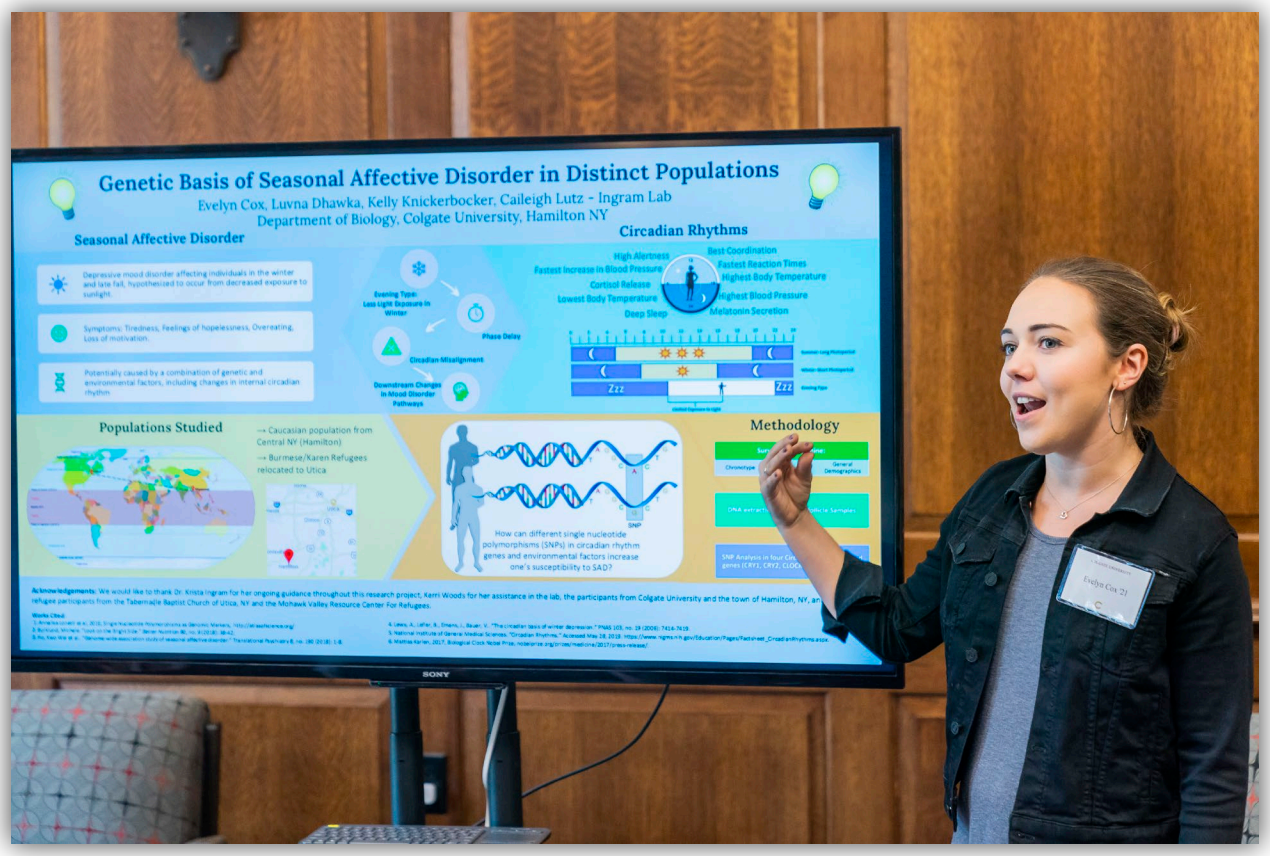
Colgate University Summer Undergraduate Research Directory



Volume 26
2019

Cover photo: Evelyn Cox ’21 explains her research on *Genetic Correlates of Seasonal Affective Disorder (SAD) in a Refugee Population in Upstate New York* at the student research poster display during Reunion Weekend in June 2019. See page 48 to read about Evelyn’s work in Professor Krista Ingram’s lab. To read more about the work of Evelyn’s collaborators in the Ingram lab, please refer to page 58 (Luvna Dhawka), page 90 (Kelly Knickerbocker), and page 103 (Caileigh Lutz). *Photo by Mark DiOrio.*

Colgate University
Summer Undergraduate
Research Directory

Volume 26
2019

Courtesy of the Office of Undergraduate Research
Center for Learning, Teaching, and Research
Colgate University
13 Oak Drive
Hamilton, NY 13346

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List of Participants

DIVISION OF THE ARTS AND HUMANITIES (AHUM)

Department of Art and Art History

Name: Keara Greene 2020 (Psychological Science)
Mentor: Margaretha Haughwout (Art and Art History)
Title: *Eco Arts in New York State*
Funding: AHUM Division

Name: Emma Kaminski 2022 (Undeclared)
Mentor: Margaretha Haughwout (Art and Art History)
Title: *Eco Arts in New York State*
Funding: AHUM Division

Department of the Classics

Name: Lauren Horstmyer 2022 (Undeclared)
Mentor: Rebecca Ammerman (Classics)
Title: *North Urban Paestum Project 2019: Researching the Geology and Archaeology of Ancient Paestum in Southern Italy*
Funding: AHUM Division

Name: Natalie Ramirez 2019 (Art and Art History; Classical Studies)
Mentor: Rebecca Ammerman (Classics)
Title: *Classical Archaeology in Italy: The Excavation of Trench 6 of the North Urban Paestum*
Funding: Center for Freedom and Western Civilization (James Madison Research Fund)

Name: Adam Zaharoni 2021 (Geology; Classical Studies)
Mentor: Rebecca Ammerman (Classics)
Title: *North Urban Paestum Project 2019: Researching the Geology and Archaeology of Ancient Paestum in Southern Italy*
Funding: AHUM Division

Department of East Asian Languages and Literatures

Name: Yan "Molly" Meng 2021 (History)
Mentor: Jing Wang (East Asian Languages and Literatures)
Title: *"Middle" as Method: Chinese Worldview of Heaven, Earth, and Human*
Funding: AHUM Division

Department of English

Name: Carina Haden 2021 (English)
Mentor: Jennifer Brice (English)
Title: *Living Writers Research*
Funding: AHUM Division

Name: Laura Mucha 2020 (English)
Mentor: Christina "CJ" Hauser (English)
Title: *Launching a Novel: Assisting an Author with the Publication of Her Second Book*
Funding: AHUM Division

Name: Kathrine “Katie” Roell 2021 (English)
Mentor: Jennifer Brice (English)
Title: *Living Writers Research*
Funding: AHUM Division

Department of Music

Name: Samuel “Sam” Evans 2022 (Music)
Mentor: R. Ryan Endris (Music)
Title: *Analyzing the Composition Style of Antonio Juanas*
Funding: AHUM Division; J. Curtiss Taylor ’54 Endowed Student Research Fund

Department of Romance Languages and Literatures

Name: Renee Congdon 2020 (Spanish)
Mentor: Marta Pérez-Carbonell (Romance Languages and Literatures)
Title: *Madrid in the Spanish Imaginary: Literature and the Remnants of the Past*
Funding: J. Curtiss Taylor ’54 Endowed Student Research Fund

DIVISION OF NATURAL SCIENCES AND MATHEMATICS (NASC)

Department of Biology

Name: Katherine “Katie” Anderson 2021 (Biology)
Mentor: Geoffrey “Geoff” Holm (Biology)
Title: *Cellular Responses to Mammalian Reovirus Infection*
Funding: Michael J. Wolk ’60 Heart Foundation

Name: Evelyn Cox 2021 (Sociology; Biology)
Mentor: Krista Ingram (Biology)
Title: *Genetic Correlates of Seasonal Affective Disorder (SAD) in a Refugee Population in Upstate New York*
Funding: NASC Division

Name: Emma Cromwell 2020 (Art and Art History; Molecular Biology)
Mentor: James “Eddie” Watkins (Biology)
Title: *Ecophysiology of Reproduction in the Hybrid Fern Complex Dryopteris*
Funding: NASC Division

Name: Luvna Dhawka 2020 (Molecular Biology)
Mentor: Krista Ingram (Biology)
Title: *Genetic Basis of Seasonal Affective Disorder (SAD) in Distinct Populations*
Funding: Oberheim Memorial Fund

Name: Rebecca Gowen 2019 (Molecular Biology)
Mentor: Krista Ingram (Biology)
Title: *Chronic Cortisol, Chronotype, and the Epidemiology of Seasonal Affective Disorder*
Funding: Beckman Scholar Program

Name: Aidan Harrington 2021 (Biology)
Mentor: James “Eddie” Watkins (Biology)
Title: *Ecophysiology of Reproduction in the Hybrid Fern Complex Dryopteris*
Funding: National Science Foundation Grant

Name: Nadia Houerbi 2020 (Molecular Biology)
Mentor: Geoffrey "Geoff" Holm (Biology)
Title: *Cellular Responses to Mammalian Reovirus Infection*
Funding: Michael J. Wolk '60 Heart Foundation

Name: Kelly Knickerbocker 2021 (Molecular Biology)
Mentor: Krista Ingram (Biology)
Title: *Genetic Correlates of Seasonal Affective Disorder (SAD) in a Refugee Population in Upstate New York*
Funding: Michael J. Wolk '60 Heart Foundation

Name: Marlene Lawston 2020 (Molecular Biology)
Mentor: Jason Meyers (Biology; Neuroscience)
Title: *Changes in Progenitor Populations Lead to Expanded Mechanosensory Lateral Line in Cavefish*
Funding: Beckman Scholar Program

Name: Emily Lencyk 2021 (Biology)
Mentor: Barbara Hoopes (Biology)
Title: *Molecular Genetics of Body Size in Dogs*
Funding: NASC Division

Name: Caileigh Lutz 2020 (Biology; Educational Studies)
Mentor: Krista Ingram (Biology)
Title: *Genetic Correlates of Seasonal Affective Disorder (SAD) in a Refugee Population in Upstate New York*
Funding: NASC Division

Name: Connor Madalo 2020 (Molecular Biology; Economics)
Mentor: Barbara Hoopes (Biology)
Title: *Molecular Genetics of Body Size in Dogs*
Funding: NASC Division

Name: Emily Metzger 2021 (Molecular Biology; German)
Mentor: Priscilla Van Wynsberghe (Biology)
Title: *Molecular Analysis of Development in C. elegans*
Funding: Michael J. Wolk '60 Heart Foundation

Name: Camila Napuri 2021 (Molecular Biology; Spanish)
Mentor: Priscilla Van Wynsberghe (Biology)
Title: *Molecular Analysis of Development in C. elegans*
Funding: Science and Math Initiative-SMI (NASC Division)

Name: Katherine Pasterczyk 2021 (Molecular Biology)
Mentor: Priscilla Van Wynsberghe (Biology)
Title: *Molecular Analysis of Development in C. elegans*
Funding: Michael J. Wolk '60 Heart Foundation

Name: Grant Ruback 2021 (Molecular Biology)
Mentor: Rajinikanth "Raj" Mohan (Biology)
Title: *Stress Hormone Signaling Crosstalk in Arabidopsis*
Funding: Michael J. Wolk '60 Heart Foundation

Name: Xin Wang 2021 (Molecular Biology)
Mentor: Geoffrey "Geoff" Holm (Biology)
Title: *Cellular Responses to Mammalian Reovirus Infection*
Funding: Science and Math Initiative-SMI (NASC Division)

Name: Jacob Watts 2021 (Biology)
Mentor: James "Eddie" Watkins (Biology)
Title: *The Physiological Response of an Australian Epiphytic Fern (Asplenium nidus) to Climate Change*
Funding: Beckman Scholar Program

Name: Morgan Wynkoop 2021 (Spanish; Molecular Biology)
Mentor: Rajinikanth "Raj" Mohan (Biology)
Title: *Stress Hormone Signaling Crosstalk in Arabidopsis*
Funding: NASC Division

Name: Flora Zhang 2022 (Undeclared)
Mentor: Rajinikanth "Raj" Mohan (Biology)
Title: *Stress Hormone Signaling Crosstalk in Arabidopsis*
Funding: Science and Math Initiative-SMI (NASC Division)

Department of Chemistry

Name: Vincent "Vinny" Betti 2021 (Biochemistry; Spanish)
Mentor: Jacob Goldberg (Chemistry)
Title: *Ratiometric Sensors for Mobile Zinc*
Funding: Michael J. Wolk '60 Heart Foundation

Name: Nicholas Blake 2021 (Biochemistry; Philosophy)
Mentor: Rick Geier (Chemistry)
Title: *Investigation of the Distribution of Porphyrinoid Products from the Reaction of Pyrrole, Pentafluorobenzaldehyde, and Acetone*
Funding: Warren Anderson Fund

Name: Matthew Bousquet 2020 (Chemistry)
Mentor: Jason Keith (Chemistry)
Title: *Applications of Density Functional Theory to Electronic Structure, Spectroscopy and Mechanism*
Funding: Warren Anderson Fund

Name: Blair Boyles 2021 (Chemistry)
Mentor: Ernie Nolen (Chemistry)
Title: *Synthesis of a Protected S,S-Beta-Vinyl Serine*
Funding: National Institutes of Health (NIH) Area Grant

Name: Jose "Fernando" Carbajal Perez 2021 (Chemistry)
Mentor: Anthony Chianese (Chemistry)
Title: *Understanding and Engineering Ruthenium Catalysts for Hydrogenation Reactions*
Funding: Science and Math Initiative-SMI (NASC Division)

Name: Yejin Cha 2021 (Chemistry; Computer Science)
Mentor: Anne Perring (Chemistry)
Title: *Measurements of Primary Biological Aerosol in Upstate New York*
Funding: NASC Division

Name: Tenzing Dakpa 2021 (Molecular Biology)
Mentor: Adaickapillai Mahendran (Chemistry)
Title: *Synthesis and Structure-Activity Relationship of Novel Thiobenzohydroxamate Drug Candidates as Inhibitors of Histone Deacetylase (HDAC)*
Funding: Science and Math Initiative-SMI (NASC Division)

Name: Jacob Esarco 2020 (Biochemistry)
Mentor: Jacob Goldberg (Chemistry)
Title: *Ratiometric Sensors for Mobile Zinc*
Funding: NASC Division

