylor

Today, the Lamar Community celebrates the Ninth Annual Exhibit of Undergraduate Research and Creative Activity. Lamar is especially honored to welcome Dr. Wei Chen from University of Texas at Arlington, Dr. Lauren Richardson from UTMB – Galveston, Dr. Paul Rizk from University of Florida, and Dr. William Miller from Baker University.

We are proud of our Lamar students who will present 24 posters and give 29 oral presentations. Also, we warmly welcome four guest student presenters from UT Arlington, UT Austin, and Tarleton University. We look forward to enjoying your talks and poster presentations. Thank you for your presence today at EXPO 2022, and for sharing your findings and research results with us.

Lamar's students and guests, today we celebrate your fine scholarly success. Congratulations to all! Enjoy a great conference experience!



LAMAR UNIVERSITY
MEMBER THE TEXAS STATE UNIVERSITY SYSTEM™

YOUR
Moment
IS HERE



Message from The Provost of Lamar University Dr. Brenda Nichols

I welcome everyone to the 9th edition of the Annual Exhibit of Undergraduate Research and Creative Activity. EXPO 2022 brings together 60 presentations from all academic areas. It is the first time when EXPO includes graduate level research with presenters from Lamar and other schools in Texas. We are proud to welcome students from UT Arlington, UT Austin, and Tarleton Univ. to Lamar, this year.

We feel privileged to have such an impressive list of plenary speakers: Dr. Wei Chen from UT Arlington, Dr. William Miller from Baker University (KS), Dr. Lauren Richardson from UTMB – Galveston, and Dr. Paul Rizk from University of Florida. We heartily welcome home our Lamar alumni, Lauren, and Paul! We are proud of your achievements and what you have become.

We welcome Dr. Chen's group from the University of Texas at Arlington. Dr. Chen is an accomplished faculty with a distinguished research record and is Fellow of the Royal Society of Chemistry in UK.

Good luck to all students with their presentations today! We will cheer for your achievements!



LAMAR UNIVERSITY
MEMBER THE TEXAS STATE UNIVERSITY SYSTEM™

YOUR
Moment
IS HERE



OFFICE OF UNDERGRADUATE RESEARCH
LAMAR UNIVERSITY

PLENARY GUEST SPEAKER

at the 9th Exhibition of Undergraduate Research and Creative Activities, EXPO 2022

Lauren Richardson, Ph.D.

Talk in The Live Oak Ballroom of the Setzer Student Center at 9:00a.m.

**Organ-On-Chip Devices: Innovative Tools
to Address Knowledge Gaps in Reproductive Biology**

**Division of Basic and Translational Research Obstetrics and Gynecology
Department of Obstetrics and Gynecology
The University of Texas Medical Branch**

Lauren Richardson is a Lamar alumnus with a BS degree in Biology and a McNair Scholar. Dr. Richardson obtained her Ph.D. in Cell Biology, with an emphasis in Reproductive Biology, from the University of Texas Medical Branch (UTMB) in Galveston.

While receiving training from the Environmental Toxicology T32 at UTMB, her research focused on the mechanistic processes of fetal membrane cellular and collagen remodeling (i.e., Epithelial-to-Mesenchymal Transition [EMT] and MET) throughout gestation and its dysregulation at term. She conducted her post-doctoral fellowship at UTMB (Kempner Scholar) and at Texas A&Ms Electrical and Computer Engineering Department (T32 Post-Doctoral Fellowship) focusing on fabricating, developing, and validating pregnancy-related organ-on-chip devices (i.e., placenta, fetal membranes, and cervix) to study the effect of maternal and fetal risk factors (i.e., Oxidative stress, toxicants, infection, drugs) on the induction of preterm labor pathways. She is now an Assistant faculty at UTMB in the Division of Basic and Translational Research where she focuses on bridging the gap between bench-to-bedside research by merging advanced engineering and biology concepts. Her research focuses on two areas. One, adapting microfluidic devices to collect underutilized biological



fluids for biomarker screening, and two, to develop novel organ-on-chip devices that physiologically recreate in utero organs and organ systems.



PLENARY GUEST SPEAKER

at the 9th Exhibition of Undergraduate Research and Creative Activities, EXPO 2022

Wei Chen, Ph.D.

Talk in The Live Oak Ballroom of the Setzer Student Center at 1:40 p.m.

Exploration of New Sensitizers for Cancer Treatment – Deeper and Better

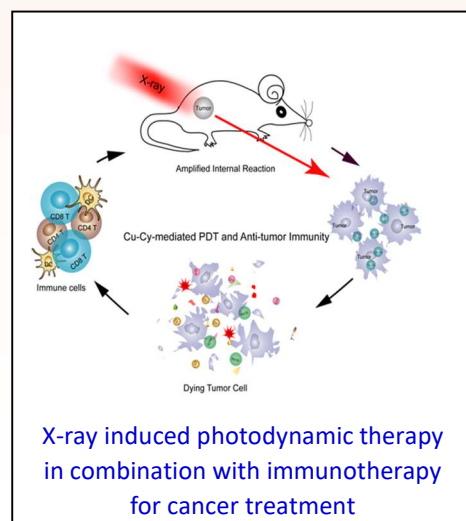
The University of Texas at Arlington.

Dr. Wei Chen is professor in the Department of Physics at UT Arlington. He has been engaged in cutting-edge nanotechnology research for many years and is an internationally renowned expert in nanomedicine and cancer nanotechnology. He is well-known for his inventions in cancer nano-targeted therapy and deep cancer photodynamic therapy. Currently he has published more than 310 papers in famous academic journals such as PNAS, Nano Letters, Signal Transduction and Targeted Therapy (Nature), Advanced Materials, Advanced Functional Materials, Materials Today Physics, Bioactive Materials, etc. His papers have been cited more than 12,500 times and his H index is 60. Dr. Chen's scientific research work has attracted wide attention and has been reported by the American TV program CBS. Dr. Chen received the University distinguished record of research and creative activity award in 2020 and was elected to be a Fellow of the Royal Society of Chemistry (UK) in 2021.

Photodynamic therapy is a combination of light and sensitizers for cancer treatment. The sensitizers and the light are non-toxic but when they interact with each other, toxins like reactive oxygen species are generated that can kill cancer cells. Photodynamic therapy has the beauty of targeting tumors by the sensitizers themselves and the light, so its side-effect is much lower than chemotherapy or radiotherapy. However, the need of light for activation has some limitations as light cannot penetrate deeply into tissue, so photodynamic therapy has been widely used for skin disease treatment but not for deep cancer treatment. In this talk, I will discuss the possible solutions for developing photodynamic therapy for deep cancer treatment and some new progress in Photodynamic therapy and the invention of new sensitizers that



can be activated by UV, X-ray, microwave, and ultrasound to produce reactive oxygen species for deep cancer treatment as well as immunity enhancement. New ideas for the combination of photodynamic therapy and radiation to overcome radiation resistance will be discussed.





OFFICE OF UNDERGRADUATE RESEARCH LAMAR UNIVERSITY

PLENARY GUEST SPEAKER

at the 9th Exhibition of Undergraduate Research and Creative Activities, EXPO 2022

Paul Rizk, MD

Talk in The Live Oak Ballroom of the Setzer Student Center at 5:30 p.m.

From Student to Surgeon: What Research Has Taught Me

Resident Doctor at the University of Florida

Paul Rizk is a Lamar alumnus with a BS Degree in Physics and BSE degree in Chemical Engineering. He graduated as a Mirabeau B. Lamar Scholar summa cum laude. He subsequently matriculated to UT Southwestern Medical School in Dallas, Texas where he graduated with his MD and was admitted to the Gold Humanism Honor Society. Currently, Paul is a fourth-year resident in orthopaedic surgery at the University of Florida. He plans to pursue a fellowship in orthopaedic oncology.

My research career began at Lamar University working with Dr. Bahrim, Dr. de la Madrid, and Dr. Lin in the Physics and Chemical Engineering departments. Initial projects ranged from working on nanofiber development to building a miniature rail gun. In medical school, research took new meaning for me as the human patient became a significant player, leading to new constraints, new goals, and different teams. Wanting to marry my prior experience with medical research, I participated in a Biomedical Innovations elective, leading to a presentation at VentureWell, a startup conference. Now I focus research ideas on patient reported outcome measures (PROMs) and their ability to measure and even predict outcomes of total joint replacement surgery. I am also interested in the field of radiomics, the study of utilizing computer algorithms and AI to analyze imaging to assist with diagnoses of metastatic disease in sarcoma pathology.



LAMAR UNIVERSITY
MEMBER THE TEXAS STATE UNIVERSITY SYSTEM™

YOUR
Moment
IS HERE



OFFICE OF UNDERGRADUATE RESEARCH
LAMAR UNIVERSITY

*The sessions in the Live Oak Ballroom of the Setzer Center will be streamed on
Zoom platform with ID: **879-918-4160** and password **88888***

WELCOME to the 9th edition of the Annual EXPO!

- 8:45 AM Opening Remarks and Conference Overview – Dr. Cristian Bahrim,
Director of O.U.R., Professor of Physics
- 8:50 AM Welcoming Remarks – Dr. Jaime Taylor, President of Lamar University and
Dr. Brenda Nichols, Provost of Lamar University
- 8:55 AM Introduction of our plenary guest speaker by Dr. Terry Randall, the Chair of
the Department of Biology
- 9:00 AM **Plenary talk** “*Organ-On-Chip Devices: Innovative Tools to Address
Knowledge Gaps in Reproductive Biology*”
Dr. Lauren Richardson, Ph. D., Assistant Professor
Department of Obstetrics and Gynecology
Division of Basic and Translational Research Obstetrics and Gynecology
The University of Texas Medical Branch at Galveston
- 9:40 AM Formal recognition of our guest speaker, Dr. Lauren Richardson

O.U.R. Grant Program at Lamar – Year 2021 – 2022

OUR Grants brief overview – Dr. Cristian Bahrim, Director of O.U.R.

- 9:45 a.m. **David Matherne** | major in Biology |
Mentor: **Dr. Ashwini Kucknoor**
Research in Molecular Biology
“*Characterization of drug resistance genes in cattle pathogen, Tritrichomonas foetus*”
- 10:00 a.m. **Caroline LeBlanc** | major in Chemical Engineering |
Co-author: Anthony Osu (graduate student)
Mentor: **Dr. Maryam Vasefi**
Research in Neurobiology
“*Glutamate receptor crosstalk in Alzheimer’s disease*”



- 10:15 a.m. **Arizbeth Lopez Garcia** | major in Biology |
Co-author: Anthony Osu (graduate student), **Hy Lai** (graduate student),
Dr. James Henry
Mentor: **Dr. Maryam Vasefi**
 Research in Neurobiology
“CBD and Alzheimer’s disease; Neuroprotection and Desensitization.”
- 10:30 a.m. **Kalen Baker** | major in Mechanical Engineering and Mathematics |
Mentor: **Dr. Ping He**
 Research in Mechanical Engineering
“Evaluation of Americium’s Molecular Dynamics Pair Potential for use in Alphavoltaic Modeling.”
- 10:45 a.m. **Callan Noak** | major in Computer Science |
Mentor: **Dr. Sujing Wang**
 Research in Data Science and Analysis
“Analyze COVID-19 Data using Advance Machine Learning Techniques.”
- 11:00 a.m. **Silvana Ochoa** | major in Computer Science |
Mentor: **Dr. Sujing Wang**
 Research in Computer Science
“COVID-19 Pandemic’s Impact on Education and Students.”
- 11:15 a.m. **Tyler Stuck** | major in Electrical Engineering and Mathematics |
Mentor: **Dr. Yueqing Li**
 Research in Driving Safety
“The Visual Behavior and Performance of Young Drivers in Construction Zones and Nighttime Driving.”
- 11:30 a.m. **Lac Nyugen** | major in Industrial Engineering |
Mentor: **Dr. Robert Kelley Bradley**
 Research in Nanocomposites
“An Investigation of Environmentally Friendly Filler for Polymer Nanocomposites”
- 11:45 a.m. **Jennifer Arredondo** | major in Industrial and System Engineering |
Mentor: **Dr. Robert Kelley Bradley**
 Research in Silicone Nanocomposite Ferroelectrets
“Exploration of Parameters for Developing a Silicone Nanocomposite Ferroelectret.”



- 12:00 PM **Damaris Thrash** – major in Exercise Science
Mentor: Dr. Shannon Jordan
 Department of Health & Kinesiology
“Effects of Motivational Music on Post-Exercise Recovery.”
- 12:15 PM **Taliah Belcher** | major in Accounting & Finance |
Mentor: **Dr. Gevorg Sargsyan**
 Research in Finance and Economics
“Impact of Militarization on Financial & Economic Growth of Developing and Highly Militarized Countries.”
- 12:30 PM **Angel Flowers** | major in Biology |
Mentors: **Dr. Matt Hoch (Lamar) and Dr. William Miller (Baker Univ.)**
 Research in Ecology
“Population Distribution Analysis of Tardigrades Found on Quercus Virginiana. (Southern Live Oak).”
- 12:45 PM **Dr. William Miller**
Professor of Biology at Baker University, Kansas
 Special Invited Speaker Presentation
“Tardigrades: A Microscopic Animal in a Visual World.”
- 1:00 PM **Mr. John H. Shrader**
 Septic Designer - An Environmental Health Specialist
 at the Septic Maintenance Company, Highlands TX 77562
 Marketing Environmental Health Careers at LU
- 1:10 PM GROUP PHOTO – In front of the Setzer Center on the side of the Quad.**

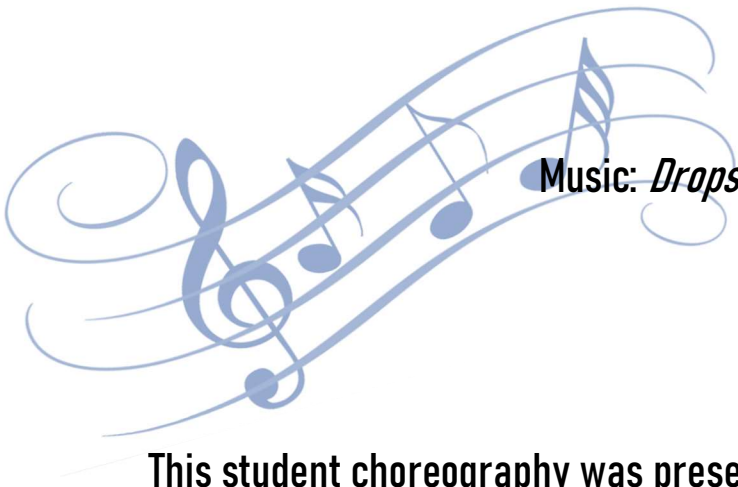
Dance Performance
Dr. Golden Wright and his dance performers
1:15 – 1:35 PM

- 1:40 AM Introduction of our plenary guest speaker by Dr. Cristian Bahrim, from the Department of Physics
Plenary talk *“Exploration of New Sensitizers for Cancer Treatment – Deeper and Better”*
Dr. Wei Chen, Professor of Physics
 Department of Physics
 The University of Texas at Arlington
- 2:10 AM Formal recognition of our guest speaker, Dr. Wei Chen

CHOREOGRAPHY IN THE LIVE OAK BALLROOM

**Dr. Golden Wright and his dance performers
from the Department of Theatre & Dance**

**1:15 – 1:35 PM
Live Oak Ballroom**



Develop-Mental (2021)

Choreographer: Katie Medicis

Music: *Drops* by Pascal Schumacher and Maxime Delpierre

Music has NOT been edited

Costume Design: Katie Medicis

Performers: Ashley Hawkin and Mia Paul

This student choreography was presented and adjudicated at the American College Dance Association South-Central Conference.

In This Together (2022)

Choreographer: Golden Wright

Music: *Tooth Wheels* by MUM

Costume Design: Golden Wright

Performers: Golden Wright and Serinity Schmidt



Thank you, all for another astonishing dance performance at EXPO!

Breakout Session A1**STEM****2:15 – 3:45 p.m.****Chair: Dr. Robert Kelley Bradley****Live Oak Ballroom**

- 2:15 PM **Eric Amador** – Ph.D. candidate in Physics
Co-authors: Akhil RK. Kalapala, George Belev, Jeotikanta Mohapatra, Nil Pandey, Ramaswami Sammynaiken, Ping Liu, Weidong Zhou,
Mentor: Dr. Wei Chen
 Department of Physics, University of Texas at Arlington
“A New Composite of 1,4-bis(5-phenyloxazol-2-yl) Benzene and Aggregation-induced Emission Luminogens for White Light-Emitting Diodes.”
- 2:30 PM *In-progress Level*
Kathryn Hardy – major in Physics
Mentor: Dr. Wei Chen
 Department of Physics, University of Texas at Arlington
“Skin Cancer Presentation.”
- 2:45 PM *In-progress Level*
Rebekah Schilberg – major in Aerospace Engineering
 University of Texas at Austin, Lamar
“Longhorn Racing Internal Combustion: Designing and Manufacturing a Formula-Style Car.”
- 3:00 PM *Advanced Level*
Taryn Gibbs – major in Physics and Chemistry
Co-authors: Marcus Gregory and Sara Tuck
Mentor: Dr. William L. Whaley
 Department of Physics, Tarleton University
“Measurement of 1-Octanol/Water Partition Coefficients and Abraham Hydrogen Bonding Acidities (A) for the Catechol Flavones.”
- 3:15 PM *In-progress Level*
Sinjin Sharma – major in Mechanical Engineering
Co-authors: Travis Lane, Cade Pellerin, Gabriel West, David Williams
Mentor: Dr. Jenny Zhou
 Department of Mechanical Engineering, Lamar
“Determining the Vibration Response and Damping Value Necessary for the Compensation of Inservice Vibrations of an Automobile Suspension.”
- 3:30 PM *Advanced Level*
Mackenzie Savage – major in Biology
Mentor: Dr. Ashwini Kucknoor
 Department of Biology, Lamar
“The Art of Microbiology: Mixing art & molecular biology of microbes on agar.”

Breakout Session B2 OUR research / HASBSEB 2:15-3:30p.m.**Chair: Dr. Mamta Singh****Cypress Breakout Room**

2:15 PM

*OUR Sponsored Research***Margo Eugenio** – major in EnglishMentor: Dr. Mamta Singh

Department of Teacher Education

“Impact of School Choice on Standardized Test Scores and the Achievement Gap.”

2:30 PM

*OUR Sponsored Research***Tiya Davi** – major in Humanities and ArtsMentor: Dr. Mamta Singh

Department of Teacher Education

“Assessing Preservice Teachers’ Understanding of Disease and its Spread using Scientific Illustrations and Virtual Labs” - Preliminary Findings

2:45 PM

*OUR Sponsored Research***Corina Mena** | major in American Sign Language Interpretation |Mentor: **Dr. Zanthia Smith**

Research in Deaf Studies & Deaf Education

“Hispanic/Latinx Students Perceptions of Diversity in Interpreting”

3:00 PM

*Early-stage Level***Madeline Doughty** – major in Speech and Hearing SciencesMentor: Dr. Lilian Felipe

Department of Speech and Hearing Sciences

“Awareness of Noise-Induced Hearing Loss Among College Band Students.”

3:15 PM

*In-progress Level***Amber Palos** and **Yared Rodriguez** – majors in AudiologyMentor: Dr. Lilian Felipe

Department of Speech and Hearing Sciences

*“The future of vestibular rehabilitation: Effects of Galvanic Vestibular Stimulation and Virtual Reality to improve balance.”***3:30 – 3:40 PM****Coffee Break**

Breakout Session C3

HASBSEB

2:15 – 3:30 p.m.

Chair: Dr. Terri Davis

Sabine II Breakout Room

2:15 PM

Early-stage Level

Umer Rasool Malik – major in Political Science

Mentor: Dr. Terri Davis

Department of Political Science

“The Afghan Diaspora and People in Crisis: An Analysis of Sanctuary and Treatment of Afghan Refugees by the International Community.”

2:30 PM

In-progress Level

Natalia Calderon – major in Political Science

Mentor: Dr. Brian Williams

Department of Political Science

“Environmental Regulation and Green Productivity Growth in the United States.”

2:45 PM

In-progress Level

Lindsey Chirafis – major in Political Science

Mentor: Dr. Terri Davis

Department of Political Science

“The Controversial Right to Die: An Analysis Between the Court’s Rulings on Passive Assisted and Active Assisted Suicide.”

3:00 PM

In-progress Level

Shelby Graham – major in English

Mentor: Dr. Terri Davis

Department of Political Science

“Board of Education, Island Trees Union Free School District v Pico: Constitutional Analysis of Literary Censorship.”

3:15 PM

In-progress Level

Shelbie Williams – major in Political Science

Mentor: Dr. Terri Davis

Department of Political Science

“Does v. Mills: An Analysis of the Free Exercise Clause Through the COVID-19 Pandemic.”

3:30 – 3:40 PM

Coffee Break

Breakout Session D4

HASBSEB

2:15 – 3:30 p.m.

Chair: Dr. Sheila Springer and Mr. Andre Favors

Sabine I Breakout Room

**#Join our Zoom platform from 2:30 to 3:10pm
Meeting ID: 844 274 2337 Passcode: 88888**

2:15 PM

Early-stage Level

Allyssa Circello – major in Communication Film Studies

Mentors: Prof. O’Brien Stanley and Mr. Andre Favors

Department of Communication and Media

“The Effects of War Shown in The Legend of Zelda: Breath of the Wild.”

2:30 PM

(withdrew)

Early-stage Level

Aliya Robertson – major in Communication Studies

Mentor: Mr. Andre Favors

Department of Communication and Media

“Aronofsky's "Black Swan": A Tragedy of Mental Health.”

2:45 PM

Early-stage Level

Hallie Svir – major in Communication Studies

Mentor: Dr. Sheila Springer

Department of Communication and Media

“The Detrimental Effect of Appearance-Based Discrimination on the Professional Development of Women’s Careers.”

3:00 PM

In-progress Level

Rachel Hellums – major in Communication Studies

Mentor: Dr. Nicki Michalski

Department of Communication and Media Studies, Lamar

“Let’s Talk About Sex: Power Dynamics in Evangelical Purity Culture.”

#3:15 PM

Advanced Level

Igor Romashets – major in History

Mentor: Dr. Brendan Gillis

Department of History

“Stamp Act Riots of New York Colony.”

#Due to special circumstances this talk is rescheduled from 3:30 to 3:45 pm

Poster Session 3:45 – 5:15pm

**Chairs: Dr. Kelley Bradley, Dr. Gina Hale, Dr. Alyse Jordan,
and Dr. Nicki Michalski**

Live Oak Ballroom

5:25 PM

Introduction of our plenary guest speaker by Dr. Cristian Bahrim

5:30 PM

**Plenary talk by Paul Rizk, Resident Doctor
University of Florida**

6:00 PM

Formal recognition of our guest speaker, Dr. Paul Rizk

**Recognition of the Faculty Mentor Award for 2022
Dr. Sujing Wang
Associate Professor of Computer Science
6:05 PM**



**Lifetime Achievement Award
Dr. Dorothy Sisk
Professor of Educational Leadership
6:15 PM**

**Recognition of Awardees by the Center for History and Culture
of the Southeast Texas and the Upper Gulf Coast
6:20 PM**

**Recognition of Awardees by O.U.R.
6:25 PM**

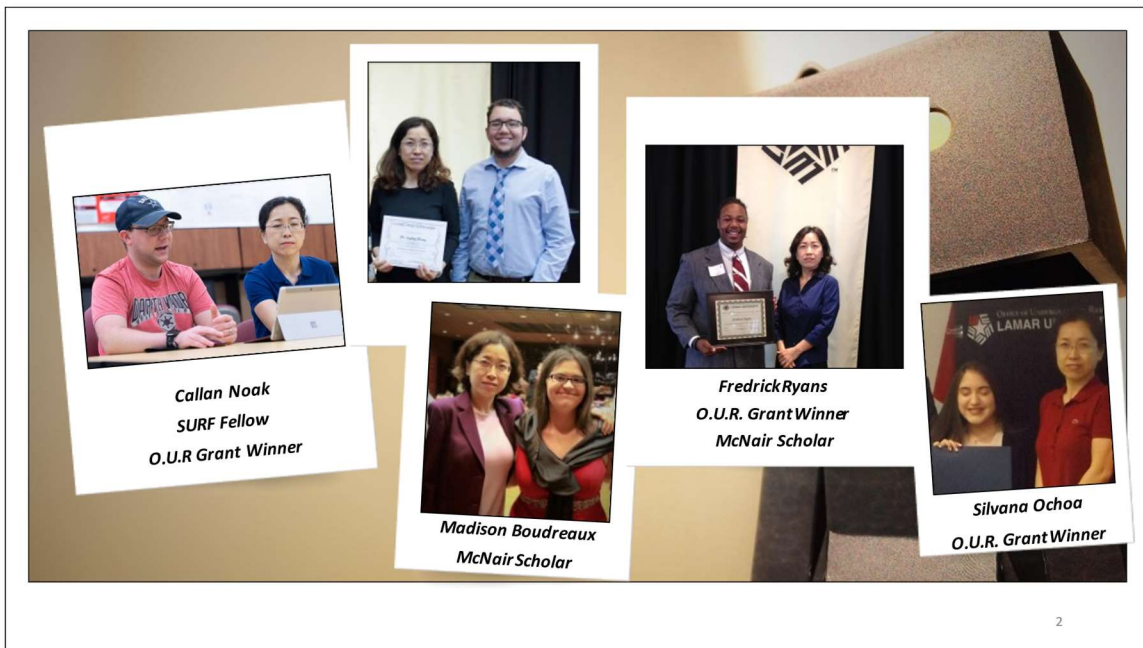


OFFICE OF UNDERGRADUATE RESEARCH
LAMAR UNIVERSITY

2022 FACULTY MENTOR AWARD RECIPIENT



Dr. Sujing Wang
Associate Professor of Computer Science



2022 UNDERGRADUATE RESEARCH EXPO

Recognition of our Plenary Speakers



**A big “Thank You!” to all judges
for their time in assessing student presentations**

Dr. Bianca Easterly

Assis. Professor of Political Science

Mr. Andre Favors

Instructor of Communication

Dr. Alyse Jordan

Head of Reference at Mary and Gray Library

Dr. Nicki Michalski

Assoc. Professor of Communication

Dr. Mamta Singh

Assoc. Professor of Science Education

Dr. Tianxing Cai

Assis. Professor of Chemical Engineering

Dr. Lilian Felipe

Assoc. Professor Speech & Hearing

Dr. Tracy Benson

Chair and Professor of Chem. Engr.

Dr. Binod Nainabasti

Instructor of Physics Education

Dr. Chun-Wei Yao

Assis. Professor of Mechanical Engineering

Perumalreddy Chandrasekaran

Assoc. Professor of Inorganic Chemistry

Julio Morales-Aponte

Assoc. Professor of Health and Kinesiology

Dr. Terri Davis

Assoc. Professor of Political Science

Dr. Brendan Gillis

Assoc. Professor of History

Dr. Ian Lian

Assoc. Professor of Biology

Dr. Gevorg Sargsyan

Assis. Professor of Finance

Dr. Sheila Springer

Instructor of Communication

Dr. Lekeitha Morris

Assoc. Professor of Speech & Hearing

Dr. Sujing Wang

Assoc. Professor Computer Science

Dr. Kelley Bradley

Assis. Professor of Industrial Engr.

Dr. Paul Bernazzani

Professor of Chemistry

Dr. Terry Randall

Assoc. Professor and Chair of Biology

Ozge Gunaydin

Assoc. Professor of Physical Chemistry



OFFICE OF UNDERGRADUATE RESEARCH
LAMAR UNIVERSITY

Recognition of Awardees

6:20 – 6:45 PM

The Center for History and Culture of the Southeast Texas and the Upper Gulf Coast will recognize with the Dr. Mary Scheer prize in the amount of \$200 the best projects related to the Southeast Texas and the *Greater Gulf Coast*. The awards will be offered by Dr. Jimmy Bryan, the Director of the Center.

Recognition of Awardees at 9th EXPO Conference by O.U.R.

6:25 – 6:45 PM

Best Presentations in OUR research category

1st (\$200), 2nd(\$150), and 3rd (\$100) place, and special mention (\$50)

Best Talks in non-OUR research category

Early-stage : *winner (\$200) and runner-up (\$150)*

In-progress : *1st (\$200), 2nd(\$150), and 3rd (\$100) place*

Advanced : *winner (\$200)*

Best Posters

Early-stage : *winner (\$200)*

In-progress : *1st (\$200), 2nd(\$150), and 3rd(\$100) place*

Advanced : *winner (\$200) and runner-up (\$150)*

Award Winners

Best Presentations in O.U.R. research



First place:

Angel Flowers – major in Biology

Research in Ecology

“Population Distribution Analysis of Tardigrades Found on Quercus Virginiana. (Southern Live Oak).”



Second place:

Kalen Baker – major in Mechanical Engineering and Mathematics

Research in Mechanical Engineering

“Evaluation of Americium’s Molecular Dynamics Pair Potential for use in Alphasoltaic Modeling.”



Third place:

Damaris Thrash – major in Exercise Science

Research in Exercise Science

“Effects of Motivational Music on Post-Exercise Recovery.”



Special Mention:

Callan Noak – major in Computer Science

Research in Data Science and Analysis

“Analysis of COVID-19 Data Using Advanced Machine Learning Models.”

Best Talks in non-O.U.R. research category – Early Phase Level



Winner:

Hallie Svir – major in Communication

“The Detrimental Effect of Appearance-Based Discrimination on the Professional Development of Women’s Careers.”



Runner-up:

Madeline Doughty – major in Communication Studies

“Awareness of Noise-Induced Hearing Loss Among College Band Students.”

Award Winners

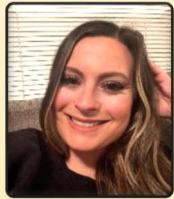
Best Talks in non-O.U.R. research category – In-progress Level



First place:

Rachel Hellums – major in Communication Studies

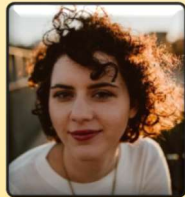
“Let’s Talk About Sex: Power Dynamics in Evangelical Purity Culture.”



Second place:

Lindsey Chirafis – major in Political Science

“The Controversial Right to Die: An Analysis Between the Court’s Rulings on Passive Assisted and Active Assisted Suicide.”



Third place:

Shelby Graham – major in English

“Board of Education, Island Trees Union Free School District v Pico: Constitutional Analysis of Literary Censorship.”

Best Talks in non-O.U.R. research category – Advanced Level



First place:

Taryn Gibbs – major in Physics and Chemistry

“Measurements of 1-Octanol/Water Partition Coefficients and Abraham Hydrogen Bonding Acidities (A) for the Catechol Flavones.”



Best Posters in non-O.U.R. research category – Early phase

First place:

Brandyn Wagstaff – major in Construction Management

“Modular Construction: Benefits, Advantages, and a Case Study”

Award Winners

Best Posters - non-O.U.R. research category – In-progress Level



First place:

Jesus Esquivel – major in Chemistry

“Quantitative Determination of the Remediation of Oil Contaminants in Dredged Material.”



Second place:

Joshua Smith – major in Biology and Chemistry

“Synchrotron-Based Attenuated Total Reflection Infrared Spectroscopy of Artificial Gasoline Blend.”



Third place:

Daniel Nicks – major in Mechanical Engineering

**Team with Kalen Baker, Destiny Lett, Luke Nelson,
Arin Preston, Jose Wong**

“Mechanical Design and Testing of Event Recorder used in Locomotives.”

Best Posters - non-O.U.R. research category – Advanced Level



First place:

Bethany Edwards – major in Nursing

“Effect of COVID-19 on the Nursing Profession in Texas.”



Runner up:

Taryn Gibbs – major in Physics and Chemistry

“Abraham Summation Solute Hydrogen Bonding Acidity Values Determined for Catechol-flavones by ¹H-NMR Spectroscopy.”

Posters

Chairs: Dr. Kelley Bradley, Dr. Gina Hale, and Dr. Nicki Michalski

Session 3:45 to 5:15 p.m. in the Atrium of the Ballroom of Setzer Student Center

Poster 1

Antenna Mounting Structure for Celestial Lander

Presenter: Lisseth Aguilar

**Co-authors: Adrian Espinoza, Adrian Galvan, Jorge Magana,
Mason Munoz, and Alexandra Villanueva**

Mentors: Dr. Chatwin Lansdowne and Dr. Jenny Zhou
Department of Mechanical Engineering, Lamar University
[Research: In-progress]

Poster 2

Abraham Summation Solute Hydrogen Bonding Acidity Values Determined for Catechol-flavones by ¹H-NMR Spectroscopy.

Presenter: Taryn Gibbs¹

Co-authors: Sara Tuck², Marcus Gregory¹, and Michael H. Abraham⁴

Mentor: Dr. William L. Whaley¹

¹Department of Chemistry, Geosciences & Physics, Tarleton State University,
P.O. T-0450, Stephenville, TX 76402.

²Department of Chemistry, Duke University, Durham, NC 27708-0354

⁴Department of Chemistry, University College of London, 20 Gordon St. London WC1H0AJ, UK
[Research: Advanced]

Poster 3

Synchrotron-Based Attenuated Total Reflection Infrared Spectroscopy of Artificial Gasoline Blend

Presenter: Joshua Smith¹

Co-authors: Brant E. Billingham², Jianbao Zhao²

Mentor: Dr. Sylvestre Twagirayezu¹

¹Department of Chemistry and Biochemistry, Lamar University

²EFD, Canadian Light Source Inc., Saskatoon, Saskatchewan, Canada.

[Research: In-progress]

Poster 4

**Effect of Natural Products on the Phamacokinetics of
Over-the-Counter Drugs**

Presenter: Millie Terrazas

Mentor: Dr. Paul Bernazzani

Department of Chemistry and Biochemistry, Lamar
[Research: Advanced]

Poster 5

**Quantitative Determination of the Remediation of
Oil Contaminants in Dredged Material**

Presenter: Jesus Esquivel¹

Co-authors: T. Thuy Minh Nguyen¹, Mien Jao²

Mentor: Dr. Paul Bernazzani¹

¹Department of Chemistry and Biochemistry, Lamar
²Department of Civil and Environmental Engineering, Lamar
[Research: In-progress]

Poster 6

**Single Tardigrade DNA Barcoding Using COI and 18S rRNA Genes
on Six Morphotypes from the Upper Coast of Texas, USA**

Presenter: Alyssa Broussard

Co-author: Angel Flowers

Mentor: Dr. Matt Hoch

Department of Biology, Lamar
[Research: In-progress]

Poster 7

**Non-destructive DNA sampling techniques
from the clam *Rangia cuneata* (Mollusca, Bivalvia)**

Presenter: Elsy Martinez

Co-author: Victoria Ontiveros

Mentor: Dr. Ana Beardsley Christensen

Department of Biology, Lamar
[Research: In-progress]



LAMAR UNIVERSITY
MEMBER THE TEXAS STATE UNIVERSITY SYSTEM™

**YOUR
Moment
IS HERE**

Poster 8

3D Printing: The Effects of Sustainability in Construction

Presenter: Javier Lopez

Co-authors: Albert Garcia and Corbin Stepan

Mentor: Dr. Zhe Luo

Department of Construction Management, Lamar

[Research: Early-stage]

Poster 9

Drone Applications in Construction

Presenter: Blake Laughlin

Co-authors: Zachary Adkins and Angel Olalde

Mentor: Dr. Zhe Luo

Department of Construction Management, Lamar

[Research: Early-stage]

Poster 10

Modular Construction: Benefits, Advantages, and a Case Study

Presenter: Brandyn Wagstaff

Co-author: Shawn Azarnoush

Mentor: Dr. Zhe Luo

Department of Construction Management, Lamar

[Research: Early-stage]

Poster 11

Mechanical Design and Testing of Event Recorder used in Locomotives

Presenter: Daniel Nicks

Co-authors: Kalen Baker, Destiny Lett, Luke Nelson, Arin Preston, Jose Wong

Mentors: Dr. Sushil Doranga and Dr. Jenny Zhou

Department of Mechanical Engineering, Lamar

[Research: In-progress]

Poster 12

Amphibious Human Powered Vehicle - HPVSea

Presenter: Daniel Iles

Co-authors: Dylan Morgan, Kennedy Kieschnick, Noah Stansel, Britney Sumayah, Vinson Nguyen

Mentor: Dr. Jiang Zhou

Department of Mechanical Engineering, Lamar

[Research: In-progress]

Poster 13

Effect of COVID-19 on the Nursing Profession in Texas

Presenter: Bethany Edwards

Mentor: Lori Wenner, MSN, RN

JoAnne Gay Dishman School of Nursing, Lamar

[Research: Advanced]

Poster 14

The Role of COVID-19 in the Mental and Physical Health of Pregnant or Non-Pregnant Mothers of Young Children in Food-Insecure Households

Presenter: Aylin Galvan

Mentor: Dr. Connie Ruiz

Department of Nutrition, Hospitality, and Human Services, Lamar

[Research: Advanced]

Poster 15

Design of a Digital Sunflower Clock

Presenter: Pargat Singh

Graduate MS student

Co-author: Manmeet Singh Grewal

Mentor: Dr. Stefan Andrei

Department of Computer Science, Lamar

[Research: In-progress]

Poster 16

Designing a Model for Analyzing Weather-Related Data for South - East Texas

Presenter: Shivam Soin¹

Graduate MS student

Co-authors: Tejinder Singh¹, Sri S. S. C. Meghana Nunnaguppala¹, and Dr. Brian Williams²

Mentor: Dr. Stefan Andrei¹

¹Department of Department of Computer Science, Lamar

²Department of Political Science, Lamar

[Research: In-progress]



LAMAR UNIVERSITY
MEMBER THE TEXAS STATE UNIVERSITY SYSTEM™

**YOUR
Moment
IS HERE**

Poster 17

Implementation of an Algorithm for Hand Gesture Recognition

Presenter: Zaw Ye Htut

Graduate MS student

Co-author: Navjot Mahal

Mentor: Dr. Stefan Andrei

Department of Computer Science, Lamar
[Research: Advanced]

Poster 18

Design of a Counterfeit Bill Detector for Visually Impaired People

Presenter: Sai Krishna Chintha

Graduate MS student

Mentor: Dr. Stefan Andrei

Department of Computer Science, Lamar
[Research: In-progress]

Poster 19

Water Knows No Geopolitical Boundaries

Presenter: Nayana Muppavarapu

Graduate MS student

Mentor: Dr. Liv Haselbach

Department of Computer Science, Lamar
[Research: Early-stage]

Poster 20

**Introducing Programming to Middle School Students to Increase
Knowledge and Interests in Computer Science**

Presenter: Callan Noak

Co-authors: Jennifer Tsan and Dr. Stefan Andrei

Mentor: Dr. Sujing Wang

Department of Computer Science, Lamar
[Research: Advanced]

**Complementary results to the talks from
the OUR sponsored research category**

Poster 21

Hispanic/Latinx Students’ Perceptions of Diversity in Interpreting

Presenter: Corina Mena

Mentor: Dr. Zanthia Smith

Department of Deaf Studies & Deaf Education, Lamar

[Research: Advanced]

Poster 22

Effects of Motivational Music on Post-Exercise Recovery

Presenter: Damaris Thrash

Mentor: Dr. Shannon Jordan

Department of Exercise Science, Lamar

[Research: Advanced]

Poster 23

**Impact of Militarization on the Financial and Economic Growth of
Developing and Highly Militarized Countries**

Presenter: Taliah Belcher

Mentor: Dr. Gevorg Sargsyan

Department of Business, Lamar

[Research: Advanced]

Poster 24

COVID-19 Pandemic’s Impact on Education and Students

Presenter: Silvana Ochoa

Mentor: Dr. Sujing Wang

Department of Computer Science

[Research: Early-stage]



LAMAR UNIVERSITY

MEMBER THE TEXAS STATE UNIVERSITY SYSTEM™

**YOUR
Moment
IS HERE**

O.U.R. SPONSORED RESEARCH

Presenter: David Matherne

Major in Biology

Mentor: Dr. Ashwini Kucknoor

Research in Molecular Biology

Department of Computer Science



Characterization of Drug Resistance Genes in Cattle Pathogen, *Tritrichomonas foetus*

Introduction:

Bovine trichomoniasis is caused by the protozoan *Tritrichomonas foetus* and is a common disease in the beef industry, costing US cattle ranchers an estimated \$650 million annually due to *fetal abortion and infertility*, and State of Texas bears the brunt of this burden due to high density of beef cattle. The tinidazole and metronidazole, has been used to treat trichomonad infections since 1960, but studies suggest emergence of resistant trichomonads worldwide.

Hypothesis:

Research done on this particular microorganism is scarce. The hypothesis is that resistance will be shown due to specific genes expressed. This proposal is aimed at characterizing those genes by following a novel functional genomics approach that has been successful in identifying drug resistance genes in other microorganisms.

Materials and Methods:

Cell Culture: *T. foetus* cells were grown using Diamond's media, supplemented with 10% donor horse serum, and 100 ug/ml Penicillin-streptomycin, and incubated at 37 degrees incubator. Cell growth is assessed daily by microscopic observation and cell counting using hemocytometer.

Isolating drug resistant cells:

Cells were exposed to varied concentrations of Metronidazole starting from 1ug/ml to 100 ug/ml. 2×10^5 cells per well were plated in a microtiter well-plate, and metronidazole was added to the wells, and incubated for 4 days, with daily observation. After 4 days, any well with motile and active trichomonads were further replenished with fresh media, and incubation continued for 4 more days. Once viable cells were observed in any of the wells, they were then expanded in a fresh flask to obtain the clonal population.

Genomic DNA isolation and cloning:

Genomic DNA was isolated from the resistance cells, checked on the gel for quality and Nanodrop was used for DNA quantification and sheared using nucleases. A sheared genomic DNA library will be constructed using NEB TA cloning kit, and transformed into E.coli cells, and selected on agar plates supplemented with the respective drugs as shown in panel 1 of the figure below. Drug-resistant E.coli clones will be subjected to sequence identification to determine which original sheared genomic fragment of trichomonad DNA was responsible for drug-resistance in the transformed E.coli cells.

Analyzing Clones:

Sequencing will then be used to analyze the DNA sequences of the E. coli clones. After comparing the drug resistant phenotypes with normal phenotypes for trichomonad DNA, the codon differences will be revealed.

Conclusions and future work:

Generation of drug resistant trichomonads of the T. foetus strain proved to be difficult for tinidazole, in the short period of time. However. Metronidazole resistant cells were isolated, after passing the cells in the presence of the drug for a two month period. Genomic DNA was isolated from the resistant cells, and subjected to mechanical shearing, for the cloning procedure that follows.

The image below shows Trichomonas cells that were treated with metronidazole. The cells that are highlighted are the living ones while the darker clumps are dead cells.



Bibliography:

1. Fuchs, Lumila I., Marcelo C. Fort, Dora Cano, Carina M. Bonetti, Hugo D. Giménez, Pablo M. Vázquez, Diana Bacigalupe, Javier D. Breccia, Carlos M. Campero, and Jorge A. Oyhenart. Clearance of *Tritrichomonas foetus* in experimentally infected heifers protected with vaccines based on killed-T. foetus with different adjuvants. *Vaccine* 35 (February 6, 2017): 1341-346. Accessed February 26, 2018.
2. Parsonson IM, Clark BL, Dufty J. The pathogenesis of *Tritrichomonas foetus* infection in the bull. *Aust Vet J* 1974;50(10):421-3
3. Parsonson IM, Clark BL, Dufty JH. Early pathogenesis and pathology of *Tritrichomonas foetus* Infection in Virgin Heifers. *J Comp Pathol* 1976;86(1):59-66
4. Baltzell, P., H. Newton, and A. M. O'Connor. A Critical Review and Meta-Analysis of the Efficacy of Whole-Cell Killed *Tritrichomonas foetus* Vaccines in Beef Cattle. *Wiley Online Library*. May 23, 2013. Accessed March 1, 2018.
5. Love, David, Virginia R. Fajt, Thomas Hairgrove, Meredyth Jones, and James A. Thompson. Metronidazole for the treatment of *Tritrichomonas foetus* in bulls. *BMC Veterinary Research*. April 14, 2017. Accessed March 01, 2018.
6. Speer CA, White MW. Bovine trichomoniasis. *Large Anim Vet*. 1991, 46: 18-20. 8. Edwards, D. I. 1993. Nitroimidazole drugs—action and resistance mechanisms. I. Mechanisms of action. *J. Antimicrob. Chemother.* 31:9-20.
7. Kulda, J. 1999. Trichomonads, hydrogenosomes and drug resistance. *Int. J. Parasitol.* 29:199-212.
8. Leitsch D. A review on metronidazole: an old warhorse in antimicrobial chemotherapy. *Parasitology*. 2019;146:1167–1178.
9. McLoughlin D.K. Drug tolerance by *Tritrichomonas foetus*. *J. Parasitol.* 1967;53:646–648.
10. Gookin J.L., Stauffer S.H., Dybas D., Cannon D.H. Documentation of in vivo and in vitro aerobic resistance of feline *Tritrichomonas foetus* isolates to ronidazole. *J. Vet. Intern. Med.* 2010;24:1003–1007.
11. Howden BP, et al. Evolution of multidrug resistance during *Staphylococcus aureus* infection involves mutation of the essential two component regulator WalKR. *PLoS Pathog.* 2011;7:e1002359. 14. Bush K, et al. Tackling antibiotic resistance. *Nature Rev. Microbiology.* 2011;9:894–896

Presenter: Caroline LeBlanc

Co-Author: Anthony Osu (graduate student)

Major in Chemical Engineering

Mentor: Dr. Maryam Vasefi

Research in Neurobiology

Department of Biology



Glutamate Receptor Crosstalk in Alzheimer's Disease

Introduction:

Alzheimer's disease (AD) is ranked as the sixth leading cause of death among adults according to the Alzheimer's Association Fact Sheet of 2021. It is also predicted that with the growing population and extended life expectancy, the number of individuals affected by dementia is expected to grow threefold by 2050. The limitation of current drug treatments available to combat the disease highlights our need to advance our understanding of the AD pathophysiology. With this understanding, we will better be able to identify and develop new therapies and drug treatments against AD.

Background:

The N-methyl D-aspartate (NMDA) receptor channels regulate functions of the brain by activating a series of calcium-mediated signaling pathways. Dysfunction of this pathway has been associated with AD, where the increase in activity of NMDA receptors is associated with the neurotoxicity and neurodegeneration that is observed in AD. Because of this observation, some treatments of AD include NMDA receptor antagonist response to decrease the receptor's activity and therefore decrease the possibility of neurotoxicity and neurodegeneration that can result from this pathway. Amyloid Beta protein ($A\beta$) is a naturally occurring protein in the brain and is highly associated with AD. The accumulation of $A\beta$ oligomers leads to the formation of plaque between neurons, disrupting cell function and influencing AD. mGluR5, an essential protein of $A\beta$ oligomers, has been suspected of changing NMDA receptor signaling in response to the drug treatment though the mechanism of this process is not understood.

Experimental Goals:

We will investigate the NMDAR response with the addition of A β oligomers. The project will image Ca²⁺ influx using the Fluo-8 Calcium Flux Assay Kit in SH-SY5Y cell. This kit, from Enzo Life Sciences, is a fluorescence-based assay for detecting intracellular calcium mobilization in cells. After growing the cells and treating them, the calcium influx will be measured by reading the fluorescence intensity using a microplate reader at multiple intervals. **Our hypothesis** for this experiment will show that the binding of A β to mGluR5 will enhance NMDA receptor activity.

Methods:

Cell Culturing:

In this experiment, SH-SY5Y cells were used. These types of cells can be used for many types of neurological studies including those related to neurodegenerative processes, neurotoxicity, and neuroprotection. The cells were then thawed, placed in a T-25 along with growth media and incubated at 37 °C along with 5% CO₂ to help the pH of the cell culture and allow the cells to grow. Cells are monitored for confluences and growth media is replaced as needed.

When ready to use the cells for the experiment, the growth media is removed from the T-25 flask that has been incubating. Once the growth media is moved, 1 mL of trypsin is added to detach the cells from the surface of the T-25 flask. The flask is allowed to sit with the trypsin within with occasional light tapping for 6 minutes to ensure that all cells within the T-25 flask lift successfully. After the 6 minutes, 3 mL of growth media is added to neutralize the trypsin. Then a total of 1 mL of the cell suspension solution is added to 4 different centrifuge tubes. The tubes are then centrifuged at 1400 rpm for 5 minutes. The centrifuge tubes were then removed, and the media removed from each tube leaving behind the cells that gathered to the bottom of each tube. The cells within each tube were then resuspended by adding 800 μ m of fresh media and were then aspirated within the tubes. This allows the clumps of cells to be broken up. The solution from each of the four tubes are then transferred into a conical tube and further aspirated. 10 μ m of the cell solution was then obtained and loaded into a hemocytometer for counting. The number of cells within the solution is then counted and transferred to a 96 well plate. 1000000 cells are then plated into each well used on the 96 well plate.

After the cells are plated on the 96 well plate, the plate is then incubated at 37 °C and 5% CO₂ for 24 hours to allows the cells the attach to the bottom of each well within the plate. After the 24-hour incubation, the growth media is then removed, and 100 m of FBS-free media is added to each well that is in use within

the plate. This will allow the cells to be starved and ready to be treated the following day for assay. The cells within the 96 well plate are then incubated again at 37 °C and 5% CO₂ for 24 hours. After this incubation period, the cells will be ready to be treated with AB peptides and Ca²⁺ assay.

AB preparation

Aβ stock is obtained from the freezer and diluted to a 5 mM concentration by adding DMSO. FBS-free culture media is then added to the AB preparation to reach 100 uM concentration. The preparation is then vortexed from 1 minute to dissolve within the solution. The solution is centrifuged for a few seconds. The prepared Aβ is then placed in the fridge for 24 hours to oligomerize. After this period this solution can be used for drug treatment.

Ca²⁺ Influx Assay

Reagent A preparation can then be done. 100 μL DMSO is added to a vial of 300 nmol of reagent A, Fluoforte dye, to completely dissolve it. An assay buffer is then prepared by mixing 4.5 mL of reagent C, HHBS, with 0.5 mL of reagent B, dye efflux inhibitor. A dye-loading solution that contains the Ca²⁺ solution can then be prepared. To make this preparation, mix 5 μL of reagent A with 5 mL of the assay buffer. The mixer can then be kept table for 2 hours at room temperature.

100 μL of dye-loading solution is then added to each well that is in use. The 96-well plate is then incubated at 37 °C and 5% CO₂ for 1 hour. After the incubation period, the cells are then treated as follows.

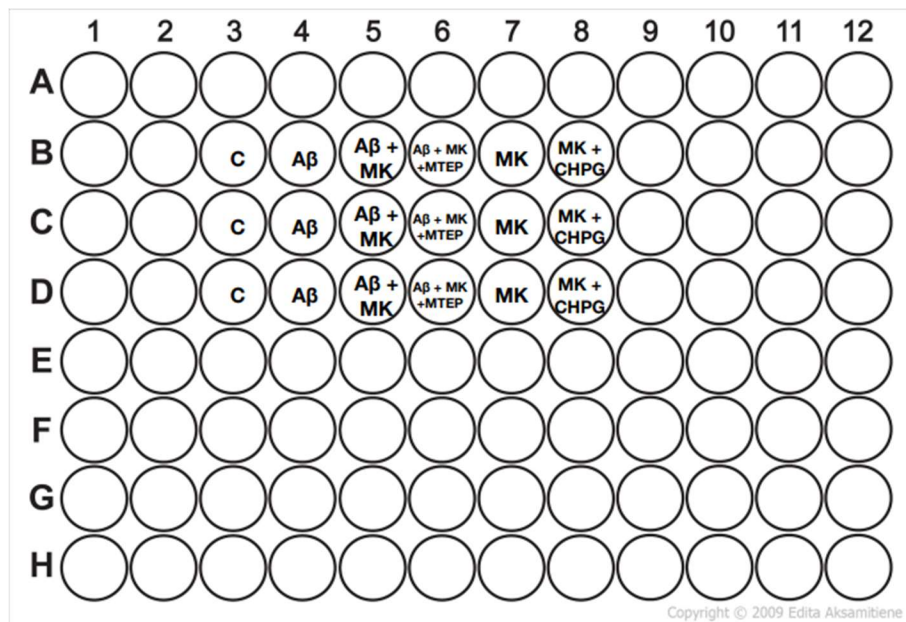


Figure 1: 96-well plate with cell and drug placement

The plate was then placed in the synergy H1 microplate reader and results were obtained.

We have our control wells that contain only cells, and wells with only cells and Aβ and we are able to observe how Aβ normally interact with cells. MK is an NMDA receptor antagonist. With the wells that contain

only cells and MK, we are able to see how an NMDA receptor antagonist affects normal cells. MTEP is an mGlu5 antagonist. CHPG is a mGlu5 agonist. With the cells that contain cells, MK and CHPG, to see if the CHPG can activate mGlu5 to modulate and increase NMDA receptor and to see if the antagonist of the receptor can reverse the effect. From here, we are able to observe how these drugs interact with the cells.

Results and discussion:

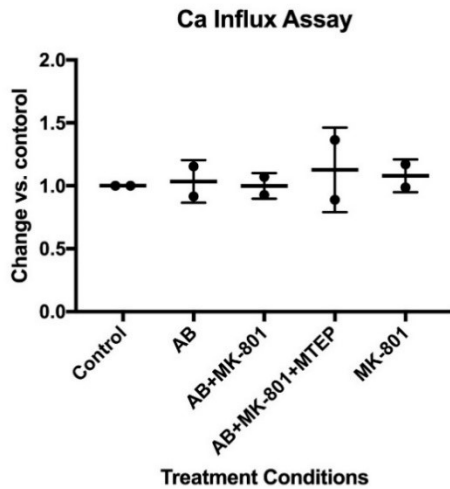


Figure 2: Levels of calcium influx between different treatment combinations

Data represent the average and standard error of two independent experiments (each triplicate). $P < 0.05$ drug treatment vs. ANOVA analysis with Tukey's post-test

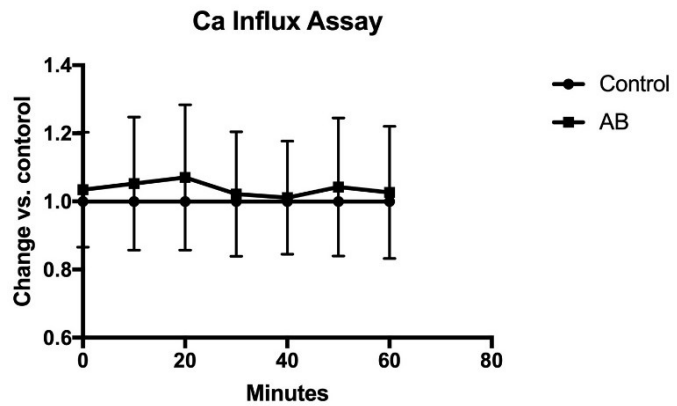


Figure 3: Levels of calcium influx is read, every 10 minutes over the course of 60 minutes

Data represents the average and standard error of two independent experiments (each triplicate). $P < 0.05$ drug treatment vs. ANOVA analysis with Tukey's post-test

Based on figures 2, this experiment did not produce a significant fluctuation of Calcium influx. There was a slight increase of Ca^{2+} influx for the cells treated with $\text{A}\beta$, from 0 to 20 minutes (Figure 3). This is followed by a decrease in Ca^{2+} influx from 30 minutes to 40 minutes. A slight increase in Ca^{2+} influx was observed between 40 minutes and 50 minutes, followed by a decrease once again after 60 minutes. Data showed minimal change in Ca^{2+} influx across treatment combinations, which was not expected. Cells that were treated with MK, an NMDA antagonist, had a very slight increase in Ca^{2+} influx which is not the expected results from adding this drug to the cells. The results obtained data does not support the proposed hypothesis. However, I believe that going forward this procedure would benefit from allowing $\text{A}\beta$ and the other drug treatments to incubate with the cells for 24 hours before having the fluorescent dye added to assess the Ca^{2+} influx. Allowing the cells to sit for a longer period of time with $\text{A}\beta$ and the drug treatments may allow for the

pathology of A β and the drug treatments to better take place within the cells and produce a greater variety of results that can be observed.

My Experience:

As a student already interested in medical school, the opportunity this research provides to take a glimpse into the research that goes into my dream future career is fascinating. The OUR grant allowed me to gain laboratory experience that I otherwise would not have been able to, due to my major being chemical engineering. I received training and guidance in learning the procedure for my experiment. I was also challenged with interpreting the results from the experiment and gained a more in-depth understanding of the research project significance. This process has sparked my interest more into the research side of medicine. While I still want to be a clinician, I hope that in the future I have the opportunity to also incorporate research into my professional career. While the idea of presenting research in front of a large group of people is incredibly nerve racking, my enjoyment of being in the lab and gaining these new experiences makes it worthwhile. I am thankful for the opportunity and hope that I can continue my research journey here at Lamar University. I am thankful that Lamar offers ample opportunities for undergraduates to get involved in research, especially since the idea of conducting and presenting research seemed improbable to me as a freshman. It is inspiring to look back and see how much I have grown over the years.

Bibliography:

1. Matyas N, Auer S, Gisinger C, Kil M, Keser Aschenberger F, Klerings I, Gartlehner G. Continuing education for the prevention of mild cognitive impairment and Alzheimer's- type dementia: a systematic review protocol. *Syst Rev.* 2017;6(1):157. Epub 2017/08/10. doi: 10.1186/s13643-017-0553-0. PubMed PMID: 28789697; PMCID: PMC5549351.
2. Hamilton A, Vasefi M, Vander Tuin C, McQuaid RJ, Anisman H, Ferguson SS. Chronic Pharmacological mGluR5 Inhibition Prevents Cognitive Impairment and Reduces Pathogenesis in an Alzheimer Disease Mouse Model. *Cell Rep.* 2016;15(9):1859-65. Epub 2016/05/24. doi: 10.1016/j.celrep.2016.04.077. PubMed PMID: 27210751.
3. Cummings JL, Morstorf T, Zhong K. Alzheimer's disease drug-development pipeline: few candidates, frequent failures. *Alzheimers Res Ther.* 2014;6(4):37. Epub 2014/07/16. doi: 10.1186/alzrt269. PubMed PMID: 25024750; PMCID: PMC4095696.
4. Reiner A, Levitz J. Glutamatergic Signaling in the Central Nervous System: Ionotropic and Metabotropic Receptors in Concert. *Neuron.* 2018;98(6):1080-98. Epub 2018/06/29. doi: 10.1016/j.neuron.2018.05.018. PubMed PMID: 29953871; PMCID: PMC6484838.
5. Li DP, Zhu LH, Pachuau J, Lee HA, Pan HL. mGluR5 Upregulation increases excitability of hypothalamic presympathetic neurons through NMDA receptor trafficking in spontaneously hypertensive rats. *J Neurosci.* 2014;34(12):4309-17. Epub 2014/03/22. doi: 10.1523/JNEUROSCI.4295-13.2014. PubMed PMID: 24647951; PMCID: PMC3960469.

6. Dong H, Yuede CM, Coughlan C, Lewis B, Csernansky JG. Effects of memantine on neuronal structure and conditioned fear in the Tg2576 mouse model of Alzheimer's disease.

Neuropsychopharmacology. 2008;33(13):3226-36. Epub 2008/04/18. 10.1038/npp.2008.53. PubMed PMID: 18418360; PMCID: PMC2664647.

doi:

7. Paoletti P. Molecular basis of NMDA receptor functional diversity. Eur J Neurosci. 2011;33(8):1351-65. Epub 2011/03/15. doi: 10.1111/j.1460-9568.2011.07628.x. PubMed PMID: 21395862.

8. Hoey SE, Williams RJ, Perkinton MS. Synaptic NMDA receptor activation stimulates alpha-secretase amyloid precursor protein processing and inhibits amyloid-beta production. Neurosci. 2009;29(14):4442-60. Epub 2009/04/10. doi 10.1523/JNEUROSCI.6017-08.2009. PubMed PMID: 19357271; PMCID: PMC6665739. 9. Verges DK, Restive JL, Goebel WD, Holtzman DM, Cirrito JR. Opposing synaptic regulation of amyloid-beta metabolism by NMDA receptors in vivo. J Neurosci. 2011;31(31):11328-37. Epub 2011/08/05. doi: 10.1523/JNEUROSCI.0607-11.2011. PubMed PMID: 21813692; PMCID: PMC3329800.

Presenter: Arizbeth Lopez Garcia

Co-Author: Anthony Osu (graduate student),

Hy Lai (graduate student), **Dr. James Henry**

Major in Biology

Mentor: Dr. Maryam Vasefi

Research in Neurobiology

Department of Biology



CBD and Alzheimer’s Disease; Neuroprotection and Desensitization

Background:

Alzheimer’s Disease (AD) is a neurodegenerative disease ranked as the sixth leading cause of death in the United States. Additionally, it is the leading cause of dementia in adults [1]. Alzheimer’s Disease is primarily characterized by the presence of β -Amyloid plaques ($A\beta$), and Neurofibrillary tangles (NFTs). $A\beta$ plaques are extracellular, toxic, misfolded proteins that clump together between neurons causing the obstruction of cell signaling, damaging neurons, and eventually leading to cell death via apoptosis [2]. Studies have shown that oxidative stress also plays a major role in the pathogenesis of AD in relation to the presence of $A\beta$. Specifically, research has shown that Oxidative stress is highly associated with $A\beta$ plaque formation and the consequent neuronal degeneration, facilitating progression of AD and cell death via apoptosis [3].

Cannabidiol (CBD) is a non-psychoactive phytocannabinoid extracted from *Cannabis sativa*. CBD recently attracted research interest due to its antidepressant, anticonvulsive, antioxidant, and neuroprotective effects [4]. Due to its neuroprotective properties against $A\beta$ toxicity, CBD is showing promise as a treatment for AD. In recent studies, CBD has been linked to exerting its neuroprotective effects on neuronal cells [5,6]. However, the mechanisms underlying this phenomenon are not fully understood. In addition, none of those studies considered desensitization and time-dependent response. Addressing the time-dependent response of the neuroprotective properties of CBD provides important information that can help optimize the use of the drug in clinical settings.

Our goal in this research was to investigate the neuroprotective effect of CBD on SH-SY5Y cells, a human neuroblastoma cell model of human neurodegenerative disease, in the presence of $A\beta$ peptides. Additionally, we explored whether CBD neuroprotective properties will be abolished by desensitization over long-term exposure. **Our hypothesis** for this research was that CBD can increase cell viability and decrease oxidative stress; however, the effect will decrease in a time-dependent response.

Methods:**Cell Culturing:**

For this experiment we utilized SH-SY5Y cell line. This cell line can be used in different types of neurological studies including those related to neurodegenerative processes, neurotoxicity, and neuroprotection [7]. The cells were thawed and placed in a T-25 along with growth medium. The cells were then incubated at 37°C (body temperature), 5% CO₂ to help maintain the pH of the cell culture. Cells were monitored for confluence, and growth medium was refreshed as needed.

The cells were then moved from the T-25 flask to a 96-well plate where they will undergo treatment. In order to move the cells, the growth medium was first removed from the T-25 flask and 1mL of trypsin was added. The T-25 flask was lightly tapped for 6 minutes so that the cells would lift from the surface of the T-25 flask. Then 3mL of growth media were added to neutralize the trypsin. Then, 1mL of cell suspension was added to a centrifuge tube (total of 4 centrifuge tubes). The centrifuge tubes were centrifuged at 1400rpm for 5 minutes. The solution was then removed from the centrifuge tubes, leaving behind just the pellet of cells. The pellet of cells was then resuspended by adding 800 µl of fresh media and aspirating. This cell solution was then transferred into a conical tube and 10 µl of cell solution was obtained and loaded into a hemocytometer for counting. After counting we plated 100,000 cells/well on the 96 well plates.

Once the cells were plated into the 96-well plate they were incubated at 37°C, and 5% CO₂ for 24 hours to allow the cells to attach to the bottom of the plate. After the 24 hours the growth media was removed, and FBS-free media was plated, and the cells were incubated under the same conditions as before for another 24 hours. At this point, cells were ready to be treated with CBD and Aβ peptides.

MTT assay:

MTT assay was split into 3 days, on the first day we treated the cells with Aβ-42 oligomer and CBD. Wells B2, B3, B4, B6, B7, and B8 were treated with 100 µl of CBD 30 minutes prior to the treatment with Aβ-42 oligomer. After 30 minutes columns 6, 7, and 8 were all treated with 4 µl of Aβ-42 oligomer. Row C was immediately treated with 100 µl CBD. Then Rows D-H were treated with the same 100 µl CBD consecutively every 30 minutes (Figure 1). After the treatments were done the cells were incubated under the same conditions as before for another 24 hours. On

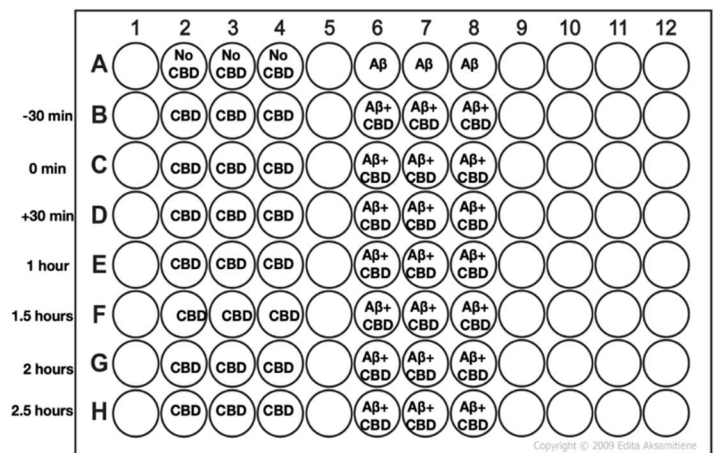


Figure 1 shows MTT assay conditions.

day two the actual assay was performed. First, 5 mL of 1mg/mL MTT was prepared by diluting 1mL of 5mg/mL of MTT and 4 mL of FBS free media. Then an SDS solution was made to be used later to dissolve the crystals made by the MTT solution. This was made by mixing 1g SDS and 100 μ L of 1N HCl and water up to 10mL. The treatment solutions were then removed from each well, and 50 μ L of 1mg/mL MTT was added to each well and incubated for 3 hours under the same conditions as before. After the 3 hours, 100 μ L of the SDS solution was added to each well and incubated under the same conditions for 18 hours, so the solubilization solution could dissolve the crystals that were made by MTT solution. After the 18 hours the plate was read by the synergy H1 microplate reader and results were obtained.

ROS assay:

For the ROS assay first, all reagents were prepared following the instructions from the kit. The ROS reagent was dissolved in 60 μ L DMF to make a 5mM stock. The ROS inducer which was used as a positive control was dissolved in 100 μ L DMF to make 10mM stock. The ROS inhibitor which was used as the negative control was dissolved in 123 μ L DI water to produce 500mM stock. Then ROS solution was prepared by adding 5mL of 1x wash buffer to 1 μ L of the prepared ROS reagent. Once these were prepared, the

supernatant was removed from the 96 well plate and the cells were washed with 1x wash buffer. Then 100 μ L of ROS solution was added to each well. Additionally, 11.2 μ L of positive control (ROS inducer) and 1 μ L of negative control (ROS inhibitor) were added to wells designated as control. The cells were incubated with the ROS treatment under the same conditions previously mentioned for 1 hour. After one hour the cells were treated as shown in Figure 2 with 4 μ L of A β -42 oligomer, and 100 μ L CBD.

The plate was immediately put in the synergy H1 microplate reader and results were obtained.

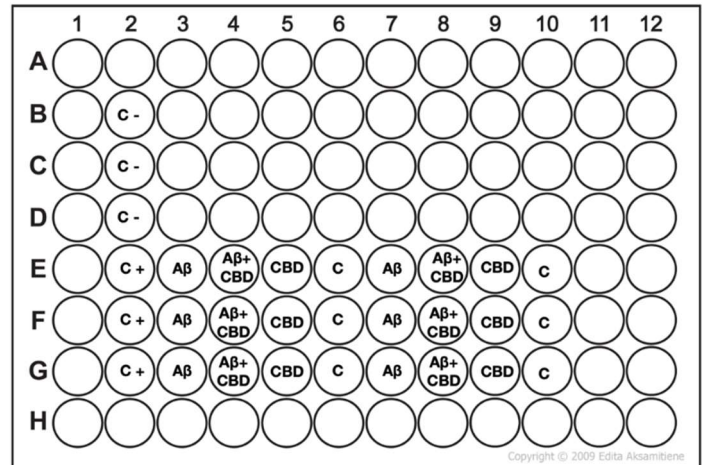


Figure 2 indicates ROS assay conditions.

Results and discussion:

MTT assay results shows that CBD is neuroprotective against A β oligomer excitotoxicity (Figure 3). ROS assay indicates that both CBD and A β oligomer increase the ROS in the SH-SY5Y cells (Figure 4), however, ROS production decrease over time (Figure 5). Based on our MTT assay results shown in figure 3 above we concluded that when cells were treated with A β cell viability decreased however, when the cells were treated with both CBD and A β cell viability increased. These results support our original hypothesis which states that CBD will increase cell viability. On the other hand, acute treatment of the cells with CBD shows an increase in ROS but over time, there is a decrease in ROS production. The future direction is to study the effect of CBD on ROS production over 24 hours.

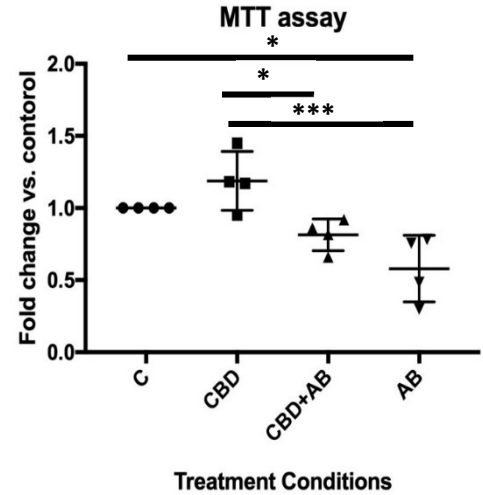


Figure 3 CBD increases cell viability

Data represent the average and standard error of three independent experiments (each triplicate). * p < 0.05 drug treatment vs. vehicle ANOVA analysis with Tukey's post-

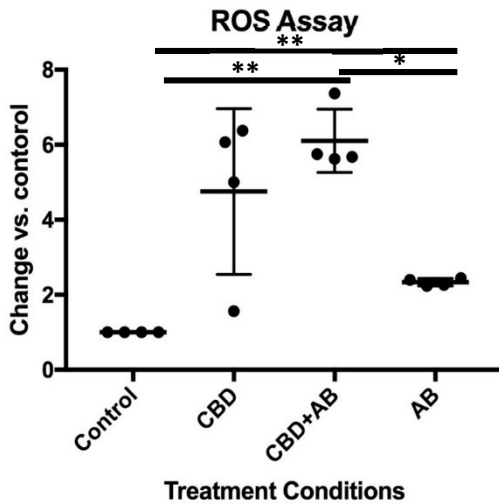


Figure 4 Acute treatment of CBD increases ROS

Data represent the average and standard error of two independent experiments (each triplicate). * p < 0.05 drug treatment vs. vehicle ANOVA analysis with Tukey's post-test.

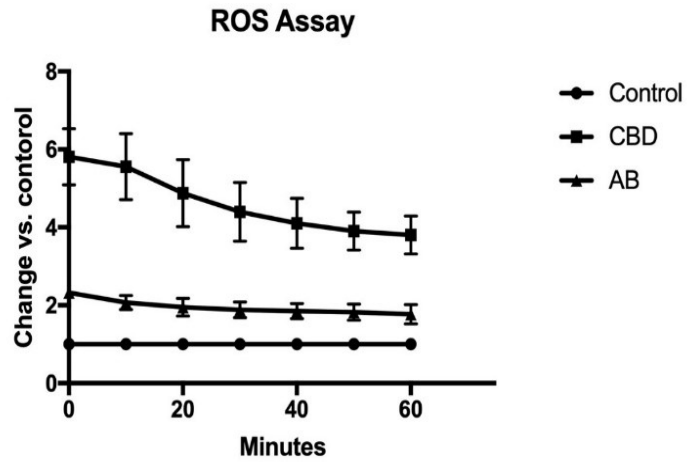


Figure 5 1-hour treatment with CBD shows that CBD decreases ROS production.

Data represent the average and standard error of two independent experiments (each triplicate). * p < 0.05 drug treatment vs. vehicle ANOVA analysis with Tukey's post-test.

A part of my results has been presented at the Texas Society of Genetics (TSG) in 2022.

Goals:

When I attended my first orientation as a newly accepted freshman at Lamar University. I remember Dr. Terry telling my group about undergraduate research. Although, I found it very interesting, I never thought I would actually have the opportunity to be a part of it. This O.U.R grant allowed me the opportunity to gain experience working in lab. I began training at the end of the spring 2021 semester with training in basic cell culturing techniques such as feeding cells and splitting cells. I also completed all my CITI trainings and Dr. Vasefi ordered all the materials we were going to need for the project.

One challenge that we had to overcome was working around delays of our materials that we ordered. Although, this was a setback it helped me witness some of the things that can go wrong when working in a lab setting and how one can work around those setbacks. Dr. Vasefi was able to borrow the materials we were missing and this way we were able to get started with the project and conduct MTT and ROS assays.