Name: Molly Frauenheim 2020 (Chemistry)
Mentor: Anne Perring (Chemistry)
Title: *Measurements of Primary Biological Aerosol in Upstate New York*
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Name: Maria-Raluca “Raluca” Ghilea 2022 (Computer Science; Physics)
Mentor: Daniel “Dan” Zaleski (Chemistry)
Title: *Development of Artificial Intelligence for Broadband Rotational Spectroscopy*
Funding: NASC Division

Name: Mariam Grigoryan 2021 (Computer Science)
Mentor: Daniel “Dan” Zaleski (Chemistry)
Title: *Development of Artificial Intelligence for Broadband Rotational Spectroscopy*
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Name: Tianyi “Mike” He 2019 (Philosophy; Chemistry)
Mentor: Anthony Chianese (Chemistry)
Title: *Dehydroalkylative Catalyst Activation of Ruthenium CNN- and PNN- Pincer Catalysts for Ester Hydrogenation*
Funding: National Science Foundation Grant

Name: Jacob Hoglund 2022 (Undeclared)
Mentor: Jacob Goldberg (Chemistry)
Title: *Ratiometric Sensors for Mobile Zinc*
Funding: Michael J. Wolk ’60 Heart Foundation

Name: Jackson Hoit 2022 (Undeclared)
Mentor: Eric Muller (Chemistry)
Title: *Mid-Infrared Tip-Enhanced Spectroscopy and Nanoscale Imaging*
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Name: Cole Jarczyk 2021 (Chemistry; Economics)
Mentor: Anthony Chianese (Chemistry)
Title: *Understanding and Engineering Ruthenium Catalysts for Hydrogenation Reactions*
Funding: Warren Anderson Fund

Name: Brianna “Bri” Jepsen 2020 (Chemistry)
Mentor: Adaickapillai Mahendran (Chemistry)
Title: *Synthesis and Structure-Activity Relationship of Novel Thiobenzohydroxamate Drug Candidates as Inhibitors of Histone Deacetylase (HDAC)*
Funding: Miller-Cochran Fund

Name: Johna Joseph 2022 (Chemistry)
Mentor: Eric Muller (Chemistry)
Title: *Mid-Infrared Tip-Enhanced Spectroscopy and Nanoscale Imaging*
Funding: NASC Division

Name: Sophie Kelly 2021 (Biochemistry)
Mentor: Anthony Chianese (Chemistry)
Title: *Understanding and Engineering Ruthenium Catalysts for Hydrogenation Reactions*
Funding: National Science Foundation Grant

Name: Thao Kim 2021 (Biochemistry)
Mentor: Anthony Chianese (Chemistry)
Title: *Understanding and Engineering Ruthenium Catalysts for Hydrogenation Reactions*
Funding: NASC Division

Name: William "Will" Leiter 2020 (Chemistry)
Mentor: Ephraim Woods (Chemistry)
Title: *Photochemical Pathways to the Production of Secondary Organic Aerosol*
Funding: National Science Foundation Grant

Name: Brynn Lewis 2020 (Biochemistry)
Mentor: Ernie Nolen (Chemistry)
Title: *Synthesis of Glyco-Amino Acids for Biomedical Studies*
Funding: National Institutes of Health (NIH) Area Grant

Name: Konrad McKalip 2020 (Biochemistry)
Mentor: Anne Perring (Chemistry)
Title: *Measurements of Primary Biological Aerosol in Upstate New York*
Funding: NASC Division

Name: Braden "Brady" Mediavilla 2020 (Chemistry; Neuroscience)
Mentor: Anne Perring (Chemistry)
Title: *Measurements of Black Carbon Aerosol in Fire Plumes*
Funding: NASC Division

Name: Colin Miller 2022 (Undeclared)
Mentor: Ephraim Woods (Chemistry)
Title: *Photochemical Pathways to the Production of Secondary Organic Aerosol*
Funding: Warren Anderson Fund

Name: John Pham 2020 (Chemistry; Applied Math)
Mentor: Anthony Chianese (Chemistry)
Title: *Understanding and Engineering Ruthenium Catalysts for Hydrogenation Reactions*
Funding: NASC Division

Name: Eamon Reynolds 2020 (Chemistry)
Mentor: Anthony Chianese (Chemistry)
Title: *Understanding and Engineering Ruthenium Catalysts for Hydrogenation Reactions*
Funding: National Science Foundation Grant

Name: Sara Robinson 2020 (Chemistry)
Mentor: Rick Geier (Chemistry)
Title: *Investigation of the Synthesis of N-Confused Ferrocenylporphyrin*
Funding: Miller-Cochran Fund

Name: Valerie Rome 2021 (Biochemistry)
Mentor: Rick Geier (Chemistry)
Title: *Refining Reaction Conditions for the Synthesis of BOPHY*
Funding: NASC Division

Name: McKella Sylvester 2021 (English)
Mentor: Ernie Nolen (Chemistry)
Title: *Synthesis of Glyco-Amino Acids for Biomedical Studies*
Funding: National Institutes of Health (NIH) Area Grant

Name: Daniel "Danny" Zelmanovich 2022 (Undeclared)
Mentor: Eric Muller (Chemistry)
Title: *Mid-Infrared Tip-Enhanced Spectroscopy and Nanoscale Imaging*
Funding: Justus '43 and Jayne Schlichting Student Research Fund

Name: Weiyu "Jessica" Zhong 2022 (Chemistry)
Mentor: Ephraim Woods (Chemistry)
Title: *Photochemical Pathways to the Production of Secondary Organic Aerosol*
Funding: Justus '43 and Jayne Schlichting Student Research Fund

Department of Computer Science

Name: Lily Davisson 2022 (Computer Science)
Mentor: Joel Sommers (Computer Science)
Title: *Automating Active Measurement Metadata Collection and Analysis*
Funding: National Science Foundation Grant

Name: Mary Festa 2020 (Computer Science)
Mentor: Aaron Gember-Jacobson (Computer Science)
Title: *Updating Computer Networks One Step at a Time*
Funding: National Science Foundation Grant

Name: Nhiem Ngo 2021 (Computer Science)
Mentor: Joel Sommers (Computer Science)
Title: *Automating Active Measurement Metadata Collection and Analysis*
Funding: National Science Foundation Grant

Name: Tam Nguyen 2022 (Computer Science)
Mentor: Michael Hay (Computer Science)
Title: *Exposed! Attacking Online Data Repositories to Infer Sensitive Information*
Funding: National Science Foundation Grant

Name: Chau Pham 2022 (Computer Science)
Mentor: Joel Sommers (Computer Science)
Title: *Automating Active Measurement Metadata Collection and Analysis*
Funding: NASC Division

Name: Ruchit Shrestha 2020 (Mathematics; Computer Science)
Mentor: Aaron Gember-Jacobson (Computer Science)
Title: *Updating Computer Networks One Step at a Time*
Funding: National Science Foundation Grant

Name: Xiaolin "Owen" Sun 2020 (Mathematical Economics; Computer Science)
Mentor: Aaron Gember-Jacobson (Computer Science)
Title: *Updating Computer Networks One Step at a Time*
Funding: Holden Endowment Fund

Name: Desmond Tuiyot 2020 (Japanese; Computer Science)
Mentor: Hiva Samadian (Computer Science)
Title: *Dynamic Programming Algorithm for Conflict Resolution in Access Control*
Funding: Research Council

Name: Hezhong "Williams" Zhang 2021 (Computer Science)
Mentor: Michael Hay (Computer Science)
Title: *Exposed! Attacking Online Data Repositories to Infer Sensitive Information*
Funding: National Science Foundation Grant

Department of Geology

Name: Francis Criscione 2021 (Computer Science)
Mentor: Karen Harpp (Geology)
Title: *Virtual Galapagos: An Innovative Science Outreach Project*
Funding: Doug Rankin '53 Endowment-Geology Research

Name: Devin Ferri 2021 (Peace and Conflict Studies)
Mentor: Karen Harpp (Geology)
Title: *Virtual Galapagos: An Innovative Science Outreach Project*
Funding: Bob Linsley/James McLelland Fund

Name: Meaghan Kendall 2021 (Natural Sciences)
Mentor: Amy Leventer (Geology)
Title: *Diatoms from Subglacial Lake Mercer*
Funding: Norma Vergo Prize

Name: Lily Kuentz 2021 (Environmental Geology)
Mentor(s): Dianne "Di" Keller and William Peck (Geology)
Title: *Mineral Weathering and Passive Carbon Sequestration at an Abandoned Wollastonite Mine*
Funding: Doug Rankin '53 Endowment-Appalachian Research

Name: Patrick Matulka 2019 (Astrogeophysics)
Mentor: Joseph "Joe" Levy (Geology)
Title: *Exploring Martian Climate through Mapping of Glacial and Permafrost Landforms*
Funding: NASA Mars Data Analysis Program

Name: Rachel Meyne 2021 (Geology)
Mentor: Amy Leventer (Geology)
Title: *Characterizing the Biological Signature of Deglaciation*
Funding: Norma Vergo Prize

Name: Aleksandra "Sasha" Mikus 2020 (Neuroscience; Environmental Geography)
Mentor: Joseph "Joe" Levy (Geology)
Title: *Where is the Limit of Life on Earth? Spoilers: In Antarctica*
Funding: Hackett-Rathmell 1968 Memorial Fund

Name: Tam Nguyen 2022 (Computer Science)
Mentor: Karen Harpp (Geology)
Title: *Virtual Galapagos: An Innovative Science Outreach Project*
Funding: Hackett-Rathmell 1968 Memorial Fund

Name: Paul Nugent 2021 (Geology; Music)
Mentor(s): Dianne "Di" Keller and William Peck (Geology)
Title: *Mineral Weathering and Passive Carbon Sequestration at an Abandoned Wollastonite Mine*
Funding: Doug Rankin '53 Endowment-Appalachian Research

Name: Marie Pugliese 2020 (Biology)
Mentor: Karen Harpp (Geology)
Title: *Virtual Galapagos: An Innovative Science Outreach Project*
Funding: Bob Linsley/James McLelland Fund

Name: Elizabeth "Liz" Rasmussen 2021 (History)
Mentor: Karen Harpp (Geology)
Title: *Virtual Galapagos: An Innovative Science Outreach Project*
Funding: NASC Division

Name: Grace Schreiber 2021 (Natural Sciences)
Mentor: Amy Leventer (Geology)
Title: *Characterizing the Biological Signature of Deglaciation*
Funding: Norma Vergo Prize

Name: Michelle Tebolt 2019 (Astrogeophysics)
Mentor: Joseph "Joe" Levy (Geology)
Title: *Exploring Martian Climate through Mapping of Glacial and Permafrost Landforms*
Funding: NASA Mars Data Analysis Program

Name: Emily Weaver 2020 (Environmental Geology)
Mentor: Karen Harpp (Geology)
Title: *Virtual Galapagos: An Innovative Science Outreach Project*
Funding: Doug Rankin '53 Endowment-Geology Research

Name: Katherine "Katie" Weber 2020 (Biology)
Mentor: Karen Harpp (Geology)
Title: *Virtual Galapagos: An Innovative Science Outreach Project*
Funding: NASC Division

Department of Mathematics

Name: Caio Rodrigues Faria Brighenti 2020 (Peace and Conflict Studies; Computer Science)
Mentor: William "Will" Cipolli (Mathematics)
Title: *Language-Based Fake News Detection: Towards an Interpretable Approach*
Funding: NASC Division

Department of Neuroscience

Name: Eleanor "Ellie" Burton 2020 (Neuroscience)
Mentor: Jun Yoshino (Neuroscience; Psychological and Brain Sciences)
Title: *Effect of Medications on Nitric Oxide Released from Glial Cells*
Funding: NASC Division

Name: Grace DiRisio 2020 (Neuroscience)
Mentor: Jun Yoshino (Neuroscience; Psychological and Brain Sciences)
Title: *Effect of Medications on Nitric Oxide Released from Glial Cells*
Funding: NASC Division

Name: Tamar Japaridze 2021 (Neuroscience)
Mentor: Bruce C. Hansen (Neuroscience; Psychological and Brain Sciences)
Title: *Mapping the Neuroelectric State-space Geometry of Natural Scenes*
Funding: NASC Division

Name: David Maynard 2021 (Molecular Biology; Spanish)
Mentor: Jason Meyers (Biology; Neuroscience)
Title: *Mantle Cells as Progenitors in the Regeneration of Zebrafish Neuromasts*
Funding: Oberheim Memorial Fund

Name: Fanyi Mo 2020 (Psychological Science; Computer Science)
Mentor: Bruce C. Hansen (Neuroscience; Psychological and Brain Sciences)
Title: *Mapping the Neuroelectric State-space Geometry of Natural Scenes*
Funding: NASC Division

Name: Cameron "Cam" Patrick 2022 (Undeclared)
Mentor: Jason Meyers (Biology; Neuroscience)
Title: *Mantle Cells as Progenitors in the Regeneration of Zebrafish Neuromasts*
Funding: Michael J. Wolk '60 Heart Foundation

Name: Maia Van Buskirk 2020 (Neuroscience)
Mentor: Jun Yoshino (Neuroscience; Psychological and Brain Sciences)
Title: *Effect of Medications on Nitric Oxide Released from Glial Cells*
Funding: NASC Division

Department of Physics and Astronomy

Name: Muhammad Bin Awais 2021 (Physics)
Mentor: Rebecca Metzler (Physics and Astronomy)
Title: *Exploring the Optics of Biological Materials*
Funding: Justus '43 and Jayne Schlichting Student Research Fund

Name: Aayam Bista 2020 (Physics)
Mentor: Enrique "Kiko" Galvez (Physics and Astronomy)
Title: *Quantum Ghost Imaging*
Funding: Justus '43 and Jayne Schlichting Student Research Fund

Name: Sandesh Chapagain 2020 (Physics; Computer Science)
Mentor: Kenneth "Ken" Segall (Physics and Astronomy)
Title: *Numerical Modeling of Superconducting Circuits*
Funding: Justus '43 and Jayne Schlichting Student Research Fund

Name: Srecko Curkovic 2020 (Physics)
Mentor: Kenneth "Ken" Segall (Physics and Astronomy)
Title: *Low Temperature Testing of Superconducting Circuits*
Funding: Justus '43 and Jayne Schlichting Student Research Fund

Name: Miguel De Los Santos 2022 (Undeclared)
Mentor: Thomas Balonek (Physics and Astronomy)
Title: *Optical Variability of Quasars and Stars at the Colgate Observatory*
Funding: Science and Math Initiative-SMI (NASC Division)