Working on this project with Dr. Vasefi introduced me to a new professional setting that I wouldn't have ever experienced if I hadn't received the O.U.R support. Although, my plan is to go to medical school and eventually become a doctor, the time I spent in the lab with Dr. Vasefi and graduate students (Anthony Osu, Hy Lai, and Claire Alexander) really fostered a new interest in me and motivated me to continue to pursue research for my remaining time at Lamar. Similarly, this experiment allowed me to see how teamwork can be beneficial to completing a successful experiment.

In addition, I will continue the research project in Dr. Vasefi's lab in Summer 2022.

Bibliography:

- [1] NIH National Institute on Aging (NIA). "What Happens to The Brain in Alzheimer's Disease?"(2021) [www.nia.nih.gov/health/what-happens-brain-alzheimers-disease #:~:text=Neurofibrillary%20Tangles&text=In%20healthy%20neurons%2C%20tau%20normally,to%20form%20tangles%20inside%20neurons](http://www.nia.nih.gov/health/what-happens-brain-alzheimers-disease#:~:text=Neurofibrillary%20Tangles&text=In%20healthy%20neurons%2C%20tau%20normally,to%20form%20tangles%20inside%20neurons).
- [2] Tiwari, S., Atluri, V., Kaushik, A., Yndart, A., & Nair, M. (2019). Alzheimer's disease: pathogenesis, diagnostics, and therapeutics. *International journal of nanomedicine*, 14, 5541–5554. <https://doi.org/10.2147/IJN.S200490>
- [3] Cheignon, C., Tomas, M., Bonnefont-Rousselot, D., Faller, P., Hureau, C., & Collin, F. (2018). Oxidative stress and the amyloid beta peptide in Alzheimer's disease. *Redox biology*, 14, 450–464. <https://doi.org/10.1016/j.redox.2017.10.014>

[4] Silvestro, S., Schepici, G., Bramanti, P., & Mazzon, E. (2020). Molecular Targets of Cannabidiol in Experimental Models of Neurological Disease. *Molecules* (Basel, Switzerland), 25(21), 5186. <https://doi.org/10.3390/molecules25215186>

[5] Iuvone, T., Esposito, G., Esposito, R., Santamaria, R., Di Rosa, M., & Izzo, A. A. (2004). Neuroprotective effect of cannabidiol, a non-psychoactive component from *Cannabis sativa*, on beta-amyloid-induced toxicity in PC12 cells. *Journal of neurochemistry*, 89(1), 134–141. <https://doi.org/10.1111/j.1471-4159.2003.02327.x>

[6] Watt, G., & Karl, T. (2017). In vivo Evidence for Therapeutic Properties of Cannabidiol (CBD) for Alzheimer's Disease. *Frontiers in pharmacology*, 8, 20. <https://doi.org/10.3389/fphar.2017.00020>

[7] Ross, R. A., Spengler, B. A., & Biedler, J. L. (1983). Coordinate morphological and biochemical interconversion of human neuroblastoma cells. *Journal of the National Cancer Institute*, 71(4), 741–747.

Presenter: Kalen Baker

Major in Mechanical Engineering and Mathematics

Mentor: Dr. Ping He

Research in Mechanical Engineering

Department of Mechanical Engineering



Evaluation of Americium's Molecular Dynamics Pair Potential for use in Alphavoltaic Modeling

There are two primary means to design a device of capturing the radioactive decay. The first method used in deep space probes and remote hardwares, called a radioisotope generator, utilizes the heat from the decay of a large number of radioactive materials, which is expensive and heavy; and the other method is by the direct decay capture in a semiconductor device that is called an alphavoltaic or betavoltaic power supply. Most of these devices exist as prototypes and suffer from a low efficiency and short lifetime.¹ The focus of this research project is on the second kind.

An alpha emitter was selected based on its power and well-defined stopping distance, or penetration depth of the alpha particle into the semiconductor, which are more applicable than a beta emitter. The power generation has two types, i.e., direct or indirect. In an indirect type, radiation is absorbed by a secondary material and then is reemitted at a different wavelength. Since the emitter size is a primary concern, the direct method will be used to limit the amount of materials exposed to radiation. The problem then is that the heavier alpha particles cause more material damage than the beta ray. So testing more resilient materials becomes critical for alpha emitters.

Before building of a physical device, to save on cost and potential contamination hazards, molecular dynamics (MD) simulations are performed. To start an MD simulation, the force between any two molecules must be well defined. There are many types of force calculations with varying levels of complexity. In this project, because of the metallic nature of the isotope, it is desired to use an embedded atom method (EAM) potential. The EAM potentials do very well at describing the long-range order presented in metallic systems. Upon investigating the literature, no such potential exists. An alternative one is found, i.e., the Lennard-Jones

(LJ) potential that only requires a few constants to be specified. The available americium LJ potential was of the 12–6 form:

$$E = 4\varepsilon \left[\left(\frac{\sigma}{r} \right)^{12} - \left(\frac{\sigma}{r} \right)^6 \right]$$

where ε is an energy constant, σ is a distance constant, and r is the distance between two atoms. The problem is that while the required constants exist, they have not yet been validated. The primary purpose of this project is to validate the LJ potential to allow further development of an alphavoltaic power supply.

Simulation Setup

Very little information of americium is available to the public. To validate the LJ potential, three metals have been chosen, i.e., titanium, uranium, and americium. Titanium is selected to take advantage of my previous work, as all material properties are well known. Uranium is selected because it is the nearest element to americium that has sufficiently available data. The behavior of americium follows the same trend as uranium over a temperature range. Even though no EAM potential exists for americium, an EAM calculation was made for the other elements so a secondary evaluation could be made to ensure the correctness. And due to the wide range of material properties to be tracked, two simulations have been run for each metal at each selected temperature. One simulation is made to calculate thermal conductivity and diffusivity. The other is for the calculation of density, potential energy, volume to find the melting point and thermal expansion coefficient. The reason for the split simulations has to do with the MD control scheme used to regulate the energy inside the system changes depending on critical values that need to be conserved. For the melting simulation, an NPH (that is constant pressure, constant enthalpy) scheme was used to prevent the thermostat in the simulation from artificially altering the energy; while an NVE (that is constant energy, constant volume) scheme is used to maintain the system's temperature and volume.

Results

Titanium data show that the LJ and EAM potentials behave similarly until the temperature approaches the melting point. Typically, at the melting point, metal atoms' self-diffusion rises in a non-linear fashion, because the atoms instead of being trapped in the lattice are now able to freely move around each other. While not as the primary purpose of the diffusion calculation, it did provide a secondary means to check for melting. The LJ potential does not make the melting transition of phase change for titanium as seen in **Fig. 1**. However, the EAM potential does make the transition but not as quickly as the reference data² due to the instability of the EAM potential at higher temperatures. The melting and thermal expansion simulations are still running.

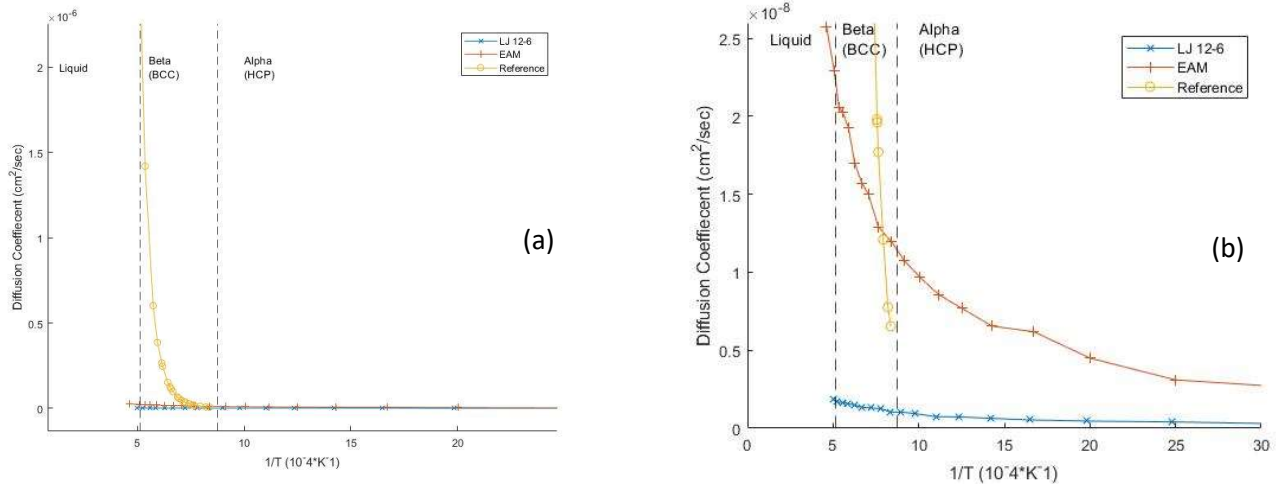


Figure 1: a) Calculated diffusion coefficients of titanium with reference data, **b)** Magnified view to better show EAM melting behavior.^{2,6}

The uranium simulations were all completed and much like titanium simulations, the diffusion data from the LJ potential did not trend as expected at higher temperatures but despite this its low temperature data gave closer to the reference. The EAM diffusion as seen in **Fig. 2** did however give proper response, and, again like the titanium curve, was separated from the reference data early and did not rise as quickly as the reference data. The EAM uranium melting simulation was constructed as infinite crystal by using the wrapped boundaries that gave a density of 18.5 g/cm^3 and a 3% error compared to the actual value of 19.1 g/cm^3 . The linear thermal expansion was $0.00000224 \text{ K}^{-1}$ compared to 0.0000139 K^{-1} resulting in a large error can be attributed to the mismatch in the lattice type between the simulated uranium and natural uranium. Natural uranium has an orthorhombic structure; but to simplify the mathematics, it is needed to generate the potential constants in a body centered cubic structure as the lattice for the simulated uranium. At the melting point, the infinite crystal did not melt due the restrained nature of the crystal, which was verified by running the simulation again but this time with an exposed face. The potential energy plot made a sharp turn-up indicating the released energy associated with melting. After evaluating the uranium and titanium simulations, the LJ potential is only suitable for low temperature applications and will need significant tuning to generate correct properties.

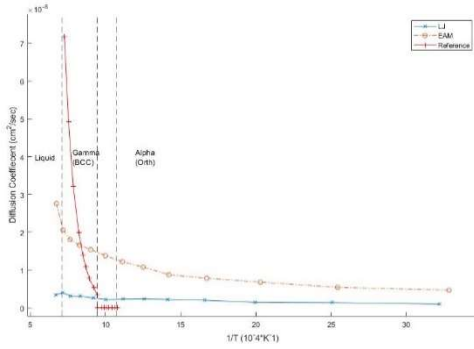


Figure 2: Diffusion Coefficient of Uranium.^{3,4,6}

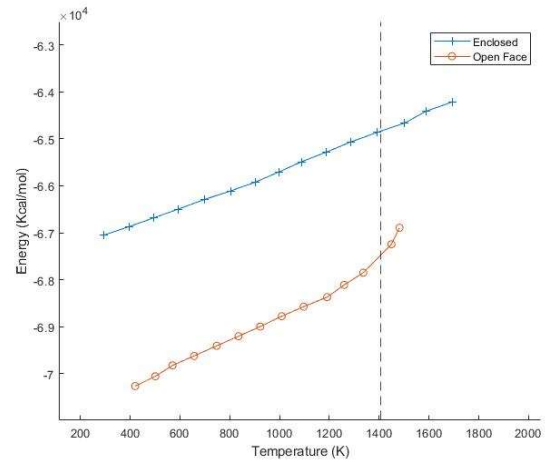


Figure 3: Potential energy of an enclosed and open face system.

The americium simulations were carried out using the LJ potential despite the apparent unsuitability for us. While no information is available for diffusion comparing the low temperature response of titanium and uranium to that of americium, our results still indicate that LJ does not perform well. The plotted diffusion immediately goes non-linear when it should have experienced a slow rise until approaching near the melting point. While attempting the melting simulation, the potential failed to produce a stable temperature control needed to perform a calculation of thermal expansion.

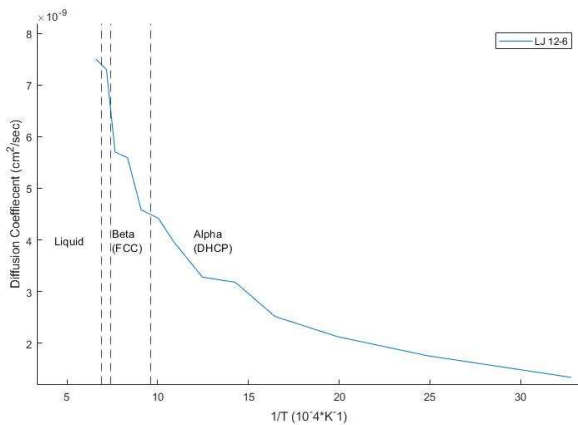


Figure 4: Diffusion coefficient of americium.⁶

All the simulations have been run on a purpose-built Raspberry Pi cluster made of 15 cards functioning as individual nodes of a single computer. The diffusivity simulations took a shorter amount of time compared to the melting simulations. Total run time is approximately 650 hours (that is 27 days) for the simulations with data outputs, and none of the equation and temperature control setup has been recorded to minimize the usage of the hard drive space. In general, the LJ simulations take longer than the EAM simulations of the same type with the total amount of data generated by both is about 34 GB. And currently many simulations are still being run to finalize the data set for titanium.

Conclusion/Future Considerations

To continue working with americium, a different potential will have to be used and more modern information is required. Current efforts are hindered by the only available data being the piecemeal declassified papers from the 1950s and 1960s and even so, there were large discrepancies in these papers such as the reference diffusion values used in Figure 2. An LJ style potential may still be capable for americium calculations. When the original LJ potential was generated, it was designed for the inert (noble) gases, however, the attractive and repulsive elements can be altered by changing the exponents from 12 and 6 to a value that better reflects the metallic behavior of the element.^{8,9}

Without much reliable data on americium, another means of testing for material properties is desired. An initial investigation has been made to perform a first principles calculation.⁷ However, much like no validated potential exists for conventional MD simulation, the same was also true for the first principles calculation in that no validated pseudopotential exists. If a pseudopotential can be made, then an EAM potential can be constructed, based on which a conventional macroscale continuum simulation can be made as well.

Bibliography

- 1) Wacharasindhu, T., et al. “Mechanisms Leading to Losses in Conventional Betavoltaics and Evolution: Utilizing Composite Semiconductor With Infused Radioisotope for Efficiency Improvement.” *Journal of Microelectromechanical Systems, Microelectromechanical Systems, Journal of, J. Microelectromech. Syst.*, vol. 23, no. 1, Feb. 2014, pp. 56–65.
- 2) Kadkhodaei, Sara, and Ali Davariashtiyani. *Phonon-Assisted Diffusion in Bcc Phase of Titanium and Zirconium from First-Principles*. 2019.
- 3) *Thermal Expansion of Alpha-Uranium Single Crystals*. June 1959.
- 4) *Self-Diffusion in Gamma Uranium*. July 1959
- 5) *SELF-DIFFUSION IN BETA URANIUM*. Partial Report--Metallurgy Division Program 4.1.2. July 1960.
- 6) *Phase Diagram of the Elements*. September 1975.
- 7) Gao, D., Ray, A. The 5f localization/delocalization in square and hexagonal americium monolayers: a FP-LAPW electronic structure study. *Eur. Phys. J. B* 50, 497–503 (2006).
- 8) Jones JE. On the Determination of Molecular Fields. I. From the Variation of the Viscosity of a Gas with Temperature. *Proceedings of the Royal Society of London A: Mathematical, Physical and Engineering Sciences*. 1924;106(738):441–62

- 9) Jones JE. On the Determination of Molecular Fields. II. From the Equation of State of a Gas. Proceedings of the Royal Society of London A: Mathematical, Physical and Engineering Sciences. 1924;106(738):463–77
- 10) A. P. Thompson, H. M. Aktulga, R. Berger, D. S. Bolintineanu, W. M. Brown, P. S. Crozier, P. J. in 't Veld, A. Kohlmeyer, S. G. Moore, T. D. Nguyen, R. Shan, M. J. Stevens, J. Tranchida, C. Trott, S. J. Plimpton, LAMMPS - a flexible simulation tool for particle-based materials modeling at the atomic, meso, and continuum scales, *Comp Phys Comm*, 271 (2022) 10817.

Presenter: Callan Noak

Major in Computer Science

Mentor: Dr. Sujing Wang

Research in Data Science and Analysis

Department of Computer Science

**Analysis of COVID-19 Data Using Advanced Machine Learning Models****Abstract**

The outbreak of COVID-19 has dramatically changed peoples' lives over the past two years. The goal of this project is to analyze COVID-19 data from John Hopkins University for the USA, Brazil, India, and Iran between January 23, 2020 and January 21, 2022, and to develop prediction models for the new daily cases and new daily deaths related to COVID-19 for these four countries. Two supervised learning techniques, i.e., Holt's double exponential smoothing and Autoregressive Integrated Moving Averages (ARIMA), were developed to generate the prediction models for each country. Based on the results of this project, both Holt's double exponential smoothing and ARIMA techniques can produce good models that fit the data well for all four countries and help to predict the patterns of the spread of COVID-19.

Introduction

In January 2020, the World Health Organization (WHO) declared COVID-19 as a Public Health Emergency of International Concern (PHEIC) [1]. This virus is infectious and spreads quickly across countries and continents *through* people, animals, and goods. People are still trying to combat the virus by wearing masks and social distancing as much as possible. The outbreak of COVID-19 has dramatically changed peoples' lives over the past two years.

Supervised machine learning is a subcategory of machine learning and artificial intelligence. Supervised machine learning techniques can build highly accurate models to solve a variety of real-world problems. In this project, we designed prediction models based on supervised machine learning techniques to predict and forecast the new daily cases and new daily deaths related to COVID-19 for the USA, Brazil, India, and Iran. These models can help to interpret patterns of the spread of COVID-19 and to assess political and economic influence of the spread of COVID-19. Two supervised machine learning techniques, i.e., Holt's double exponential smoothing [2] and Autoregressive Integrated Moving Averages (ARIMA) [3], were

utilized for this project. The data used for this project was downloaded from Kaggle [4]. The data was from John Hopkins University between January 23, 2020 and January 21, 2022.

Literature Review

There are several works in the literature focusing on analyzing and predicting COVID-19 data. In [5], four supervised machine learning models were used to perform 10-day predictions of COVID-19 data. The models used in this project were linear regression, least absolute shrinkage and selection operator (LASSO), support vector machine, and exponential smoothing. The project predicted data collected from John Hopkins University that was related to the number of cases, deaths, and recoveries for Australia, Canada, Algeria, and Afghan between January 22, 2020 to March 27, 2020. Doroshenko [6] used two clustering techniques, i.e., k-means and hierarchical clustering, to analyze COVID-19 data in Italy and provide more information about the impact of COVID-19. It was found that each cluster contained similar regions with similar levels of industrial development. Moreover, those regions with heavy industry were more affected by COVID-19. In [7], ARIMA models were developed to predict the number of COVID-19 total confirmed cases for 145 countries. The experimental results showed that those ARIMA models were able to accurately predict the data with a low RMSE average of 144.81. In [8], time series models such as Holt's exponential smoothing and ARIMA were used to forecast the number of COVID-19 cases in Jakarta between March 1, 2020 and July 6, 2020. The results of this project showed that the ARIMA model provided the best prediction. Therefore, ARIMA was determined to be the optimal forecasting model.

Chakraborty et al. [9] proposed to use Granular box regression combined with linear regression and polynomial regression to predict the number of confirmed COVID-19 cases and deaths in India between January 30, 2020 and May 15, 2020. The results showed that polynomial regression performed better than granular box regression when limiting the highest polynomial degree to two and the highest number of boxes to four. In [10], time series models such as exponential smoothing, ARIMA, Seasonal Autoregressive Integrated Moving Average (SARIMA), and Seasonal Autoregressive Integrated Moving Averages with eXogenous factors (SARIMAX) were used to predict the new COVID-19 cases in India between January 30, 2020 and December 23, 2020. The best model for prediction was found to be ARIMA with a root mean squared error (RMSE) of 2773.27. In [11], support vector machine and polynomial regression models were adopted to analyze COVID-19 data and trends in India between January 22, 2020 and June 24, 2020. The study found that the polynomial regression model was better at predicting the data with an accuracy of 93%. In [12], different machine learning models, such as linear regression, polynomial regression, and support vector machine, were used to predict the number of global confirmed cases, deaths, and cardiovascular related

deaths due to COVID-19. It was found that linear regression generated results close to the actual data. Mary et al. [13] proposed that classification models such as support vector machine, K-nearest neighbor, and Naïve Bayes could be used to predict the number of positive cases of COVID-19 in India. The project used both numerical and categorical variables for classification. The experimental results showed that support vector machine generated the best results with an accuracy of 85%.

In [14], a Susceptible-Exposed-Infectious-Recovered (SEIR) mathematics model in combination with the machine learning model of polynomial regression was implemented to predict and analyze the trend of COVID-19 confirmed cases in Xinjiang, China. The results of this project showed that the confirmed COVID-19 cases could be accurately predicted in a short term. Nurrahma et al. [15] utilized different machine learning classification techniques, i.e., support vector machine, decision tree, and neural network, to predict the different symptoms of COVID-19. It was found that the neural network model produced the best overall results for prediction of symptoms with an average accuracy of 97.10%. In [16], machine learning models such as linear regression, polynomial regression, and support vector regression were adopted to model the number of confirmed cases of COVID-19 in Saudi Arabia and Bahrain. The deep learning model of Long Short-Term Memory (LSTM) was also used to predict the number of cases, deaths, and recoveries in both countries. The results of this project showed that support vector regression was the best model for Saudi Arabia and linear regression was the best model for Bahrain. In [17], the machine learning algorithms of ARIMA, artificial neural network, LSTM, and convolutional neural network were utilized to perform a 7-day prediction of COVID-19 cases for 189 different countries. It was found that convolutional neural network performed the best out of those four models.

Hossen et al. [18] proposed that three machine learning models, i.e., random forest, support vector machine, and k-nearest neighbors, could be utilized to predict the recovery rate of patients affected by COVID-19 based on their eating habits. The experimental results showed that certain foods were more likely to increase patients' recovery rate related to COVID-19. In [19], an artificial neural network machine learning technique was developed to analyze the COVID-19 data in India for the cumulative confirmed cases, daily confirmed cases, and cumulative confirmed deaths. The case studies showed that each model was highly accurate at predicting the data with the mean absolute percentage error (MAPE) values of 3.981, 4.173, and 4.413 for cumulative confirmed cases, daily confirmed cases, and cumulative confirmed deaths respectively. In [20], support vector regression and polynomial regression were utilized to predict the global number of confirmed cases, confirmed deaths, recovered cases, and daily cases of COVID-19 between March 1, 2020 and April 30, 2020. The results of the study showed that the support vector regression models were able to

predict the data more accurately for each category than the polynomial regression models. Podder et al. [21] used the machine learning techniques such as random forest, XGBoost, and logistic regression in a stacking ensemble to predict the number of COVID-19 patients and the intensive care unit required for a hospital in Brazil. The results of the project showed that the number of COVID-19 patients could be predicted with a 94.39% accuracy and the intensive care unit requirement could be predicted with a 98.13% accuracy.

All these works used machine learning techniques to analyze and predict the COVID-19 data for various countries and cities across different timeframes. While some works used the same techniques or studied the same countries as our project, most of these works used the COVID-19 data from before the vaccine was available. Vaccination can effectively change the spread of COVID-19 patterns. Our project focuses on analyzing four countries selected globally and the most recent data which includes COVID-19 data from after the vaccine was available.

Methodology

In this project we utilized two supervised machine learning techniques, i.e., Holt's double exponential smoothing and ARIMA to predict the COVID-19 cases and deaths. Holt's double exponential smoothing is a derivative of the exponential smoothing technique. Exponential smoothing assigns weights to previous data points that exponentially decrease over time. The value of the current data point called the level is calculated using a smoothing factor. The smoothing factor ranges from 0 to 1. If the smoothing factor is closer to 1, more weight is given to that data point. Typically, data close to the current level have a smoothing factor close to 1 and data further away from the current level have a smoothing factor close to 0. Holt's double exponential smoothing uses a trend in addition to the level. The trend is expressed as the difference between the previous two levels and shows whether the data are increasing or decreasing. The trend is also calculated based on a smoothing factor that can range from 0 to 1. A trend smoothing factor close to 1 means that more weight will be put towards the recent trends of the data. The current level and trend are combined to calculate the forecast of the model which is the actual prediction value. Equation (1) defines Holt's double exponential smoothing formula for calculating the level of the model. The formula consists of x as the observation, t as the time, S as the level of the data, α as the smoothing factor of the level, and B as the trend of the data [2]:

$$S_t = \alpha x_t + (1 - \alpha)(S_{t-1} - B_{t-1}) \quad (1)$$

Equation (2) defines Holt's double exponential smoothing formula for calculating the trend of the model. Equation 2 uses of similar variables to Equation 1 with an additional smoothing factor of the trend as β [2]:

$$B_t = \beta(S_t - S_{t-1}) + (1 - \beta)B_{t-1} \quad (2)$$

Equation (3) defines Holt's double exponential smoothing formula calculating the forecast of the model. The formula combines the results of Equations 1 and 2 to compute the final forecast value F at time $t = (N+m)$ and m as the sum of the last forecast plus last trend [2]:

$$F_{N+m} = S_t + mB_t \quad (3)$$

ARIMA [3] is a forecasting model that has been widely used in many application domains. ARIMA integrates autoregressive (AR) model and moving average (MA) model. ARIMA model is generally denoted as ARIMA(p,d,q) where, p is the order of auto-regression, d is the degree of difference and q is the order of moving average. When a dataset is stationary, the value of d is 0. Equation (4) is the formula for ARMA model [3].

$$Y_t = \sum_{i=1}^p \Phi_i Y_{t-i} + a_t - \sum_{j=1}^q \theta_j a_{t-j} \quad (4)$$

Y is the output variable, t is time, Φ is the autocorrelation coefficient, a is the error residuals, θ is the weight given to current and previous value, p is the order of autoregression, and q is the number of lagged values. Equation 4 can be simplified by introducing the Box-Jenkins backshift operator, B . Equation (5) shows the definition of B [3].

$$B^p X_t = X_{t-p} \quad (5)$$

Equation (6) is the result of substituting this relationship into the ARMA formula. Equations (7) and (8) can be used to further simplify the model. Equation (9) is the final simplified ARMA model [3].

$$(1 - \sum_{i=1}^p \Phi_i B^i) Y_t = (1 - \sum_{j=1}^q \theta_j B^j) a_t \quad (6)$$

$$\Phi_p(B) = (1 - \sum_{i=1}^p \Phi_i B^i) \quad (7)$$

$$\theta_q(B) = (1 - \sum_{j=1}^q \theta_j B^j) \quad (8)$$

$$\Phi_p(B) Y_t = \theta_q(B) a_t \quad (9)$$

When a dataset is nonstationary, the difference between predicted values can be used to simulate stationary behavior. Equation (10) shows an order of differencing of 1. Equation (11) shows the formula for finding the difference for an order of differencing d [3].

$$W_t = Y_t - Y_{t-1} = (1 - B)Y_t \quad (10)$$

$$W_t - \sum_{k=1}^d W_{t-k} = (1 - B)^d Y_t \quad (11)$$

This differencing relationship can be added to the ARMA model. The result of this is the final ARIMA(p,d,q) model which is used to forecast the data. Equation (12) shows the formal definition of the ARIMA model [3].

$$\Phi_p(B)(1 - B)^d Y_t = \theta_q(B)a_t \quad (12)$$

Experimental Results

COVID-19 Global Data

We collected the global COVID-19 data between January 23, 2020 and January 21, 2022 from Kaggle [4]. The data were reported by John Hopkins University with the number of new daily cases and number of new daily deaths related to COVID-19 for every country in the world. Figure 1 displays the top ten countries' average daily cases by January 21, 2022 based on John Hopkins University data. The USA, Brazil, and India ranked as the top three countries with at least 30,000 new cases per day, and Iran ranked no. 10 with 10,000 new cases per day. Figure 2 shows top ten countries with the number of average daily deaths since January 2020 based on the John Hopkins University data. The USA, India, and Brazil ranked as the top three countries with at least 600 deaths per day. Iran is ranked no. 9 with 200 new deaths per day. For this project, we chose four countries to analyze, i.e., USA, Brazil, India, and Iran.

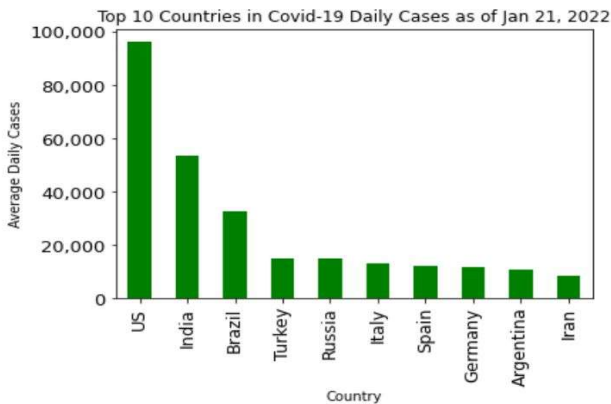


Fig. 1. Top 10 Countries in Average Daily Cases

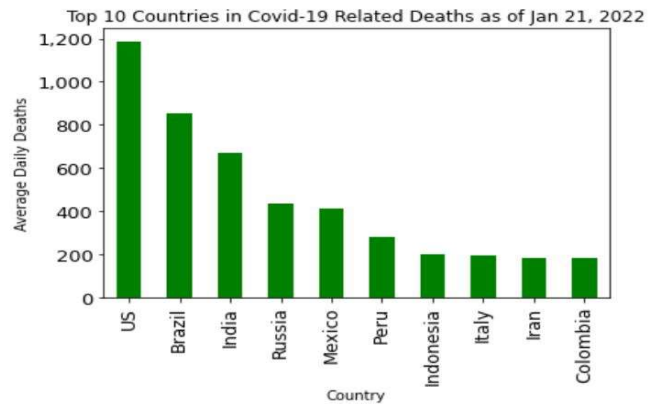


Fig. 2. Top 10 Countries in Average Daily Deaths

We used Python 3 in Jupyter Notebook for experimental study. The data was preprocessed by replacing all missing values with 0. We computed the 14-day rolling average of new daily cases and new daily death for each country. For Holt's double exponential smoothing, the built-in Holt function was used to compute the smoothing factors for both the level and trend with the best fit for the data. For ARIMA, an auto-ARIMA function was used to determine the values of the parameters p , d , and q . Similar to the Holt function, the auto-ARIMA function calculates the value of each parameter that will create a model with the best fit of the data. Those parameters were used in the built-in ARIMA function to create the prediction models.

The accuracy of each model was evaluated using several metrics, i.e., mean absolute error (MAE), mean squared error (MSE), root mean squared error (RMSE), R-squared (R^2), and adjusted R-squared (R^2_{adj}). Both R-squared and adjusted R-squared measure how close the model is to the actual data. For R-squared and adjusted R-squared, a value closer to one indicates a better fit of the model. For mean absolute error, mean squared error, and root mean squared error, a value closer to zero indicates a better fit.

In the following sections we discuss models for each selected country individually. Each graph shows three lines presenting the training data, the prediction data, and the model, respectively. The solid black line shown on each figure represents the training data used to create the model with dates ranging from January 23, 2020 to January 7, 2022. The solid red line shown on each figure represents the actual data between January 8, 2022 and January 21, 2022 that the model predicts. The dashed yellow line shown on each figure represents the predicted values of the model.

USA Models

Figure 3 shows the prediction model created using the Holt's double exponential smoothing technique with a level smoothing factor of 0.9950 and a trend smoothing factor of 0.4027. Figure 4 shows the prediction model created using the ARIMA technique with a (p, d, q) of $(3, 2, 0)$.

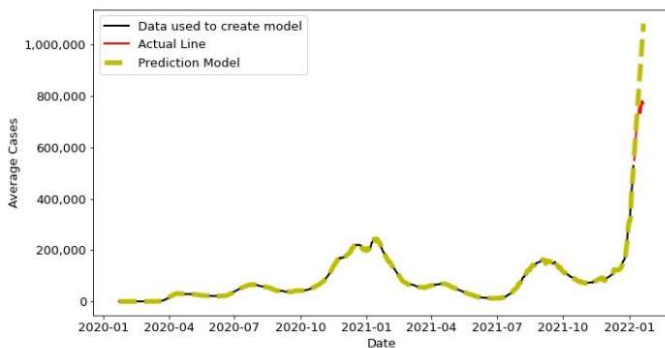


Fig. 4. Holt's Double Exponential Smoothing Model for the USA's Daily Cases

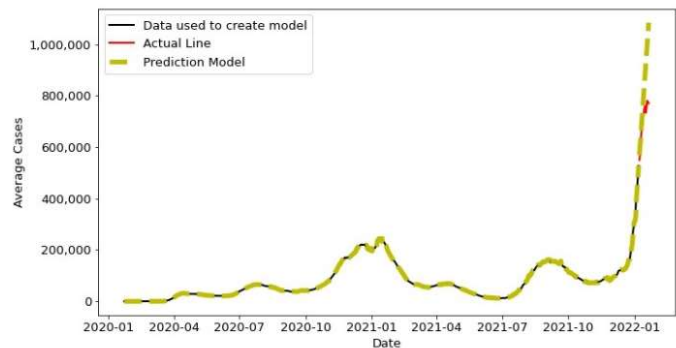


Fig. 3. ARIMA Model for the USA's Daily Cases

For the USA’s daily cases, both the Holt’s double exponential smoothing and the ARIMA models perform well with the R-squared values close to 1 and low root mean squared error values. Table I shows the results of our evaluation metrics for fitting the USA’s daily cases using Holt’s Double Exponential Smoothing (HDES) and ARIMA.

Table I: Evaluation Metrics for the USA's Daily Cases

Model	MAE	MSE	RMSE	R ²	R ² _{adj}
HDES	3279.77	462231127	21499.56	0.9624	0.9624
ARIMA	3336.62	468454106	21643.80	0.9619	0.9619

Figure 5 shows the prediction model created using the Holt’s double exponential smoothing technique with a level smoothing factor of 0.9950 and a trend smoothing factor of 0.2842. Figure 6 shows the prediction model created using the ARIMA technique with a (p, d, q) of $(2, 1, 1)$.

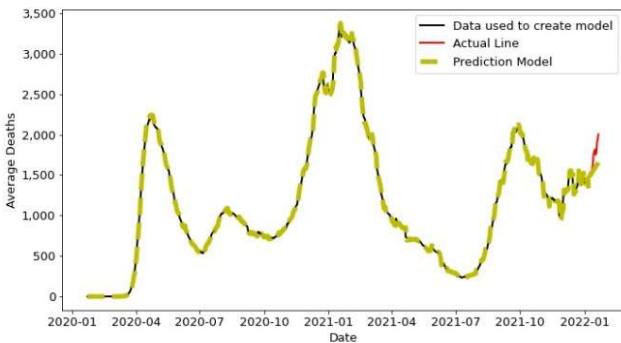


Fig. 5. Holt's Double Exponential Smoothing Model for the USA's Daily Deaths

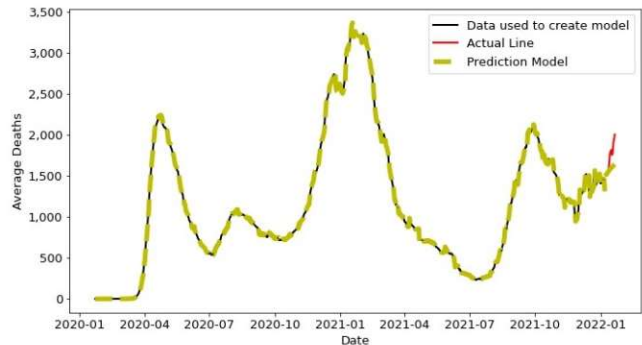


Fig. 6. ARIMA Model for the USA's Daily Deaths

For the USA’s daily deaths, both the Holt’s double exponential smoothing and the ARIMA models produced good models with R-squared values close to 1 and low root mean squared error values. Table II shows the results of our evaluation metrics for fitting the USA’s daily deaths using HDES and ARIMA.

Table II. Evaluation Metrics for the USA's Daily Deaths

Model	MAE	MSE	RMSE	R ²	R ² _{adj}
HDES	20.63	1547.08	39.33	0.9976	0.9976
ARIMA	19.81	1515.04	38.92	0.9976	0.9976

Brazil Models

Figure 7 shows the prediction model created using the Holt’s double exponential smoothing technique with a level smoothing factor of 0.9950 and a trend smoothing factor of 0.2369. Figure 8 shows the prediction model created using the ARIMA technique with a (p, d, q) of $(1, 2, 1)$.

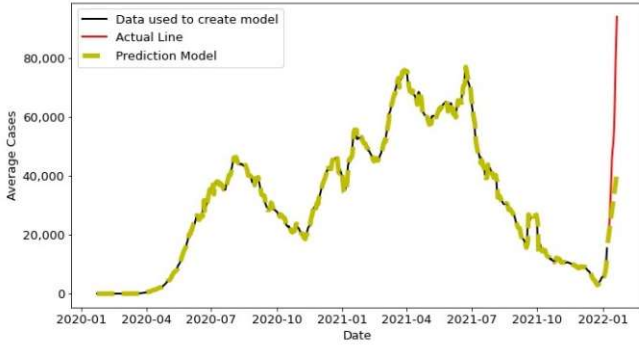


Fig. 7. Holt's Double Exponential Smoothing Model for Brazil's Daily Cases

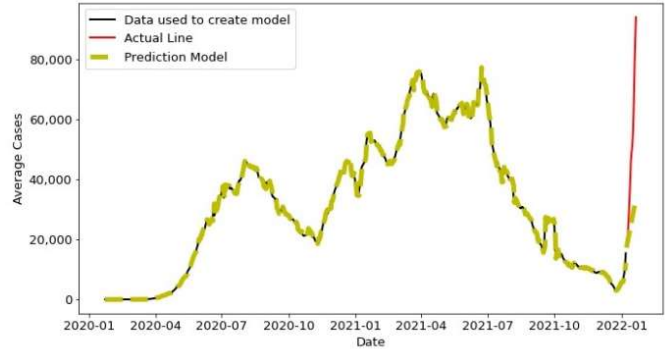


Fig. 8. ARIMA Model for Brazil's Daily Cases

For Brazil’s daily cases, both the Holt’s double exponential smoothing and the ARIMA models produced good models with R-squared values close to 1 and low root mean squared error values. Table III shows the results of our evaluation metrics for fitting Brazil’s daily cases using HDES and ARIMA.

Table III. Evaluation Metrics for Brazil's Daily Cases

Model	MAE	MSE	RMSE	R ²	R ² _{adj}
HDES	869.17	13363196	3655.57	0.9725	0.9725
ARIMA	920.12	17819353	4221.30	0.9633	0.9633

Figure 9 shows the prediction model created using the Holt’s double exponential smoothing technique with a level smoothing factor of 0.9950 and a trend smoothing factor of 0.2606. Figure 10 shows the prediction model created using the ARIMA technique with a (p, d, q) of $(2, 2, 2)$.

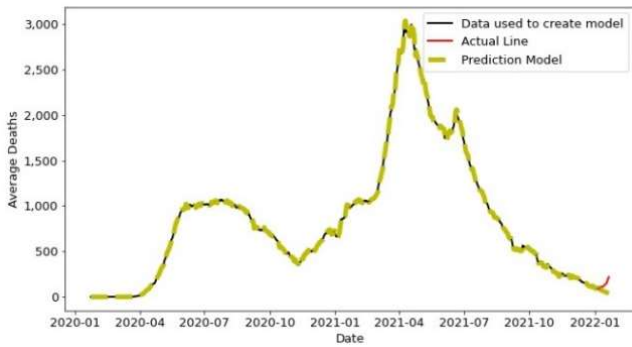


Fig. 9. Holt's Double Exponential Smoothing Model for Brazil's Daily Deaths

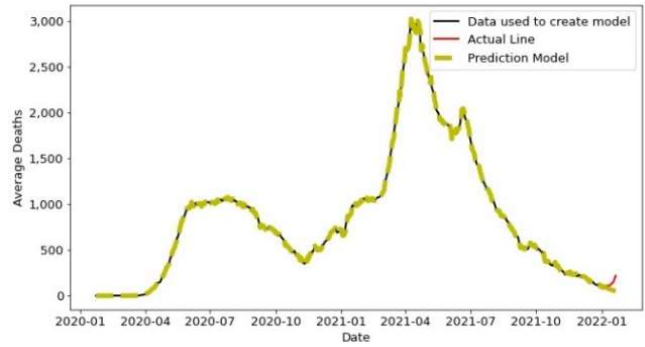


Fig. 10. ARIMA Model for Brazil's Daily Deaths

For Brazil's daily deaths, both the Holt's double exponential smoothing and the ARIMA models produced good models with R-squared values close to 1 and low root mean squared error values. Table IV shows the results of our evaluation metrics for fitting Brazil's daily deaths using HDES and ARIMA.

Table IV. Evaluation Metrics for Brazil's Daily Deaths

Model	MAE	MSE	RMSE	R ²	R ² _{adj}
HDES	11.75	454.10	21.31	0.9991	0.9991
ARIMA	11.43	398.12	19.95	0.9992	0.9992

India Models

Figure 11 shows the prediction model created using the Holt's double exponential smoothing technique with a level smoothing factor of 0.9950 and a trend smoothing factor of 0.9950. Figure 12 shows the prediction model created using the ARIMA technique with a (p, d, q) of $(2, 1, 2)$.

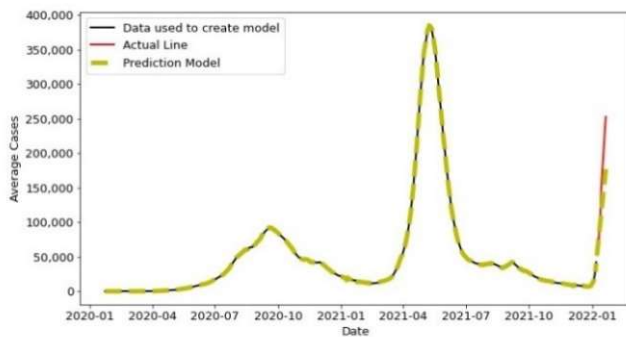


Fig. 11. Holt's Double Exponential Smoothing Model for India's Daily Cases

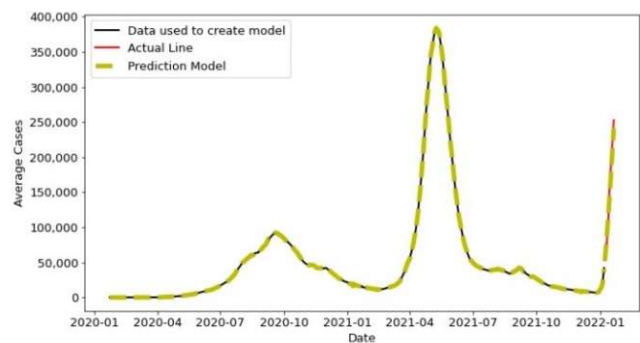


Fig. 12. ARIMA Model for India's Daily Cases

For India's daily cases, both the Holt's double exponential smoothing and the ARIMA models produced good models with R-squared values close to 1 and low root mean squared error values. Table V shows the results of our evaluation metrics for fitting India's daily cases using HDES and ARIMA.

Table V. Evaluation Metrics for India's Daily Cases

Model	MAE	MSE	RMSE	R ²	R ² _{adj}
HDES	897.63	36328714	6027.33	0.9936	0.9936
ARIMA	404.40	2294557.16	1514.78	0.9996	0.9996

Figure 13 shows the prediction model created using the Holt's double exponential smoothing technique with a level smoothing factor of 1.0000 and a trend smoothing factor of 0.3178. Figure 14 shows the prediction model created using the ARIMA technique with a (p, d, q) of $(4, 1, 3)$.

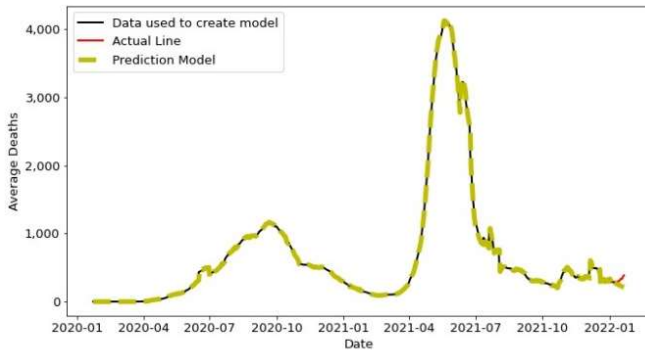


Fig. 13. Holt's Double Exponential Smoothing Model for India's Daily Deaths

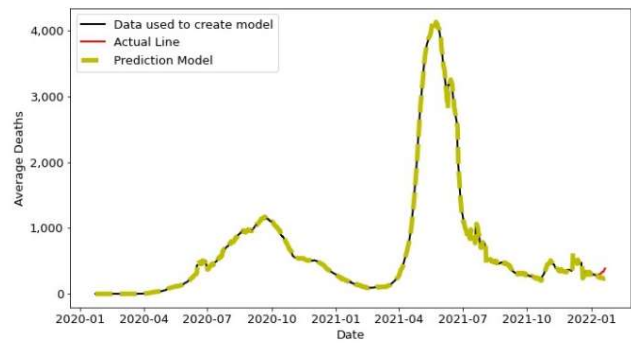


Fig. 14. ARIMA Model for India's Daily Deaths

For India's daily deaths, both the Holt's double exponential smoothing and the ARIMA models produced good models with R-squared values close to 1 and low root mean squared error values. Table VI shows the results of our evaluation metrics for fitting India's daily deaths using HDES and ARIMA.

Table VI. Evaluation Metrics for India's Daily Deaths

Model	MAE	MSE	RMSE	R ²	R ² _{adj}
HDES	12.67	1123.12	33.51	0.9986	0.9986
ARIMA	13.06	998.18	31.59	0.9987	0.9987

Iran Models

Figure 15 shows the prediction model created using the Holt’s double exponential smoothing technique with a level smoothing factor of 0.9950 and a trend smoothing factor of 0.7581. Figure 16 shows the prediction model created using the ARIMA technique with a (p, d, q) of $(1, 1, 2)$.

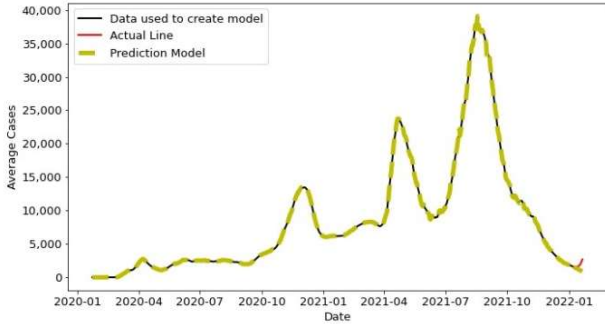


Fig. 16. Holt's Double Exponential Smoothing Model for Iran's Daily Cases

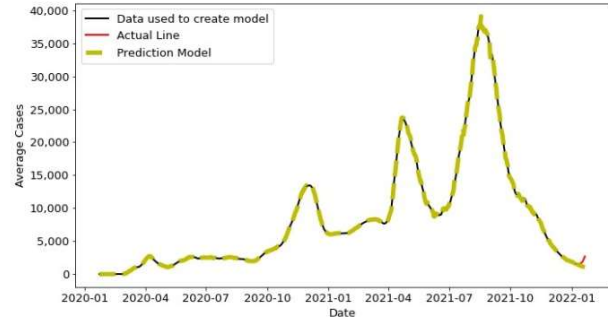


Fig. 16. ARIMA Model for Iran's Daily Cases

For Iran’s daily cases, both the Holt’s double exponential smoothing and the ARIMA models produced good models with R-squared values close to 1 and low root mean squared error values for the size of the data. Table VII shows the results of our evaluation metrics for fitting Iran’s daily cases using HDES and ARIMA.

Table VII. Evaluation Metrics for Iran’s Daily Cases

Model	MAE	MSE	RMSE	R ²	R ² _{adj}
HDES	71.34	27027.08	164.40	0.9996	0.9996
ARIMA	70.14	23962.95	154.8	0.9997	0.9997

Figure 17 shows the prediction model created using the Holt’s double exponential smoothing technique with a level smoothing factor of 0.9763 and a trend smoothing factor of 0.5415. Figure 18 shows the prediction model created using the ARIMA technique with a (p, d, q) of $(1, 1, 1)$.

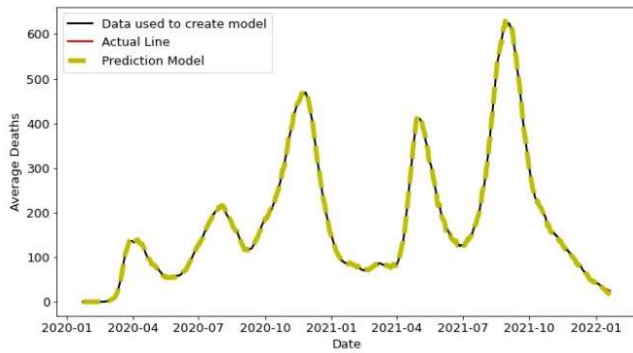


Fig. 17. Holt's Double Exponential Smoothing Model for Iran's Daily Deaths

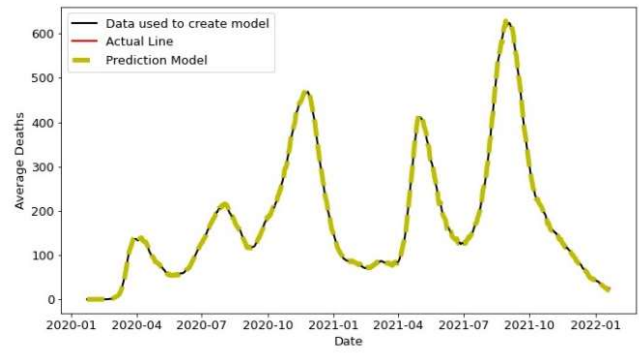


Fig. 18. ARIMA Model for Iran's Daily Deaths.

For Iran's daily deaths, both the Holt's double exponential smoothing and the ARIMA models produced good models with R-squared values close to 1 and low root mean squared error values for the size of the data. Table VIII shows the results of our evaluation metrics for fitting India's daily deaths using HDES and ARIMA.

Table VIII. Evaluation Metrics for Iran's Daily Deaths

Model	MAE	MSE	RMSE	R ²	R ² _{adj}
HDES	1.62	5.26	2.29	0.9997	0.9997
ARIMA	1.58	4.91	2.22	0.9998	0.9998

Based on our experiment results discussed in this section, the prediction models based on both Holt's double exponential smoothing and ARIMA performed well. The lowest R-squared value was 0.9619 for the ARIMA model for the USA's daily cases. This value also indicates a good fit. The small root mean squared error for each model also indicates a good fit. Overall, ARIMA models performed better than Holt's double exponential smoothing models. However, this difference is not significant and both techniques were able to produce well fitted models.

Conclusion

COVID-19 has affected millions of lives around the world over the past two years and we are still struggling to combat the virus. Analyzing COVID-19 data can help us better understand the spread of the virus. In this project, we analyzed COVID-19 data reported by John Hopkins University for the USA, Brazil, India, and Iran, and developed prediction models for the new daily cases and new daily deaths for these four countries utilizing two

machine learning techniques, i.e., Holt’s double exponential smoothing and ARIMA. Based on the experimental results, both techniques produced models that performed well. None of the models had a R-squared value of lower than 0.96. Both techniques produced similar performing models.

Bibliography

- [1] World Health Organization, “World Health Organization,” *Who.int*, 2021. <https://www.who.int/>.
- [2] V. K. Sharma and U. Nigam, “Modeling and Forecasting of COVID-19 Growth Curve in India,” *Trans Indian Natl. Acad. Eng.* 5, 697–710, 2020. <https://doi.org/10.1007/s41403-020-00165-z>.
- [3] “14.5.1 - ARIMA Models | STAT 501,” PennState: Statistics Online Courses. 2022. <https://online.stat.psu.edu/stat501/lesson/14/14.5/14.5.1>.
- [4] A. Goldbloom, “COVID-19 data from John Hopkins University dataset,” Retrieved February 4, 2022, from <https://www.kaggle.com/antgoldbloom/covid19-data-from-john-hopkins-university>.
- [5] F. Rustam, A. A. Reshi, A. Mehmood, S. Ullah, B. On, W. Aslam, and G. S. Choi, “COVID-19 Future Forecasting Using Supervised Machine Learning Models,” *IEEE Access*, vol. 8, pp. 101489-101499, 2020. <https://doi.org/10.1109/ACCESS.2020.2997311>.
- [6] A. Doroshenko, “Analysis of the Distribution of COVID-19 in Italy Using Clustering Algorithms,” 2020 IEEE Third International Conference on Data Stream Mining & Processing (DSMP), pp. 325-328, 2020. <https://doi.org/10.1109/DSMP47368.2020.9204202>.
- [7] A. Hernandez-Matamoros, H. Fujita, T. Hayashi, and H. Perez-Meana, “Forecasting of COVID19 per regions using ARIMA models and polynomial functions,” *Applied Soft Computing*, vol. 96: 106610, 2020. <https://doi.org/10.1016/j.asoc.2020.106610>.
- [8] A. Sulasikin, Y. Nugraha, J. Kanggrawan, and A. L. Suherman, “Forecasting for a data-driven policy using time series methods in handling COVID-19 pandemic in Jakarta,” 2020 IEEE International Smart Cities Conference (ISC2), pp. 1-6, 2021. <https://doi.org/10.1109/ISC251055.2020.9239066>.
- [9] M. Chakraborty, A. Mukhopadhyay, and U. Maulik, “A Comparative Analysis of Different Regression Models on Predicting the Spread of Covid-19 in India,” 2020 IEEE 5th International Conference on Computing Communication and Automation (ICCCA), pp. 519-524, 2020. <https://doi.org/10.1109/ICCCA49541.2020.9250748>.
- [10] A. Jain, T. Sukhdeve, H. Gadia, S. P. Sahu and S. Verma, “COVID19 Prediction using Time Series Analysis,” 2021 International Conference on Artificial Intelligence and Smart Systems (ICAIS), pp. 1599-1606, 2021. <https://doi.org/10.1109/ICAIS50930.2021.9395877>.
- [11] E. Gambhir, R. Jain, A. Gupta, and U. Tomer, “Regression Analysis of COVID-19 using Machine Learning Algorithms,” 2020 International Conference on Smart Electronics and Communication (ICOSEC), pp. 65-71, 2020. <https://doi.org/10.1109/ICOSEC49089.2020.9215356>.

- [12] D. R. Krithika and K. Rohini, "Comparative Interpretation Of Machine Learning Algorithms In Predicting The Cardiovascular Death Rate For Covid-19 Data," 2021 International Conference on Computational Intelligence and Knowledge Economy (ICCIKE), pp. 394-400, 2021. <https://doi.org/10.1109/ICCIKE51210.2021.9410777>.
- [13] L. W. Mary and S. A. A. Raj, "Machine Learning Algorithms for Predicting SARS-CoV-2 (COVID-19) – A Comparative Analysis," 2021 2nd International Conference on Smart Electronics and Communication (ICOSEC), pp. 1607-1611, 2021. <https://doi.org/10.1109/ICOSEC51865.2021.9591801>.
- [14] Y. Liu and Y. Xiao, "Analysis and Prediction of COVID-19 in Xinjiang Based on Machine Learning," 2020 5th International Conference on Information Science, Computer Technology and Transportation (ISCTT), pp. 382-385, 2020. <https://doi.org/10.1109/ISCTT51595.2020.00072>.
- [15] Nurrahma and R. Yusuf, "Comparing Different Supervised Machine Learning Accuracy on Analyzing COVID-19 Data using ANOVA Test," 2020 6th International Conference on Interactive Digital Media (ICIDM), pp. 1-6, 2020. <https://doi.org/10.1109/ICIDM51048.2020.9339676>.
- [16] H. Khaloofi, J. Hussain, Z. Azhar and H. F. Ahmad, "Performance Evaluation of Machine Learning Approaches for COVID-19 Forecasting by Infectious Disease Modeling," 2021 International Conference of Women in Data Science at Taif University (WiDSTaif), pp. 1-6, 2021. <https://doi.org/10.1109/WiDSTaif52235.2021.9430192>.
- [17] O. Istaiteh, T. Owais, N. Al-Madi and S. Abu-Soud, "Machine Learning Approaches for COVID-19 Forecasting," 2020 International Conference on Intelligent Data Science Technologies and Applications (IDSTA), pp. 50-57, 2020. <https://doi.org/10.1109/IDSTA50958.2020.9264101>.
- [18] M. S. Hossen and D. Karmoker, "Predicting the Probability of Covid-19 Recovered in South Asian Countries Based on Healthy Diet Pattern Using a Machine Learning Approach," 2020 2nd International Conference on Sustainable Technologies for Industry 4.0 (STI), pp. 1-6, 2020. <https://doi.org/10.1109/STI50764.2020.9350439>.
- [19] P. Kumari and D. Toshniwal, "Real-time estimation of COVID-19 cases using machine learning and mathematical models - The case of India," 2020 IEEE 15th International Conference on Industrial and Information Systems (ICIIS) pp. 369-374, 2020. <https://doi.org/10.1109/ICIIS51140.2020.9342735>.
- [20] S. Bhardwaj, H. Bhardwaj, J. Bhardwaj and P. Gupta, "Global Prediction of COVID-19 Cases and Deaths using Machine Learning," 2021 Sixth International Conference on Image Information Processing (ICIIP), pp. 422-426, 2021. <https://doi.org/10.1109/ICIIP53038.2021.9702560>.
- [21] P. Podder and M. R. H. Mondal, "Machine Learning to Predict COVID-19 and ICU Requirement," 2020 11th International Conference on Electrical and Computer Engineering (ICECE), pp. 483-486, 2020. <https://doi.org/10.1109/ICECE51571.2020.9393123>.

Presenter: Silvana Ochoa

Major in Computer Science with Concentration in Game Development

Mentor: Dr. Sujing Wang

Research in Computer Science and Statistical Analysis

Department of Computer Science



Impact of the COVID-19 Pandemic on Education and Students

Introduction

Starting from 2020, the appearance of the Coronavirus has impacted populations on a worldwide scale, affecting working environments, social gatherings, the economy, and the well-being of U.S. citizens. With the inclusion of safety regulations, digital media platforms have never played a larger role in communication than during these unprecedented times. In fact, new challenges have been posed to our current education system since the pandemic's requirement to social distancing, causing many facilities to move towards virtual learning. This change has clearly been the cause for hurdles in students' education and instructor's teaching plans, but by analyzing the impact of COVID-19 on students, solutions can be derived to better overcome these new obstacles and prepare for future catastrophes.

Purpose

By conducting this research, a few goals are set to be accomplished. These include identifying the most affected students, finding common characteristics amongst these, and developing solutions to further aid students in these situations. It is imperative to discover the impacting factors that create distress, low engagement, and poor performance among students to better combat the effects. In doing so, this research can improve our current teaching methodologies, while offering support to students and mentors to achieve academic merit. Moreover, future preparation can be done in instances of natural disasters, emergencies, and other scenarios that impede education. Currently, the pandemic continues to deter our way of life, but through understanding of the causes for academic deterioration, society can begin implementing new programs to battle the pandemic and its effects on our education system.

Methodology

For the project’s methodology, Figure 1 illustrates the steps followed in the development and completion of the research. It is imperative to consider that if not enough findings are obtained from the data, collecting more data could help provide more accurate results. Thankfully, this research managed to offer some considerable findings, but more testing methods could further expand and develop this topic.

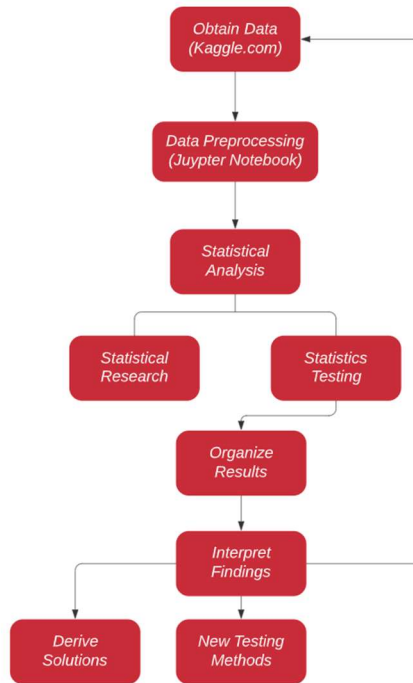


Figure 1: Project Framework

The research was organized over a series of databases that measured three factors, student stress ratings, performance, and engagement of digital products during the pandemic. These databases contained survey results for three different populations in the United States, but participants were mostly from elementary to high school education-levels. All databases were obtained from Kaggle.com, a data science company website, which allowed the research to skip the survey development phase. Through the usage of a database handling software, Jupyter notebook, modifications to the databases were prepared using python, a data science programming language.

Preprocessing of the data lead to elimination of duplicate elements, handling of missing or NA values, dropping non-related data and participants, and organization of databases to be concise and legible. Changes made to the stress rating database was minimal because of its small sample size; however, major modifications to the performance and engagement databases had to be completed to better read the information.

In the cleansing of the performance database, six test scores from before and after the pandemic were provided for each student for three school subjects-reading, math, and writing. With the addition of state test

grades, a total of six exam categories were included, and so, averaging the exam types reduced duplication of student ID rows. The database was split into two tables, where one contained scores from before the pandemic, and the other, scores during the pandemic.

Figure 2: Performance Database Test Scores from Before the Pandemic

Out [30]:

studentID	school	gradelevel	gender	readingscore	writingscore	mathscore	readingscoreSL	writingscoreSL	mathscoreSL
1	0.0	6.0	1.0	71.333333	60.000000	67.333333	73.666667	70.666667	79.333333
2	0.0	6.0	1.0	83.666667	76.000000	75.000000	76.666667	66.333333	65.666667
3	0.0	6.0	1.0	82.000000	74.000000	61.333333	75.333333	74.000000	68.000000
4	0.0	6.0	1.0	87.000000	90.666667	78.000000	83.000000	88.000000	67.333333
5	0.0	6.0	0.0	78.000000	79.333333	83.333333	77.666667	73.000000	72.666667
...
1396	1.0	12.0	0.0	62.333333	69.000000	60.333333	61.333333	68.000000	59.333333
1397	1.0	12.0	0.0	68.000000	63.000000	71.333333	67.000000	62.000000	70.333333
1398	1.0	12.0	1.0	68.666667	73.666667	73.000000	67.000000	72.333333	71.666667
1399	1.0	12.0	1.0	65.666667	72.333333	67.000000	63.666667	70.333333	65.000000
1400	1.0	12.0	1.0	64.000000	60.666667	75.333333	61.666667	58.000000	73.333333

1400 rows x 9 columns

Out [31]:

studentID	school	gradelevel	gender	readingscore	writingscore	mathscore	readingscoreSL	writingscoreSL	mathscoreSL
1	0.0	6.0	1.0	72.000000	69.666667	67.000000	83.666667	79.333333	71.333333
2	0.0	6.0	1.0	71.666667	83.333333	76.333333	65.333333	71.000000	67.666667
3	0.0	6.0	1.0	70.000000	80.333333	79.000000	84.000000	75.000000	72.000000
4	0.0	6.0	1.0	72.000000	73.666667	83.333333	82.333333	85.333333	72.666667
5	0.0	6.0	0.0	75.666667	80.666667	81.000000	57.666667	78.666667	68.666667
...
1396	1.0	12.0	0.0	61.666667	71.000000	64.000000	60.666667	70.000000	63.000000
1397	1.0	12.0	0.0	58.333333	59.000000	59.333333	57.333333	58.000000	58.333333
1398	1.0	12.0	1.0	70.000000	72.000000	78.000000	68.333333	70.333333	76.000000
1399	1.0	12.0	1.0	74.333333	78.666667	81.666667	72.333333	76.666667	79.666667
1400	1.0	12.0	1.0	56.333333	72.666667	71.000000	54.000000	70.333333	69.000000

1400 rows x 9 columns

Figure 3: Performance Database Test Scores During the Pandemic

For measuring engagement of digital products, multiple databases were included, one for product information and others for districts engagement measurements for every product used. The google chrome browser calculated these measurements for 176 school districts from all over the country, where student access percentages and page loads per 1000 students made-up the two measurements provided. Since the values were for everyday of the year 2020, averaging of the values was conducted to reduce each district data significantly.

Demographic Profiling of Participants

After the preprocessing phase, profiling analysis for student participants of each research category granted lead way into identifying common characteristics amongst students, especially those who were most affected by the pandemic. Through python programming and program utilities, pie charts and count were calculated to derive the following tables.

Table 1: Demographic profile of students in Stress Database

Characteristics	Frequency (n)	Percentage (%)
	School Category	
SchoolCollegeTraining	23	82.14
Homeschool	5	17.86
	States	
Texas	5	17.86
Florida	4	14.29
Illinois	2	7.14
Pennsylvania	2	7.14
Georgia	2	7.14
Washington	2	7.14
Maryland	1	3.57
West Virginia	1	3.57
Colorado	1	3.57
Michigan	1	3.57
Arizona	1	3.57
Montana	1	3.57
New York	1	3.57
California	1	3.57
Utah	1	3.57
Indiana	1	3.57
Minnesota	1	3.57
	Age	
13	1	3.57
14	5	17.86
15	7	25.00
16	6	21.43
17	6	21.43
18	2	7.14
19	1	3.57
	Gender	
Female	14	53.85
Male	10	38.46
Other	2	7.69

The stress ratings table above demonstrates the demographic profile of students based on different characteristics. From this table, we gather that 25% or 1/4th of the 28 students were 15 years old with mean age of 15.75 and median age of 16. Majority of the participants attended some public or college preparation

educational facility over being homeschooled. Also, the largest portion of participants were from Texas, but not by much. There was a larger participation of female students with a 53.85%, but this also indicates that there was about an even participation in a male to female ratio.

Table 2: Before Pandemic Stress Ratings

Before Pandemic		
Characteristics	Frequency (n)	Percentage (%)
	Environment	
Physical	23	82.14
Virtual	2	7.14
Hybrid	3	10.71
Rating (0-6)	Classwork Stress	
0	1	3.57
1	8	28.57
2	9	32.14
3	4	14.29
4	3	10.71
5	2	7.14
6	1	3.57
	Homework Stress	
0	1	3.57
1	3	10.71
2	5	17.86
3	9	32.14
4	6	21.43
5	4	14.29
6	0	0.00
Average Hours Spent	Homework Hours	
0	3	10.71
1	4	14.29
2	5	17.86
3	6	21.43
3.5	1	3.57
4	4	14.29
5	2	7.14
6	1	3.57
9	1	3.57
10	1	3.57

Table 3: Pandemic Period Stress Ratings

Pandemic Period		
Characteristics	Frequency (n)	Percentage (%)
	Environment	
Physical	3	10.71
Virtual	22	78.57
Hybrid	3	10.71
	Classwork Stress	
Rating (0-6)		
0	0	0.00
1	2	7.14
2	4	14.29
3	7	25.00
4	6	21.43
5	5	17.86
6	4	14.29
	Homework Stress	
0	0	0.00
1	1	3.57
2	2	7.14
3	4	14.29
4	4	14.29
5	13	46.43
6	4	14.29
	Homework Hours	
Average Hours Spent		
1	3	10.71
1.5	1	3.57
2	4	14.29
2.5	1	3.57
3	1	3.57
4	4	14.29
4.5	1	3.57
5	4	14.29
6	3	10.71
7	2	7.14
8	1	3.57
10	1	3.57
14	1	3.57
15	1	3.57

Table 4: Demographic profile of students in Performance Database

Characteristics	Frequency (n)	Percentage (%)
School Category		
School A (financially well-off)	700	50.0
School B (not so financially stable)	700	50.0
Grade Level		
6	200	14.29
7	200	14.29
8	200	14.29
9	200	14.29
10	200	14.29
11	200	14.29
12	200	14.29
Gender		
Female	678	48.43
Male	722	51.57
COVID History		
Negative	936	66.86
Positive	464	33.14
Lunch		
Free/Reduced	1185	84.64
Paid	215	15.36
Computer Availability		
0	172	12.29
1	330	23.57
2	362	25.86
3	184	13.14
4	113	8.07
5	239	17.07
Family Size		
0	68	4.86
1	348	24.86
2	530	37.86
3	338	24.14
4	102	7.29
5	14	1.0
Family Income		
Income <20,000	41	2.93
20,000< income <44,999	198	14.14
45,000<income<139,999	1065	76.07
140,000< income <149,999	68	4.86
150,000<income<200,000	28	2.0
Mother Education		
0	150	10.71
1	833	59.50
2	337	24.07
3	57	4.07
4	23	1.64
Father Education		
0	140	10.0
1	826	59.0
2	294	21.0
3	121	8.64
4	19	1.36

The table above demonstrates the demographic profile of students based on different characteristics. From this table, we see that there is an even number of students from School A and B, where school A is wealthier than B. There is also an even distribution of students from each grade level from middle school to high school (6-12th grade). Majority of students were male with 51.57%, which isn't much more than half. In terms of the COVID testing in students during the pandemic, results showed that 66.86% students tested negative, and 84.64% of students received free or reduced lunch. About a fourth (25.86%) of students possessed two computers available during the pandemic. Majority of students at 37.86% came from families of size 2, including parents and siblings (not student). Most students were from middle class income families, where income ranged from \$45,000- \$139, 999 (76.07 %). For the mother and father education, students choose between 5 options 0-4, where 0 is no high school diploma, 1 is high school, 2 is bachelor's degree, 3 is the master's degree, and 4 is a PhD. 59.5% of mothers gained a high school diploma, and similarly, 59% of fathers also only received a high school education.

Table 5: District Information in Engagement Database

Characteristics	Frequency (n)	Percentage (%)
	State	
Connecticut	30	17.54
Utah	28	16.37
Massachusetts	21	12.28
Illinois	18	10.53
Ohio	11	6.43
California	11	6.43
New York	8	4.68
Indiana	7	4.09
Missouri	6	3.51
Washington	5	2.92
Virginia	4	2.34
North Carolina	4	2.34
Wisconsin	3	1.75
Michigan	2	1.17
Tennessee	2	1.17
New Hampshire	2	1.17
New Jersey	2	1.17
District of Columbia	2	1.17
North Dakota	1	0.58
Texas	1	0.58
Arizona	1	0.58
Florida	1	0.58
Minnesota	1	0.58
	Locale	
Suburb	102	59.65
Rural	33	19.30
City	26	15.20
Town	10	5.85

Based on the table above, majority of districts' engagement tests came from Connecticut with 17.54% of the 176 districts tested. While majority of districts were categorized as Suburbs with 59.65%.

Statistical Analysis:

For the statistical analysis test conducted, a series of descriptive statistics including central tendencies measurements such as mean, mode, and median and correlation tests were completed to analyze changes in the data from periods before and after the pandemic. Other measurements like standard deviation, min, and max values were computed using python 3 in Jupyter's Notebook.

Two-tailed T-tests were utilized to determine the statistical significance between stress ratings and test scores from before and during the pandemic. If results indicate a statistical significance, then the data gathered is determined to not have occurred by chance, but rather by some factor, in this case the pandemic. The formula used to make this calculation is shown below.