Name: Daniel Dougherty 2021 (Philosophy; Astronomy/Physics)
Mentor: Thomas Balonek (Physics and Astronomy)
Title: *Astrophotometry with the Nikon D3500*
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Name: Amogh Gupta 2021 (Physics)
Mentor: Rebecca Metzler (Physics and Astronomy)
Title: *Exploring the Multi-Scale Relationship between Structure, Composition, and Mechanical Properties in Calcium Carbonate Biominerals*
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Name: Fairuz Ishraque 2022 (Astrogeophysics; Applied Math)
Mentor: Thomas Balonek (Physics and Astronomy)
Title: *Optical Variability of Quasars and Stars at the Colgate Observatory*
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Name: Joshua “Josh” Liberman 2022 (Astronomy/Physics)
Mentor: Thomas Balonek (Physics and Astronomy)
Title: *DSLR Astrophotometry of the Eclipsing Binary Star Beta Lyrae*
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Name: Eric Matt 2022 (German; Physics)
Mentor: Beth Parks (Physics and Astronomy)
Title: *Analyzing Airborne Particulates to Determine Sources of Ugandan Air Pollution*
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Name: Anupama “Annie” Motee 2020 (Physics)
Mentor: Enrique “Kiko” Galvez (Physics and Astronomy)
Title: *Topological Singularities in Light Beams*
Funding: National Science Foundation Grant

Name: Cheeranjeev Purmessur 2020 (Physics)
Mentor: Kenneth “Ken” Segall (Physics and Astronomy)
Title: *Numerical Modeling of Superconducting Circuits*
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Name: Benjamin “Ben” Reilly 2021 (Physics)
Mentor: Kenneth “Ken” Segall (Physics and Astronomy)
Title: *Low Temperature Testing of Superconducting Circuits*
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Name: Baibhav Sharma 2021 (Physics)
Mentor: Enrique “Kiko” Galvez (Physics and Astronomy)
Title: *Quantum Hyperentanglement of Photons*
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Name: John Slater 2022 (Astronomy/Physics)
Mentor: Thomas Balonek (Physics and Astronomy)
Title: *The Recent Flare and Possible Pattern of Outbursts of Quasar 1308+326*
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Name: Jack Tregidga 2021 (Physics)
Mentor: Rebecca Metzler (Physics and Astronomy)
Title: *Exploring the Multi-Scale Relationship between Structure, Composition, and Mechanical Properties in Calcium Carbonate Biominerals*
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Name: Saiyang “Sylvan” Zhang 2019 (Astronomy/Physics; Applied Math)
Mentor: Cosmin Ilie (Physics and Astronomy)
Title: *Effects of Capture of non-WIMP Dark Matter by the First Stars*
Funding: NASC Division

Department of Psychological and Brain Sciences

Name: Karen Aguilar 2020 (Spanish; Psychological Science)
Mentor: Lauren Philbrook (Psychological and Brain Sciences)
Title: *Child Sleep, Stress, and Learning Study*
Funding: Science and Math Initiative-SMI (NASC Division)

Name: Kaila Daza 2021 (Psychological Science; Educational Studies)
Mentor: Lauren Philbrook (Psychological and Brain Sciences)
Title: *Child Sleep, Stress, and Learning Study*
Funding: NASC Division

Name: Tai Goldstein 2022 (Undeclared)
Mentor: Wan-chun Liu (Psychological and Brain Sciences)
Title: *Hippocampal Mapping in the Zebra Finch*
Funding: NASC Division

Name: Katrina Judicke 2020 (Psychological Science; Geography)
Mentor: Caroline “Carrie” Keating (Psychological and Brain Sciences)
Title: *Improving Confidence and Performance in Women Faced with Gender Stereotype Threat*
Funding: NASC Division

Name: Leonardo “Leo” Motta-Zacks 2021 (Neuroscience)
Mentor: Wan-chun Liu (Psychological and Brain Sciences)
Title: *Social Influence on the Development of Vocal Learning and Brain Circuits*
Funding: NASC Division

Name: Gillian “Gill” Schutt 2020 (Neuroscience)
Mentor: Wan-chun Liu (Psychological and Brain Sciences)
Title: *Attentive Listening Behavior and Song Learning in Taeniopygia guttata*
Funding: NASC Division

Name: Carolyn Senneca 2020 (Neuroscience; English)
Mentor: Wan-chun Liu (Psychological and Brain Sciences)
Title: *Social Influence on the Development of Vocal Learning and Brain Circuits*
Funding: NASC Division

DIVISION OF SOCIAL SCIENCES (SOSC)

Department of Anthropology

Name: Andrea De Hoyos 2020 (History; Anthropology)
Mentor: Santiago Juarez (Anthropology)
Title: *A Look into Organizations that Provide Support to Undocumented Immigrants*
Funding: SOSC Division

Name: Siena Frost 2019 (Middle East and Islamic Studies)
Mentor: Mary Moran (Anthropology; Africana and Latin American Studies)
Title: *Refugee Resettlement in Germany and the United States: Best Practices for Success*
Funding: Center for Freedom and Western Civilization (James Madison Research Fund)

Department of Educational Studies

Name: Faith Altomare 2021 (French; Educational Studies)
Mentor: Mark Stern (Educational Studies)
Title: *Punitive Discrimination and Restorative Hope: Disciplinary Practices in Elementary Schools*
Funding: SOSC Division

Name: Emma Gaylo 2021 (Educational Studies; Sociology)
Mentor: Mark Stern (Educational Studies)
Title: *Teachers Strike Back: Organized Resistance and its Effectiveness*
Funding: SOSC Division

Name: Jailekha Zutshi 2021 (Mathematical Economics; Psychological Science)
Mentor: Ashley Taylor (Educational Studies)
Title: *The Effects of a Common Braille System on Urdu and Hindi Speakers in India*
Funding: Lampert Institute for Civic and Global Affairs

Department of Geography

Name: Theodore "Teddy" Campbell 2020 (Geography)
Mentor: Daisaku "Dai" Yamamoto (Asian Studies; Geography)
Title: *Community Response to Nuclear Power Plant Closures*
Funding: SOSC Division

Name: Elena Forbath 2021 (Geography; Biology)
Mentor: Michael "Mike" Loranty (Geography)
Title: *Quantifying Spatial Variation in Vegetation Indices after Fire in Siberia Larch Forests*
Funding: National Science Foundation Grant

Name: Isobel Hooker 2021 (Russian and Eurasian Studies)
Mentor: Jessica Graybill (Geography; Russian and Eurasian Studies)
Title: *Arctic Storytelling – Teriberka, by way of Earlville*
Funding: SOSC Division

Name: Wyman Huang 2022 (Geography)
Mentor: Daisaku "Dai" Yamamoto (Asian Studies; Geography)
Title: *Community Response to Nuclear Power Plant Closures*
Funding: SOSC Division

Name: Yang Zhang 2021 (Russian and Eurasian Studies; Political Science)
Mentor: Jessica Graybill (Geography; Russian and Eurasian Studies)
Title: *Arctic Storytelling – Teriberka, by way of Earlville*
Funding: SOSC Division

Department of History

Name: Alara Burgess 2021 (Sociology; History)
Mentor: Graham Hodges (History; Africana and Latin American Studies)
Title: *Black Flight in the Americas, 1500s-1865*
Funding: SOSC Division

Name: Hannah Grote 2022 (Undeclared)
Mentor: Graham Hodges (History; Africana and Latin American Studies)
Title: *Black Flight in the Americas, 1500s-1865*
Funding: SOSC Division

Name: Jun Yuan "JY" Khoo 2022 (History; Peace and Conflict Studies)
Mentor: Robert Nemes (History)
Title: *No Longer Dragon Tooth Gate: Shaping Singaporean Chinese Identity through Sites of Memory*
Funding: Lampert Institute for Civic and Global Affairs

Name: Annina "Anna" Pluff 2020 (History)
Mentor: Andrew "Andy" Rotter (History; Peace and Conflict Studies)
Title: *Study of the Foreign Policy of the American Founders*
Funding: Center for Freedom and Western Civilization (James Madison Research Fund)

Name: Lijun "Karen" Zhang 2021 (History)
Mentor: Monica Mercado (History)
Title: *Looking for Women's Voice: The Portrayal of Revolutionary Women in Contemporary Chinese Museums and History Textbooks*
Funding: Lampert Institute for Civic and Global Affairs

Name: Zhelun Zhou 2020 (History; Philosophy and Religion)
Mentor: Alexander "Xan" Karn (History)
Title: "*The grass must bend, when the wind blows across it": British Colonial Hong Kong's Education Policy, 1967 to 1978*
Funding: Lampert Institute for Civic and Global Affairs

Department of Political Science

Name: Vedika Almal 2021 (History; International Relations)
Mentor: Navine Murshid (Political Science)
Title: *Cricket, Culture, and Diplomacy in South Asia*
Funding: Lampert Institute for Civic and Global Affairs

Name: Christopher "Chris" Burke 2021 (Political Science; Peace and Conflict Studies)
Mentor: Sam Rosenfeld (Political Science)
Title: *Study of Climate Change and Western Security in Connection with the CEVRO Institute in Prague*
Funding: Center for Freedom and Western Civilization (Stone Summer Research Fund)

Name: Kasey Chan 2021 (Political Science)
Mentor: Robert Kraynak (Political Science)
Title: *Study of the American and French Revolutions through the Eyes of Alexis de Tocqueville and the American Founders*
Funding: Center for Freedom and Western Civilization (James Madison Research Fund)

Name: Ziyu "Vicky" Zhou 2020 (Political Science)
Mentor: Stanley Brubaker (Political Science)
Title: *Study of Fake News in the French and American Constitutional Systems*
Funding: Center for Freedom and Western Civilization (James Madison Research Fund)

Department of Sociology

Name: Erika Fox 2021 (Film and Media Studies; Computer Science)
Mentor: Alicia Simmons (Sociology)
Title: *Extracting and Analyzing User Comments to Expose How Americans Respond to Gun Violence*
Funding: SOSC Division

Name: Matthew "Matt" Freniere 2020 (Sociology; Biology)
Mentor: Carolyn L. Hsu (Sociology)
Title: *Investigating Online Media: Content Analysis of a Conservative YouTube Channel PragerU*
Funding: Walter Broughton '63 Research Fund

Name: Ethan So 2021 (History)
Mentor: Alicia Simmons (Sociology)
Title: *News Framing of Police Killings of Unarmed Blacks*
Funding: SOSC Division

Name: Rachel Thompson 2020 (Sociology)
Mentor: Alicia Simmons (Sociology)
Title: *News Framing of Police Killings of Unarmed Blacks*
Funding: SOSC Division

DIVISION OF UNIVERSITY STUDIES (UNST)

Environmental Studies

Name: Matthew "Matt" Chistolini 2021 (Applied Math)
Mentor: Linda Tseng (Environmental Studies; Physics and Astronomy)
Title: *A Single Use Society: A Study on the Environmental Impacts of Microplastics*
Funding: Lampert Institute for Civic and Global Affairs

Name: Amanda Lue 2022 (Undeclared)
Mentor: Linda Tseng (Environmental Studies; Physics and Astronomy)
Title: *Monitoring Nutrients and Trace Chemicals in Local Waters*
Funding: UNST Division

Name: Andrew Pratt 2020 (Physics)
Mentor: Linda Tseng (Environmental Studies; Physics and Astronomy)
Title: *Monitoring Nutrients and Trace Chemicals in Local Waters*
Funding: UNST Division

Name: ChanJu "Zoe" You 2022 (Undeclared)
Mentor: Linda Tseng (Environmental Studies; Physics and Astronomy)
Title: *Microplastic Chemical Retention*
Funding: UNST Division

Film and Media Studies

Name: Molly Adelman 2021 (History; Film and Media Studies)
Mentor: Mary Simonson (Film and Media Studies; Women's Studies)
Title: *Staging Cinema: Performance, Liveness, and the Transition to Sound*
Funding: UNST Division

Name: ChanHa "Chloe" You 2022 (Undeclared)
Mentor: Mary Simonson (Film and Media Studies; Women's Studies)
Title: *Staging Cinema: Performance, Liveness, and the Transition to Sound*
Funding: UNST Division

Linguistics

Name: Zhongwen "Kevin" Lian 2020 (Computer Science)
Mentor: Yukari Hirata (East Asian Languages and Literatures; Linguistics)
Title: *Design a Way to Better Help Mandarin Native Speaker's Distinguish and Pronounce English Vowels and Consonants*
Funding: UNST Division

Peace and Conflict Studies

Name: Anne Getz Eidelhoch 2020 (Peace and Conflict Studies)
Mentor: Susan Thomson (Peace and Conflict Studies)
Title: *Necklacing and White Genocide in South Africa*
Funding: Lampert Institute for Civic and Global Affairs

Name: Alyssa Kryzelle Reyes 2022 (Undeclared)
Mentor: Philippe Duhart (Peace and Conflict Studies)
Title: *From Rebel to Partners in Peace: Understanding the Moro Islamic Liberation Front's Role in Building Peace in Bangsamoro, Philippines*
Funding: UNST Division

Russian and Eurasian Studies

Name: Dvorah Southland 2021 (Russian and Eurasian Studies; International Relations)
Mentor: Jessica Graybill (Geography; Russian and Eurasian Studies)
Title: *Russian Eyes on the North*
Funding: UNST Division

CENTER FOR FREEDOM AND WESTERN CIVILIZATION

Name: Christopher "Chris" Burke 2021 (Political Science; Peace and Conflict Studies)
Mentor: Sam Rosenfeld (Political Science)
Title: *Study of Climate Change and Western Security in Connection with the CEVRO Institute in Prague*
Funding: Center for Freedom and Western Civilization (Stone Summer Research Fund)

Name: Kasey Chan 2021 (Political Science)
Mentor: Robert Kraynak (Political Science)
Title: *Study of the American and French Revolutions through the Eyes of Alexis de Tocqueville and the American Founders*
Funding: Center for Freedom and Western Civilization (James Madison Research Fund)

Name: Siena Frost 2019 (Middle East and Islamic Studies)
Mentor: Mary Moran (Anthropology; Africana and Latin American Studies)
Title: *Refugee Resettlement in Germany and the United States: Best Practices for Success*
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Name: Annina "Anna" Pluff 2020 (History)
Mentor: Andrew "Andy" Rotter (History; Peace and Conflict Studies)
Title: *Study of the Foreign Policy of the American Founders*
Funding: Center for Freedom and Western Civilization (James Madison Research Fund)

Name: Natalie Ramirez 2019 (Art and Art History; Classical Studies)
Mentor: Rebecca Ammerman (Classics)
Title: *Classical Archaeology in Italy: The Excavation of Trench 6 of the North Urban Paestum*
Funding: Center for Freedom and Western Civilization (James Madison Research Fund)

Name: Ziyu "Vicky" Zhou 2020 (Political Science)
Mentor: Stanley Brubaker (Political Science)
Title: *Study of Fake News in the French and American Constitutional Systems*
Funding: Center for Freedom and Western Civilization (James Madison Research Fund)

LAMPERT INSTITUTE FOR CIVIC AND GLOBAL AFFAIRS

Name: Vedika Almal 2021 (History; International Relations)
Mentor: Navine Murshid (Political Science)
Title: *Cricket, Culture, and Diplomacy in South Asia*
Funding: Lampert Institute for Civic and Global Affairs

Name: Matthew "Matt" Chistolini 2021 (Applied Math)
Mentor: Linda Tseng (Environmental Studies; Physics and Astronomy)
Title: *A Single Use Society: A Study on the Environmental Impacts of Microplastics*
Funding: Lampert Institute for Civic and Global Affairs

Name: Anne Getz Eidelhoch 2020 (Peace and Conflict Studies)
Mentor: Susan Thomson (Peace and Conflict Studies)
Title: *Necklacing and White Genocide in South Africa*
Funding: Lampert Institute for Civic and Global Affairs

Name: Jun Yuan "JY" Khoo 2022 (History; Peace and Conflict Studies)
Mentor: Robert Nemes (History)
Title: *No Longer Dragon Tooth Gate: Shaping Singaporean Chinese Identity through Sites of Memory*
Funding: Lampert Institute for Civic and Global Affairs

Name: Lijun "Karen" Zhang 2021 (History)
Mentor: Monica Mercado (History)
Title: *Looking for Women's Voice: The Portrayal of Revolutionary Women in Contemporary Chinese Museums and History Textbooks*
Funding: Lampert Institute for Civic and Global Affairs

Name: Zhelun Zhou 2020 (History; Philosophy and Religion)
Mentor: Alexander "Xan" Karn (History)
Title: "*The grass must bend, when the wind blows across it": British Colonial Hong Kong's Education Policy, 1967 to 1978*
Funding: Lampert Institute for Civic and Global Affairs

Name: Jailekha Zutshi 2021 (Mathematical Economics; Psychological Science)
Mentor: Ashley Taylor (Educational Studies)
Title: *The Effects of a Common Braille System on Urdu and Hindi Speakers in India*
Funding: Lampert Institute for Civic and Global Affairs

OTHER

Name: Daniel Gathogo 2020 (Computer Science)
Mentor: Joseph "Joe" Eakin (Vis Lab; Learning and Applied Innovation)
Title: *Virtual Galapagos: An Innovative Science Outreach Project*
Funding: Ho Tung Visualization Laboratory

Name: Justin Mailom 2020 (Japanese; Physics)
Mentor: Joseph "Joe" Eakin (Vis Lab; Learning and Applied Innovation)
Title: *Virtual Galapagos: An Innovative Science Outreach Project*
Funding: Ho Tung Visualization Laboratory

Name: Kathryn "Kate" Robinson 2022 (Philosophy)
Mentor: Jessica "Jesi" Buell (University Libraries)
Title: *DCMO BOCES Grade Level Reading Campaign*
Funding: SOSC Division

Name: Eric Roels 2021 (Astronomy/Physics)
Mentor: Joseph "Joe" Eakin (Vis Lab; Learning and Applied Innovation)
Title: *Virtual Galapagos: An Innovative Science Outreach Project*
Funding: NASC Division

RESEARCH COUNCIL

Name: Desmond Tuiyot 2020 (Japanese; Computer Science)
Mentor: Hiva Samadian (Computer Science)
Title: *Dynamic Programming Algorithm for Conflict Resolution in Access Control*
Funding: Research Council

UPSTATE INSTITUTE

Name: Elaina Alzaibak 2020 (Biology)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Cornell Cooperative Extension of Madison County "Farming for the Future: Climate Adaptation Strategies for Northeast Farmers"*
Funding: Upstate Institute

Name: Nadav "Davi" Bendavid 2022 (Biology)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Ausable River Association "Using Environmental DNA to Map Adirondack Trout Occupancy in the Ausable Watershed"*
Funding: Upstate Institute

Name: Makenna Bridge 2020 (Environmental Geography)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Adirondack Action "Pollinator Conservation in the Adirondack Park"*
Funding: Upstate Institute

Name: Peter Bulan 2021 (English)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Legal Aid Society of Mid New York, Inc. "Consumer Bankruptcy Law Project"*
Funding: Upstate Institute

Name: Johanna Burke 2021 (Political Science; Environmental Studies)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Mohawk Valley Resource Center for Refugees "Naturalization Preparation: Best Practices for Preparing Non-English Speaking Adults to Become U.S. Citizens"*
Funding: Upstate Institute

Name: Julia "JJ" Citron 2020 (Peace and Conflict Studies)
Mentor: Julie Dudrick (Upstate Institute)
Title: *National Abolition Hall of Fame and Museum "Community Engagement and Activism"*
Funding: Upstate Institute

Name: Jared Collins 2021 (Biology)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Adirondack Center for Loon Conservation "Conservation Strategies in a Changing World: The Adirondack Loon"*
Funding: Upstate Institute

Name: Alden DeBouter 2019 (Anthropology; Film and Media Studies)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Cornell Cooperative Extension of Madison County "Visual Storytelling for Farmers in Madison County"*
Funding: Upstate Institute

Name: Aliyah Kennise De Jesus 2021 (Molecular Biology; Women's Studies)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Abraham House "A Community Effort: Exploring the Importance of Local Partnerships in Quality Hospice Care"*
Funding: Upstate Institute

Name: Taylor Dumas 2020 (Peace and Conflict Studies)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Mountain Lake PBS "Dissecting Rural Racism through Documentary"*
Funding: Upstate Institute

Name: Erin Hendry 2020 (Neuroscience)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Chenango United Way "Volunteerism: Visualizing Change through Innovative Readiness Training"*
Funding: Upstate Institute

Name: Andrew Jaworski 2021 (Political Science)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Village and Town of Hamilton "Unpacking the Climate Smart Community Checklist"*
Funding: Upstate Institute

Name: Nathan "Nate" Jeffries 2020 (Biology)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Young Scholars Liberty Partnerships Program at Utica College "The Parent Engagement Challenge: Overcoming Barriers to Parental Involvement in Education"*
Funding: Upstate Institute

Name: Abigail Kelly 2021 (Neuroscience)
Mentor: Julie Dudrick (Upstate Institute)
Title: *BRiDGES: Madison County Council on Alcoholism and Substance Abuse, Inc. "Harm Reduction as a Tool in the Opioid Crisis"*
Funding: Upstate Institute

Name: Dipesh Khati 2022 (Undeclared)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Partnership for Community Development "What's Next for the Hamilton Farmers' Market?"*
Funding: Upstate Institute

Name: Sahil Lalwani 2022 (Undeclared)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Village of Hamilton Airport Commission "Estimating the Economic Impact of the Hamilton Municipal Airport"*
Funding: Upstate Institute

Name: Bailey Larson 2019 (Educational Studies)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Madison County Department of Social Services "The Need for Long-Term Supportive Housing in Madison County"*
Funding: Upstate Institute

Name: Linh "Christine" Le 2019 (Economics; International Relations)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Mohawk Valley Resource Center for Refugees "Secondary Migration in Utica, New York and the Mohawk Valley Resource Center for Refugees"*
Funding: Upstate Institute

Name: Carly Leifken 2020 (Political Science; English)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Fiver Children's Foundation "Fiver Children's Foundation: Central New York Community Engagement"*
Funding: Upstate Institute

Name: Dylann McLaughlin GR (English MAT)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Yleana Academy "Design-Thinking and Entrepreneurship in a Leadership Academy Curriculum"*
Funding: Upstate Institute

Name: Elizabeth "Lizzy" Moore 2020 (Peace and Conflict Studies; Geography)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Farmers' Museum "Museum Engagement: Utilizing Technology and Participatory Experiences for Young Audiences"*
Funding: Upstate Institute

Name: Emily "Emmy" Ritchey 2020 (English)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Mohawk Valley Resource Center for Refugees "Utica's Refugees: Empowered in Entrepreneurship"*
Funding: Upstate Institute

Name: Victoria Rykaczewski 2020 (Political Science)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Madison County Department of Health "Using Health Information to Improve Community Health Outcomes"*
Funding: Upstate Institute

Name: Emily Schwartz 2021 (Environmental Studies)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Adirondack Council "How is Climate Change Impacting Adirondack Farmers?"*
Funding: Upstate Institute

Name: Elizabeth Shaw 2022 (Anthropology)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Fenimore Museum "Heroines of Abstract Expressionism"*
Funding: Upstate Institute

Name: Annalise Simons 2021 (International Relations)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Adirondack Foundation "Measuring Foundation Impact"*
Funding: Upstate Institute

Name: Samto Wongso 2019 (Geography)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Community Action Partnership "Program Assessment with Community Action Partnership for Madison County"*
Funding: Upstate Institute

Research Summaries

Research Fellow(s): **Molly Adelman (2021)** **Concentration(s): History; Film and Media Studies**
ChanHa "Chloe" You (2022) **Concentration: Undeclared**

Faculty Mentor: Mary Simonson **Department(s): Film and Media Studies; Women's Studies**

Title of Project: Staging Cinema: Performance, Liveness, and the Transition to Sound

Project Summary:

Cinema has been a prominent feature of American society since the early 20th century; however its presentation has evolved significantly during its century long lifespan. Our task was to research the early stages of cinema, from 1916-1926, and examine live performance, new technology, and sound in the formative years of cinema.

Before the introduction of "talkies" in the late-1920s, cinema exhibitors were experimenting with different ways of using sound to enhance films. Using archival materials, including trade journals, newspaper articles, and advertisements, we examined silent-era audio-visual experiments, such as stage prologues with music, dance, and dialogue that were developed to introduce and create "atmosphere" for feature films; the advertisement of films using theme songs and recorded music; and live radio broadcasts of narrated film programs from cinemas, among others. Taken as a whole, these experiments expand our narrative of the silent era, encouraging discourse about technology and voice in the early 20th century film arena.

This research helped us to imagine film's transition to sound not as a rapid technological conversion, but as an ongoing exploration of liveness, mediation, and the concept of the "audio-visual" by a diverse group of exhibitors, performers and filmmakers, as well as the American public. We are working to find evidence in order to shift the narrative from the idea of an explosion of sound with the introduction of the talkie to a discussion of a more gradual transition that culminates in the speaking film.

In addition to archival research about sound, technology, and live performance in the silent era, we also dug into the history of our local Hamilton Movie Theater. We scoured through the university archives, the Hamilton Public Library's primary sources, and local and university newspapers to eventually construct a comprehensive history of the Hamilton Movie Theater. With our information, we created a narrative, detailing the different eras of the theater and created an essay. This essay will be shared via booklet at the re-opening of the Hamilton Theater in the fall and as a website available to the public. This research project allowed us to see the evolution of cinema and presentation through the lens of our local theater.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☒ UNST Div.
☐ Other (specify):

Research Fellow(s): Karen Aguilar (2020) Concentration(s): Spanish; Psychological Science
Kaila Daza (2021) Concentration(s): Psychological Science; Educational Studies

Faculty Mentor: Lauren Philbrook Department: Psychological and Brain Sciences

Title of Project: Child Sleep, Stress, and Learning Study

Project Summary:

This summer we conducted research focusing on the factors affecting sleep habits in preschool-aged children and the effects of sleep duration and quality on various aspects of their development. Recent research has shown that a significant number of preschool-aged children have sleep problems (Simola et al., 2010). Young children are especially sensitive to the effects of sleep quality, because both sleep patterns and behavioral processing are in stages of rapid development (Nelson, et al., 2015). Chronic sleep deprivation and poor sleep quality have been shown to predict child behavioral outcomes as well as cognitive performance (Vaughn et al., 2015). Sleep quality is also linked to temperament (Molfese et al., 2015), or the inherent behavioral and emotional traits of a child.

The objective of our study was to identify factors within children's bedtime routines that affect their sleep duration and quality in order to inform interventions targeting improvement in preschool-aged children's sleep. For this study, we used a variety of different methods to measure sleep and its predictors and outcomes, including an actigraphy watch, sleep diary, questionnaires, and a video recording of a typical bedtime routine. The purpose of the camera for the video recording was to observe how parents helped their children go to sleep. We examined several different behaviors from the video recordings, including parent presence, close contact, sensitivity, and quiet activities with the child, as well as the overall level of structure in the bedtime routine and use of technology. We collected saliva samples in order to measure changes in children's diurnal cortisol, a hormone related to sleep and circadian patterning that typically is at its highest levels in the morning and decreases throughout the day. Also, in order to measure the children's cognitive performance, participants completed a series of learning and memory tasks or "games" on an iPad using the NIH Toolbox application.

Results showed that the combination of high levels of structure and a longer bedtime routine was associated with higher child cognitive performance (Figure 1), perhaps due to increased high quality time interacting with parents. Additionally, the combination of lower father sensitivity during the bedtime routine and lower child effortful control was associated with poorer cognitive performance (Figure 2). Together, less supportive parenting and child difficulty self-regulating may challenge children's executive/attention abilities.