T-Test t- value:

$$t = \frac{(\sum D)/N}{\sqrt{\frac{\sum D^2 - \frac{(\sum D)^2}{N}}{(N-1)(N)}}$$

The correlation tests were utilized to calculate the degree of relationship between unrelated variables. Thus, these tests determined whether certain characteristics among survey participants could be possibly responsible for the results viewed, and whether any of these factors were shared among students most impacted by COVID-19 and the quarantine. The formulas for the two types of correlation tests, namely Pearson and Spearman, are listed as follows:

Pearson's r- value:

$$r = \frac{\sum_i (x_i - \bar{x})(y_i - \bar{y})}{(\sqrt{\sum_i (x_i - \bar{x})^2})(\sqrt{\sum_i (y_i - \bar{y})^2})}$$

Spearman's ρ - value:

$$\rho = 1 - \left(\frac{6 \sum d_i^2}{n(n^2 - 1)}\right)$$

Experimental Results

Table 6: Descriptive Statistical Results for Central Tendency Measurements for Stress Database

Before Pandemic			
	Average	Median	Mode
Homework Hours Spent	3.089	3.0	3.0
Classwork Stress	2.357	2.0	2.0
Homework Stress	3.0	3.0	3.0
Environment	Physical- 82.14%		
During Pandemic			
Homework Hours Spent	4.91	2, 4, 5	4.25
Classwork Stress	3.71	4.0	3.0
Homework Stress	4.35	5.0	5.0
Environment	Virtual- 78.57%		

Table 7: Descriptive Statistical Results of Central Tendency Measurements for Performance

	school	gradelevel	gender	covidpos	householdincome	freelunch	numcomputers	familysize	fatheduc	motheduc
count	1400.000000	1400.000000	1400.000000	1400.000000	1400.000000	1400.000000	1400.000000	1400.000000	1400.000000	1400.000000
mean	0.500000	9.000000	0.515714	0.331429	84290.232143	0.846429	2.323571	2.071429	1.334048	1.264286
std	0.500179	2.000715	0.499932	0.470895	37763.727553	0.360666	1.617104	1.030228	0.809708	0.767558
min	0.000000	6.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
25%	0.000000	7.000000	0.000000	0.000000	53210.750000	1.000000	1.000000	1.000000	1.000000	1.000000
50%	0.500000	9.000000	1.000000	0.000000	85214.500000	1.000000	2.000000	2.000000	1.000000	1.000000
75%	1.000000	11.000000	1.000000	1.000000	115974.750000	1.000000	4.000000	3.000000	2.000000	2.000000
max	1.000000	12.000000	1.000000	1.000000	179297.000000	1.000000	5.000000	5.000000	4.000000	4.000000

Table 8: Two-Tailed T-Tests for Stress Ratings Database

Stats	Classwork Stress	Homework Stress	Homework Hours
Degrees of Freedom	27		
Alpha Value	.05		
T-Value	2.052		
Calculated T-value	3.042	3.062	2.951
Results	Statistically Significant		

Table 8 illustrates the data used to calculate the T-tests and compare stress ratings from before and during the pandemic. The t-tests were conducted over the three different categories that include Classwork Stress, Homework Stress, and number of hours spent on homework. All the t-values calculated for the categories were larger than the original t-value, rejecting the null hypothesis and proving a statistical significance for all categories measured. This infers that a common factor is responsible for the data witnessed.

r-value for correlation:
0.32564115496516255

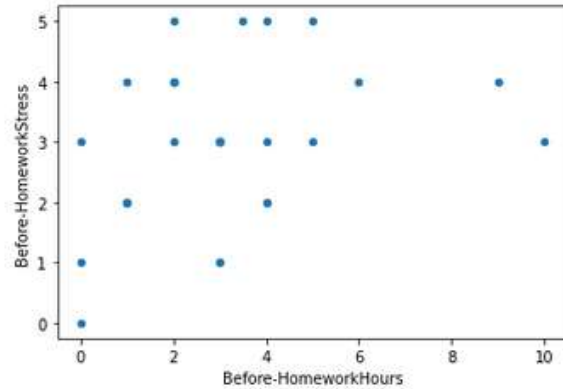


Figure 4: Pearson Correlation between Before Pandemic Homework Stress and Hours Spent

This Pearson correlation test explains the relationship between number of hours spent on Homework and the stress rating related to Homework from before the pandemic. The r-value was .325, meaning that there exists a moderate positive linear relationship, and so, when students spent more hours on homework there were also higher ratings in stress related to homework done before the pandemic.

r-value for correlation:
0.21514658930994082

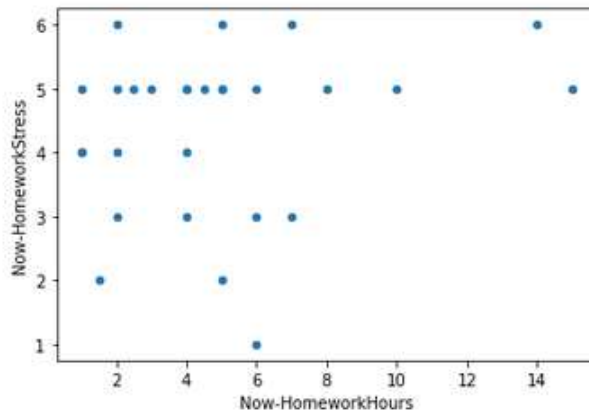


Figure 5: Pearson Correlation between During Pandemic Homework Stress and Hours Spent

For this Pearson correlation test, the r-value was .215, meaning that there exists a very weak positive linear relationship, and so, the inference that students who spent more time on homework were also the most stressed is not necessarily true.

Table 9: Two-Tailed T-Tests for Performance Database

Stats	Reading Score	Writing Score	Math Score	Reading SL Score	Writing SL Score	Math SL Score
Degrees of Freedom	1399					
Alpha Value	.05					
T-Value	1.96					
Calculated T-value	1.01	0.51	1.38	0.70	1.56	0.43
Results	Not Statistically Significant					

Table 9 displays the t-test results used to compare average scores from before and during the pandemic for the subjects listed (SL refers to state test scores). Because the t-values calculated were smaller than the shared T-value, results indicate that the null hypothesis fails to be rejected, and thus, means there exists no statistical significance. This infers that the results were coincidental rather than caused by a common factor.

Table 10: Before Pandemic Correlation Tests for Performance Database

Pearson Test R -values								
Factors	Reading Score	Writing Score	Math Score	Reading SL Score	Writing SL Score	Math SL Score	Correlation	Results
Number of Computers	.265	.244	.192	.243	.215	.169	Positive	Weak
Covid-19 History	.271	.202	.233	.279	.254	.200	Negative	Weak
Lunch	.316	.306	.246	.132	.122	.051	Positive	Weak
Father's Education	.113	.091	.110	.132	.111	.122	Positive	Very Weak
Mother's Education	.019	-.001	-.003	.040	.044	.034	Positive & Negative	Very Weak
Spearman's Test ρ -values								
Number of Computers	.347	.344	.274	.322	.298	.234	Positive	Very Weak
Covid-19 History	.379	.342	.300	.402	.366	.304	Negative	Very Weak
Lunch	.424	.429	.349	.197	.192	.078	Positive	Weak
Father's Education	.148	.102	.133	.178	.139	.168	Positive	Weak
Mother's Education	.049	.033	.040	.101	.125	.125	Positive	Weak

Table 10 shows results for two different correlation tests completed over scores from before the pandemic for the subjects listed. Factors being tested for correlation to the scores are listed on the left-hand side. The purpose of these tests is to check whether these factors prove to have been a cause over the scores depicted, but all tests showed weak to almost no correlation. This is because, for the Pearson test, the closer the values are to 0 the

correlation is less likely, and when values are closer to 1, the opposite is true. As for the Spearman test, values less than .01 would indicate strong correlations between factors, but results show values larger than .1, proving very to no correlation.

For the Covid-19 History results, the relationship between the Covid history to the scores was negative, meaning that when students were previously ill, their scores were lower. Mother's education had a mix in positive and negative correlations for the Pearson test for only two subjects, which meant that for these instances students' whose mothers were more educated had lower scores, but in other subjects, the opposite was true. Regardless correlation was too weak to consider these conclusions.

Table 11: After Pandemic Correlation Tests for Performance Database

Pearson Test R -values								
Factors	Reading Score	Writing Score	Math Score	Reading SL Score	Writing SL Score	Math SL Score	Correlation	Results
Number of Computers	.259	.236	.174	.240	.216	.161	Positive	Weak
Covid-19 History	.249	.243	.204	.250	.253	.219	Negative	Weak
Lunch	.313	.318	.247	.128	.135	.056	Positive	Weak
Father's Education	.131	.116	.092	.119	.119	.121	Positive	Very Weak
Mother's Education	.016	.011	.010	.035	.038	.042	Positive	Very Weak
Spearman's Test ρ -values								
Number of Computers	.338	.316	.247	.319	.298	.220	Positive	Very Weak
Covid-19 History	.351	.337	.312	.362	.360	.333	Negative	Very Weak
Lunch	.424	.422	.354	.193	.204	.090	Positive	Weak
Father's Education	.145	.143	.109	.139	.144	.149	Positive	Weak
Mother's Education	.064	.048	.055	.095	.099	.118	Positive	Weak

Table 11's results for the two different correlation tests were conducted over average scores during the pandemic for the same subjects. Factors being tested for correlation to the scores are listed on the left-hand side, and again, the purpose of these tests is to check whether these factors prove to have been a cause over the scores depicted, but all tests showed weak to almost no correlation. This is because the closer the values are to 0 the correlation is less likely, and when values are closer to 1, the opposite is true. As for the Spearman test, values less than .01 would indicate strong correlations between factors, but results show values larger than .1, proving very to no correlation.

For the Covid-19 History results, the relationship between the Covid history to the scores was negative, meaning that when students were previously ill, their scores were lower. Regardless correlation was too weak to consider that conclusion.

Figure 6: Average Percentage of student access for the Google Classroom Product

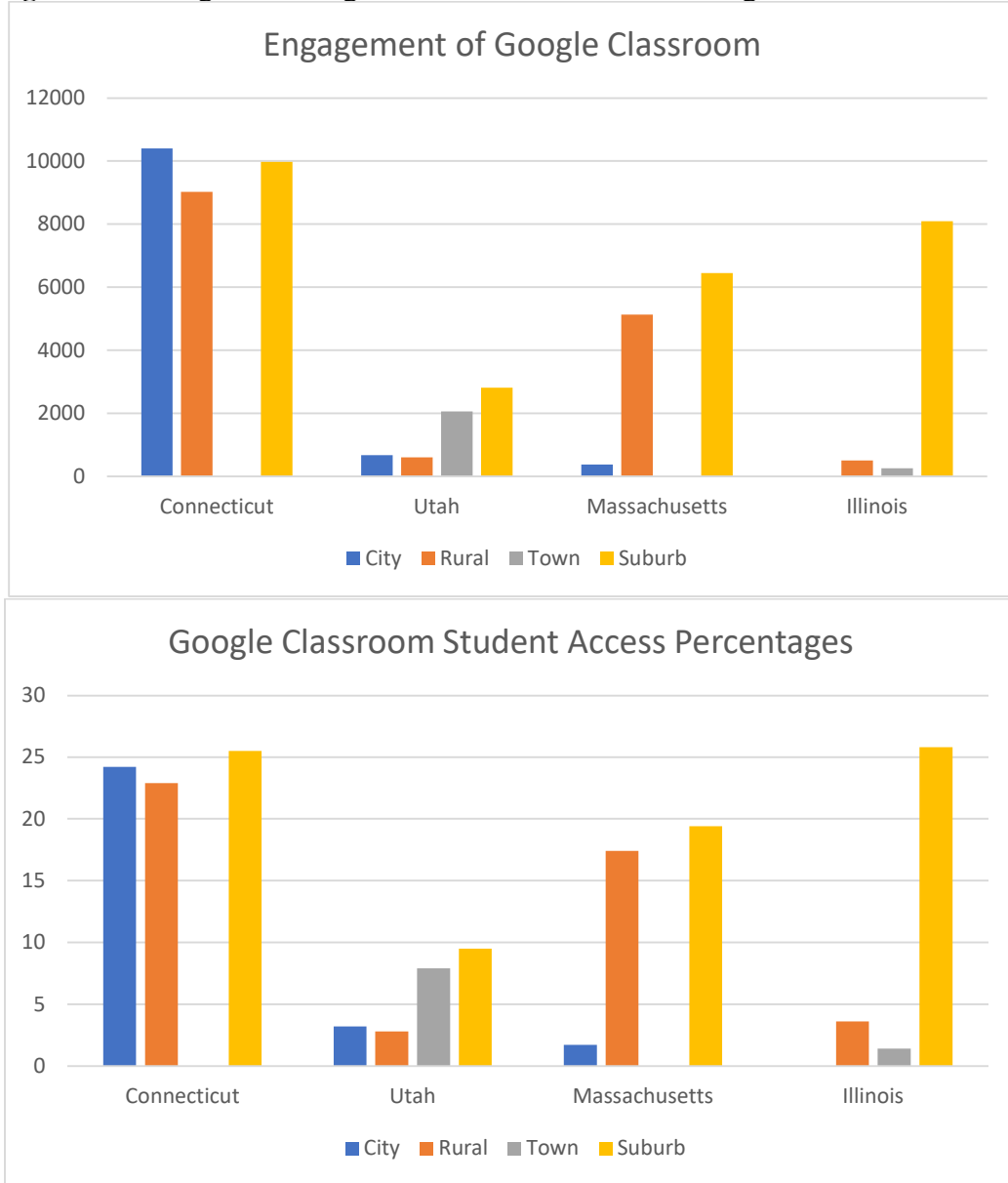


Figure 7: Average Number of Page Loads per 1000 Students of the Google Classroom Product

The bar graph in Figure 6 demonstrates the student access percentages for districts belonging to the states that had the largest sample size in the engagement database and is divided into the different locales types. Results indicate that Illinois’s and Conneticut’s suburb districts have the highest student access percentage for this particular product.

As for the bar graph of Figure 7, the highest engagement for google classroom comes from the city districts in Connecticut.

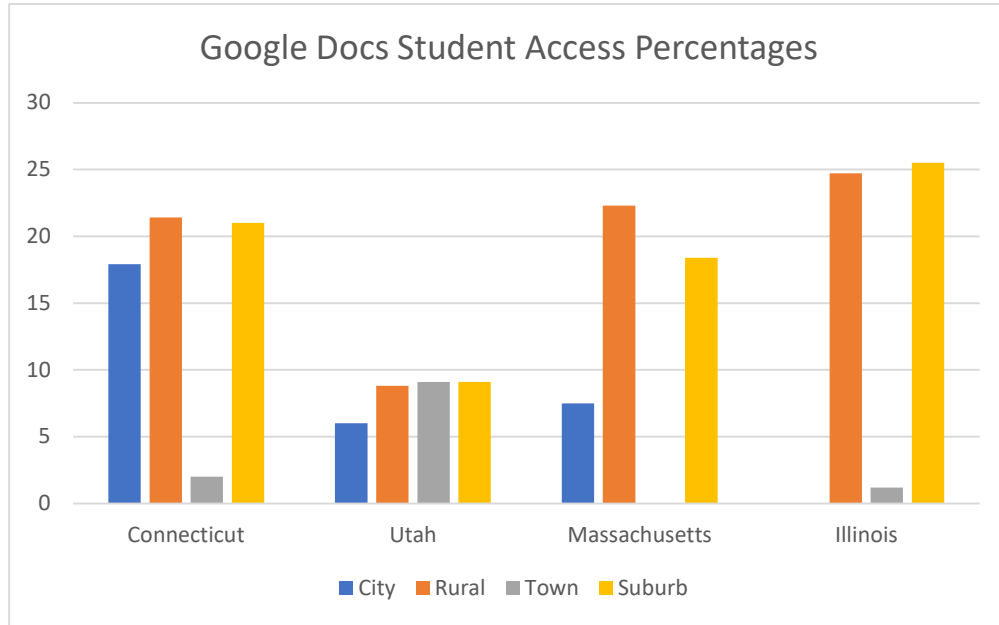


Figure 8: Average Percentage of student access for the Google Docs Product

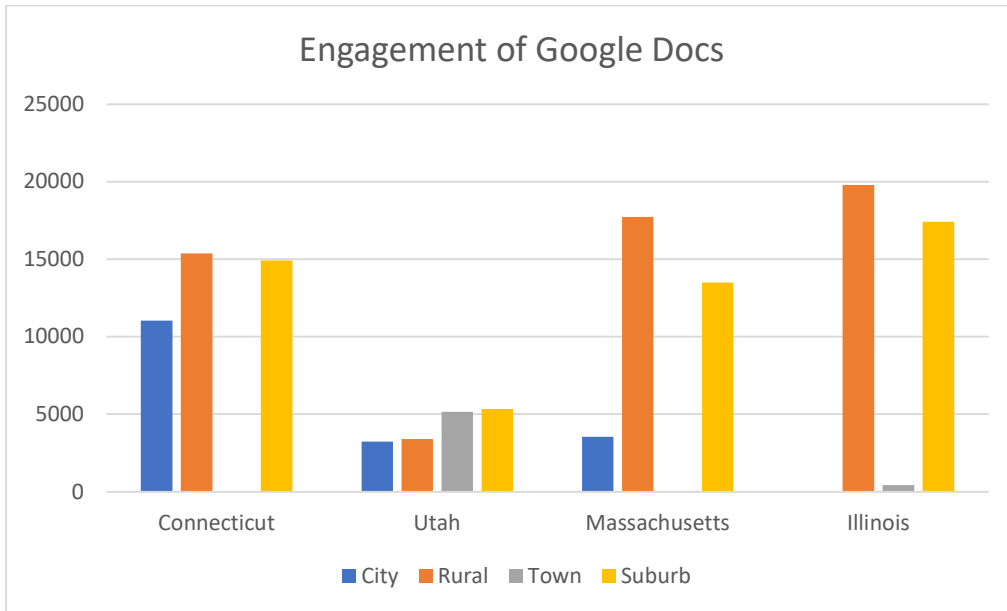


Figure 9: Average Number of Page Loads per 1000 Students of the Google Docs Product

These bar graphs show the percentage of student accesses and engagement for the google docs product that possessed the highest engagement. Results show that districts from Massachusetts and Illinois contained the largest engagement for this product.

Table 12: Products with Highest Engagement for Districts of All States

State	Sample Size	Product	Total Usage (%)	Suburb Usage (%)	City Usage (%)	Rural Usage (%)	Town Usage (%)
Connecticut	30	Google Docs	96.67	100	50	100	NA
Utah	28	Google Docs	46.42	50	25	0	66.67
Massachusetts	21	Google Docs	95.23	94.44	100	100	NA
Illinois	18	Google Docs	88.89	92.85	NA	100	0
Ohio	11	Google Docs	90.9	87.5	100	100	100
California	11	Google Docs	63.63	75	50	100	NA
New York	8	Google Docs	62.5	0	100	100	NA
Indiana	7	Google Docs	71.42	0	50	100	100
Missouri	6	Google Docs	83.33	100	0	NA	100
Washington	5	Google Docs	60	0	100	NA	NA
Virginia	4	Google Docs	75	100	0	100	NA
North Carolina	4	Canvas	50	100	0	0	NA
Wisconsin	3	Google Docs	100	100	NA	NA	NA
Michigan	2	Google Classroom	50	50	NA	NA	NA
		Google Meet	50	50			
Tennessee	2	Kahoot	50	0	NA	100	NA
		Google Docs	50	100			
New Hampshire	2	Google Docs	100	NA	NA	100	NA
New Jersey	2	Google Docs	50	50	NA	NA	NA
		Google Meet	50	50			
District of Columbia	2	YouTube	100	NA	100	NA	NA
North Dakota	1	Kahoot	100	NA	NA	100	NA
Texas	1	Imagine Learning	100	100	NA	NA	NA
Arizona	1	Google Docs	100	NA	100	NA	NA
Florida	1	Google Docs	100	100	NA	NA	NA
Minnesota	1	Schoology	100	100	NA	NA	NA

Table 12 presents products with the highest engagement for each state. The percentage of usage of the product is also calculated. Distribution of the percentage of usage is also illustrated between the different locales. If more than one product is listed for a single state, this means that there existed ties between products that demonstrated highest engagement for the districts of that state, while “NA” simply means that no districts fell under the locale category listed.

Conclusion

To conclude the findings of the study, each database measured different aspects of students’ experience with the pandemic. The most concrete findings were derived from the stress ratings and engagement of digital products databases, but the performance database did not offer any conclusions as to how student grades were affected. Thus, it is necessary to continue experimenting over this data using other testing methods or possibly gathering more data. Overall, the students rated their stress highest during the pandemic, and the digital platforms of google classroom and google docs possessed the largest engagement of the districts tested. Since most of the findings apply to middle school and high school grade levels, this study can be expanded further to venture the pandemic’s effects on other education levels

Presenter: Tyler Stuck

Major in Electrical Engineering and Mathematics

Mentor: Dr. Yueqing Li

Research in Driving Safety

Department of Industrial Engineering



The Visual Behavior and Performance of Young Drivers in Construction Zones and Nighttime Driving

The vast majority of individuals involved in motor vehicle accidents are teens and young drivers (Mueller & Trick, 2012) (Robbins & Chapman, 2019) (Bao, Wu, & Sayer, 2020). The result of being frequently involved in motor vehicle accidents is apparent when looking at the leading cause of death *for young people in the United States*. Between the years 1999 and 2019 the leading cause of death for those of age 15 to 24 involved motor vehicle traffic (Centers for Disease Control and Prevention, 2020). The most accepted factor that leads to these accidents was found to be inexperience (Konstantopoulos, Chapman, & Crundall, 2010) (Mueller & Trick, 2012) (Bao, Wu, & Sayer, 2020). Experience shapes multiple aspects of a driver's behavior but identifying its influence on visual behavior may provide a way of reducing the frequency of car accidents.

This study attempts to identify the effect of inexperience by comparing the visual behavior of young and older drivers under different visibility and driving conditions. The participants will drive under two different visibility and two different driving conditions in a driving simulator. Participants will complete four driving scenarios, daytime-free driving, daytime-construction zone driving, nighttime-free driving, and nighttime-construction zone driving. Eye tracking software will be used during each scenario to measure the visual behavior of the participants. The eye tracking software will capture visual fixation and pupil dilation data. This visual behavior data will then be compared between the two age groups to determine if there is an effect of inexperience on visual behavior. We expect that the older, experienced age group will have better visual behavior than the younger, inexperienced age group. This research was able to be conducted through the support of the Office of Undergraduate Research and Lamar University's Driving Simulator Lab.

Bibliography:

Bao, S., Wu, L., & Sayer, J. R. (2020). An examination of teen drivers' car-following behavior under naturalistic driving conditions: With and without an advanced driving assistance system. *Accident Analysis and Prevention*, 1-7.

Centers for Disease Control and Prevention. (2020, February 20). 1999-2019, United States Unintentional Injuries Ages 15-24. Centers for Disease Control and Prevention. Retrieved January 5, 2022, from <https://wisqars.cdc.gov/fatal-leading>

Article is found by submitting a request with the year parameters 1999 to 2019, then selecting the 15-24 age group.

Konstantopoulos, P., Chapman, P., & Crundall, D. (2010). Driver's visual attention as a function of driving experience and visibility. Using a driving simulator to explore drivers' eye movements in day, night, and rain driving. *Accident Analysis and Prevention*, 827-834.

Mueller, A. S., & Trick, L. M. (2012). Driving in fog: The effects of driving experience and visibility on speed compensation and hazard avoidance. *Accident Analysis and Prevention*, 472-479.

Robbins, C., & Chapman, P. (2019). How does drivers' visual search change as a function of experience? A systematic review and meta-analysis. *Accident Analysis and Prevention*.

Presenter: Lac Nguyen

Major in Industrial Engineering

Mentor: Dr. Robert Kelley Bradley

Research in Nanocomposites

Department of Industrial Engineering



An Investigation of Environmentally Friendly Filler for Polymer Nanocomposites

Introduction

Nanocomposites are created by the incorporation of nanofillers that have nano-scale lengths in at least one dimension. Plastic polymers are non-biodegradable which can create environmental problems because it can take hundreds of years for them to be degraded (Honarvar, 2016). The nanocomposite can improve the physical properties of a polymer consisting of mechanical strength, thermal stability, and gas barrier properties (Arora, 2010). Polymers have been used in packaging applications due to their functionality, lightweight ease of processing, and low cost. The use of synthetic polymers can be found anywhere in food packaging where they provide mechanical, chemical, and microbial protection from the environment (Arora, 2010). Plastic discarded as waste can originate from many sources, one common source is food packaging. Food packaging is often discarded, and the use of biodegradable filler to replace some percentage of the polymer can have a positive environmental impact. Thermoplastic like polyethylene is used widely in food packaging, however, our work has focused on silicone due to the equipment available to us.

The purpose of my research is to study the properties of silicone composites made with nanoparticles of ball-milled rice hulls. Filler made from plant material is biodegradable and the goal is to replace as much silicone with filler as possible while maintaining the desirable properties of the silicone. Rice hulls are an important part of commercial agriculture in Southeast Texas because rice hulls are an agricultural byproduct of rice farming.

Materials and Methods

Rice hulls were milled into particles by using an Across VQ-N 80mL High Energy Ball Mill. The rice hulls were compounded with silicone materials in the Three-roll mill The Torrey Hills T50-HT. A mold was created by using a CNC milling machine. Me and Dr. Bradley had to use the g-code to drill the mold. I cast the mixed silicone

immediately after the Three-roll mill. We used The Hitachi S-3400N Scanning Electron Microscopy to study the mixed silicone.

Results

The following is the experimental design

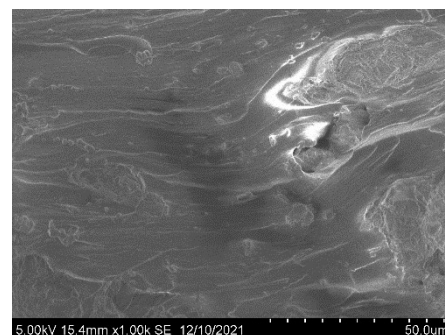
Ball size	Weight	Time
20mm	0.31g	10 min
20mm	1.00g	7 min
20mm	1.08g	5 min
6mm	1.34g	5 min
20mm	2.01g	5 min
6mm	2.33g	10 min
20mm	2.41g	15 min
10mm	2.78g	15 min
20mm	2.80g	15 min
20mm	3.14g	10 min
10mm	3.31g	10 min
20mm	4.00g	10 min
20mm	4.53g	20 min

Current progress includes process development for milling rice hulls, compounding the milled rice hulls with silicone, and curing the silicone in an aluminum mold to make test samples. The advantage of the aluminum mold is very convenient because we can put the mixed silicone in the aluminum mold after using the 3 rolling mills. Figure 1 is a photo of a test sample and figure 2 is a Scanning Electron Microscope Image of the sample.

Figure 1: After casting



Figure 2: SEM Image



Future Work

Data on the performance of the mixed silicone will be collected using dielectric spectroscopy and tensile strength testing. These data will be used to find to optimal processing parameters to maximize the inclusion of rice hulls while maintaining good mechanical properties.

Conclusion

I learned a lot about improving efficiency through process development during the research project. The project helped me gain experience in experimentation and process improvement. This valuable experience has helped me to become a better engineer student. As part of the project, I arranged a tour of the ExxonMobil Polyethylene Plant in Beaumont, TX which is allowed me and 14 other Lamar students to learn more about plastics.

Acknowledgments

We think the Office of Undergraduate Research for funding this work and Exxon Mobil for providing the tour of the PE Plant.

Bibliography

1. Arora, Amit, and G. W. Padua. "Review: Nanocomposites in Food Packaging." *Journal of Food Science*, vol. 75, no. 1, 2010, pp. R43–49. *Wiley Online Library*, <https://doi.org/10.1111/j.1750-3841.2009.01456.x>.
2. Ronca, Sara. "Chapter 10 - Polyethylene." *Brydson's Plastics Materials (Eighth Edition)*, edited by Marianne Gilbert, Butterworth-Heinemann, 2017, pp. 247–78. *ScienceDirect*, <https://doi.org/10.1016/B978-0-323-35824-8.00010-4>.
3. Azeredo, Henriette M. C. de. "Nanocomposites for Food Packaging Applications." *Food Research International*, vol. 42, no. 9, Nov. 2009, pp. 1240–53. *ScienceDirect*, <https://doi.org/10.1016/j.foodres.2009.03.019>.
4. Honarvar, Zohreh, et al. "Nanocomposites in Food Packaging Applications and Their Risk Assessment for Health." *Electronic Physician*, vol. 8, no. 6, June 2016, pp. 2531–38. *PubMed Central*, <https://doi.org/10.19082/2531>.
5. Salavati-Niasari, Masoud, et al. "Ball Milling Synthesis of Silica Nanoparticle from Rice Husk Ash for Drug Delivery Application." *Combinatorial Chemistry & High Throughput Screening*, vol. 16, no. 6, July 2013, pp. 458–62. *PubMed*, <https://doi.org/10.2174/1386207311316060006>.
6. "Recycled & Bio Fillers." *Composition Materials Co.*, 4 Dec. 2012, <http://compomat.com/fillers-extendors/>.
7. "Because You Asked: What Is Silicone And How "Green" Is It?" *Recyclebank*, <https://livegreen.recyclebank.com/column/because-you-asked/what-is-silicone-and-how-green-is-it>. Accessed 25 Sept. 2021.

Presenter: Jennifer Arredondo

Major in Industrial and System Engineering

Mentor: Dr. Robert K. Bradley

Research in Silicone Nanocomposite Ferroelectret

Department of Industrial and System Engineering



Exploration of Parameters for Developing a Silicone Nanocomposite Ferroelectret

In this research, we are investigating ferroelectrets, a cellular polymer foam that can convert compressive and bending forces into electrical signals (Luo, Zhu, and Beeby 2016), Our objective is to engineer ‘foam’ by combining thin sheets of silicone that contain arrays of ‘voids’ or ‘pockets’ by stacking them on top of each other. Research questions include 1) can we control the movement of a ferroelectret by engineering the ‘voids’ or ‘pockets’ in the silicone? and 2) can an engineered silicone foam be made via this technique? A study of AC corona discharge treatment to improve adhesion between silicone sheets was conducted. Corona discharge will be investigated as a surface treatment to bond silicone base on a method of bonding used to combine molded layers as well as the alignment of the interconnections between layers. (Yang, Wang. 2009) Samples will be analyzed using a dielectric spectroscopy system and a piezometer.

Materials and Methods

We used Sylgard 184, In order to mix the elastomer base and curing agent via a Torrey Hills T50-HT 3-roll mill, a machine that uses stress applied through rotating wheels to help mix materials together. We used the aluminum plates and Kapton tape cut with an Epilog M2 Fusion Laser cutter to make the molds. The tape is made to endure the elevated temperature from the laser cutter. Molds were also made entirely from aluminum by using a CNC milling machine and custom g-code. An Electro-Technic Products BD-20AC Laboratory corona treater was used to give the silicone sheets an adhesive property again after being cured in the oven.

In making laser-cut molds, molds are built from the Kapton tape. The walls of the mold are 3 layers of tape tall with a single layer of tape cut into circles in the middle.

In the process of the aluminum molds, the dimensions were generated by G-coding. Then, using the CNC milling machine to achieve the precise cuts needed.

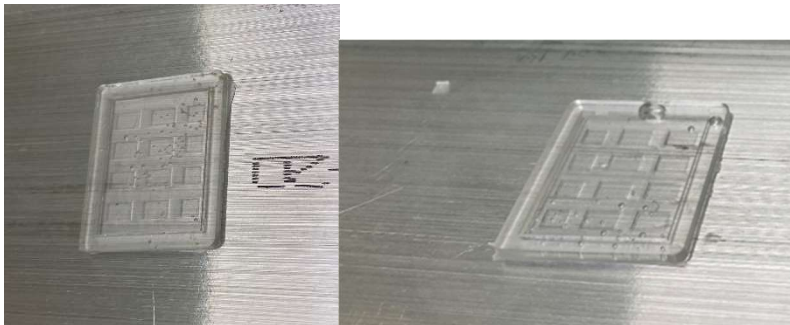
For both the laser-cutter and the aluminum molds, the process of making the castings is the same. By adding a drop of silicone into the mold and using a second aluminum plate to squeeze out the excess silicone. Cure the silicone at about 150C for 20 minutes in the Quincy Lab 10GC Gravity Convection Lab Oven. Making multiple silicone castings and using the corona treater on each one. Finally, we assemble the castings together- creating a material with engineered voids.

Results

The advantage of the laser-cutter molds was the ability to quickly make new molds. The main disadvantage of these molds was that the silicone would turn out very delicate, almost thin jelly-like, so it would easily tear when pulling it up from the mold. When we would attempt to bring the silicone out of the mold, the Kapton tape would produce it. We could not find a solution for this issue, which is why we moved onto aluminum molds.



The advantage of the aluminum molds is having the molds come out sturdy, compared to the delicacy of the laser-cutter molds. The walls made from pure silicone, rather than the Kapton tape, provided for easier removal of the entire casting without ripping the silicone.



To ensure all sheets are even after adding a drop of silicone to the mold, an additional plate is placed on top to squeeze out excess silicone. Both molds had issues with the silicone curing with the top aluminum plate used to remove the excess material and create an even layer – a thin layer of Vaseline on the plate was able to resolve this.

Future Work

A study exploring the adhesion between the silicone sheets will be conducted further. Additionally, a comparison between the silicone sheets' voltage measurements will be made using the dielectric spectroscopy vs the piezometer. Once a piezoelectric response is detected, process parameters will be studied to optimize the response.

Conclusion

This project benefited me as a student by sharpening my critical thinking skills and allowing me to network with those around me in the Engineering department. I collaborated with several different professors, and students, to help make progress throughout this project.

Bibliography

C. Yang, W. Wang and Z. Li, "Optimization of corona-triggered PDMS-PDMS bonding method," 2009 4th IEEE International Conference on Nano/Micro Engineered and Molecular Systems, 2009, pp. 319-322, doi: 10.1109/NEMS.2009.5068586.

Luo, Z. Zhu, D and Beeby, S. (2016, March 14). An Electromechanical model of ferroelectret for energy harvesting. <https://iopscience.iop.org/article/10.1088/0964-1726/25/4/045010/meta#smsaa16d3s1>

Presenter: Corina Mena

Major in American Sign Language

Mentor: Dr. Zanthia Smith

Research in Deaf Studies & Deaf Education

Department of Deaf Studies & Deaf Education



Hispanic/Latinx Students' Perceptions of Diversity in Interpreting

Abstract

Hispanic/Latinx students are under-represented in Interpreter Training Programs (ITP) across the United States. They make up only a small percentage of the overall number of certified sign language interpreters. Their perceptions of the field of sign language interpreting are rarely addressed in the literature. Having such a small footprint, it is critical to provide insight whenever possible. A group of Hispanic/Latinx student interpreters shared their perceptions of their thoughts about the impact of culture on occupational expectations, motivation, preparedness, and the field of interpreting in general. The study consisted of individual interviews and a focus group consisting of the participants. Utilizing open coding and In Vivo, five themes arose (culture, previous experiences with interpreters, representation, mentoring, and recruitment).

Introduction

The field of sign language interpreting has suffered from a lack of ethnic diversity for many years. Additionally, as the need for sign language interpreters has increased, so has the need for Interpreters of Color, including those of Hispanic/Latinx heritage. Statistics compiled by the Registry of Interpreters for the Deaf (RID) from 2014 to 2019 indicate that the number of Hispanic/Latinx members ranged from 3 to 5% (RID, 2021). While the membership of RID has fluctuated during this timeframe, the number of Hispanic/Latinx members remains low. The increasing population within the Hispanic/Latinx deaf community (Call 2016) requires interpreters who are culturally sensitive to their communication needs (Warshaw, Crume & Pinzon-Perez, 2020), therefore, greater representation of Hispanic/Latinx students in interpreter training programs (ITP) is necessary. The perceptions of Hispanic/Latinx interpreting students may be instrumental in finding occupational expectations, motivation, and the cultural impact of training on interpreter preparedness.

Objective

The purpose of this study was to share the views and unique cultural experiences of Hispanic/Latinx interpreting students to promote greater diversity and inclusion in the field of interpreting.

Methodology

A questionnaire was developed to gain knowledge of the perceptions of Hispanic/Latinx students with respect to the impact of culture on the interpreting field. Following submission and approval of an Institutional Review Board (IRB), a convenient sample of Hispanic/Latinx students was recruited for individual interviews followed by a focus group discussion. Interactions were conducted through Zoom. Transcript texts were verified by watching the videos to confirm content accuracy. First and second cycle descriptive and In Vivo coding were used to determine the main themes.

Results

Five themes were found from individual interviews and the focus group discussion. The themes included culture, mentoring, previous experience with interpreting, preparedness, and advocacy. Culture impacts not only the decision to enter this field but also the perception of the community where services are offered. If the perception of disability is negative, that affects the willingness of individuals from the culture to enter the profession. As the numbers of trilingual members are small, access to mentorship from a cultural peer becomes challenging. Previous experience with interpreting tends to revolve around Spanish-to-English and vice versa. Trilingualism (Spanish, English, American Sign Language) usually comes into play when there is a deaf family member or friend. Recruitment into the field, outside of direct interaction, occurs through the instruction of the language (i.e., sign language classes). Preparedness is vital to success in the field of interpreting. The better prepared an individual is, the better they can acclimate to cultural aspects of the job. Interpreters of color serve a necessary role as advocates/allies for deaf/hard-of-hearing persons of color.

Conclusion

Knowledge of the impact of culture on the recruitment of students of color would benefit the field of interpreting. Through the lived experiences of the Hispanic/Latinx student interpreters can be used to predict the methods of recruiting and retaining other students of color to the field. Culture seems to have had the biggest influence on students' choice of major, retention in their program of choice, preparedness for entry into the profession, motivation to graduate, and advocacy for themselves and for members of the general Deaf community and specifically the Hispanic/Latinx Deaf community. Mentorship is the key to the successful training of students of color. Students indicated that mentorship is one of the aspects that inspires them to continue developing their skills so that they can thrive in the interpreting field.

Bibliography

Call, M. (2006). ASL/Spanish/English trilingualism of Hispanic/Latino deaf children in the United States. Retrieved March 21, 2012.

Registry of Interpreters for the Deaf (RID). (2021) Annual Reports. <https://rid.org/about-rid/governance/annual-reports/>

Warshaw, J. S., Crume, P., & Pinzon-Perez, H. (2020). Impact of service-learning on Hispanic college students: Building multi-cultural competence. *International Journal of Multicultural Education*, 22(3), 50-75.