Figure 1:

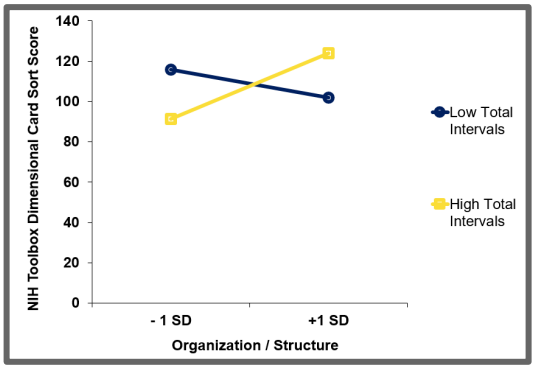
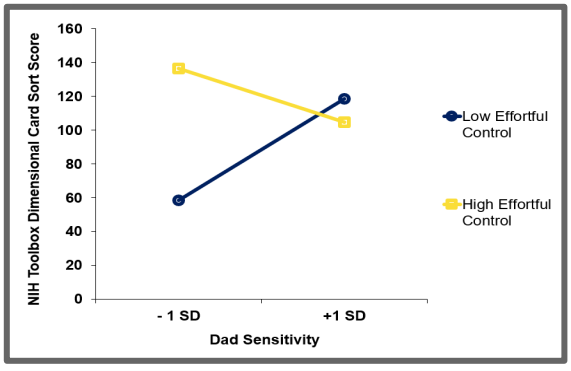


Figure 2:



Altogether, these findings provide preliminary evidence of how bedtime routines may be associated with children's daytime performance and how children's temperament may act as a vulnerability factor in these relations. Early childhood may be an important time for identifying constellations of child experiences and characteristics that predict vulnerability or protection for cognitive performance as part of understanding readiness for formal schooling. Overall, this study provides more information about the importance of bedtime routines and parenting practices that can later be used in sleep interventions for children.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Science and Math Initiative-SMI (NASC Division)

Research Fellow: Vedika Almal (2021) **Concentration(s): History; International Relations**

Faculty Mentor: Navine Murshid **Department: Political Science**

Title of Project: Cricket, Culture, and Diplomacy in South Asia

Project Summary:

I received the Lampert Fellowship this summer to study the effectiveness of cricket diplomacy between India and Pakistan and assess whether or not cricket diplomacy is actually beneficial for the two nations. Cricket is by far the biggest sport in the subcontinent and the citizens of both countries are extremely passionate about the sport, leading them to often engage in belligerent displays of patriotism during games. Paradoxically, leaders have come together in the past to discuss peace terms over a game of cricket. My research analyzed the cricketing culture in India and Pakistan and evaluated the success of previous attempts at cricket diplomacy to conclude whether or not it has the potential to work in the future.

The first part of my research was to read up about the history of cricket and the development of a cricketing culture in the subcontinent. It was extremely enlightening to read about how cricket was introduced by the British in India. The biggest tournament in colonial India, called the Bombay Quadrangular, featured four teams -- the British, the Parsis, the Hindus, and the Muslims. As the idea of Partition started becoming more of a reality, the masses started identifying the Muslim team as Pakistani and the rivalry started even before the two countries formally came into existence.

Understanding the close connection between cricket and national identity in both countries was also essential for my research. This feature of the sport allows politicians to either weaponize it or use it as a diplomatic tool. India-Pakistan cricket matches have historically served as a platform for the nations to prove parity. Cricketers from the 1970s and 80s describe games as somewhere between sport and war while political leaders have sought to use it as a vehicle of peace. Pakistani General Zia-ul-Haq's visit to India in 1987 to watch a game with Indian Prime Minister Rajiv Gandhi started a tradition of "cricket diplomacy." This allowed bilateral tournaments to send political messages by encouraging the people of the two nations to engage with each other through the sport. I studied these instances of cricket diplomacy through the lens of the theory of two-track diplomacy in order to judge their successes and failures.

The highlight of my summer research was traveling to Manchester to watch India play Pakistan in the 2019 Cricket World Cup. I witnessed Indian and Pakistani fans engage in friendly banter as they cheered their teams. There was a distinct sense of competition but spectators left the stadium with a genuine appreciation of the sport. My interviews with Sourav Ganguly, one of India's most successful cricket captains, and Biwarup Dey, a former Indian Cricket Team Manager, also echoed the atmosphere of the stadium -- while the political relationship has negatively affected cricket in the past, every effort should be made to separate the two so that the sport itself doesn't suffer.

The conclusion from my research was quite sobering. Although cricket has been a useful diplomatic and symbolic tool in the subcontinent, it is not powerful enough to change the narrative of the otherwise fraught political relationship. The reduction in violence at stadiums indicates that people have begun to differentiate between the results of cricket and those of political interactions. This is good for diplomacy as it allows cricket to create a conversational space and enforce positive visions of the other. However, the larger problems between India and Pakistan remain too big for the sport to solve. Seventy years of border tensions and disagreements over Kashmir, four wars, and the horrific memories of Partition are issues cricket cannot resolve on its own. Only when leaders are ready to take formal diplomatic action will cricket be able informally assist those processes.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Lampert Institute for Civic and Global Affairs

Research Fellow: Faith Altomare (2021) **Concentration(s): French; Educational Studies**

Faculty Mentor: Mark Stern **Department: Educational Studies**

Title of Project: Punitive Discrimination and Restorative Hope: Disciplinary Practices in Elementary Schools

Project Summary:

I first became interested in the topic of discipline during an education class I took in the recent spring semester that focused on violence. In that class, we often discussed who is directing the actions of others. We discussed why a certain person or group ends up telling other people what to do. Certain people create the rules for others, and the result is discipline. If a person deviates from what has been deemed acceptable behavior, they are punished in some form. I wondered why these rules were created. Who decided that they were qualified to be in charge? What was the purpose of the rules; who were they affecting? Specifically, I wanted to examine these questions in the context of education. I wanted to look at how young children were affected by discipline in their schools. I asked how discipline affects learning as well as how discipline affects different children in different ways. To begin to answer some of these questions, I decided on starting my research by reading a multitude of books, journals, and articles to grasp the history that has led to discipline as we know it. This helped me to build a foundation off of which I could ask more specific and intricate questions.

As I continued to increase my knowledge of the subject, I decided that I would present my information through an intensive literature review. I came to the conclusion that discipline is also a way in which figures of authority stay in power; through threats of violence or removal from society, a ruler exerts dominance over others. I asked myself: Why does discipline mean compliance in so many circumstances? When discipline functions like this, there is little learning about right and wrong going on among the people. In theory, the ruler, or whoever is in the position of authority, is just and hypothetically rules with moral high ground. In theory, discipline is used to keep people from doing wrong and to bring attention to it when they have so that it may not happen again. What ensures that the ruler is morally correct? History has shown that this is not always the case. Why do we punish for questioning, if it should lead to a more just future? I began to wonder why in a classroom it is generally accepted that the teacher holds the microphone and all others are required to listen. In commanding silence and controlled speech of students, of children who are learning what it means to exist and to learn in itself, we are telling the children that their voices only matter sometimes.

I read literature that discussed an alternative to this form of discipline: restorative justice. Restorative justice allows for all voices to be heard and for all angles to be viewed. RJ removes ambiguity and randomness from punishment; discussion between all those affected by the infraction results in a solution in which the perpetrator is absolved in undoing the damage that was caused. RJ is focused intensely on accountability and each person involved acknowledging and understanding where they were accountable.

While perhaps more research is needed so that schools can have more confidence when they do attempt restorative justice, it is important that the attempt is not tentative or unsure (Winn, 2018). A potential stepping stone towards this goal would be connecting restorative justice and its outcomes among the incarcerated to what has been attempted in schools. There is much research that has already been completed in that area, but is not being utilized among our schools. Much like the school-to-prison pipeline, a strong connection does exist (Goodman, 2018). Using that information, predictions of the outcomes of restorative justice in schools would become more clear. It is evident that an immediate solution is not within reach. Even our best options are flawed and wrinkled for the time being. There is much still to be considered. We must decide, though, that our children, all of them, are worth the time that this requires. Only with this commitment is it possible for healing to begin. My research, then, would continue in the direction of figuring out how schools could implement these restorative justice practices while enforcing a curriculum that benefits and best prepares students for life after school.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☒ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Elaina Alzaibak (2020) **Concentration: Biology**

Faculty Mentor: Julie Dudrick **Department: Upstate Institute**

Title of Project: Cornell Cooperative Extension of Madison County "Farming for the Future: Climate Adaptation Strategies for Northeast Farmers"

Project Summary:

As climate impacts become more severe, farmers are vulnerable to production and economic failure. Dairy farmers in particular are susceptible in both livestock and crop enterprises. Climate adaptation strategies are key to preparing dairy farmers for a changing future as they can protect animal wellness, increase crop yield, protect farmer livelihood, and maintain ecosystem services. The goal of this project was to create a climate adaptation workbook aimed at dairy farmers. Based on the USDA's *Adaptation Resources for Agriculture: Responding to Climate Variability and Change in the Midwest and Northeast*, the workbook produced through this Fellowship with Cornell Cooperative Extension of Madison County would be accessible and easy to use while maintaining the informational integrity on climate change and adaptation strategies.

The workbook has four sections: background information, adaptation strategies, worksheets, and additional resources. The first section contains information on climate change, how to use the workbook, the process of adaptation, and climate impacts affecting agriculture. The five-step adaptation process includes defining goals, assessing on-farm climate impacts, evaluating priorities, identifying strategies, and monitoring success. The following climate impact areas have been identified as the major areas influencing farm productivity and profitability:

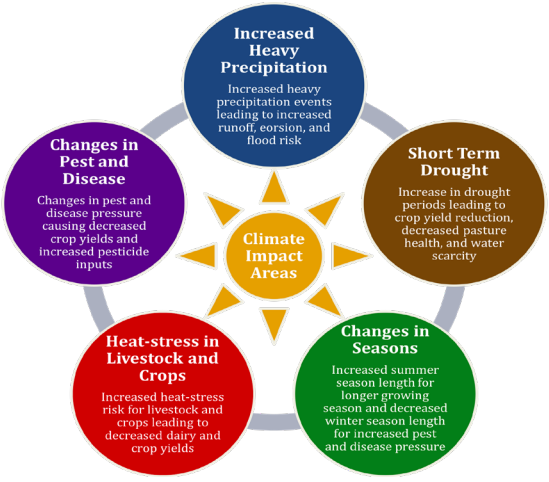


Figure 1. Climate impact areas with expected change that affect the success of livestock and crop production (Janowiak et al. 2016, 9-11)

The second section contains a menu of strategies for climate adaptation in the areas of soil health, water management, pest management, farm diversification, heat stress management, farm planning and adaptive management, and ecosystem preservation. The third section contains a series of worksheets to aid farmers in working through the adaptation process and keeping track of adopted strategies. The fourth section includes pertinent definitions, external resources for strategy implementation, and references.

The next stage for the climate adaptation workbook is to share the document with extension educators and farmer focus groups to further develop its usability in the field. With the completion of the project, farmers who utilize the workbook can protect their livelihoods and productivity through climate adaptation strategies which capitalize on favorable condition changes and mitigate current and expected harm.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow(s): **Katherine "Katie" Anderson (2021)** **Concentration: Biology**
Nadia Houerbi (2020) **Concentration: Molecular Biology**

Faculty Mentor: Geoffrey "Geoff" Holm **Department: Biology**

Title of Project: Cellular Responses to Mammalian Reovirus Infection

Project Summary:

Viruses are omnipresent on Earth, acting as parasites across a broad range of hosts to introduce their own genetic material and cause subsequent pathogenesis. Due to their ubiquitous nature, as well as potential to serve within antibacterial, anticancer, and genetic disease treatments, viruses are key avenues to translational scientific discovery. Their small viral particles, virions, are composed of a DNA or RNA genome encased in a protective protein coat, or capsid. Specifically, reovirus is a segmented, non-enveloped virus composed of a double-stranded RNA genome. The ten reovirus gene segments encode eleven proteins in total, most of which contribute structurally to the viral particle. One such protein, the S1 attachment protein, dictates the serotype (strain) of reovirus based on how the viral particle is able to pathologically invade host cells. The three main serotypes of reovirus are Type 1 Lang (T1L), Type 2 Jones, and Type 3 Dearing (T3D).

To infect a host cell, the reovirus virion binds via contact with a cell surface receptor, which is followed by a higher affinity contact with a junctional adhesion molecule (JAM-A), positioning the particle for endocytosis. Once inside the cell, the virion disassembles into an infectious subvirion particle, eventually shedding its capsid to release a transcriptionally-active core into the host cytoplasm. Through intracellular receptors, the host cell recognizes the viral RNA being produced— inducing its first line of host defense. This defense comes in the form of an innate immune response of Type I interferons— cytokines that signal the presence of viral infection and stimulate the expression of particular genes that work to suppress viral replication, spread, and further infection.

C19ORF66 (also known as "shiftless") was identified as one such interferon-stimulated gene (ISG) in a few viruses, including Dengue virus and HIV. In reovirus, it was identified as a potential ISG through a flow-cytometry based screen previously performed by our lab. This summer, our project focused on trying to understand how C19ORF66 restricts reovirus infection. We performed qPCR of viral gene expression at various time points in cells transfected with C19 and control cells. According to preliminary results, we found that C19 restricts infection around 24 hours post infection. In addition, we looked at how C19 is able to restrict infection. Previous experiments in the lab showed that it does not restrict entry of the virus. Therefore, we looked at whether C19 restricts the process of core formation, which occurs further downstream in the viral pathway. Specifically, we transfected T1L reovirus cores into cells expressing GFP vs cells expressing the C19 gene. We found no difference in infection between cells expressing C19 and cells expressing GFP (figure below), implying that C19 is working to restrict infection at a step other than core formation within the reovirus pathway.

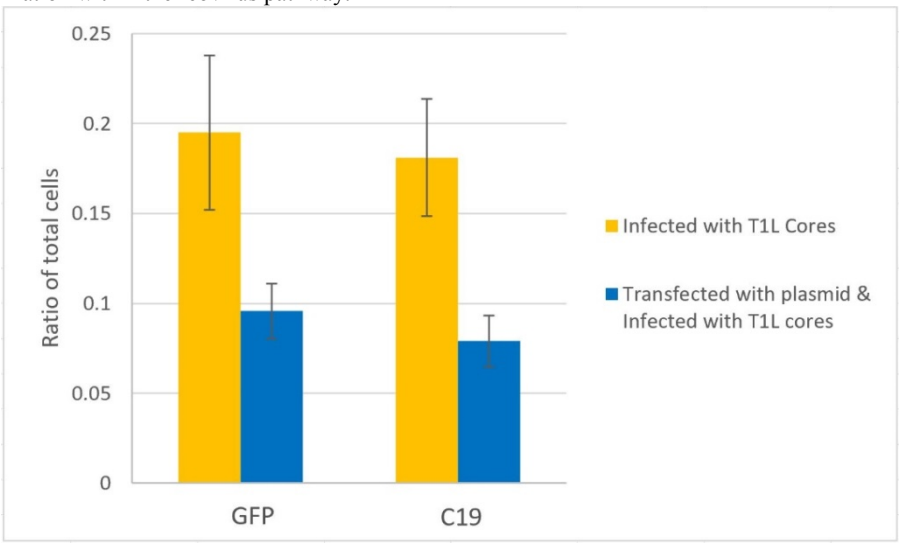


Figure 1: C19 does not restrict infection with reovirus cores. L929 cells transiently expressing C19-GFP or GFP were transfected with T1L cores. At approximately 16 hours post infection, Cells were fixed and immunostained with viral antibody 3E10. The number of cells infected and expressing C19 (yellow) was counted and compared to cells infected expressing GFP (blue).

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Michael J. Wolk '60 Heart Foundation

Research Fellow(s): Vincent "Vinny" Betti (2021) **Concentration(s): Biochemistry; Spanish**
Jacob Esarco (2020) **Concentration: Biochemistry**
Jacob Hoglund (2022) **Concentration: Undeclared**

Faculty Mentor: Jacob Goldberg **Department: Chemistry**

Title of Project: Ratiometric Sensors for Mobile Zinc

Project Summary:

Research in the Goldberg laboratory is focused on the development of chemical tools to study biological systems. This summer, we prepared unnatural amino acids that will be used to site-selectively label proteins to study their structure, function, and stability. At the same time, we explored methodology to incorporate these amino acids into large proteins of interest. We also synthesized different small molecule sensors that will be shared with neuroscientists to visualize metal ions in the brain. Among these sensors is a ratiometric peptide with optical properties that change in response to the presence of zinc(II) ions in a concentration-dependent manner. Zinc(II) is emerging as an important neuromodulator that affects glutamate signaling pathways. New evidence suggests that zinc(II) may play a key role in how animals analyze their environment and respond to stimuli, but much remains to be learned about the exact mechanisms through which this process occurs.

The ratiometric peptide we prepared, LZ9, has three subunits, ZP1, LRB and P9KE. Zinpyr1 (ZP1) is a fluorescein-based sensor that fluoresces in the presence of zinc(II). Lissamine rhodamine B (LRB) is a red fluorophore that is not sensitive to zinc(II). These two fluorophores are linked by a rigid peptide (P9KE) consisting of nine proline residues, a lysine residue, and a glutamic acid residue. The ZP1 is attached to the side chain amine of the lysine residue and the LRB is installed as a reactive sulfonyl chloride at the N-terminus. The P9KE peptide was synthesized manually using standard solid phase techniques and ZP1 was prepared in a three-step synthesis. The resulting construct was purified by reverse-phase high performance liquid chromatography.

The spectroscopic properties of the purified sample were studied in the presence and absence of zinc(II). In the absence of any metals, excitation of the ZP1 chromophore with 490 nm light resulted in fluorescence emission from LRB. Direct excitation of the LRB chromophore with 545 nm light also induced LRB fluorescence. Upon addition of a small amount of zinc sulfate, the LRB fluorescence in response to excitation at 490 nm increased considerably, but not in response to excitation with 545 nm. By comparing these values, the concentration of zinc(II) in solution can be determined. Treatment of the peptide with ethylenediaminetetraacetic acid, a zinc(II) chelator, restored the original fluorescent properties of the molecule and confirmed that the response was reversible.

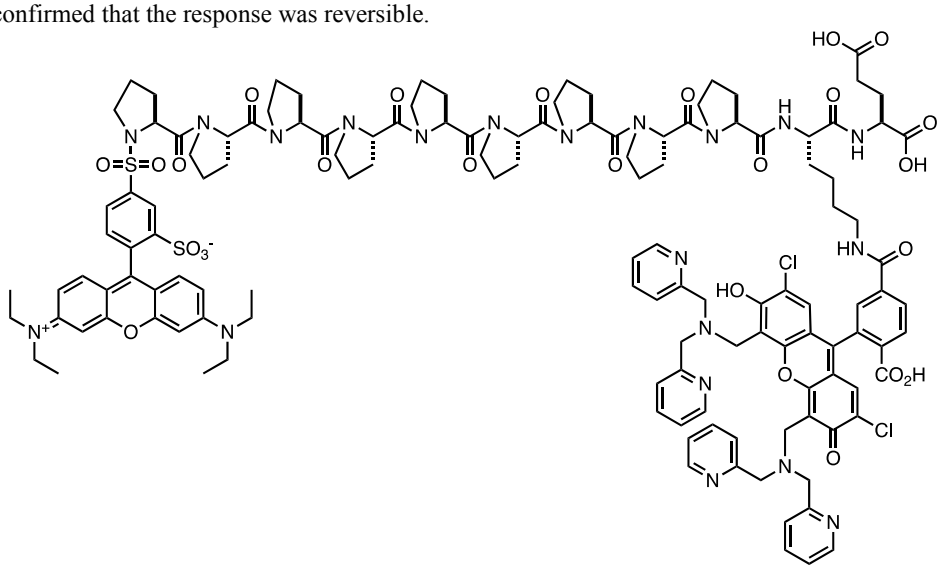


Figure 1. The chemical structure of LZ9. The LRB subunit is shown on the left, attached to the amino terminus of the P9KE peptide scaffold. The ZP1 subunit is shown on the right, connected to the lysine residue of the P9KE peptide.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Michael J. Wolk '60 Heart Foundation

Research Fellow: Aayam Bista (2020) **Concentration: Physics**

Faculty Mentor: Enrique "Kiko" Galvez **Department: Physics and Astronomy**

Title of Project: Quantum Ghost Imaging

Project Summary:

Ghost Imaging refers to the capturing of the image of an object without pointing the camera at the object. This is done by making use of pairs of quantum entangled photons. One photon interacts with the object but does not reach the camera whereas its partner never interacts with the object but is received by the camera. The phenomenon has been successfully demonstrated by several researchers. Our research focuses on how the thin lens equation relates to ghost imaging. The thin lens equation gives the relationship between the focal length of a lens, the distance between the object and the lens (object distance) and the distance from the lens at which the image is formed (image distance). Figure 1 shows a ray diagram for converging lens while Figure 2 shows the thin lens equation.

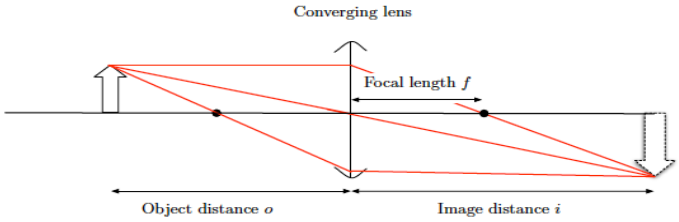


Figure 1

$$\frac{1}{o} + \frac{1}{i} = \frac{1}{f}$$

$$\frac{1}{\text{object distance}} + \frac{1}{\text{image distance}} = \frac{1}{\text{focal length}}$$

Figure 2

We aim to verify the thin lens equation for ghost imaging. We use down converted entangled photons that travel in two separate paths. The object is placed in one path while the lens and the camera are in the other path. One photon interacts with the object while the other passes through the lens to produce the image. Figure 3. Shows the basic outline of our setup and Figure 4 shows our actual set up. The object distance includes parts of paths of both photons. As shown in Figure 3., the dotted red line and the solid red line combine to give the total object distance even though they are paths of two different photons. The math seems to show that the photon travelling in the dotted path acts like its partner photon travelling backwards in time!

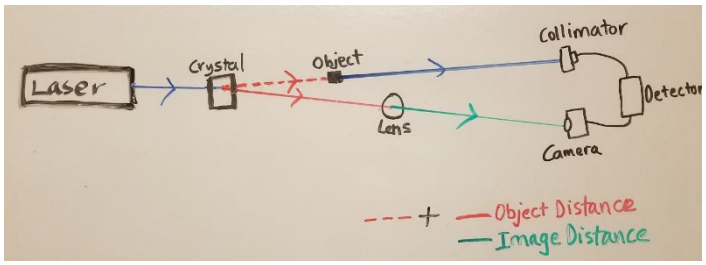


Figure 3

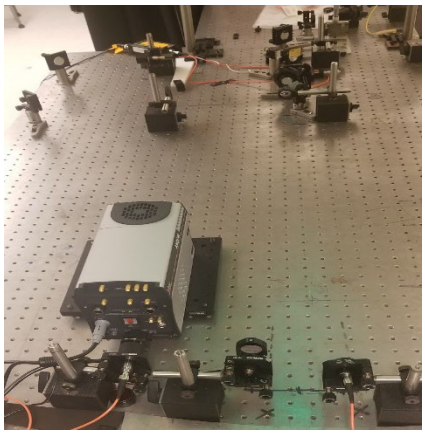


Figure 4

References:

1. https://bilimfili.com/hiperfizik/hbase/geoopt/lenseq.html
2. https://phys.libretexts.org/Courses/University_of_California_Davis/UCD%3A_Physics_7C/09%3A_Optics/9.3%3A_Lenses/9.3.3%3A_The_Thin_Lens_Equation

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Justus '43 and Jayne Schlichting Student Research Fund

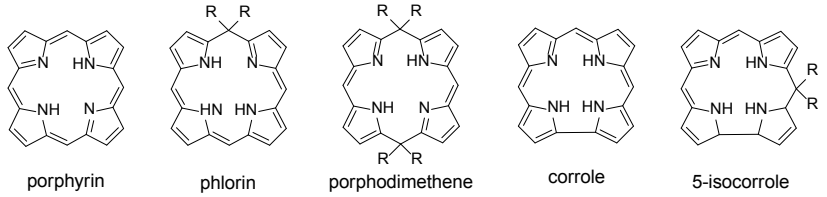
Research Fellow: Nicholas Blake (2021) **Concentration(s): Biochemistry; Philosophy**

Faculty Mentor: Rick Geier **Department: Chemistry**

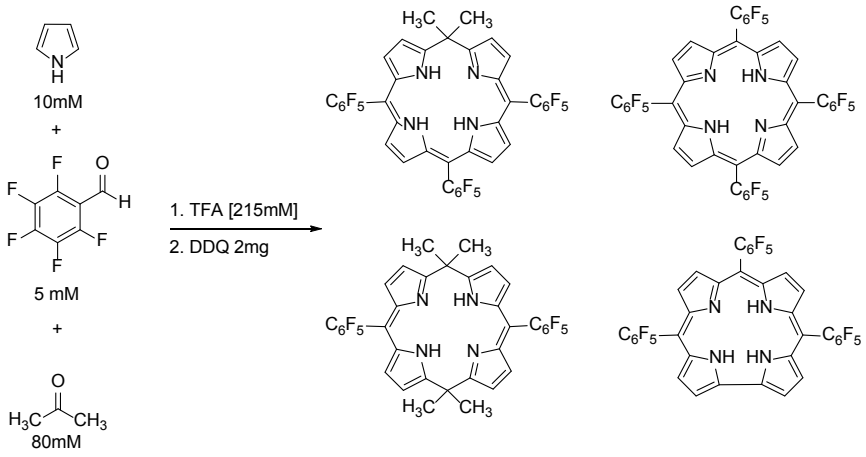
Title of Project: Investigation of the Distribution of Porphyrinoid Products from the Reaction of Pyrrole, Pentafluorobenzaldehyde, and Acetone

Project Summary:

The Geier lab is interested in porphyrinoid compounds. Porphyrinoids are best known for their important roles in biological processes (e.g., heme, chlorophyll). Our lab investigates synthetic routes to porphyrinoids that do not exist in nature. Some examples of these compounds are shown below.



Our group previously discovered conditions for a two-step, one-flask synthesis of lower symmetry porphyrinoids (most notably phlorin) shown in the reaction depicted below. Lower symmetry porphyrinoids are normally made through more labor intensive stepwise syntheses.



The work this summer focused on a further investigation of this reaction by examining different acid catalysts and by varying the acid catalyst concentration. Changes in the product distribution were assessed by HPLC. Much of the summer was spent learning the reaction and analysis procedures, along with performing control experiments. A survey of TFA concentration was performed twice to demonstrate reproducibility with data previously collected by our group. We then proceeded with a survey of $BF_3 \bullet OEt_2$ concentration in presence of sodium chloride which our group had previously observed to provide a good yield of a porphodimethene. Time course experiments were performed to examine to distribution of porphyrinoid products from reaction times of 1 min to 48. The results of these experiments provide encouragement to further examine these reaction conditions.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Warren Anderson Fund

Research Fellow: Matthew Bousquet (2020) **Concentration: Chemistry**

Faculty Mentor: Jason Keith **Department: Chemistry**

Title of Project: Applications of Density Functional Theory to Electronic Structure, Spectroscopy and Mechanism

Project Summary:

The insertion of O_2 into metal hydride bonds is an important mechanism within the field of chemistry, specifically in relation to aerobic oxidation chemistry with applications in artificial fuels. Several proposed mechanistic pathways exist, like Radical Chain (RC), Hydrogen Atom Abstraction (HAA). While there are many possible pathways little is known about how to control this mechanistic landscape. Typically Rhodium systems proceed through a known radical chain mechanism that involves dimer formation. Kinetic data for a Rhodium Porphyrin system of interest from Wayland et al. suggests that this pathway is not energetically favorable. This begs the question: what is the most favorable pathway. To test the energetics of each proposed pathway were calculated for both tetramesytilporphrin (TMP) and porphine (P) systems. These energies were used to generate a potential energy surface (figure for HAA shown at the end of the summary) that yields further insight into the reaction barriers and ultimately, the mechanism.

For each of the Intermediates and transition states the energy was calculated using B3LYP-d3 Flavor of dispersion corrected hybrid density functional theory, 6-31G(d,p) basis set on H, C, N, O when applicable, and LANL08(f) effective core potential (pseudopotential) and basis set on Rh. Stability calculations were performed on the structures to ensure that the most stable structure of each was used in further calculations. After the stability calculations frequency calculations were performed to obtain data on each structures Zero-point energy, and thermal corrections to the internal energy, enthalpy and entropy. Each transition state was verified to have the correct number of imaginary frequencies. All solvent calculations were done using benzene as the solvent.