Presenter: Taliah Belcher

Major in Accounting & Finance

Mentor: Dr. Gevorg Sargsyan

Research in Finance and Economics

Department of Business



Impact of Militarization on the Financial and Economic Growth of Developing and Highly Militarized Countries

The focus of this research project is to analyze the impact of militarization on the financial and economic growth of developing and highly militarized countries. There is debate on the effect of defense spending on the economy of a country. Many presuppose those military expenditures hinder the growth of an economy by reducing the size of capital resources available for investment in public goods and services (such as education, health care, developing infrastructure, etc.). The guns-versus-butter trade-off theory assumes that the use of resources for military expenditures prevents the resources from being used for the well-being of the public. The opportunity cost of spending on defense, rather than on infrastructure and social programs, is a huge burden to bear, especially for developing countries. In addition, defense spending drains out the skilled human capital from the economy into the military sector, thus depriving the economy and causing adverse effects on its growth. In an economy where resources are already scarce, proper allocation of capital must exist to achieve the optimal macroeconomic and financial goals.

To begin our research, we constructed a list of developing and highly militarized countries. Once creating this list, we utilized the Casual Multiple Regression Method in analyzing the effects of military expenditures on gross domestic product (GDP), foreign direct investment (FDI), investment growth, and import growth. Our results illustrated that defense spending has an inverse relationship with FDI, investment growth, and import growth in developing countries. For GDP, the results were inconclusive. This suggests that militarization can have damaging effects on the economy of a developing country. These conclusions are beneficial in determining how the allocation of funds for militarization over investments in public goods and services affects the economic and financial status of a country.

Presenter: Angel Flowers¹

Major in Biology

Mentors: Dr. Matt Hoch¹ and Dr. William R. Miller²

Research in Ecology

¹Department of Biology, Lamar University²Department of Biology, Baker University, Baldwin City, KS

Population Distribution Analysis of Tardigrades found on *Quercus virginiana* (Southern Live Oak)

Introduction

Tardigrades are bilateral, eight legged lobopods of the Panarthropoda clade best known for their ability to survive extreme environmental conditions, and even space, while in a cryptobiotic state (Kinchen, 1994; Jönsson et al., 2008; Nelson et al., 2010). These aquatic microinvertebrates can be found in every biome on earth living in the water trapped in the interstitial spaces of moss, lichen, detritus, and sediment of various environments (Nelson et al., 2018). Despite this, ecological studies are scarce, and the phylum remains relatively understudied (Nelson et al., 2018). Tardigrades, like other microorganisms, are indicators of the health of the larger ecosystem. Understanding their inner workings and role they play in the big picture is extremely important for future conservation efforts. As of July 2021, only 1,380 species have been described by science (Degma et al., 2021). Previous studies have focused on the identification of species on specific substrates and habitats, but there is little evidence to explain why or how these species exist within their preferred microhabitats. Tardigrades require only a thin film of water to be active, and those found in terrestrial environments generally survive in moist microhabitats of moss and lichens (Møbjerg et al., 2018). Formerly, tardigrades found in moss samples were collected within reach at ground level, however, studies of the canopy in the late 1960's revealed their presence well above ground level (Chang et al., 2015; Kimmel and Meglitsch, 1969; Erwin, 1982; Counts et al, 2001). Studies of tardigrade distribution patterns in trees have identified substrate (tree) selection, with some trees demonstrating a denser, more diverse population at the top of the tree (Miller et al., 2013; Chang et al., 2015; Mitchell et al., 2009).

Quercus virginiana, the Southern Live Oak, is easily identifiable by a massive, short trunk, buttressed base, and long sprawling branches (National Wildlife Federation, 2008). The trees offer collection points for tardigrades transmitted on the winds as they blow past, as well as for tardigrades hitching rides on the feathers

and feet of birds (Nelson et al., 2010; Ramazzotti & Maucci, 1983; Mogle et al., 2018). To date there is no publication on tardigrade population distributions in the *Q. virginiana* on the Gulf coast, USA. This research contributes to filling this knowledge gap by defining the distribution, density and diversity of tardigrade population of epiphytic moss on five tree features, roots, trunk, crotches, and limbs. The study site is a small 27-acre stand of *Q. virginiana* managed by the Texas Ornithological Society known as Sabine Woods Bird Sanctuary and located a few miles west of Sabine Pass, Texas, on the Gulf of Mexico. Its position on a chenier ridge dominated by coastal live oak trees surrounded by saltmarsh makes it a critical stopover for annual avian migrations including neotropical species (Port Arthur Convention and Visitors Bureau, 2022; Beaumont Convention and Visitors Bureau, 2022). This location was partly chosen because of the potential for migratory birds from North and Central America to deposit various species of tardigrades from afar during their stopovers. It was also chosen for the fact that it is barraged with warm, moist, Southern winds for much of the year, again believed to increase the chances for finding various tardigrade species.

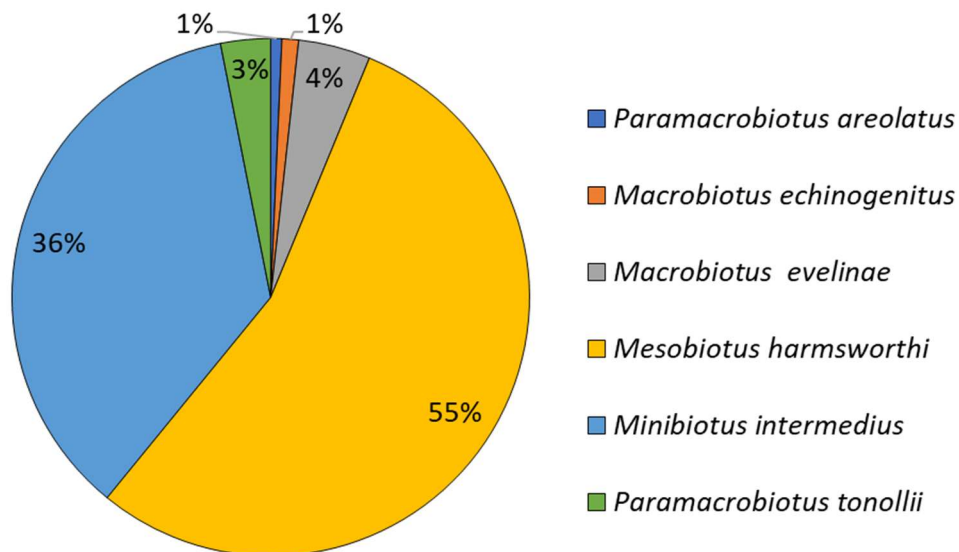
Materials and Methods

Five of the oldest, largest live oak trees were chosen for sampling in Sabine Woods Bird Sanctuary. A total of 12 moss samples were collected around each tree from each of four features: limbs, crotches, trunk, and roots. Sample was collected by scraping the moss off the tree bark with a knife into a labeled paper bag (Tibbs et al., 2016; Kim-Koutsis and Miller, 2019; Vilella et al., 2020). Distance from the ground and distance from the base of the tree were recorded for each sample, as well as directionality of the sample (N, S, E, W). The paper bags were stored in the field lab with a dehumidifier and moss samples were allowed to dry over the weekend. Once dry, one gram of moss was weighed and placed into a labeled 2oz cup with a lid (Tibbs et al., 2016; Kim-Koutsis and Miller, 2019; Vilella et al., 2020). Samples were prepared for sorting by adding 20 mL of DI water and soaking for 24 hours (Tibbs et al., 2016; Kim-Koutsis and Miller, 2019; Vilella et al., 2020).

From each sample cup, a 1 mL disposable pipet was used to place 1 mL of water and debris drawn from the bottom of the cup into each of three small petri dishes (Tibbs et al., 2016; Kim-Koutsis and Miller, 2019; Vilella et al., 2020). Another 10 mL of water from each sample was placed into a labeled tube for testing pH and conductivity. 5 uL of Bioquip double stain was added to each 1 mL subsample. This would stain the tardigrades and their eggs pink, making them much easier to find under the dissecting scope. Each 1 mL subsample was then searched thoroughly under 40x magnification, and any tardigrades or eggs found were extracted with an Irwin loop (Schram and Davison, 2012) and mounted in PVA mounting medium on a glass slide labeled with the sample number and either A, B, or C to indicate the subsample (Tibbs et al., 2016; Kim-Koutsis and Miller, 2019; Vilella et al., 2020). A cover slip was applied, and after a few days of allowing the mounting medium to dry, slides were

sealed with clear nail polish to preserve the specimen morphology (Tibbs et al., 2016; Kim-Koutsis and Miller, 2019; Vilella et al., 2020). Mounted tardigrades were viewed with an inverted microscope equipped with phase contrast and differential interference contrast optics at 40x and 200x and 1000x with oil immersion. Images were capture digitally for claws and buccal-apparatus to identify and document morphological variations. Using the characteristics of the cuticle, claws, and buccal-pharyngeal apparatus, identification of species was made using the key by Ramazzotti and Maucci (1983) and Pilato & Binda (2010). Molecular analysis of 18SrRNA and COI gene sequences were performed on the morphological variations (see Broussard et al. poster at this EXPO 2022) in conjunction with visual identification to confirm identification (Bertolani et al., 2010; Nelson et al., 2010; Boothby et al., 2018). The tardigrade counts from the three 1 mL pipetted aliquots of each sample were combined for relative density of the sample, and the number of species per sample is referred to as the sample richness (Kim-Koutsis and Miller, 2019; Vilella et al., 2020).

Figure 1. Percentages of tardigrade species for all identifiable specimens.



Results

Out of 60 moss samples, 321 tardigrades and six eggs were found. All total there were six species belonging to four genera of the tardigrade super-family Macrobiotidae: *Macrobotus echinogenitus*, *Macrobotus evelinae*, *Mesobiotus harmsworthi*, *Minibiotus intermedius*, *Paramacrobotus areolates*, and *Paramacrobotus tonollii*. Collectively the identifiable tardigrade specimens were dominated by *Mesobiotus harmsworthi* (55%) followed by *Minibiotus intermedius* (36%; Fig. 1). Single-factor ANOVA demonstrated that four tree features drives significant variation in both relative density ($p = 0.00849$) and species richness ($p = 0.03186$). A two-factor ANOVA tests the importance of individual trees, features, and their interaction on each parameter, relative

diversity and species richness. Neither trees, or their interaction with features explained significant variation for either relative density ($p > 0.05$) or species richness ($p > 0.05$). Sample relative density positively correlated with species richness ($p < 0.01$; $R^2 = 0.45$; Fig. 2A). Mean relative density ($\pm 95\%$ CI) was not significantly different among most feature type, except the branches had significantly greater mean density than in the roots (Fig. 2B). Mean species richness ($\pm 95\%$ CI) in branches was significantly greater than in the crotches, but there was no significant difference between the other tree features (Fig. 2B).

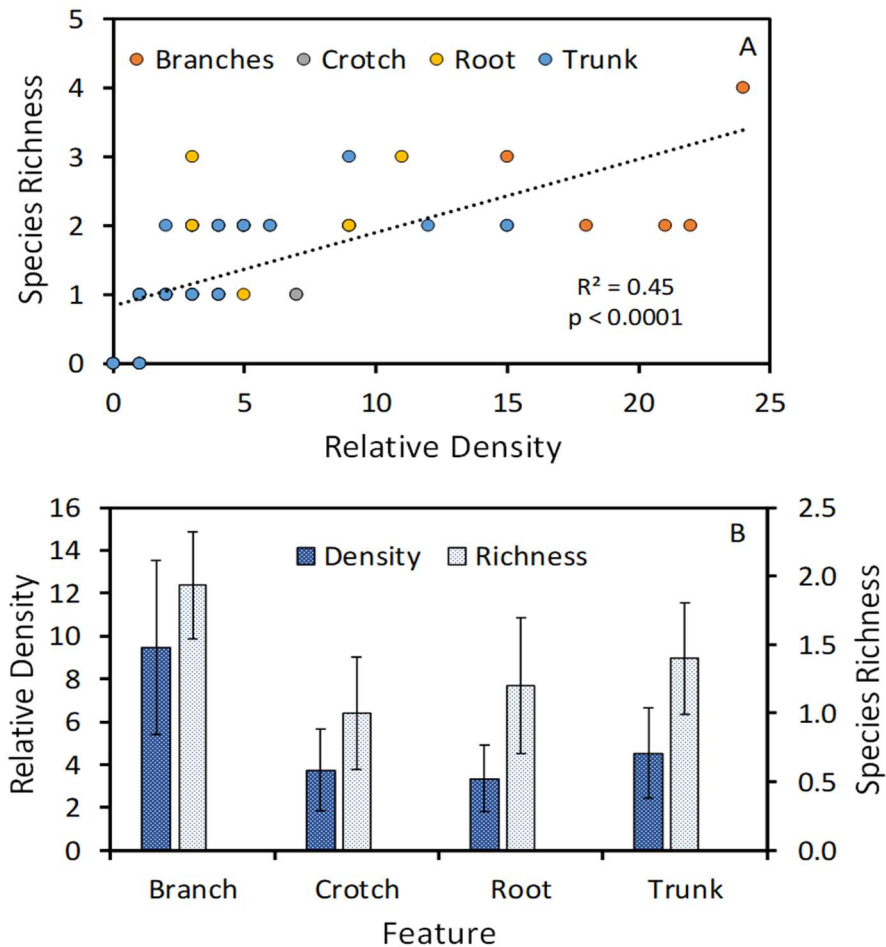


Figure 2. Relative density versus species richness of all sample from the four features (A) and means ($\pm 95\%$ CI error bars) of relative density and species richness for each feature type.

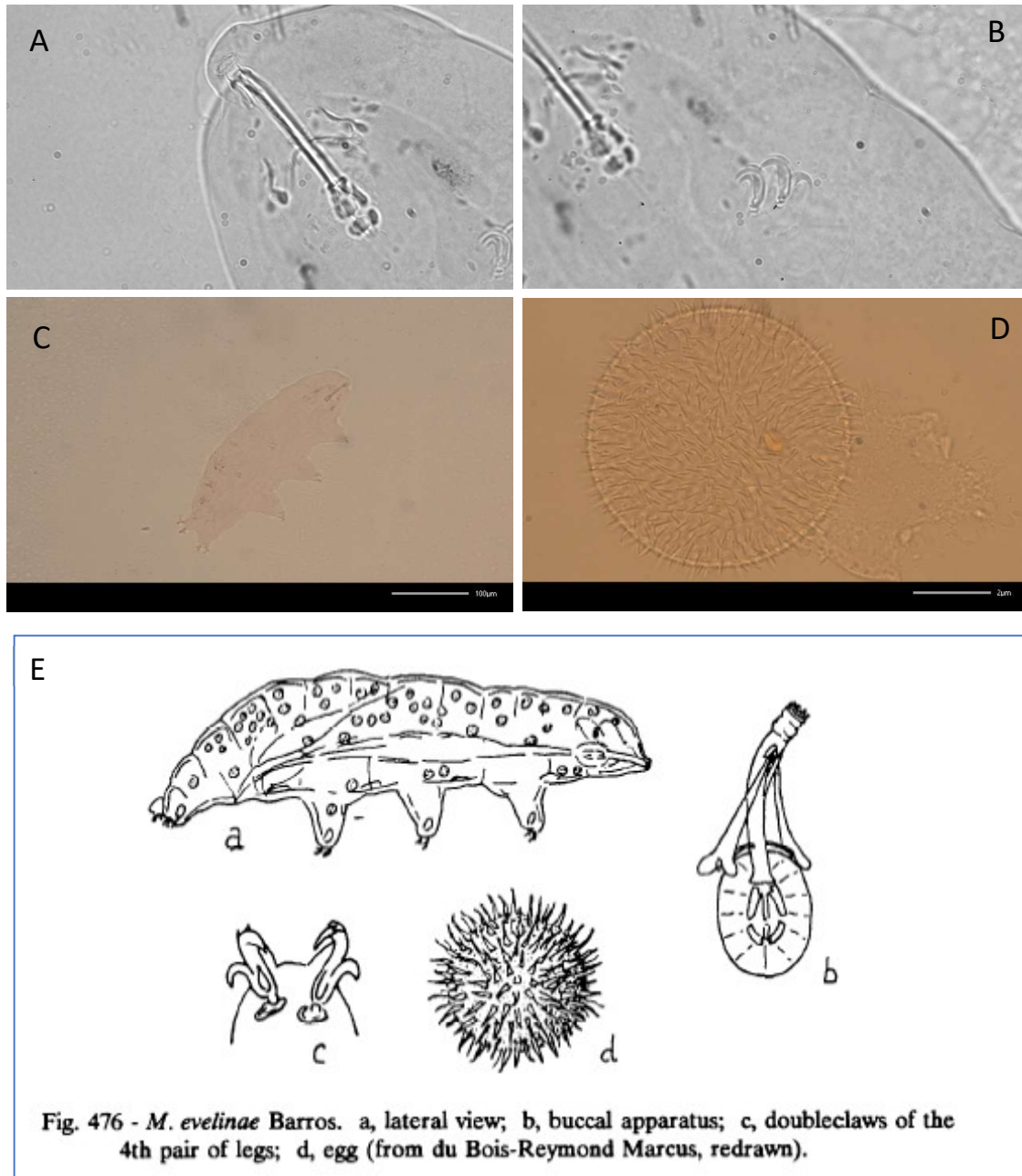


Figure 3. *M. evelinae* images from this study (A-D): 100x oil immersion of buccal-pharyngeal apparatus (A); 100x oil immersion of claws (B); 20x image of *M. evelinae* body (C); and 100x oil immersion of eggs of similar type of *M. evelinae* (D). Description of *M. evelinae* from Ramazzotti and Maucci, 1983 (E).

Discussion

Distribution analysis of the tardigrades found on the southern live oak reveal that their presence is greatly increased in epiphytic moss of the limbs or branches, which have greater height from the ground and distance

from the tree center. Branches were more heavily populated and there was a greater species richness moving from the tree center outward. Most interesting of note was the discovery of *Macrobotus evelinae* (Fig. 3A). This tardigrade was last described by de Barros in 1938 in Brazil (Fig. 3B; Ramazzotti and Maucci, 1983). It was listed in the 2021 edition of *Actual Checklist of Tardigrada Species* (Degma et al., 2021) as *nomen inquirendum* by Stec et al. (2021). This discovery of *M. evelinae* is the first in North America (Miller and Perry, 2019).

Acknowledgements

Funding for this project was provided by the Office of Undergraduate Research at Lamar University. Permission for sampling the Sabine Woods Bird Sanctuary was graciously provided by the Texas Ornithological Society. Also, a very special thanks to Alyssa Broussard for her assistance in sample collection and sorting of samples.

Bibliography

- Beaumont Convention and Visitors Bureau. (2022). *Sabine Woods: Beaumont's Best Birding Secret*. <https://www.beaumontcvb.com/things-to-do/birding/sabine-woods/>
- Bertolani, R., Rebecchi, L., Cesari, M. (2010). A model study for tardigrade identification. pp. 333-339 In: Nimis P.L., Vignes Lebbe R. (eds.) *Tools for Identifying Biodiversity: Progress and Problems*. ISBN 978-88-8303-295-0.EUT, 2010.
- Boothby T.C. (2018). Molecular Biology in Tardigrades. pp. 331-347 In: Schill R. (ed) *Water Bears: The Biology of Tardigrades*. Zoological Monographs, vol 2. Springer, Cham. https://doi.org/10.1007/978-3-319-95702-9_13
- Chang, L., Powell, D., Miller, W.R., & Lowman, M. 2015. Tardigrades of the Canopy: Evidence of Stratification. *Transactions of the Kansas Academy of Science*, vol 18(3-4): pp. 230-236
- Counts, J.W., Henley, L., Skrabal, M. and Keller, H.W. 2001 Biological jewels in the tree canopies. *Transactions of the Missouri Academy of Science* 35: pp. 69-70
- Degma, P., Bertolani, R. & Guidetti, R. (2021). Actual checklist of Tardigrada species. DOI: 10.25431/11380_1178608. Accessed 03.25.2022
- Erwin, T.L. 1982. Tropical Forests: their richness in Coleoptera and other arthropod species. *Coleopterists Bulletin*. 36: pp. 74-75
- Jönsson, K.I., Raboow, E., Schill, R.O., Harms-Ringdahl, M. and Rettberg, P. (2008). Tardigrades survive exposure to space in low earth orbit. *Current Biology* 18 (17): pp. 729-731
- Kinchin, I.M. (1994). *The Biology of Tardigrades*. Portland Press, London.
- Kim-Koutsis, A. and Miller, W.R. 2019. Tardigrades of North America: First records of six species of water bears in New York, U.S.A. *Transactions of the Kansas Academy of Science* 122(1-2):112-118.
- Kimmel, R.G. and Meglitsch, P.A. 1969. Notes on Iowa Tardigrades. *Iowa Academy of Science*. 76: pp. 454-462
- Miller, W.R., Gallardo, L., & Clark, T. 2013. Chapter 30: Do Water Bears Climb Trees Too? pp. 307-311 In: Lowman, M.D. (ed.), *Treetops at Risk: Challenges of Global Canopy Ecology and Conservation*, Springer, New York. https://doi.org/10.1007/978-1-4614-7161-5_30

- Miller, M.R. and Perry, E.S. 2019. Adjustments to the Annotated zoogeography of non-marine Tardigrada. Part III: North America and Greenland by Kaczmarek, Michalczyk & McInnes (Zootaxa 4203). Zootaxa 4543 (1): 099–114.
- Mitchell, C., Miller, W.R., & Davis, B. 2009. Tardigrades of North America: Influence of substrate on habitat selection. Journal of the Pennsylvania Academy of Science, vol 83(1): pp. 10-16
- Møbjerg, N., Jørgensen, A., Kristensen, R.M., Neves, R.C. (2018). Phylogeny and Integrative Taxonomy of Tardigrada. pp. 57-94 In: Schill R. (ed) Water Bears: The Biology of Tardigrades. Zoological Monographs, vol 2. Springer, Cham. https://doi.org/10.1007/978-3-319-95702-9_2
- Mogle, M.J., Kimball, S.A., Miller, W.R., McKown, R.D. (2018). Evidence of avian-mediated long distance dispersal in American tardigrades. PeerJ 6:e5035; DOI 10.7717/peerj.5035
- National Wildlife Federation, 2008. Field Guide to Trees of North America. Sterling, New York. pp. 430
- Nelson, D.R., Guidetti, R., Rebecchi, L. (2010). Tardigrada. pp. 455-484 In: Thorp, J.H. and Covich, A.P. (eds) Ecology and Classification of North American Freshwater Invertebrates. Elsevier, London.
- Nelson, D.R., Bartels, P.J., & Guil, N. (2018). Tardigrade Ecology. pp. 163-210 In: Schill R. (ed) Water Bears: The Biology of Tardigrades. Zoological Monographs, vol 2. Springer, Cham. https://doi.org/10.1007/978-3-319-95702-9_7
- Pilato, G., Binda, M.G. (2010). Definition of families, subfamilies, genera, and subgenera of the Eutardigrada, and keys to their identification. Zootaxa 2404: pp. 1-54
- Port Arthur Convention and Visitors Bureau. (2022). *Sabine Woods*. Visit Port Arthur Texas. <https://visitportarthurtx.com/things-to-do/attraction/sabine-woods/>
- Ramazzotti, G., Maucci, W. (1983). II phylum Tardigrada. Mem Ist Ital Idrobiol 41: pp. 1-1016
- Schram, M.D. and Davison, P.G. (2012) Irwin Loops- A History and Method of Constructing Homemade Loops. *Transaction of the Kansas Academy of Science*, 115 (1/2): pp. 35-40
- Stec, D., Vecchi, M., Calhim, S., and Michalczyk, L. (2021). New multilocus phylogeny reorganizes the family Macrobiotidae (Eutardigrada) and unveils complex morphological evolution of the *Macrobiotus hufelandi* group. *Molecular Phylogenetics and Evolution*, 160: 106987. <https://doi.org/10.1016/j.ympev.2020.106987>
- Tibbs, L.E., Emanuels, A. and Miller, W.R. 2016. Tardigrades of the Canopy: Argentine species *Milnesium beatae* Roszkowska, Ostrowska and Kaczmarek, 2015 (Eutardigrada, Milnesidae) discovered in the trees of Kansas, U.S.A. *Transactions of the Kansas Academy of Science*, 119(2):173-178.
- Villella, J., Miller, J.E.D., Young, A.R., Carey, G., Emanuels, A., and Miller, W.R. 2020. Tardigrades in the Forest Canopy: Associations with Tree Vole Nests in Southwest Oregon. *Northwest Science* 94(1):24-30.

Presenter: Margo Eugenio

Major in Interdisciplinary Studies, with EC-6 Generalist Concentration

Mentor: Dr. Mamta Singh

Research in Private Education

Department of Teacher Education



Impact of School Choice on Standardized Test Scores and the Achievement Gap

Abstract

The purpose of the study was to assess the impacts of school choice on standardized test scores and the achievement gap in diverse student populations. The study used secondary resources and datasets published from 2010 to 2021 to identify qualitative and quantitative evidence that impacts school choices and their relationship with standardized test scores. The findings suggest that school choices had a positive impact on student achievement, thus, widening the achievement gap between diverse student populations. The study recommends equitable access to resources to minimize further development of the achievement gap between populations without access or means to attend school choice.

1. Introduction

It would be irresponsible for us to deny that far too many of our public schools are experiencing low student performance, due to a variety of issues; consequently, parents and guardians are encouraged to seek out alternative options, in hopes of fostering a better, more comprehensive education. Our goal, as a society, should be to provide and ensure equitable education- investing in staff and administrative development, incorporating social-emotional learning into classroom curricula, and guaranteeing access to high-quality learning environments. However, the funding necessary for these measures to be taken is, instead, being put into school choice programs that tend to amplify socioeconomic disparities.

School choice was an idea first introduced in modern America in the 1950s and 1960s as part of massive resistance to desegregation. Southern states introduced the idea to combat the ruling of *Brown v. the Board of Education*, attempting to recreate isolated, exclusive classrooms. However, the federal courts ruled this

unconstitutional in the 1970s, and school choice programs shifted focus to how public funding could support religious schools. Resistance to desegregation is only a portion of the history regarding school choice vouchers; during the 1960s, various left-leaning figures supported the idea of school choice, citing the program’s potential to create more equitable educational opportunities. School choice programs saw a new wave of support in the 1990s, as many African American politicians grew frustrated with the shortcomings in urban education. Despite the bipartisan support school vouchers seem to have, the support is not unanimous.

A large part of the controversy surrounding school choice programs stems from a financial perspective. These programs utilize tax credits, which drain money from underserved public schools to provide for private schools and other school choice programs. While some private schools and other school choice programs claim that they will “improve education opportunities for Black and Brown students and students from low-income families,” the reality is that they do not (Pierce, 2021). Rather, enrollment trends in private schools highlight a majority white student body, free from any economic disadvantages.

School choice programs emphasize educational disparities and allow public schools to continually face funding challenges. The resource disparities between public and school choice programs contribute to the longstanding gaps in student education.

1.1 Socioeconomic status and the achievement gap

Socioeconomic status (SES) refers to the social standing of an individual or group. It is often a combined measurement, encompassing income, educational progress, financial stability, and social status and class. SES analyzes the quality of life, considering the privileges associated with certain people in society. SES has a considerable impact on a student’s educational career as a result.

Students from low-income families and communities develop academic skills at a much slower rate than those from higher-income families and communities; low SES in childhood, for example, is linked to poor cognitive development, language, memory, and social-emotional processing. Furthermore, low-SES communities’ school systems are frequently underfunded, further impacting children’s academic development and achievement. The realities of such disparities highlight test score variances and, resultantly, the achievement gaps that have remained unchanged over several decades.

The systematic disparities between student populations create fundamental achievement gaps between socioeconomic classes. The persistent gap in resources and academic outcomes from students with low-SES need be addressed; however, as mentioned, the funding necessary to rectify this achievement gap is split.

1.2 School choice demographics

School choice programs not only take away funding from underserved schools, but also attract populations with higher SES due to their financial stipulations. Such programs can install tuition fees, maintenance fees, and other monetary requirements that help to further fund the school. Due to the costly nature of such programs, a student with a low-SES background may not be able to attend simply because they are not able to afford such stipulations; resultantly, the student must attend public schools that often lack the resources needed to fully support student achievement. While there is nothing inherently wrong with the demographics able to attend school choice programs, it is important to note how this could contribute to a socioeconomic achievement gap. If students with high-SES can consistently attend school choice programs that do not fear a lack of resources or support, the academic gap between such students and low-SES students begins to widen. Therefore, the purpose of this study was to assess the impact school choice programs had on test scores and the overall achievement gap. The study addresses the following research objectives-

- a. Identify the impacts schools of choice have on test scores
- b. Identify the impacts schools of choice have on the achievement gap

2. Methods

The study used an exploratory method based on existing literature. Fifteen journal articles published between 2010 to 2021 were reviewed. The articles were retrieved from journals including- American Applied Journal: Applied Economics, Children and Youth Services Review, National Assessment of Educational Progress, AERA Open, SSRN Electronic Journal, British Educational Research Journal, Social Psychology of Education, Economic Insights, Journal of Indonesian Applied Economics, American Enterprise Institute, Education and Urban Society, Journal of Education Finance, Economics of Education Review journals. These articles were retrieved from Lamar University Library Journal search engine and Google Scholar using keywords to search for specific topics/articles, including- “School choice” + “attainment,” “Private school vs. public school,” “Public schools + test scores,” “Private schools+ test scores,” “Achievement gap + private school + public school,” “Effects of a private school on test scores,” “Effects of a private school on the achievement gap,” “Effects of public school on test scores,” and “Effects of public school on the achievement gap.”

Each article was reviewed through an analytical scope, evaluating the findings that corresponded with the research topic and supported the hypothesis- school choice programs have a significant impact on standardized testing and, thus, the socioeconomic achievement gap. Furthermore, additional studies that contradicted the goal

of the research were assessed to identify the differences. The study used vocabularies such as school choice, achievement gap, specific population, as defined below.

- School Choice

- a program in which students are given the choice to attend a school other than their district's public school (as at a charter school, private school, home school, or at a public school in a different district) – Merriam-Webster

- School choice allows public education funds to follow students to the schools that best fit their needs- whether that is to a public school, private school, charter school, home school, or any other learning environment families choose- (EdChoice, n.d.)

- the Voluntary Public-School Choice Program supports efforts to establish or expand intra-district, inter-district, and open-enrollment public school choice programs to provide parents, particularly parents whose children attend low-performing public schools, with expanded education options. This includes charter schools, magnet schools, private schools, and homeschools- U.S. Department of Education (US Department of Education, 2014)

- Achievement Gap

- The “achievement gap” in education refers to the disparity in academic performance between groups of students. The achievement gap shows up in grades, standardized-test scores, course selection, dropout rates, and college completion rates, among other success measures- (Ansell, 2011)

- the term achievement gap refers to any significant and persistent disparity in academic performance or educational attainment between diverse groups of students, such as white students and minorities, for example, or students from higher-income and lower-income households. – (The Glossary of Education Reform, 2013)

- Specified populations are defined in this study by students with a low-SES background versus those with a high-SES background.

3. **Findings & Discussion**

The average price of tuition for school choice programs, scholarships aside, is \$10,940; as seen in Figure 1, the costly nature of these programs suggests a “strong positive role of family income in predicting private-school enrollment” (Murnane et al., 2018). When compared to public high school pupils, those in private schools came

from households with a higher socioeconomic position (Hitt et al., 2018). Private schools have higher fees that are associated with an added higher value that make them more attractive than public schools (Davies & Davies, 2014). Resultantly, the “well-educated affluent parents who send their children to private schools may be less interested in devoting their political and social capital to advocating for better public schools,” further contributing to the under-served nature of public schools that inhibits test scores (Murnane et al., 2018). The under-served nature contributes to the overall achievement gap, becoming victims of the unfair success rate.

The disinterest in public schools continues to academically disadvantage those who attend. Especially as the fact presides that a student’s SES is among the strongest determinant of learning in a school environment (Coleman et al., 1966, as cited in Berkowitz, 2021). In fact, as portrayed in Figure 2, “on average, students who attended private high schools scored higher on academic tests at age 15 and had higher levels of educational attainment by age 23, than students who attended public high schools” (Frenette & Chan, 2015). More specifically, “charter schools had a significant and positive effect on language arts and math scores” (Hitt et al., 2018). Those who had attended a private high school are, on average, more likely to “have graduated from high school, attended and graduated from a post-secondary institution, and began graduate or professional studies,” as seen in Figure 3 (Frenette & Chan, 2015). Furthermore, “CTE schools had positive and significant impacts on ELA and math scores, high school graduation, college attendance, and graduating with a four-year college degree” (Hitt et al., 2018). Across the board, school choice programs are more able to provide a better academic career.

The impact school choice programs have on test scores and, more generally, the achievement gap is not exclusive to American education; verily, this impact is seen globally. With Seoul's new school choice legislation, the variance in students' test results increased as better students segregated themselves into autonomous private high schools (Jaesung & Jisoo, 2018). Additionally, in a study conducted through Brazil’s educational system, “it is observed that, for all quantiles, the students attending public schools score less” compared to their private school counterparts; moreover, the students with richer families perform better (Rodrigues de Oliveira et al., 2013). Furthermore, “...there are differential effects across school types in Seoul such that autonomous private high schools’ test scores increased substantially whereas other (regular, autonomous public, and special purpose) high schools’ test scores fell” (Jaesung & Jisoo, 2018).

The gap in student success is the result of a lack of inputs in public schools (Rodrigues de Oliveira et al., 2013) As mentioned, school choice programs have financial requirements for attendance that their public counterparts do not have. As such, “private schools detain more resources at their disposal to invest in structure, whereas public schools rely solely on public funding” (Rodrigues de Oliveira et al., 2013). The sole reliance on

public funding results, across the board, in public schools that are underserved, maintaining a severe lack of resources that cannot afford greater test scores or the narrowing of the achievement gap.

The reality is that school choice programs have greater financial benefits that allow such programs greater access to a variety of resources (i.e., the ratio of computers to students is often smaller in private institutions). This outreach creates a positive impact on test scores compared to public counterparts. Whilst that fact alone may not be problematic, the implications of such a fact contribute to the widening of the achievement gap, as private institutions and high-SES families continue to be better equipped to academically succeed. Comparatively, public institutions and low-SES families are consistently underserved and left behind to fight against inequities.

4. **Conclusion**

The data implies that school choice programs had a favorable impact on student achievement, measured through test scores, which expands the overall achievement gap between differing student groups, defined by their socioeconomic classifications. The study suggests that equitable access to resources be implemented to reduce the achievement gap between populations that do not have access to or the financial means to attend school of their choice.

5. **Bibliography (APA)**

Abdulkadiroğlu, A., Pathal, P. A., & Walters, C. R. (2018). Free to Choose: Can School Choice Reduce Student Achievement? *American Applied Journal: Applied Economics*, 10(1), 175-206. <https://www.aeaweb.org/articles?id=10.1257/app.20160634>

Allen, Sharonda. "Eradicating the Achievement Gap: History, Education, and Reformation." *Black History Bulletin*, vol. 71, no. 1, 2008, pp. 13-17. ProQuest, <https://www.proquest.com/openview/c908f4d082a1ee21220196e74f4ae41c/1?pq-origsite=gscholar&cbl=15762>.

Berkowitz, R. (2021). School climate and the socioeconomic literacy achievement gap: Multilevel analysis of compensation, mediation, and moderation models. *Children and Youth Services Review*, 130. Science Direct. <https://doi.org/10.1016/j.chilyouth.2021.106238>

Braun, H., Jenkins, F., & Grigg, W. (2006, July). Comparing Private Schools and Public Schools Using Hierarchical Linear Modeling. *Institute of Education Sciences: National Assessment of Educational Progress*. Retrieved October 2021, from <https://nces.ed.gov/nationsreportcard/pubs/studies/2006461.asp>

Brewer, T.J. (2019). NEPC Review: The 123s of School Choice: What the Research Says About Private School Choice: 2019 Edition. National Education Policy Center. <http://nepc.colorado.edu/thinktank/school-choice>.

Cowen, J. M., & Creed, B. (2017). School Choice and Student Achievement: Evidence from Michigan's Interdistrict Open Enrollment System. *AERA Open*, 3(3), 1-12. <https://eric.ed.gov/?id=EJ1194188>

Choi, J., & Hwang, J. (2014). The Effect of School Choice on Student's Academic Performance: Evidence from Policy Change in Korea. *SSRN Electronic Journal*. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2417170#

Davies, P., & Davies, N. M. (2014). Paying for quality? Associations between private school income, performance, and use of resources. *British Educational Research Journal*, 40(3), 421-440. 10.1002/berj.3107

Day, E., & Dotterer, A. M. (2020). Does school choice have implications for parents' social capital and adolescents' academic outcomes? *Social Psychology of Education*, 23, 815-836. Springer Link. <https://doi.org/10.1007/s11218-020-09560-4>

Frenette, M., & Chan, P. C. W. (2015). Why Are Academic Prospects Brighter for Private High School Students? *Economic Insights*, 44. <https://files.eric.ed.gov/fulltext/ED585314.pdf>

Harvard Graduate School of Education. "Studies Show School Choice Widens Inequality: Popular Among Parents, But Little Evidence that Children Learn More." Harvard, 1995, <https://www.gse.harvard.edu/news/95/07/studies-show-school-choice-widens-inequality-popular-among-parents-little-evidence>. Accessed 23 September 2021.