Barriers garnered from potential energy surfaces did not match the experimental data, so the methods used were examined. This inquiry revealed a discrepancy between B3LYP, B3LYP-d3 and B3LYP-d3bj methods when applied to the RC pathway. As such the project was expanded to include an investigation into the accuracy of each method. Two main questions were posed: does each different flavor of DFT change the geometry of the system and does it change the energy. As such the project as expanded to include optimized pathways with each flavor was well as a single point calculation at each step using the B3LYP-d3 structure. This work is still ongoing.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Warren Anderson Fund

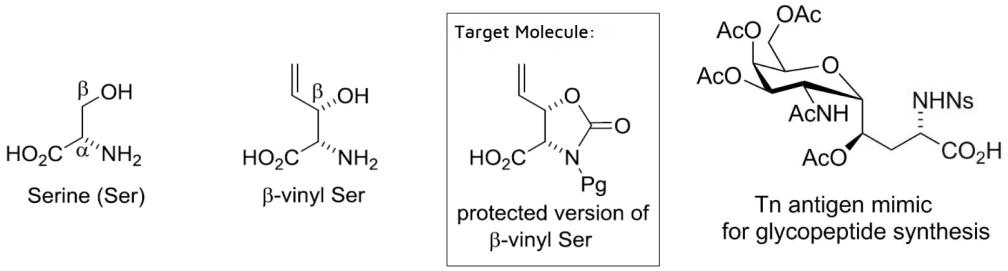
Research Fellow: Blair Boyles (2021) **Concentration: Chemistry**

Faculty Mentor: Ernie Nolen **Department: Chemistry**

Title of Project: Synthesis of a Protected S,S-Beta-Vinyl Serine

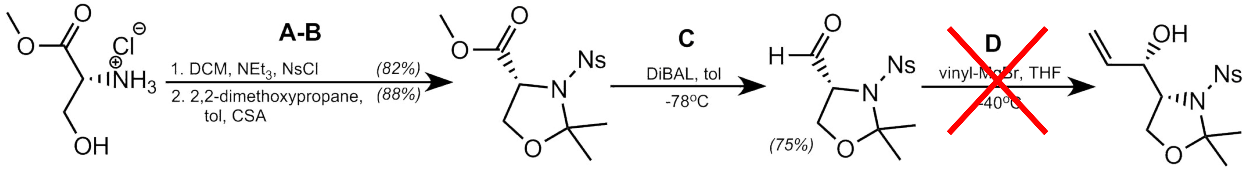
Project Summary:

The overall goal of the Nolen group is to synthesize a target molecule that will serve as the amino acid end of a glycosyl amino acid, which will mimic a tumor-associated carbohydrate antigen (TACA) that can be used for future immunological studies with potential as a cancer treatment. Our target molecule is a protected beta-vinyl serine since it has the skeleton structure of a serine amino acid in addition to a vinyl group at the beta position and various protecting groups necessary for further elaboration into the TACA mimic.



In the past, the Nolen group has been able to successfully synthesize the beta-vinyl serine with the use of a different protecting group, and in a key step recorded a remarkably high diastereoselectivity of 12:1 in comparison to the literature diastereoselectivity of 4:1. Unfortunately, at the conclusion of the synthesis, the Nolen group was unable to remove the protecting group from the target molecule.

This summer, I have been working on repeating the synthesis of the beta-vinyl serine with a related protecting group, the nitrobenzenesulfonyl (Ns). The use of Ns protection is advantageous since the Ns group can be more easily and reliably deprotected at a later stage in the TACA synthesis. I have been able to successfully complete three reactions with Ns protection, including the protection and addition of the Ns protecting group, forming a ring between the nitrogen and the oxygen atoms, and reducing the ester to an aldehyde in a diisobutylaluminum hydride reduction reaction. Unfortunately, the Ns group has shown to be incompatible with the key step to add the beta-vinyl in a stereoselective manner.



Given this issue, we redirected our synthesis to add the Ns protection at a later stage.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): National Institutes of Health (NIH) Area Grant

Research Fellow: Makenna Bridge (2020) **Concentration: Environmental Geography**

Faculty Mentor: Julie Dudrick **Department: Upstate Institute**

Title of Project: Adirondack Action "Pollinator Conservation in the Adirondack Park"

Project Summary:

The Adirondack Pollinator Project works to spread awareness about the decline of pollinator populations through workshops, lectures and brochures that educate the public about the importance of pollinators and how to identify as well as protect them. The project also distributes native wildflower seed packets that can be planted in order to increase pollinator habitat. AdkAction began the project in 2011 to increase awareness and habitats for monarch butterflies by distributing milkweed seeds and information packets, and hosting lectures and film screenings. In 2016 the project was expanded to include all pollinators, and sought to address threats to pollinators like habitat loss and fragmentation, as well as pesticide use, climate change, pests and pathogens, and nutrient deficiencies.

Their newest initiative involves the planting of pollinator gardens throughout the Adirondack region. This work was the focus of my summer Fellowship with the Upstate Institute. The project works through an application process where schools, libraries, community centers and other public areas can express interest in a garden and provide some general information about the site. After we collect this initial information, I made an initial site visit and assessment, taking photos, soil samples, and talking with the community partners about their vision for the garden. We collaborated on plans that outline the distancing and variety of wildflowers to be planted and set a date for the install that would allow volunteers to join.

On installation day, I would begin with a brief introduction of our project as well as some supplementary information on pollinators and their importance to our ecosystem before jumping into the planting. A few sites required some initial site preparation, which we accomplished by either rototilling a section of lawn or pulling up the sod. The Pollinator Project also provided each new garden with a sign that educates visitors about the meaning of a pollinator garden and how it aids in conservation.

I was also able to attend a few different events on behalf of the project where I was able to speak to community members about the importance of pollinator conservation and hand out seed packets, encouraging folks to plant their own gardens. These events included local farmers markets, the Wild Center BioFest, as well as AdkAction's Pollinator Symposium.

Through this project, I have gained so much knowledge about the integral role pollinators play in our food system and a new appreciation for the native flora of New York State. I also have become acutely aware of the challenges faced by grassroots conservation initiatives, but also have seen firsthand the success they can have at a local level.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow: Peter Bulan (2021) **Concentration: English**

Faculty Mentor: Julie Dudrick **Department: Upstate Institute**

Title of Project: Legal Aid Society of Mid New York, Inc. "Consumer Bankruptcy Law Project"

Project Summary:

This summer I completed a Fellowship with the Upstate Institute at the Legal Aid Society of Mid-New York (LASMNY) with attorney Susan Conn, who graduated from Colgate in '79. LASMNY is a non-profit law office based in Utica that provides free expansive legal services to low income clients in the surrounding area. The advice that LASMNY offers, which is civil in nature, ranges from divorce and domestic violence cases to social security to tenant law. Working at the Legal Aid Society has presented me with the opportunity to understand the prevailing economic issues of the Upstate New York region especially in and around Utica. Perhaps more importantly, this has granted me the chance to see the face of poverty. Having now seen the ways that poverty affects the daily lives of many has instilled in me an awareness of the dire situation that is poverty and why LASMNY is so critical. The legal system can be cold, harsh, and convoluted, and as a result LASMNY is an important resource that help clients navigate this system, with the hopes that they can come out unscathed. Many of those overwhelmed by the system simply submit without giving a fight and end up accumulating debt and fees. LASMNY is the solution for many who have nowhere else to turn.

The idea that one is deserving of legal representation, a right afforded to all citizens, is a key principle upon which the United States of America was founded. Two-hundred forty-three years later, the phrase "liberty and justice for all" may not ring true. Justice has not in fact been available to all. According to a report by the Legal Services Corporation, "86% of the civil legal problems reported by low-income Americans in the past year received inadequate or no legal help" (LSC[1]). The legal needs of the low-income population and the resources that are available to them reveal a profound inequality, a 'justice gap' that LASMNY serves to address. The Legal Aid Society is a bastion of hope for the downtrodden, and serves thirteen counties in the central New York area.

While at Legal Aid, my primary responsibility has been working on the Consumer Bankruptcy Law Project in a student paralegal capacity. This project, which also exists as a volunteer project offered at Colgate, aims to guide a client through the entire process of filing for bankruptcy at no cost to them. I am tasked with parsing through a number of legal and financial documents, including credit reports and tax forms, in order to complete several of the forms, called schedules, required for one to file for bankruptcy. Completing schedules requires a significant amount of time and detail in order to ensure accuracy; this is important to note because once completed and verified for accuracy, we refer the case to a pro bono attorney in the area who will then be saved a number of hours of work. The process is therefore easier for all parties involved. A significant amount of my time has been spent working on improvements to Susan's course. These include write ups in order to facilitate learning as well as the development of a hypothetical bankruptcy case from which students can learn.

[1] https://www.lsc.gov/sites/default/files/images/TheJusticeGap-FullReport.pdf

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow(s): Alara Burgess (2021) **Concentration(s): Sociology; History**
Hannah Grote (2022) **Concentration: Undeclared**

Faculty Mentor: Graham Hodges Department(s): History; Africana and Latin American Studies

Title of Project: Black Flight in the Americas, 1500s-1865

Project Summary:

Our research project, *Black Flight in the Americas, 1500s-1865*, used slave narratives from the United States and some nearby locations to document patterns found in the vast escapes from slavery. Using the University of North Carolina's database of 400 North American Slave Narratives compiled in their "Documenting the American South" collection, we worked to individually summarize each history and then catalogue it within a larger matrix, finding similarities in the various escapes and noting aspects of the writing itself.

The summary of each narrative began with publication details of the account; detailing author, title, publisher, and date and place of publication. Though there are very few repeat publishers, nearly all places of publication are located in the Northern states, and in some cases, Canada and England.

Each narrative was then sorted based on time period and placed into one of five categories: Colonial period, Revolutionary period, Early National to 1810, 1810-1840, and 1840-1865. The histories were sorted based on the date of the subject's escape, not the date of publication, since some were published years after fleeing, once the author felt free enough to write about their experience in slavery, or after the subject's death by a biographer.

The majority of the research on these narratives was spent detailing the elements of the subjects' lives and escapes. For each history, we began with the aspects of the subject's early life, noting their childhood and introduction to work as a slave, the probable separation from their family, and the relationship with their master. Most of this section then focused on their flight from slavery. We looked at their reason for fleeing, their methods, destinations, and length of time spent escaping, as well as any assistants or adversaries on their passage. After reaching freedom, we documented how they lived their lives as freemen, summarizing their familial relations, place of residence, and work. We also examined whether or not the subject was involved in the Civil War or with the Underground Railroad as either a passenger or conductor.

After compiling all of this information within a spreadsheet, we documented specific aspects of the style of the history itself, as many of the narratives use the same literary and rhetorical devices to convince readers to the Abolitionist cause. Some of these included the use of religion, poetry, history, literature, or a focus on education, in addition to the incorporation of shorter tales of other slaves—though among these, religion is the most often used.

After two summers of work, we have concluded with the UNC database. In the majority of cases, the writers of the narratives were male, as were those who escaped and had their stories told. More than a quarter worked in the fields during their lives, though more than a third of people fulfilled multiple roles while in slavery, and many people did not disclose their position or were vague about what exactly they did. If the person escaped, the most popular method of doing so was on foot, and in most cases the subject of each narrative escaped alone. In their lives as free people, many made their livings doing religious work like preaching and evangelizing, but just as often they chose a profession that required physical labor like farming or woodcutting. Despite the qualities found as stated above, it was also very common to find narratives in which the subject did not escape at all or was freed only by Emancipation Proclamation or the end of the Civil War.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☒ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Christopher "Chris" Burke (2021) **Concentration(s): Political Science; PCON**

Faculty Mentor: Sam Rosenfeld **Department: Political Science**

Title of Project: Study of Climate Change and Western Security in Connection with the CEVRO Institute in Prague

Project Summary:

This summer, I conducted research through Colgate's Center for Freedom and Western Civilization as a Stone Fellow. My research focuses on the intersection of climate change and western security, exploring militarization and emergent security dilemmas in the Arctic Circle.

With this project, I have blended the environmental science experience I gained through Colgate's diverse liberal arts curriculum with my major specialization, studying the emergence of realism and decline of cooperation in a newly accessible Arctic region.

My research focuses on melting sea ice in the Arctic and the new security dilemmas posed by this development, specifically looking at military build-up, resource competition, Arctic security institutions, and contested shipping lanes. With the help of faculty at the CEVRO Institute — a university in Prague, Czech Republic — and Colgate's own Harvey Picker Professor of International Relations Fred Chernoff, I interviewed military leaders, ministers in the Czech department of defense and foreign affairs, and leading scholars in the field of Arctic security.

Through my research, I have found that the existing Arctic dynamic favors the West, as four out of the five Arctic coastal states are North Atlantic Treaty Organization (NATO) members that coalesce to manage relations with Russia. However, non-Arctic players have the potential to disrupt this balance and eliminate existing Western leverage.

Despite the region's history of cooperation, climate change has exacerbated the strain of insufficient security institutions and tangible militarization, as well as the risk of a resurgent Russia looking to reassert itself as a global superpower. To ensure Western security in the era of climate change, leaders must encourage Russian predictability, establish more concrete security institutions, and institute a robust, but peaceful, naval presence in the region.

I have found that growing Russian authoritarianism, regime change, climate-driven geopolitical destabilization, reactionary militarization, and non-Arctic intrusion are emerging as the most pressing threats to Arctic security. While the competition for resources and shipping lanes is on the forefront of Arctic media coverage, Arctic security, and Western interests, are most threatened by the shattering of an established regional balance.

My skills as a researcher have been greatly enhanced through this fellowship — particularly my ability to conduct interviews, network with scholars and leaders, and integrate a large number of sources into a cohesive paper. After examining more than 70 scholarly sources, interviewing five security experts, and working with domestic and international faculty, I have fine-tuned my ability to extract and analyze information from a wide variety of sources.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Center for Freedom and Western Civilization
(Stone Summer Research Fund)

Research Fellow: Johanna Burke (2021) **Concentration(s): Political Science; ENST**

Faculty Mentor: Julie Dudrick **Department: Upstate Institute**

Title of Project: Mohawk Valley Resource Center for Refugees "Naturalization Preparation: Best Practices for Preparing Non-English Speaking Adults to Become U.S. Citizens"

Project Summary:

This summer, I have had the pleasure of working with the Mohawk Valley Resource Center for Refugees (MVRCR), with their Office for New Americans. MVRCR is a non-profit organization that serves Utica's refugee community, which makes up almost a quarter of Utica's population. MVRCR is a resettlement agency, meaning that it arranges refugees' travels to the U.S. and helps them settle in Utica, but their assistance does not stop there. MVRCR also has traffic safety, employment, translation, and interpretation departments, offers assistance with immigration issues, and offers many classes and workshops to the community, including ESOL classes. The Office for New Americans provides assistance in applying for naturalization, citizenship classes to prepare refugees for the naturalization exam, free legal consultation, and community workshops and trainings. MVRCR works to help refugees settle in Utica and build meaningful lives in their new homes.