Hendajany, N. (2016). The Effectiveness of Public vs. Private Schools in Indonesia. *Journal of Indonesian Applied Economics*, 6(1), 66-89. doi:<http://dx.doi.org/10.21776/ub.jiae.2016.006.01.4>

Hitt, C., McShane, M. Q., & Wolf, P. J. (2018). Do Impacts on Test Scores Even Matter? Lessons from Long-Run Outcomes in School Choice Research. American Enterprise Institute. <https://www.aei.org/wp-content/uploads/2018/04/Do-Impacts-on-Test-Scores-Even-Matter.pdf>

Jeynes, W. H. (2014). School Choice and the Achievement Gap. *Education and Urban Society*, 46(2), 163-180. <https://doi.org/10.1177/0013124512447101>

Murnane, R. J., Reardon, S. F., Mbekeani, P. P., & Lamb, A. (2018). Who Goes to Private School? *Education Next*, 18(4). <https://www.educationnext.org/who-goes-private-school-long-term-enrollment-trends-family-income/>

National Center for Education Statistics. "Education Indicator: An International Perspective." NCES, <https://nces.ed.gov/pubs/eiip/eiip45s1.asp>. Accessed 24 September 2021.

Neymotin, F. (2010). The Relationship between School Funding and Student Achievement in Kansas Public. *Journal of Education Finance*, 36(1), 88-108. JSTOR.

Pierce, R. (2021, May 6). The Racist History Of "School Choice." *Forbes*. Retrieved March 31, 2022.

Rodrigues de Oliveria, P., Belluzzo, W., & Pazello, E. T. (2013, August). The Public-Private Test Score Gap in Brazil. *Economics of Education Review*, 35, 120-133. Science Direct. <https://doi.org/10.1016/j.econedurev.2013.04.003>

Rotherham, A. J., & Markell, J. (2017, July 25). The History of School Choice Is Complicated | Knowledge Bank. USNews.com. Retrieved April 1, 2022, from <https://www.usnews.com/opinion/knowledge-bank/articles/2017-07-25/the-history-of-school-choice-is-complicated>

The Nation's Report Card. (2011). NAEP Achievement Gap Dashboards. National Assessment of Educational Progress. Retrieved October 2021, from https://www.nationsreportcard.gov/dashboards/achievement_gaps.aspx

Presenter: Tiya Davi

Major in Humanities and Arts

Mentor: Dr. Mamta Singh

Research in Pre-service Teachers

Department of Teacher Education



Assessing Preservice Teachers' Understanding of Disease and its Spread using Scientific Illustrations and Virtual Labs - Preliminary Findings

Introduction

Drawing methods have been utilized for a variety of purposes. Scientists have been using methods of illustrations in science education since the early 20th century (Landin, 2015). They have found that discoveries that have been captured through drawings could have never been captured through words. Teacher education has been the most effective way of providing knowledge and skills to preservice teachers to understand the complicated parameters related to the subject areas and pass them on to growing minds. The study assessed preservice teachers' understanding of disease and its spread through a series of assessments, virtual labs, and surveys. The study identified certain indicators, common terminology, and illustrations that were used to address research questions: 1. Did preservice teachers increase their *knowledge and understanding* of disease and its spread? 2. How did preservice teachers' *perception* of disease and its spread change? 3. How did preservice teachers' *visual representation* of disease and its spread change?

Methods

Preservice teachers enrolled in science methods for teachers' course were the participants in the study: Virtual lab: twenty-one participants (pre-post) multiple-choice questions; Final survey: fourteen participants; and Virtual worksheet: thirteen participants (worksheet data has not been analyzed yet). The study was first conducted with a pilot survey that consisted of 2 open-ended questions. Following the pilot survey, the final survey and post-assessment were developed and administered. Twenty-one preservice teachers participated in virtual interactive labs (pre-and-post- assessments) consisting of 5 multiple choice questions on disease and its spread content knowledge assessments (explorelarning, 2022). Nineteen preservice teachers participated in explaining their understanding of disease and its spread by drawing. Pre-post assessments were administered in the 2nd and 4th

week of the spring semester, respectively, preservice teachers were given 40-45 minutes to complete the virtual lab and survey based on the disease spread.

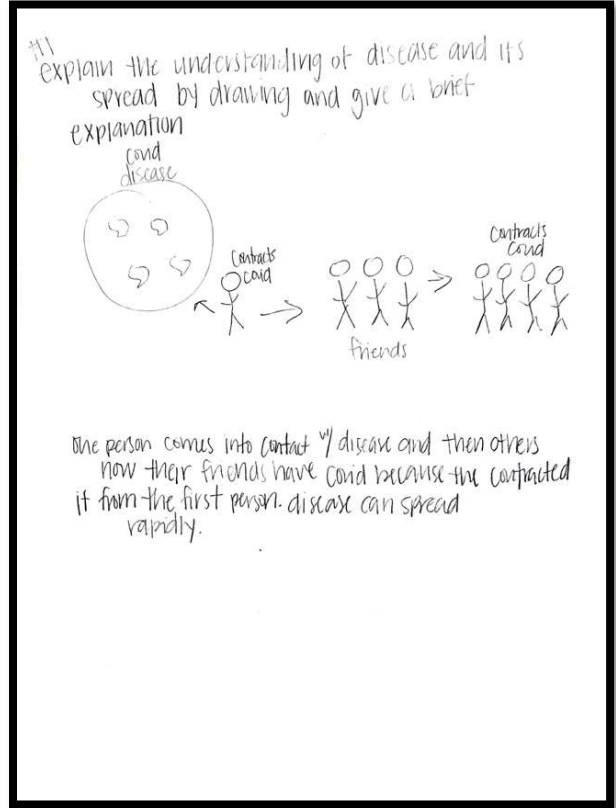
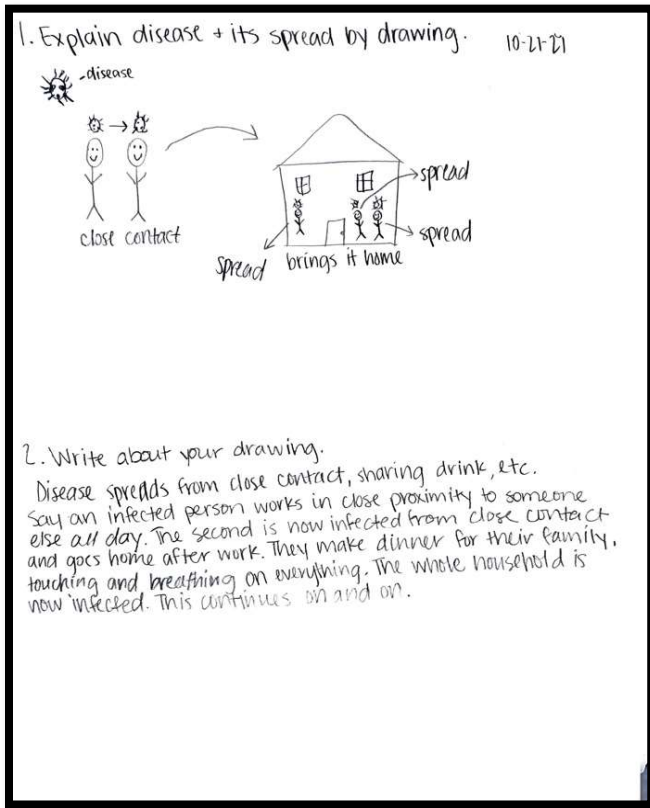
Findings:

The study findings are represented by three different instruments as stated below: A pilot survey, virtual pre-post assessments, and a final survey.

Pilot Survey Results

Table 1: Survey conducted with open-ended questions to assess the knowledge of preservice teachers' understanding of disease and its spread.

Questions	Responses
1. Explain the understanding of disease and its spread by drawing.	The preservice teachers answered this question using the method of drawing and by this, there were many common indicators used such as, coughing, sneezing, touching, etc. Broadness of the illustrations also were demonstrated by how the preservice teachers exactly pictured disease and its spread. For example, some would demonstrate disease and its spread by drawing more than 3 people, as for some would just draw 2 or 3 people making interactions. Depicted in image 1 and 2.
2. Provide a brief description of the drawing.	Since many of the preservice teachers used the method of labeling on the pictures, it was quite easy to explain what they saw. However, even with the different illustrations the preservice teachers drew out, everyone used similar vocabulary. This showed that most students used the same terminology when describing disease and its spread but when it came to illustrating their knowledge on disease and its spread, they all had different viewpoints.

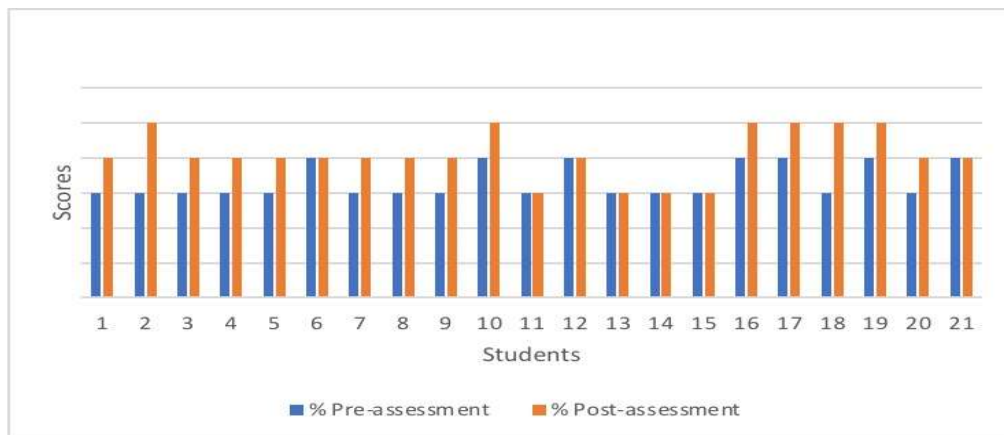


Images 1 & 2: Preservice teachers' understanding of disease and its spread

Virtual Lab (Pre-Post Online Assessment) Results

Pre-post online assessment results indicate as shown that most of the preservice teachers were able to incorporate their knowledge from the first assessment and virtual lab worksheets into the post-assessment and achieve a higher score. Therefore, the preservice teachers were able to get a better understanding of disease and its spread through virtual assessments. Results are depicted in Figure 1.

Figure 1: Pre-Post Content-Based Knowledge



Final Survey Results:

Table 2: The survey conducted a series of questions to assess the knowledge of preservice teachers’ understanding of disease and its spread.

Questions (Q)	Answers (A)
1. Below draw and reflect upon your understanding of disease spread?	Many of the preservice teachers answered this question by indicating the causes of diseases such as touching, coughing, sneezing, etc. This is reflected in the viewpoint of the students and how they identified the spread of disease.
2. What is your definition of disease spread?	Most of the preservice teachers would describe what is portrayed in question number one and go off the image they drew out as reference while others would go in more of an in-depth explanation to how and why diseases spread.
3. What type of vocabulary would you use to describe this?	The preservice teachers chose terms such as contagious, germs, bacteria, contact, sickness, etc. Their usage of these terms defined their knowledge of disease and its spread.
4. Would you learn better about a specific disease using pictures or reading off content? Or both?	Most preservice teachers chose terms such as contagious, germs, bacteria, contact, sickness, etc. Their usage of these terms defined their knowledge of disease and its spread. Figure 2 represents the results from this question.
5. What are some diseases that you are familiar with?	Diseases such as coronavirus, flu, cold, etc. were commonly used by the preservice teachers.
6. What are the common symptoms of these diseases?	Symptoms such as coughing, pain, nausea, fatigue, and vomiting were often used as an answer.

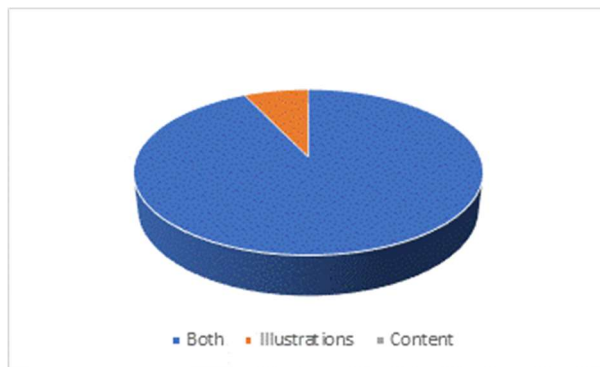


Figure 2 (referring to Q4): Preservice Teachers’ method of Learning about Disease and its Spread.

Discussion

The findings from the current study which is related to drawings and their relation to understanding the scientific content are related to the findings of Chambers (1983), Frick (1990), Mason *et al.* (1990) because they discuss the social image of a scientist similarity like the present study, which is to discuss the viewpoint of disease and its spread through the perspective of preservice teachers. The conclusions of Chambers (1983) identified at what age children first developed distinctive images of the scientist but did not address drawing out a scientific illustration and were not tested with preservice teachers. Frick (1990) attempted to investigate Greek Children's impression of scientists and their work through drawings and semi-structured interviews. This article addressed students' perception of scientists but did not use the idea of preservice teachers' understanding of scientists. Mason, Kahle, & Garnder (1990) extra listed a study showing the need for the image of a scientist to change because of the effect it has on a students' learning environment. Although this article demonstrates the element of drawing it does not discuss the viewpoint of preservice teachers towards the spread of disease. Similarly, the instruments and conception of the current study, Vamos, Xie, & Yeung (2019) recent study concluded that health education is beneficial for the preservice teachers to increase their knowledge and preparation for teaching school health. Although the research assesses pre-service teachers' knowledge of health education through surveys and quantitative data, it lacks assessing preservice teachers' knowledge of disease and its spread.

Furthermore, Darling-Hammon, Branford, Lepage, Hammerness, and Duffy (2007) explain how teachers learn certain teaching methods and the targeted audience of the article is ore-service teachers that are interested in the education field. The study shows interest in how teachers learn; however, it does not regard information on the teaching of diereses and its spread. Landin (2015) explains that drawing was a social science research method that began in the early 20th century and was required as part of the school curriculum. This research article showed the significance of drawing in science, however, does not specifically ask students to picture their knowledge of disease and its spread by using the method of drawing. Mosley's *et al.* (2002) study shows the effects of teaching outdoor environmental education on preservice teachers, this study also relates to Darling-Hammon *et al.* (2007) which also explained the learning environment pre-service teachers. Although both studies use the knowledge of preservice teachers as an important element, they did not mention their knowledge of the disease and its spread which is mentioned in the current study. After comparing and contrasting, it has been concluded that there is a limited amount of research done over assessing preservice teachers' understanding of scientific illustration and no research done on their understanding of disease and its spread.

Conclusions

The purpose of this study was to assess preservice teachers' understanding of disease and its spread through scientific illustrations and virtual labs. Furthermore, the survey responses revealed interesting findings such as 95% of preservice teachers prefer both content and illustration-based knowledge because every description requires a picture, and every image requires an explanation, as well as 76% of students, scored higher on the post-assessment than the pre-assessment, and 24% of preservice teachers' results did not change.

Acknowledgments

The authors of this study would like to thank The Office of Undergraduate Research for its funding support.

Bibliography

- Chambers, D. W. (1983). Stereotypic images of the scientists: The draw-a-scientist test. *Science Education*, 67: 255–265.
- Darling-Hammond, L., Bransford, J., LePage, P., Hammerness, K. and Duffy, H. (eds.) (2007) *Preparing Teachers for a Changing World: What Teachers Should Learn and be Able to Do*. San Francisco, CA: Jossey-Bass.
- Flick, L. (1990). Scientists in residence programs are improving children's image of science and scientists. *School Science and Mathematics*, 90: 204–214.
- Landin, J. (2015, September 4). Rediscovering the forgotten benefits of drawing. Retrieved on March 22nd 2021 from <http://blogs.scientificamerican.com/symbiartic/rediscovering-the-forgottn-benefits-of-drawing>.
- Mason, C., Kahle, J. G., & Gardner, A. L. (1991). Draw-a-scientist test: Future implications. *School Science and Mathematics*, 91:193–198.
- Moseley, C., Reinke, K., & Bookout, V. (2002). The Effect of Teaching Outdoor Environmental Education on Preservice Teachers' Attitudes toward Self-Efficacy and Outcome Expectancy. *The Journal of Environmental Education*, 34: 9-15.
- Vamous, S. & Xie, X, & Yeung, P. (2020). Effects of a health education course on preservice teacher's preparedness, knowledge, and beliefs in teaching health education. *Journal of School Health*, 90: 224-233. DOI: 10.1111/josh.12868

Presenter: Damaris Thrash

Major in Exercise Science

Mentor: Dr. Shannon Jordan

Research in Exercise Science

Department of Health and Kinesiology

**Effects of Motivational Music on Post-Exercise Recovery**

Previous studies have been conducted to analyze the physiological effects listening to motivational music has on exercise performance. For music to be considered “motivational”, literature suggests a tempo of 120-140 bpm if it is expected to elicit a positive response during high-intensity exercises. However, there is a scarcity of research analyzing the effects of music during the post-exercise recovery period (EPOC). Due to this, my research study was meant to examine the effects of types of music on exercise recovery.

With OUR support, my mentor Dr. Shannon Jordan and I were able to carry out this project. With the funds provided, we purchased materials needed to conduct this experiment, including filters, hoses, and headgear for the Lamar University Health and Kinesiology Department’s ParvoMedics Metabolic Cart (in order to measure metabolic gas exchange variables) and the book *Applying Music in Exercise and Sport* by Costas I. Karageorghis. This textbook provided the Music Brunel Rating Inventory (MBRI), a validated survey tool that was used to assess the degree to which is deemed motivational.

While working on this research project, I learned many new skills that will be beneficial to me in the future, as one of my goals is to attend graduate school. These new skills include becoming more proficient in taking exercise blood pressure, analyzing data, and using Excel. Dr. Jordan has also taught me how to calibrate and perform maintenance on the metabolic cart, as well as analyze lactate samples.

Previously, ten healthy, college-age (non-smokers, 18-30 years) people participated in a pilot study using this protocol. Currently, five additional participants are in various stages of completing the protocol. The goal is to have 20 participants total for the final data analysis. Each participant completed an initial evaluation – including providing an informed consent and a PARQ+ (an IRB approved screening tool). Participants meeting the criteria performed a treadmill exercise test to determine their aerobic fitness level (VO_{2peak}). Throughout the test heart rate (HR), blood pressure (BP), and lactate were monitored, along with metabolic gas exchange. Next,

participants performed at 70% of their VO_{2peak} for three different exercise trials in which they would listen to different types of music during the recovery period of each session. Participants completed three trials in random order:

Exercise	Recovery
Motivational Music	No Music
Motivational Music	Motivational Music
Motivational Music	Calming Music

Exercise recovery was determined based on post-exercise gas exchange data, heart rate, blood pressure, and blood lactate. Data were organized into an excel sheet and analyzed in the statistical program SPSS. At this time, a total of ten participants have finished the experiment by completing all five visits. Five additional participants have completed some of their visits to the lab but not all, and we are continuing to recruit participants until we reach 20 participants. We will continue to schedule these participants and complete their data collection. The data we present in this final report will be for the ten completed data sets, as incomplete data sets pose an issue with analysis. Once the other participants complete their trials (which we anticipate prior to the conclusion of spring 2022 semester), we will add their data to the analysis in SPSS.

Our findings, to date, show no difference in recovery when comparing the three different trials. This conflicts with our research hypothesis that calm music or no music would allow the participants to recover more quickly during the EPOC. In the attached data table, you can see the means \pm SD for heart rate, lactate, VO_2 (absolute and relative), ventilation (VE), respiratory rate (RR), and respiratory exchange ratio (RER). When the statistical analysis was performed in SPSS, there were no significant differences between music trials for any physiological variable associated with recovery during the EPOC. The additional completed data sets will allow us to determine if this trend is accurate or if the pilot data set of $n=10$ was too small to determine statistical significance.

Throughout this process, there were challenges we faced and overcame, one being when a participant's braces made it difficult to fit the mouthpiece in their mouth correctly, causing it to pop out in the middle of their run. Since the trial was not completed, the participant had to reschedule while the team retrieved a mouthpiece

that was shaped differently and more suitable for the participant's condition. Another problem manifested itself with scheduling and the number of participants able to complete all five visits of the experiment.

Personally, I also found monitoring blood pressure to be a little challenging; it can be difficult to detect Korotkoff sounds (the sounds emitted while recording a person's blood pressure) when the person being monitored is running; their constant arm movement can affect the gauge, and their footfalls can make it difficult to hear. For this experiment, motivational music was required during exercise at a certain volume, adding to the noise levels. However, as I grew more experienced, I also grew more confident in my readings.

While I have had the opportunity to present my pilot study at the Ninth Texas STEM Conference and will present at the EXPO 2022, I hope to present my updated research at the Spring 2023 Texas American College of Sports Medicine meeting and subsequently at the national conference for the American College of Sports Medicine. Following this, my mentor and I plan to prepare a manuscript for a publication in a peer-reviewed scientific journal within the field of exercise science.

This experience fueled my interests for this topic and my love for the study of exercise science in general. Not only has it made me more confident in my abilities and what I want my future career to revolve around, but it has created a much more curious mind and stimulated a great and newfound appreciation for research within me as well. If I had known how much I would come to enjoy research through this experience beforehand, I would have applied for SURF and OUR and all the opportunities they offer sooner. As it is, I cannot wait for future chances to conduct more studies.

Exercise Intensity During 20-minute Exercise Trials

	Absolute VO ₂ (L/min)	Relative VO ₂ (ml/kg/min)	Percent VO ₂ peak	Max Heart Rate (bpm)	Percent HRmax
No music	2.1 ± 0.7	24.29 ± 6.57	70.1 ± 4.59	187 ± 7	81.4 ± 4.7
Motivational	2.1 ± 0.6	23.73 ± 6.44	72.3 ± 4.8	188 ± 7	82.8 ± 5.4
Calm	2.1 ± 0.7	23.13 ± 6.71	69.8 ± 4.7	188 ±	83.4 ± 6.7

N=10. The objective of exercise intensity at 70% of VO_{2max} was confirmed as seen above.

		No Music	Motivational Music	Calm Music
Heart Rate (bpm)	IPE	136 ± 12	146 ± 13	135 ± 14
	7 Min Post	98 ± 9	100 ± 8	100 ± 8
	15 Min Post	92 ± 8	91 ± 8	91 ± 9
SBP (mmHg)	IPE	152 ± 18	165 ± 25	160 ± 17
	7 Min Post	131 ± 13	131 ± 18	131 ± 18
	15 Min Post	124 ± 7	124 ± 9	121 ± 8
DBP (mmHg)	IPE	75 ± 7	77 ± 8	77 ± 7
	7 Min Post	82 ± 6	82 ± 7	82 ± 4
	15 Min Post	82 ± 6	83 ± 8	81 ± 6
Blood Lactate (mmol/L)	IPE	4.2 ± 2.3	4.7 ± 2.6	4.5 ± 2.1
	7 Min Post	3.0 ± 1.6	3.1 ± 1.6	3.1 ± 2.0
	15 Min Post	2.1 ± 0.9	2.0 ± 1.1	2.1 ± 1.1

No significant differences between treatments for any time point.

SBP= Systolic Blood Pressure; DBP=Diastolic Blood Pressure

		No Music	Motivational Music	Calm Music
Absolute VO ₂ (L/min)	IPE	0.7 ± 0.2	0.7 ± 0.2	0.6 ± 0.2
	7 Min Post	0.4 ± 0.1	0.7 ± 1.2	0.4 ± 0.1
	15 Min Post	0.3 ± 0.1	0.3 ± 0.1	0.3 ± 0.1
Relative VO ₂ (ml/kg/min)	IPE	8.50 ± 2.25	7.86 ± 2.32	7.15 ± 2.38
	7 Min Post	4.20 ± 1.20	3.82 ± 1.17	4.11 ± 1.46
	15 Min Post	3.69 ± 0.94	2.99 ± 1.11	3.89 ± 1.24
Ventilation (L/min)	IPE	20.18 ± 6.06	19.94 ± 3.76	19.10 ± 5.55
	7 Min Post	11.48 ± 4.03	9.61 ± 2.48	10.25 ± 2.17
	15 Min Post	9.89 ± 4.33	7.17 ± 1.82	8.63 ± 2.57
Respiratory Rate (bpm)	IPE	21.00 ± 3.61	22.40 ± 3.10	22.80 ± 2.90
	7 Min Post	18.67 ± 3.94	19.70 ± 3.56	17.90 ± 4.56
	15 Min Post	16.11 ± 4.26	15.20 ± 2.30	16.20 ± 2.30
Respiratory Exchange Ratio	IPE	1.13 ± 0.11	1.13 ± 0.07	1.14 ± 0.05
	7 Min Post	0.97 ± 0.12	0.95 ± 0.06	1.02 ± 0.14
	15 Min Post	0.85 ± 0.07	0.90 ± 0.11	0.83 ± 0.05

No significant differences between treatments for any time point.

NON–OUR SPONSORED RESEARCH

Abstracts in the Alphabetical Order of the Main Presenter

STEM – In-progress / Poster #1

Presenter: Lisseth Aguilar

Major in Mechanical Engineering

Co-authors: Adrian Espinoza, Adrian Galvan, Jorge Magana, Mason Munoz, and Alexandra Villanueva

Mentors: Dr. Chatwin Lansdowne and Dr. Jenny Zhou

Department of Mechanical Engineering, Lamar

Antenna Mounting Structure for Celestial Lander

The antenna mounting landing structure project comes from the proposed TSGC design challenge. On missions to other celestial bodies, antennas play a vital role in providing proximity wireless communication coverage, which is why much of the mission cost and payload size is dominated by ensuring a successful deployment of the antenna. Our team is designing an antenna mounting structure for the NOVA-C Lunar Lander that can transform the lander into a cell tower capable of achieving a coverage radius of 10 km. The mast will be self-deployable in order to maintain payload size efficiency and safe passage to its destination. We are designing for no human intervention during the deployment process. We hope to provide an antenna mast structure with an extraordinarily high success rate while maintaining cost and weight efficiency. Because the antenna mounting structure is to be used on a moon lander, there are certain design specifications that must be considered. The structure will be able to withstand thermal extremes and exposure to dust and grit. Its mechanisms and structure will function in a vacuum. Finally, when deflected the structure will be able to return the antennas to a designed location and pointing angles.

Presenter: Eric Amador¹

Ph.D. candidate in Physics

Co-authors: Akhil RK. Kalapala¹, George Belev², Jeotikanta Mohapatra¹, Nil Pandey³, Ramaswami Sammynaiken⁴, Ping Liu¹, Weidong Zhou⁴, Wei Chen¹

Mentor: Dr. Wei Chen¹

¹Department of Physics, University of Texas at Arlington, Texas 76019.

²Saskatchewan Structural Sciences Centre, University of Saskatchewan, Saskatoon, Canada

³Department of Physics, Pennsylvania State University, Pennsylvania, 16802

⁴School of Chemistry and Chemical Engineering, South China University of Technology, Guangzhou, China

A New Composite of 1,4-bis(5-phenyloxazol-2-yl) Benzene and Aggregation-induced Emission Luminogens for White Light-Emitting Diodes

As the standards for white light emitting diode become higher and higher, research is being done to test our different source of white light to improve the lighting and their appliances. Here we show that is possible to use an organic scintillator in the blue region (POPOP) and a red emitting pyridinium based aggregation induced emission luminogens (TPEPy-PF6) complex which when illuminated by UV light, emits white luminescence. This mixture of both luminescent materials when placed onto a polymer matrix on top of a UV-LED chip can produce efficient white light source. TPEPy-PF6 has also been shown to produce singlet oxygen when exposed to NIR radiation, however Forster resonance energy transfer (FRET) is seen when both of these molecules are placed with 28 angstroms which could lead to a dual application for protein tagging and cancer destruction.

Presenter: Alyssa Broussard

Major in Biology

Co-author: Angel Flowers

Mentor: Dr. Matt Hoch

Department of Biology, Lamar

Single Tardigrade DNA Barcoding Using COI and 18S rRNA Genes on Six Morphotypes from the Upper Coast of Texas, USA

Phylum Tardigrada is part of the Panarthropoda clade which also contains Arthropoda and Onychophora. The phylum has two classes. Heterotardigrada and Eutardigrada, and each has two orders. Collectively, over 1,000 extant species have been described globally. About ten-fold more species are projected to be waiting discovery. These microscopic animals can be found in marine, freshwater, and limo-terrestrial habitats. Tardigrades are hard to identify by morphological analyses alone, so DNA barcoding must also be done to have a Tardigrade identified to the species level. This project performs DNA barcoding on six different tardigrade morphotypes found in moss from the ground and epiphytic moss in Sabine Woods bird sanctuary on the Upper Texas Coast, USA. Specimens of each morphotype were imaged under phase contrast microscopy and then genomic DNA of single tardigrades or their eggs was extracted. Regions of the 18S rRNA and mitochondrial cytochrome oxidase I (COI) genes were PCR amplified, validated by electrophoresis, and Sanger sequenced. Sequences were NCBI BLAST against known databases for determination of nearest identity.

Presenter: Natalia Calderon

Major in Political Science

Mentor: Dr. Brian Williams

Department of Political Science, Lamar

Environmental Regulation and Green Productivity Growth in the United States

Green productivity is an important concept because it allows for there to be a balance between economic growth and environmental protection for sustainable development. To better understand this concept, this study examines the effect environmental regulations have on green productivity in the United States. There is currently an abundance of research of green productivity in mainly European and Asian countries. These non-U.S. studies have employed various models such the Malmquist-Lenberger index, which is the most prevalent and is often used to assess environmental productivity growth with the inclusion of undesirable outputs.

There is a vast body of research, conducted from the 1960s to the early 2000s, which study the effects of environmental regulation on productivity growth in industries in the United States. However, there is a lack of research that thoroughly explores green productivity in the United States. This research utilizes descriptive statistics and predicted impact to find if there is a correlation between environmental regulations and the green productivity growth in the United States. The results from this research will help environmental policies to adopt environmental regulations that will not negatively affect the economy.

Presenter: Sai Krishna Chintha

Major in Computer Science

Mentor: Dr. Stefan Andrei

Department of Computer Science, Lamar

Design of a Counterfeit Bill Detector for Visually Impaired People

United States is the home for about one million visually impaired people and an additional three million people who are suffering from vision impairment even after correction. This is due mainly to the identical size and shape of all the currency notes these people are facing lots of difficulties in identifying the currency denominations in their day-to-day life. To overcome this drawback, the U.S. Bureau Of Engraving and Printing distributes the iBill reader (that is, a small device which tells us the denomination of the currency). Despite that, this iBill reader cannot identify counterfeit currency notes. In addition, there is one more mobile application called EyeNote, developed by the U.S. Bureau Of Engraving and Printing for visually impaired people to identify currency denomination. These tools may be not affordable for many of them because they need a smart phone. Hence, we would like to develop a device with which visually impaired people would be able to identify counterfeit currency notes.

Presenter: Lindsey Chirafis

Major in Political Science

Mentor: Dr. Terri Davis

Department of Political Science, Lamar

The Controversial Right to Die: An Analysis Between the Court's Rulings on Passive Assisted and Active Assisted Suicide

The U.S. Supreme Court ruled in 1997 that laws prohibiting physician-assisted suicide in New York and Washington State did not violate the Due Process or Equal Protection Clauses of the Constitution. The thrust of the Court's decision was that assisted suicide was not a fundamental liberty, and laws allowing or prohibiting assisted suicide is a power traditionally reserved to the states through the Tenth Amendment. My research examines how the Court has historically ruled on the issue of assisted suicide and examines the differences between cases involving passive assistance (allowing death through the withholding of sustenance or refrain from medical intervention) and active assistance (positively intervening to assist in death through medical intervention). I hypothesize the Supreme Court has traditionally been more willing to allow death through passive rather than active medical intervention. My paper concludes with a summary of my findings and a discussion about how the right to privacy may be extended to include death with dignity as well as whether the states or the national government should be the ultimate governmental authority over issues involving right-to-die legislation.

HASBSEB – Early-stage / Talk – D4 – 2:15 p.m.

Presenter: Allyssa Circello

Major in Communication Film Studies

Mentors: Prof. O’Brien Stanley and Mr. Andre Favors

Department of Communication and Media, Lamar

The Effects of War Shown in The Legend of Zelda: Breath of the Wild

The effects of war are often explored in media, and the game *The Legend of Zelda: Breath of the Wild* is one such piece of media. Throughout the course of the game, the player sees the aftermath of a war that they lost a hundred years ago, and as they explore the world that they left behind, they are faced with ruined villages and hordes of monsters that have taken over the kingdom of Hyrule in their absence. By utilizing the incredibly large and expansive game world as well as the simple but surprisingly emotive soundtrack and sound library, Nintendo is able to instill a feeling of intimate loneliness into the player and change their mood at a moment's notice. Throughout this essay, I will outline the ways that *The Legend of Zelda: Breath of the Wild* utilizes its worldbuilding and sound library to highlight the atrocities of war and the dangers of a volatile post-war world, as well as the effects that the huge open world and soundtrack can have on the player and how that effects the way that they interact with the game.

HASBSEB – Early-stage / Talk – B2 – 3:00 p.m.

Presenter: Madeline Doughty

Major in Speech and Hearing Sciences

Mentor: Dr. Lilian Felipe

Department of Speech and Hearing Sciences

Awareness of Noise-Induced Hearing Loss Among College Band Students

Exposure to loud noise and its attendant health and social effects is a public health problem. Noise-induced hearing loss (NIHL) is permanent and can be acquired at home, schools, concerts, sporting events, and at workplaces. Research shows that many young adults are unaware of how severely their hearing may be damaged from this exposure, and as a result are at a risk of acquiring NIHL. The goal of this study is to assess the awareness of Noise-Induced Hearing Loss among Lamar University college band students. In this study a survey will be administered to assess if college students are aware of noise-induced hearing loss. Based on the results, it will be determined if exist or not a lack of awareness of hearing conservation education. This will allow for future health interventions regarding hearing loss.

Presenter: Bethany Edwards

Major in Nursing

Mentor: Lori Wenner, MSN, RN

JoAnne Gay Dishman School of Nursing, Lamar

Effect of COVID-19 on the Nursing Profession in Texas

Coronavirus has negatively impacted the nursing profession and the mental health of nurses contributing to the global nursing shortage (Morris, 2021). This quantitative research study was implemented to explore the impact of COVID-19 on the nursing profession in Texas.

Study samples (N=13) were obtained through convenience sampling with an online survey distributed via social media platforms using Qualtrics. Data was collected about demographics, ethical dilemmas, patient safety, personal relationships, coping mechanisms, mental health, and perspectives about the nursing profession.

Survey responses were enlightening, offering an insight into the reality of issues nurses are facing during this time. The most common age range of participants is 35-44 years old, and the mean years of experience is 12. Seventy-seven percent of participants stated the pandemic has altered their perspective on the nursing profession. Ten out of 13 participants agreed they have been instructed to do things that place them or their patients at risk. Thirty-eight percent of participants expressed seriously thinking about changing occupations at some point in the pandemic.

The results confirm similar research studies regarding the impact of COVID-19 on nurses' mental health and their perspective on the nursing profession. Further research is needed about interventions promoting the well-being of nurses which may positively impact the current nursing shortage.

Morris, Gayle. (2021). Post-pandemic nursing shortage: what it means for aspiring nurses. Nurse Journal.

<https://nursejournal.org/articles/post-pandemic-nursing-shortage/>

Presenter: Jesus Esquivel¹

Major in Forensic Chemistry

Co-authors: T. Thuy Minh Nguyen¹ and Mien Jao²

Mentor: Paul Bernazzani¹

¹Department of Department of Chemistry and Biochemistry, Lamar

²Department of Civil and Environmental Engineering, Lamar

Quantitative Determination of the Remediation of Oil Contaminants in Dredged Material

The reuse of dredged materials (DM) is an important problem for waterways and port management systems. One of the key issues associated with dredged soils is the possible chemical contaminants they contain. The use of biochemical entrapments of contaminants to control this issue was investigated. The organic content of untreated and treated dredged soils was extracted using liquid-liquid extraction techniques and analyzed by gas chromatography. A calibration curve was calculated to determine the concentration of the specific contaminant. Quantitative determination showed that the bio-treatment induced an 85% reduction of the one of the largest contaminants.

Presenter: Aylin Galvan

Major in Nutrition

Mentor: Dr. Connie Ruiz

Department of Nutrition, Hospitality, and Human Services, Lamar

The Role of COVID-19 in the Mental and Physical Health of Pregnant or Non-Pregnant Mothers of Young Children in Food-Insecure Households

The purpose of this study was to ascertain the prevalence and effects of food insecurity on a specific sample of participants during the COVID-19 pandemic. The data were collected by using a questionnaire completed by participants who were pregnant, lactating, or mothers of living children during the COVID-19 pandemic. Collected data were used to analyze differences in food insecurity between pregnant and non-pregnant women and to investigate the perceptions of study participants regarding effects on pregnancy from food insecurity and the pandemic. Participants were asked about their financial situation, food insecurity status, if they were diagnosed with COVID-19, and more. All observed demographic variables were shown to have been significant in the prevalence of food insecurity amongst maternal individuals: ethnicity, race, level of education, income, COVID-19, and body mass index (BMI). The present study focused on women during their reproductive years and current mothers and how they coped with the challenges of COVID-19 financially, emotionally, and physically. The COVID-19 pandemic has only been a part of our lives for almost two years; much research still needs to be done on the demands of women made by such a worldwide tragedy. Future pandemics will occur, and further research can be done to make necessary changes in lowering food insecurity rates amongst more food-insecure individuals.

Presenter: Taryn Gibbs¹

Major in Physics and Chemistry

Co-authors: William L. Whaley¹, Sara Tuck², Marcus Gregory¹, Michael H. Abraham⁴

Mentor: William L. Whaley¹

¹Department of Chemistry, Geosciences & Physics, Tarleton State University, P.O. T-0450, Stephenville, TX 76402.

²Department of Chemistry, Duke University, Durham, NC 27708-0354

⁴Department of Chemistry, University College of London, 20 Gordon St. London WC1H0AJ, UK

Abraham Summation Solute Hydrogen Bonding Acidity Values Determined for Catechol-flavones by ¹H-NMR Spectroscopy

There is evidence supporting the potential use of catechol-flavones for the treatment of neurological diseases. The catechol group is known to confer free radical scavenging activity and may be important for binding to certain proteins such as amyloid beta peptide. For treatment of brain disorders, these compounds must be efficiently absorbed into the blood stream and translocated across the blood-brain barrier. The logarithm of the 1-octanol/water partition coefficient (LogP) is the most commonly used descriptor for predicting absorption, delivery, metabolism and excretion (ADME) properties. LogP for flavonoids can be calculated from the Abraham general solvation equation (AGSE) if certain measured parameters, such as the summation solute hydrogen bonding acidity (A), are known. For catechol (ortho-dihydroxy) groups, there is reciprocal intramolecular hydrogen bonding (IMHB) that diminishes the value of A for each hydroxyl group. For flavonoids, there is another complication due to IMHB between a hydroxyl group and the position 4 carbonyl group or the position 1 oxygen atom. The value of A was estimated by measuring the ¹H-NMR chemical shift difference for the hydroxyl groups in DMSO-d₆ versus CDCl₃. The compound 5,6-dihydroxyflavone was sufficiently soluble in both solvents to determine the overall value of A as 0.56, which is lower than for catechol. All other catechol-flavones were insoluble in CDCl₃. An alternative approach using flavonoids with a methoxy group ortho to a hydroxyl group was used to estimate the values of A for the other catechol-flavones. These values of A were then used to calculate LogP values by the AGSE.

Presenter: Taryn Gibbs¹

Major in Physics and Chemistry

Co-authors: Marcus Gregory², Sara Tuck³

Mentor: Dr. William L. Whaley¹

¹Department of Chemistry, Geosciences & Physics, Tarleton State University, Box T-0540, Stephenville, TX 76402

²Department of Chemistry, University of North Texas, Denton, TX

³Department of Chemistry, Duke University, Durham, NC 27708-0354

Measurement of 1-Octanol/Water Partition Coefficients and Abraham Hydrogen Bonding Acidities (A) for the Catechol Flavones

The flavones are a class of natural products, present in fruits and vegetables, that have demonstrated anti-cancer, anti-atherosclerosis and neuroprotective activities. The structures of many dietary flavones, such as quercetin and fisetin, include a catechol (ortho-dihydroxy) group on the flavone ring system. Very recently, catechol-flavones (CFs) have been demonstrated to have efficacy in pre-clinical models of several neurological diseases. For dietary flavones to function as therapeutic agents, they must be absorbed in the small intestine and transported by the bloodstream to target organs. For the treatment of brain disorders, CFs must cross the blood-brain barrier to achieve therapeutic levels in specific regions of the human brain. The logarithm of the 1-octanol/water partition coefficient (LogP_{oct}) is the most used physical descriptor for predicting absorption, distribution, metabolism and excretion (ADME) properties of drugs. For a compound to be absorbed by the small intestine, a LogP_{oct} value between 1.38 and 1.80 is considered ideal. For a compound to cross the blood-brain barrier, a LogP_{oct} value of 2.00 (or slightly greater) is considered ideal. Each of the five synthetic CFs and 3,2'-dihydroxyflavone (3,2'-DHF) were assayed for LogP_{oct} with the aqueous phases at pH=3.0 and at pH=1.5. For each compound, the measured LogP_{oct} values at both pH values had overlapping 95% confidence intervals. The values of the Abraham summation hydrogen bonding acidity (A) were measured by ¹H-NMR spectroscopy and used in the AGSE to calculate LogP_{oct} values. There was good agreement between measured LogP_{oct} values and those calculated by the AGSE.

Presenter: Shelby Graham

Major in English

Mentor: Dr. Terri Davis

Department of Political Science, Lamar

Board of Education, Island Trees Union Free School District v Pico: Constitutional Analysis of Literary Censorship

The controversial topic of banning literature is on the forefront of recent news but is not a new one. The 1975 case Board of Education, Island Trees Union Free School District v Pico involves a New York school district's attempt to remove a long list of literature from their libraries, including famous works such as Slaughterhouse Five, Best Short Stories of Negro Writers, The Naked Ape, and several more. My research examines the U.S. Supreme Court's decision in the Pico case. Justice Brennan wrote for the majority that while school boards do have the authority to control the content of literature allowed in schools, their authority does not extend to what students could read on grounds of First Amendment freedoms. The Pico decision demonstrated, however, fractures in the Court and left the lower courts little guidance on how to interpret and rule on similar cases. Constitutional analysis of the Pico decision provided through my research seeks to unravel the judicial parameters of literary censorship and provide a more comprehensive understanding of how courts interpret literature as "acceptable" in our society.

Presenter: Kathryn Hardy

Major in Physics

Mentor: Dr. Wei Chen

Department of Physics, University of Texas at Arlington

Skin Cancer Presentation

There are many ways to treat skin cancer, but as with any cancer treatment, it is not always without its downsides. Whether the downside is based on finance, cosmetics, or even further health concerns there always is one. New research into nanotechnology has given hope that these downsides can be lessened if not erased entirely. The research papers discussing the new Copper-Cysteamine nanoparticles show evidence that someday soon skin cancer will be able to be treated cheaply, efficiently, and with little to no scarring. In this presentation we will discuss the different types of skin cancer and the problems associated, as well as the benefits and downsides of the various different treatments that are currently offered before finishing up by discussing the potential that nanotechnology has to help people suffering from skin cancer.

Presenter: Zaw Ye Htut

Master in Computer Science

Co-author: Navjot Mahal

Mentor: Dr. Stefan Andrei

Department of Computer Science, Lamar

Implementation of an Algorithm for Hand Gesture Recognition

Gestures are one of the most natural modes of communication and used for verbal or non-verbal communication in our daily lives. Hand gestures offer an inspiring field of research because they can facilitate communication and provide a natural means of interaction that can be used across a variety of applications. The human gestures are sensed with the help of computer vision. The algorithms attempt to segment and detect hand features such as palm detection model, hand landmark model. It is coded in such a way that the required actions for the human gesture are done. Thus, this proposed model will be helpful and avoid danger for the people working in hazardous areas.

HASBSEB – In-progress / Talk – D4 – 3:00 p.m.

Presenter: Rachel Hellums

Major in Communication Studies

Mentor: Dr. Nicki Michalski

Department of Communication and Media Studies, Lamar

Let's Talk About Sex: Power Dynamics in Evangelical Purity Culture

In Christian evangelical purity movement, the expectation to “save sex for marriage” defines a woman’s worth based on her ability to “stay pure.” This project explores the burden created by the expectation to not only remain “pure,” but to suppress all forms of sexual exploration. This auto-ethnographic project includes research on opposing viewpoints: the Evangelical Purity Culture movement and those that oppose it. The author explores Evangelical Purity Culture and how it harms women and the LGBT+ community, including how traumatic it can be for an individual to be held responsible for someone else’s sexuality.

Presenter: Daniel Iles

Major in Mechanical Engineering

Co-authors: Dylan Morgan, Kennedy Kieschnick, Noah Stansel, Britney Sumayah, and Vinson Nguyen

Mentor: Dr. Jiang Zhou

Department of Mechanical Engineering, Lamar

Amphibious Human Powered Vehicle - HPVSea

The first Human Powered Vehicle (HPV) was the bicycle, invented in 1418. The motion of HPVs is provided by the rider's bodily power and is most often used as a means of transportation. The vehicle designed in this project, nicknamed HPV-Sea, will navigate and transition between both terrains of land and water efficiently. This project emphasizes traversing terrain efficiency, buoyancy, balance, and ease of pedaling for the vehicle. The team designed and will produce a frame capable of efficient water traversal along with proper controls for maneuverability. The buoyant and propelling agents for the water were major challenges that were overcome with a pour-and-mix boat foam and a 3-D printed propeller. The components designed and selected for the project including sprockets, steering mechanisms, materials, and bearings were based on the friction, drag, and buoyant forces. The overall delivery of the project will be an amphibious human-powered vehicle that moves efficiently on land and water. Before the manufacturing of this vehicle, engineering analysis using knowledge from engineering coursework including physics, economics, fluids, and design of mechanisms was conducted to determine measurements and specifications. The team was able to secure full funding for the project from outside sponsors. The final deliverable for the project will be a workable prototype of the HPV-Sea.

Presenter: Blake Laughlin

Major in Construction Management

Co-authors: Zachary Adkins and Angel Olalde

Mentor: Dr. Zhe Luo

Department of Construction Management, Lamar

Drone Applications in Construction

The construction industry can maximize profit through cost savings and safe-distance observation of the pre-construction, current, and post-construction phases of a project. There are several different types of drones that can be used based on the type of project. Flight time, equipment, mounted cameras, and aerial or ground level are some implications that can help decide which type of drones best suits your use. The purpose of the drone flight will determine what equipment needs to be affixed to a drone and if a pre-planned flight path is preferred over a remote-controlled flight. Drones make the job of site safer as inspectors can conduct inspections remotely without entering hazardous areas. Drone inspections are faster and are cost-effective. A human-led site survey can take weeks to complete, especially on large construction sites. Drone inspections can be done by one person offsite in a relatively short time, reducing the cost of additional personnel and other expenses due to delays. Using drones to monitor a construction site is a flexible approach with low manpower costs. The flying speed of the drone is optimized to ensure that the drone spends the most time monitoring areas of the construction site that deserve the most attention while ensuring that the drone completes the route within a certain time and without depleting its battery. This study is carried out to demonstrate the applicability of drone scheduling.

Presenter: Javier Lopez

Major in Construction Management

Co-authors: Albert Garcia and Corbin Stepan

Mentor: Dr. Zhe Luo

Department of Construction Management, Lamar

3D Printing: The Effects of Sustainability in Construction

3D printing is a concept in which an automated machine prints out a 3D model using a variety of materials in which the model is designed through separate computer software. Using 3D printing in construction affects the sustainability of the industry by introducing new technological methods that can expedite work whilst reducing the industry's carbon footprint. This concept also brings sustainability to construction as it helps limit the costs, durations, and material waste of daily projects. The benefits do come with their own challenges as this method is not completely practical yet, but 3D printing is a very sustainable method of performing construction that can greatly affect the construction industry's future.

Presenter: Umer Rasool Malik

Major in Political Science

Mentor: Dr. Terri Davis

Department of Political Science, Lamar

The Afghan Diaspora and People in Crisis: An Analysis of Sanctuary and Treatment of Afghan Refugees by the International Community

The number of refugees is increasing day by day and many countries are not stepping up to do what they are capable of. In my research Analysis of the Afghan refugee crisis, I will examine the countries that are taking in Afghan refugees; the focus will be on countries in close geological proximity to Afghanistan which include Pakistan, Iran, Turkey, and Germany. They host almost 90% of the Afghan refugee population. In my research, I will also be examining why Germany is taking in Afghan refugees because it is not close to Afghan geographically as they are the host to the third-largest Afghan refugee population. With the summary of my findings, I conclude my paper with a normative statement on the countries doing their part in taking in refugees and countries declining to take in refugees.

Presenter: Elsy Martinez

Major in Biology

Co-author: Victoria Ontiveros

Mentor: Dr. Ana Beardsley Christensen

Department of Biology, Lamar

Non-destructive DNA sampling techniques from the clam *Rangia cuneata* (Mollusca, Bivalvia)

Rangia cuneata is a brackish water species of bivalve mollusk endemic to estuaries of the Gulf coast. They have thick valves and strong adductor muscles, making it difficult to obtain tissue samples without seriously damaging or killing the clams. The aim of this study was to develop a non-destructive/nonlethal sampling method to obtain DNA to be used in polymerase chain reaction (PCR) and DNA sequencing. Sampling methods tested include: 1) scrapings of the periostracum (outer shell layer), 2) insertion of an interdental cleaning brush into the posterior gape (two types tested), and 3) removal of water from mantle cavity with a syringe at different time intervals. Samples were processed using a DNA extraction kit (Bioline), subjected to PCR using universal primers for barcoding region of the COI mitochondrial gene, and any resulting products visualized by gel electrophoresis. Successful DNA extraction and amplification was confirmed by DNA sequencing and comparing with *Rangia* sequences deposited in GenBank. Periostracum scrapings did not yield any PCR products. Both dental brushes yielded DNA samples but were difficult to insert into all clams. The method that proved to be the easiest to perform was syringe removal of mantle cavity water, with longer wait times after valve closure (20+ minutes).

Presenter: Nayana Muppavarapu

Major in Civil and Environmental Engineering

Mentor: Dr. Liv Haselbach

Department of Civil and Environmental Engineering, Lamar

Water Knows No Geopolitical Boundaries

More and more flood related disasters have been plaguing the Southeast Texas region. There have been four major storms in the last five years resulting in loss of lives and homes, destruction of property, and costing billions of dollars in damages. One of the important ways to address these flooding issues is mitigation and resiliency which started with one or a few governmental entities focusing on the issue. And the number of stakeholder entities participating in the mitigation and resiliency activities have been increasing in response to the increasing threat of flooding. Almost, if not all governmental entities such as local municipalities, district and county governmental entities, regional entities, educational institutions, and state and federal level entities are actively planning and participating. This created a complex network of organizations working in the same area and towards the same goal, which is currently happening in Jefferson County in the Southeast Texas region. However, there isn't an understanding of the complexity of this network of organizations, how they interact, share knowledge and tasks and how the presence of one entity might affect the actions or plans of another entity. One of the goals of the project is to understand how these interactions are shaped by the water flowing through different jurisdictions in the county. A part of this goal requires a comprehensive understand of the flood maps and topological maps of the county.

Presenter: Callan Noak

Major in Computer Science

Co-authors: Jennifer L. Tsan and Dr. Stefan Andrei

Mentor: Dr. Sujing Wang

Department of Computer Science

Introducing Programming to Middle School Students to Increase Knowledge and Interests in Computer Science

This poster introduces the organization, curriculum design, and assessment results of two one-week summer camps to teach middle school students fundamental programming concepts to increase their knowledge and interests in computer science. We designed several hands-on programming projects to develop and build creative confidence, design thinking and problem-solving skills.

Presenter: Daniel Nicks

Major in Mechanical Engineering

Co-authors: Kalen Baker, Destiny Lett, Luke Nelson, Arin Preston, Jose Wong

Mentor: Dr. Sushil Doranga and Dr. Jenny Zhou

Department of Mechanical Engineering

Mechanical Design and Testing of Event Recorder used in Locomotives

Event recorders, commonly known as black boxes, allow for the determination and evaluation of crash events. An event recorder must be armored and well mounted to survive so that the information they contain can be recovered. One type of armor is a thermal insulation to protect the memory module inside in the event of a fire after an accident. Typically, in addition to standard insulation, another material that is part of the thermal protection is one that changes phase and absorbs significant heat in the process. A common one is boric acid, which while incredibly effective, is also used as rat and roach poison making it incredibly environmentally unfriendly. The goal is to replace these phase changing materials with more modern materials, while maintaining the thermal integrity of the electronics inside. Currently, in accordance with Federal Railroad Administration and IEEE guidelines, thermal and structural modeling and simulation has been completed and the initial physical testing has begun. With the overall end goal being a more environmentally safe and more reusable event recorder.

Presenters: Amber Palos and Yared Rodriguez

Majors in Audiology

Mentor: Dr. Lilian Felipe

Department of Speech and Hearing Sciences

The Future of Vestibular Rehabilitation: Effects of Galvanic Vestibular Stimulation and Virtual Reality to Improve Balance

Introduction: Approximately 35% (69 million) Americans aged 40 years or older exhibit some form of vestibular dysfunction when assessed via a postural metric. Current rehabilitation plans and existing therapies are shown to provide relief of symptoms within 4-6 weeks. It is theorized that the use of vestibular galvanic stimulation may accelerate relief given to balance and dizziness patients. This tool combined with the use of virtual reality will allow a unique form of therapy to target all necessary points for a successful balance system being visual, vestibular, and somatosensory. Purpose: The goal of this study was to utilize galvanic stimulation in combination with virtual reality to create a more effective and efficient therapy protocol for vestibular disorders. Method: The protocol was then tested in three different groups: one control group (individuals with no report of balance disorders) and two study groups (athletes and subjects with balance issues). SOT testing was administered thereafter, and data was compared and analyzed. Results: Preliminary results established a positive correlation between galvanic stimulation in combination with virtual reality and vestibular outcomes recorded by SOT testing. Conclusion: This protocol has the potential to help those who experience balance pathologies and provide a better understanding of the physiology workings of the human body.

Presenter: Aliya Robertson

Mentor: Mr. Andre Favors

Department of Communication Studies, Lamar

Major in Communication Studies

Aronofsky's "Black Swan": A Tragedy of Mental Health

The spread of misinformation concerning mental disorders has become increasingly overwhelming within most recent years, due to the symptom overlap of various mental disorders. However, Borderline Personality Disorder (BPD) is among one of the most stigmatized recognized mental disorders. The lack of BPD media representation has only furthered the problem. This research will re-imagine Aronofsky's 2010 film, "*Black Swan*" as representation for those suffering from BPD. I will argue that in understanding Nina Sawyer's experiences within the context of BPD, it allows for a critical reflection of the way in which society constantly ignores those experiencing mental crises. Through the discussion of what BPD is, how it is created, and the way its symptoms affect the main character's understanding of reality, this research will seek to offer a repositioning of the way society views Borderline Personality Disorder.

Presenter: Igor Romashets

Major in History

Mentor: Dr. Brendan Gillis

Department of History, Lamar

“Stamp Act Riots of New York Colony”

The New York Colony was greatly entwined with the greater British Empire through trade, naval and military connections in the aftermath of the Seven-Years’ war. The Colony contained permanent military forces, vice-admiralty courts, customs offices, and other institutions of the British Empire¹. However, when the Stamp Acts were enacted by Parliament extensive protests and riots erupted to the extent that the acting colonial governor Cadwallader Colden was forced to seek refuge with the newly arrived stamps at Fort George. Scholarship into this development has been extensive citing interests of merchants, a political culture conducive to such actions and rhetoric which emphasized Lockean natural rights. My paper seeks to add to that by analyzing the reasons in detail on this occurred focusing on the correspondences of prominent members of the New York colony. My research will explain the political landscape in New York City, analyze the motivating factors of the colonists, and conclude that riots occurred due to the political development of the colony which provided enfranchisement to individuals most affected by Parliament’s actions. Utilizing a variety of academic sources by authors Bernard Friedman, F.L. Engelman, Beverly McAnear, Fred Anderson, Milton M. Klein, Charles H Levermore, Patricia U. Bonomi, Ernst Stacey Griffith, Allan Tully, correspondences, newspaper articles, treatises and documents this work formulates a comprehensive analysis of the reasons why the New York colony rioted extensively in response to the Stamp Act.

Bibliography

¹BONOMI, PATRICIA U. “New York: The Royal Colony.” *New York History* 82, no. 1 (2001): 4–24.
<http://www.jstor.org/stable/42677750>

Presenter: Mackenzie Savage

Major in Biology

Co-authors: Liam Gore, Byanca Cabrera, Catherine Twing, Kaylee Simon, Shamel Simon

Mentor: Dr. Ashwini Kucknoor

Department of Biology, Lamar

The Art of Microbiology: Mixing Art and the Molecular Biology of Microbes on Agar

Alexander Fleming, the pioneer of penicillin, enjoyed searching for bacteria that offered new and unique pigments to make his own agar art. This curiosity for the undiscovered helped him find penicillin, which forever changed the world. The annual agar art competition sponsored by the American Society for Microbiology (ASM) started in 2015 to show the world how diverse and beautiful microbes can be. Incorporating art into the discussion of gene expression and microbiology introduces us to a multidisciplinary approach to STEM, and provides an opportunity to explore the use of science in different fields such as design and arts. In this project, we used concepts of molecular biology, gene-expression, and microbial genetics to create living bio-paints using recombinant bacterial cultures. Color-producing microbes were painted onto an agar plate canvas and then incubated. After incubation, the agar art was visualized. This project is an example of the concept of STEM in education, as well as collaborative efforts between art and biology.

STEM – In-progress / Talk – A1 – 2:45 p.m.

Presenter: Rebekah Schilberg

Major in Aerospace Engineering

Co-authors: Longhorn Racing Combustion Team

University of Texas at Austin

Longhorn Racing Internal Combustion: Designing and Manufacturing a Formula-Style Car

The Formula Society of Automotive Engineering (FSAE) student design competition was constructed at UT Austin in 1981 to facilitate student involvement in the engineering design process. Now an internationally recognized project, over 100 teams compete yearly to design and manufacture the most successful formula-style car within the provided constraints and rules. We report the 2022 Longhorn Racing Internal Combustion (LHRiC) team's progress in the preliminary research and design phase, as well as the fabrication of the car through manufacturing and assembly in UT Austin's mechanical engineering machine shop. As the work over about 100 students, this organization is dedicated to the education of incoming members, as well as the success of the vehicle produced for competition.

Presenter: Sinjin Sharma

Major in Mechanical Engineering

Co-authors: Travis Lane, Cade Pellerin, Gabriel West, David Williams

Mentor: Dr. Jenny Zhou

Department of Mechanical Engineering, Lamar

Determining the Vibration Response and Damping Value Necessary for the Compensation of Inservice Vibrations of an Automobile Suspension

Suspension is one of the most important systems in a vehicle, especially when it comes to driver and passenger comfort and vehicle performance and stability. A poorly tuned or constructed suspension setup may have a negative impact on ride quality and overall vehicle controllability. One major aspect to consider when developing a suspension system are the imperfections on the road surface or “in-service vibrations”. The first step taken in this report was to determine the spring constant of the springs acquired from a used 1989 Honda CRX HF. The next step was to determine the damping force and spring coefficient required to keep the vertical acceleration of the CRX chassis equal to or less than 0.5g. The spring constant measurement was conducted through a combination of finite element analysis and handwritten calculations and the damping coefficient was found via ANSYS simulation by measuring chassis response. The results of this research made it possible to determine the proper damping force and coefficient that is necessary for the CRX to perform well in an endurance race.

Presenter: Pargat Singh

Master in Computer Science

Co-author: Manmeet Singh Grewal

Mentor: Dr. Stefan Andrei

Department of Computer Science, Lamar

Design of a Digital Sunflower Clock

Abstract: Solar energy systems have been a research interest for decades now. One main problem in an ordinary system is how to get more intensity of heat to convert it into electricity - it depends on the position of the sun. This poster describes a new methodology to detect the position of the Sun with the help of light sensors and the Arduino processor. Our methodology uses a deep learning approach to determine the position of the Sun by following its path. Our proposed system solution should have a solar panel that faces the sun and follows it throughout the day with the help of Arduino, servo motors, LDR sensors, and other mechanical components. We used Arduino programming to program this project.

Presenter: Shivam Soin¹

Master in Computer Science

Co-authors: Tejinder Singh¹, Sri S. S. C. Meghana Nunnaguppala¹, and Dr. Brian Williams²

Mentors: Dr. Stefan Andrei¹

¹Department of Department of Computer Science, Lamar

²Department of Political Science, Lamar

Designing a Model for Analyzing Weather-Related Data for South - East Texas

Weather interpretation and prediction have been of interest for centuries. There exist many weather models useful for analysis and prediction. For our people, we describe a new wind model that is processing new vector-based representation in an incremental way. The wind model described in this paper is proven to be correct and efficient ($O(n)$ time complexity, where n is number of wind - vectors). Humans have been studying wind directions, speed, and patterns for centuries. All these factors have been contributing largely to forecasting the weather.

As part of our research, we calculated the average of wind direction and speed. We worked on discovering a formula to find the average of two or more wind speeds. The formula can be applied to calculate the resultant wind speed and direction, for an hour, a day or even a month as per our requirement. We will describe a rough estimation on how the average weather conditions are for a location in a particular instance of time. This would further assist us in predicting any disturbances in the climate.

Presenter: Joshua Smith¹

Major in Biology and Chemistry

Co-authors: Brant E. Billingham², Jianbao Zhao²

Mentor: Dr. Sylvestre Twagirayezu

¹Department of Chemistry and Biochemistry, Lamar

²EFD, Canadian Light Source Inc., Saskatoon, Saskatchewan, Canada.

Synchrotron-Based Attenuated Total Reflection Infrared Spectroscopy of Artificial Gasoline Blend

Attenuated Total Reflection (ATR) Infrared spectra (IR) of an artificially prepared gasoline blend have been recorded in the 600-4000 cm^{-1} region using the Far-Infrared Beamline at Canadian Light Source. The observed spectra reveal rich but distinct vibrational signatures of the ethanol and artificial gasoline blend. The analysis of C-C (880 cm^{-1}) and C-O (1046/1088 cm^{-1}) stretch bands indicates significant vibrational blue shifts due to the changes in their force constants as the hydrocarbon content increases. The present data provides vibrational centers useful for the characterization of ethanol in the presence of a hydrocarbon matrices. The validity of ATR-IR for ethanol analyzation within a gasoline mixture has been validated by measuring the ATR-IR signal response of the artificial gasoline blend over a wide range of ethanol concentrations (0 - 100%). The obtained linear correlations allowed for the determination of recovery percentage (95-100%) and thus confirming the accuracy of the ATR-IR method.

Presenter: Hallie Svir

Major in Communication

Mentor: Dr. Sheila Springer

Department of Communication and Media, Lamar

The Detrimental Effect of Appearance-Based Discrimination on the Professional Development of Women's Careers

Leadership cannot be defined as a masculine or feminine skill; however, almost every profession in the United States is plagued by gendered stereotypes and norms. Male professionals are expected to excel in management, engineering, and construction while expectations of female professionals are limited to education, caretaking, and administrative assistance (Johnson, et al, 2010). Women are outnumbered by men in maintaining leadership positions despite equal qualifications and experience. A correlation between perceived attractiveness and perceived intelligence has been discovered in the corporate hiring process (Kleisner et al., 2014). Appearance-based discrimination and occupational sex bias detrimentally harm women in excelling in their career to leadership roles. Prior research indicates that these factors equally impact men and women as entry-level applicants (Kleisner et al., 2014). At a certain point appearance-based discrimination and occupational sex bias lead to different advancement into leadership positions for men and women. (Kleisner et al., 2014). I will draw on previous studies and documented workplace evidence, relevant to leadership, beauty, intelligence, and their relationship to gender. To explore this issue, I will perform a qualitative study using interviews and examine that data using content analysis. The interviews will be conducted online with women who currently or have previously held C-Suite leadership positions. Interview questions will focus on the subject's work experience, position duties, company policies, and workplace culture. The purpose of this study is to identify disparities in women's professional development due to perceived attractiveness and raise awareness with the goal of mitigating this issue.

Presenter: Millie Terrazas

Major in Forensic Chemistry

Mentor: Dr. Paul Bernazzani

Department of Chemistry & Biochemistry, Lamar

Effect of Natural Products on the Pharmacokinetics of Over-the-Counter Drugs

Natural remedies have attracted the attention of scientists because of their positive physiological responses and lower side effects. However, only a limited number of investigations are available that relate their effects on the pharmacokinetics of common medications. In this work, we evaluate the consequence of the presence of ginger compounds on the metabolites of a model over-the-counter drug, acetaminophen. In vitro pharmacokinetic parameters of the interaction of these two compounds on two model eukaryotic cells lines (*Pinus palustris* and mammalian liver cells) were followed using reverse phase gas chromatography, testing the hypothesis that chemical components of ginger slow down the metabolic reaction kinetics of acetaminophen.

Presenter: Brandyn Wagstaff

Major in Construction Management

Mentor: Dr. Zhe Luo

Department of Construction Management, Lamar

Modular Construction: Benefits, Advantages, and a Case Study

The housing market is more cramped than ever, and the world is looking for solutions. One such solution is the concept of modular construction. This is a look into how the construction industry has created a niche in the industry that is leading to sustainability, efficiency, and cost savings in the housing market due to modular construction. This will show the data correlating to these aspects relating to Modular Construction. It will show the benefits and advantages of warehouse built, easily installable modular construction. These benefits include less waste, a reduced schedule, and even a safer construction practice. These advantages can be seen clearly when closely examining Boxabl, a modular construction company that has seen massive success. This is a construction practice that will only get bigger as the needs for efficiency and sustainability grow. Modular construction is no longer a concept of the future but a necessity of the present.

Presenter: Shelbie Williams

Major in Political Science

Mentor: Dr. Terri Davis

Department of Political Science, LU

Does v. Mills: An Analysis of the Free Exercise Clause Through the COVID-19 Pandemic

Religious freedom is among “one of our most treasured and jealously guarded constitutional rights” (*Harvard Law Review*, 2021). In August 2021, Janet Mills, the Governor of the Maine, announced an emergency rule requiring certain workers at health care facilities in Maine be fully vaccinated against Covid-19 by the end of October 2021. A group of 2,000 health-care workers subsequently sued Mills and her administration on grounds the mandate violates First Amendment religious liberty (Hanneman, 2021). The health-care workers’ lawsuit advanced to the First Circuit Court of Appeals in the case *Does v. Mills*, and to the Supreme Court in a request for a preliminary injunction to delay the implementation of the governor’s mandate. My research examines the First Circuit Court’s opinion with respect to the Free Exercise Clause of the First Amendment, the Supreme Court’s ruling on the request for preliminary injunction, and the arguments provided for granting or denying the exemptions requested to the governor’s mandate. The paper concludes with a normative discussion about the balance between a state’s power to regulate the safety and health of its citizens and an individual’s right to free religious exercise.

Does v. Mills, No. 21-1826 (1st Cir. 2021)

Harvard Law Review, “Constitutional constraints on free exercise analogies.” (2021, March 10). Retrieved March 31, 2022. <https://harvardlawreview.org/2021/03/constitutional-constraints-on-free-exercise-analogies/>

Hanneman, Joseph, “Maine health workers fighting vaccine mandate turn again to Supreme Court,” *The Catholic World Report*, October 21, 2021. Retrieved March 31, 2021. <https://www.catholicworldreport.com/2021/10/21/maine-health-workers-fighting-vaccine-mandate-turn-again-to-supreme-court/>

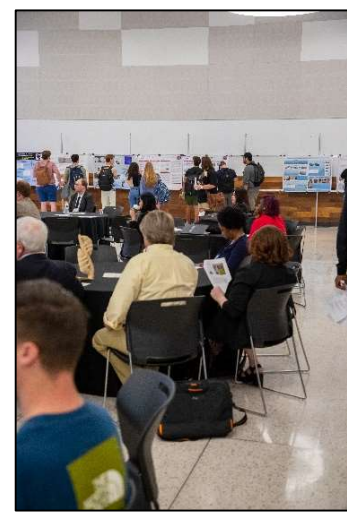
MOMENTS FROM A GREAT EVENT – EXPO 2022



Opening EXPO 2022 -
Dr. Cristian Bahrim, Director
of O.U.R.



Plenary speaker Dr. Lauren Richardson from
UTMB – Galveston is recognized with a plaque
by Dr. Ian Lian (left) and Dr. Bahrim (right).



The Live Oak Ballroom of
the Setzer Center hosted
the EXPO 2022 event.



Poster Session



David Matherne an OUR grant
recipient giving his talk



Kalen Baker presenting in front of
students from the Deaf Education
program with Dr. Zanthia Smith



Dr. Golden Wright and
Serinity Schmidt performing
“In This Together”



Dr. Bahrim (center) applauding dancers after
the performance: Dr. Golden Wright, Serinity
Schmidt, Ashley Hawkin, and Mia Paul



**Dr. Sujing Wang's
Faculty Mentor
Award (FMA)
Acceptance Speech**



Attendees at the EXPO 2022



**Dr. Wei Chen, from
UT Arlington, during
Q&A session**



**Dr. Stefan Andrei on his
FMA nomination for
Dr. Sujing Wang**



**Tiya Davi with Dr. Mamta Singh
showing off her certificate**



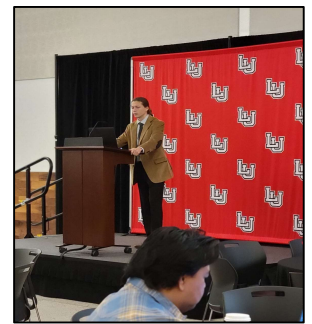
**Taryn Gibbs, from Tarleton
University, accepting the
award for Best Talk in the
"Advanced" research
category.**



**Mr. and Mrs. Rizk are presented an award on
behalf of their son, Dr. Paul Rizk (in the back)**



**Rachel Hellums with her
award**



Tyler Stuck presenting



**Angel Flowers with her mentors,
Dr. Matt Hoch and Dr. William Miller**

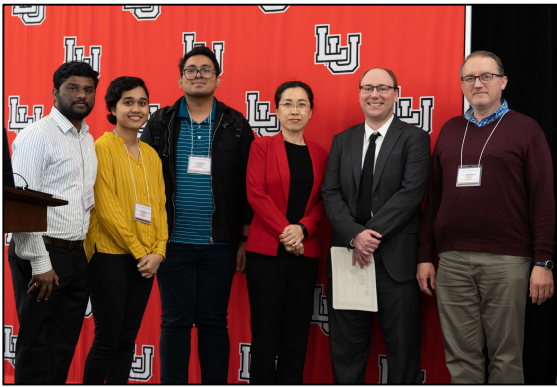




Dr. Sujing Wang with her mentee, Callan Noak, and Dr. Stefan Andrei, Chair of Computer Science



Kalen Baker - Second Place O.U.R. Sponsored Research



Dr. Sujing Wang and students from Computer Science



Daniel Nicks from Mechanical Engineering



Madeline Doughty from Speech & Hearing



Attendees at EXPO 2022



Lindsey Chirafis from Political Science



Eric Amador, PhD Candidate in Physics from UT Arlington



Attendees at EXPO 2022



Join our student organization:

Lamar University Undergraduate Research Association (LURA)

“LURA was founded in fall 2019 to fulfill the need for a community by and for undergraduate students to discuss, collaborate, and learn how effectively one can conduct research. The consistent quality and volume of research conducted by undergraduate students at Lamar University has made it clear that there is a need for an organization to act as a vital resource for building young researchers. Thus, LURA provides an academic forum that connects all level students from freshmen to seniors with their professors and mentors and facilitates communication between Lamar undergraduates and their peers around the nation.”

LURA is a platform for offering panel discussions about

- Research opportunities inside and outside Lamar,
- Better ways to deliver undergraduate research results in poster and oral presentations,
- Ways to perform peer-mentoring,
- Organizing workshops and panel discussions on various topics, including how to successfully apply to graduate schools.

LURA is the premier student organization at Lamar University for undergraduates interested in doing research and creative activities.

Contact URALamar@gmail.com or visit the Office of Undergraduate Research—
Chemistry 115D

**THE OFFICE OF UNDERGRADUATE RESEARCH PROVIDES STRONG
SUPPORT AND OFFERS LOGISTICS TO THIS STUDENT ORGANIZATION**



OFFICE OF UNDERGRADUATE RESEARCH
LAMAR UNIVERSITY



Please join us for future OUR events

THE SURF SYMPOSIUM

Friday, August 5, 2022
(from 1:30 p.m.)

The Texas STEM Conference
Saturday, November 5, 2022

HASBSEB Conference
Saturday, November 19, 2022



LAMAR UNIVERSITY
MEMBER THE TEXAS STATE UNIVERSITY SYSTEM™

YOUR
Moment
IS HERE