Since 1981, MVRCR has helped resettle over 16,500 refugees from over 25 different countries. Refugees often come to America with very few resources and limited English language skills, and MVRCR works to help refugees become successful despite these barriers, and thus far, they have been incredibly successful in this mission. Refugees have revitalized Utica by increasing the population, starting new businesses, stimulating the housing market, and much more. Like most rust belt cities, Utica suffered a sharp population decline after the 1980s, but refugees are helping to bring this population back. This population increase rejuvenates neighborhoods by bringing money back into the housing market and local economy[1]. Refugees are also more likely than U.S. born citizens to start businesses, which benefit the economy and create jobs. Refugees have turned a declining city into a growing hub of diversity, but it is important to note that the heart of MVRCR's mission is to help individuals who have been torn away from their homes to find a new home in Utica, and these economic outcomes are simply an added bonus.

Over the course of the summer, I have worked mainly with the Office for New Americans. In the Office for New Americans I have assisted with citizenship classes, community educational events and community outreach. My main project within that has been to research the ways in which the citizenship class that MVRCR offers could be improved. In today's political climate, it is especially important for refugees to apply for citizenship as soon as possible. However, the civics exam and interview requires applicants to have a basic understanding of how to read, write, and speak English, and also an understanding of the history of the United States and its government. Therefore, most of my research was centered around teaching adults ESOL, and I found that the best practices often involve high levels of participation and interaction to connect the material to real world applications. The other interns and I also helped with preparing for World Refugee Day in the beginning of the summer, which was a large event on June 22nd that celebrates the refugees in Utica. We hung posters throughout Utica in different languages to advertise for the event, and it was interesting to explore the area and see the diverse businesses, restaurants, community centers and churches that are run and supported by Utica's refugee community. I think Colgate can sometimes be a bubble within Upstate New York, and the Upstate Institute does an excellent job of bridging the gap between Colgate and the outside community.

[1](June 19, 2017). "From Struggle to Resilience: The Economic Impact of Refugees in America." *New American Economy.* Retrieved from: https://research.newamericaneconomy.org/report/from-struggle-to-resilience-the-economic-impact-of-refugees-in-america/

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow(s): Eleanor "Ellie" Burton (2020) **Concentration: Neuroscience**
Grace DiRisio (2020) **Concentration: Neuroscience**
Maia Van Buskirk (2020) **Concentration: Neuroscience**

Faculty Mentor: Jun Yoshino **Department(s): Neuroscience; Psychological and Brain Sciences**

Title of Project: Effect of Medications on Nitric Oxide Released from Glial Cells

Project Summary:

In addition to neurons, the brain is home to a cell type referred to as glia. Two main types of glial cells are astrocytes and microglia. Astrocytes comprise the blood-brain barrier, which helps prevent pathogens from outside the brain entering. Microglia are macrophages and serve to maintain the brain in a healthy state through cleaning up debris. The microglia also become activated in response to the presence of pathogens resulting in the production of nitric oxide (NO) and other inflammatory markers such as Interleukin-6 (IL-6). Increased levels of IL-6 are observed in depressed patients, along with inflammatory molecules, suggesting an inflammatory theory of depression. Inflammation has also been linked to other psychiatric disorders, such as bipolar disorder.

The overarching goal of our research was to examine the effects of certain psychiatric medications, all with implications for alleviating depression, and seeing if they are capable of reducing inflammation caused by these cells. Investigating this provides insight into some of the mechanisms of why these medications seem to be effective in alleviating depressive symptoms. Our process includes culturing glial cells from neonatal rats, or using BV2 cells which mimic the phenotype and function of microglia, and then stimulating them with lipopolysaccharide (LPS), which would mimic the inflammatory response. Then, by adding various concentrations of our drugs, we evaluated whether each drug had an impact. The medications primarily used were lithium, clomipramine, and maprotiline.

Lithium, a mood stabilizer commonly prescribed for bipolar disorder, is a medication that despite its popularity, its mechanism of action is not completely elucidated. Our research found that in the BV2 cells, only 5 mM and 10 mM lithium were able to produce a significant decrease in nitrite response, while in the mixed glia 3 mM, 5 mM, and 10 mM all were able to significantly inhibit. Morphologically the cells appeared to remain healthy, implying that the lithium was actually inhibiting the response and not simple killing the cells. When the microglia were isolated away from the astrocytes, there was not a significant decrease due to high variability, but 10 mM lithium appeared to trend downward. The variations in dose response between the cell cultures further suggests a role of astrocytes in mediating the inhibition.

Clomipramine, also known as Anafranil, is a tricyclic antidepressant that has been shown to decrease levels of inflammatory markers in primary microglia and BV2 cells. When applied for 24 hours to the BV2 cells stimulated with LPS, clomipramine significantly inhibited NO production up to 80% in a dose dependent manner from 1.25 μM up to 15 μM without decreasing cell density. 20 μM clomipramine also significantly inhibited NO production, but led to a decrease in cell density, indicating cell death. Next, clomipramine was added to LPS- stimulated mixed glia cultures, comprised mostly of astrocytes and microglia. Mixed glia cells survived the 20μM clomipramine treatment, however there was no inhibition of NO production. 20μM clomipramine trended toward increasing NO production. This suggests an interaction between astrocytes and microglia during clomipramine treatment, leading to increased NO.

Maprotiline, a tetracyclic antidepressant also known as Ludiomil, functions as a selective norepinephrine reuptake inhibitor (SNRI). Maprotiline has been shown to decrease the expression of inflammatory enzymes iNOS and COX2, and is thought to reduce inflammation in vitro after stimulation with LPS. When BV2 cells were treated with 20 μM maprotiline for 24 hours, there was a significant decrease in NO production. This decrease may have been due to cell death from the maprotiline. Cell death of the BV2s, rather than inhibition, was further supported when 20 μM maprotiline was administered for 24 hours to a mixed glia culture, which resulted in a significant increase in NO production. This indicates that the interaction of microglia and astrocytes in the presence of maprotiline could lead to an increase in NO production.

Purified rat secondary astrocytes do not produce NO in response to LPS. Astrocytes were isolated from the microglia through various steps to evaluate their contribution to the above inflammation response. The results showed that at each stage of microglial removal, the NO response decreased. This suggests that microglia are the primary source of the NO when treated with LPS and are regulated by astrocytic communication. Our next step is to reseed BV2 or microglia cells onto purified astrocytes, and to examine the effect of these psychiatric drugs on the LPS-response of the reconstructed culture.

Overall, our research showed that while all these medications are categorized differently, they were each able to decrease the inflammatory response in the glial cells to some degree, whether it be through cell death or inhibition. Further research will aim to explore other aspects of the inflammatory pathway to determine more precisely how these drugs are playing a role.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow(s): **Jose "Fernando" Carbajal Perez (2021)** **Concentration: Chemistry**
Cole Jarczyk (2021) **Concentration(s): Chemistry; Economics**
Sophie Kelly (2021) **Concentration: Biochemistry**
Thao Kim (2021) **Concentration: Biochemistry**

Faculty Mentor: Anthony Chianese **Department: Chemistry**

Title of Project: Understanding and Engineering Ruthenium Catalysts for Hydrogenation Reactions

Project Summary:

The overall goal of the Chianese Group is to synthesize a more efficient catalyst for ester hydrogenation reactions based on the Milstein catalyst design. Additionally, we want to understand the mechanism of the catalyst as it progresses the hydrogenation reactions. Over the course of the summer, this group synthesized catalysts via the steps shown in the above figure. As we were synthesizing catalysts with various substituents (denoted in general as R_1 and R_2), we have used diethylamine, dimethylamine and diisopropylamine as our starting point in the past, during the summer we started using three new amines as our starting point: adamantylamine, 2,4,6-trimethylaniline and neopentylamine. The synthesis of these new catalysts was the focal point of our research as we wanted to use these compounds to test the reaction mechanism of the catalyst in ester hydrogenation reactions.

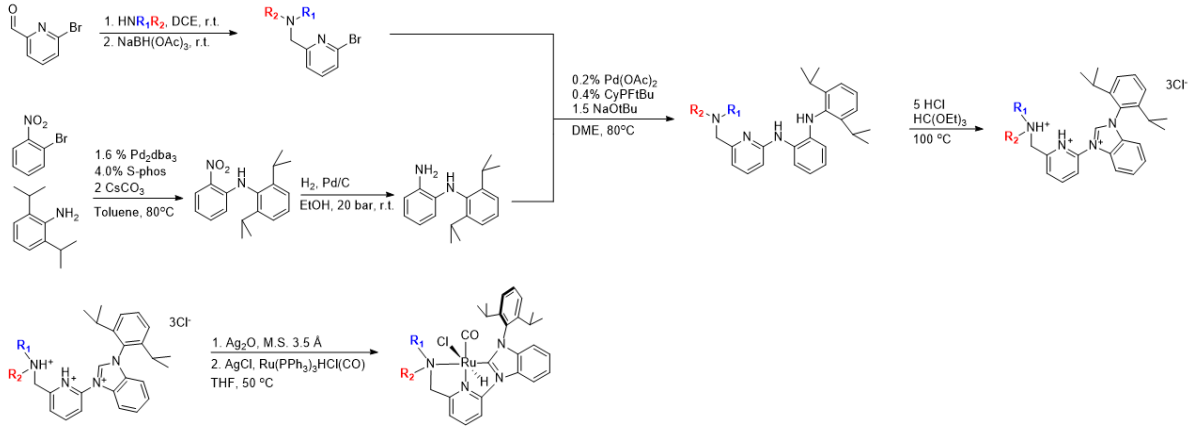


Figure 1: General Reaction Scheme for Synthesis of Catalyst

Our group hypothesizes that in order for our catalyst to function in the hydrogenation reactions, one of the amine substituents must be eliminated. From previous testing we know that isopropyl and ethyl groups are capable of being cleaved while methyl is not. We hypothesized that this is due to a lack of a beta hydrogen being present in the methyl. Since we suspect that the ruthenium (0) complex is the precatalyst, we have begun the testing of various substituents. In order to do so, we kept R_2 as ethyl or isopropyl group which we know is capable of leaving, while changing R_1 among adamantyl, neopentyl and mesityl. We want to see if we are able to keep the R_1 substituent on the ligand while cleaving off R_2 to form an imine. The goal of this is to help further show if a beta hydrogen is necessary to form the imine. Beta hydrogens are not present in the mesityl nor the neopentyl. Similarly, a double bond cannot form at a bridgehead in the adamantyl due to Bredt's rule.

Result:
For the ligand using the mesityl and ethyl substituents, the metalation reaction was not successful. Various NMR spectra showed that the cyclized product did not form a tridentate ligand as expected, but only formed a bidentate ligand. For the ligand with the adamantyl and ethyl substituents, the synthesis was successful up to the metalation reaction. We were able to obtain the crystal structure of the precatalyst, but due to limited time we have not been able to test whether the precatalyst is active.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): National Science Foundation Grant; Science and Math Initiative-SMI (NASC Division); Warren Anderson Fund

Research Fellow: Yejin Cha (2021) **Concentration(s): Chemistry; Computer Science**

Faculty Mentor: Anne Perring **Department: Chemistry**

Title of Project: Measurements of Primary Biological Aerosol in Upstate New York

Project Summary:

Primary Biological Aerosol Particles (PBAP) refer to solid airborne particles emitted directly into the atmosphere from biological organisms. Major categories of PBAP include bacteria and archaea, fungal spores and fragments and detritus[1]. From affecting cloud formation and precipitation and causing diseases by spreading pathogens, they play important roles in the environment.[2] Since tracking of these biological aerosols has become a recently growing interest in the field of atmospheric chemistry, there is still a lot unknown about bioaerosols in the atmosphere. Our goal this summer was to develop efficient and reliable techniques for identifying PBAP and regional/seasonal variations that will be useful in future studies. Moreover, we aimed to examine aeroallergen concentration in the US.

After different methods of monitoring PBAP have been attempted, light induced fluorescence technique, which include WIBS, SIBS, and Instascope, became a most-widely used technique. Data utilized in this research was collected with Instascope, a real-time bioaerosol detector. As shown in Figure 1, particles are drawn through the path of 635 nm diode laser, which scatters light in all directions. The forward-scattered light is used to determine particle shape. Side-scattered light is collected, passed through a dichroic beam-splitter, and converted to electrical pulses. These pulses then trigger the first xenon flash tube, Xe1, at 280 nm. The resulting fluorescence emission is collected, filtered, and passed to two fluorescent detectors, F1, which detects light from 300nm to 400 nm and F2, which detects light from 420 to 650 nm. The Xe2 xenon flash tube then fires at 370 nm. The resulting fluorescence emission is again collected, filtered, and passed to F1 and F2. Using this information, we can classify PBAP into seven different types. According to previously conducted research, type A was dominant in all bacterial and most fungal populations. The fungal spores are presented in types A, AB, and ABC. Type B fluorescent type is uncommon for PBAP, so a high number can be representative of non-biological interferents.

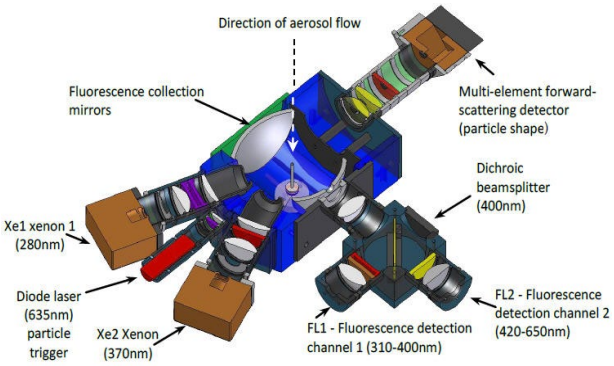


Figure 1: WIBS-4 [3]

DetectionTek Holdings LLC provided more than 350 individual observations, taken during home inspections in early 2019, from four Instascope instruments. Serial numbers 6 and 8 were operated in DC, VA, and MD, representing the Eastern part of the US, and numbers 24 and 27 operated in UT and CO, representing the West. A Python program was built to import and parse data files and to extract useful information. For each observation, a fluorescent threshold was first determined for each of three channels using "forced trigger" data (lamps were flashed in the absence of particles). Next each particle sampled was classified according to its fluorescent signal or lack thereof. Finally, preliminary data analysis was performed examining number concentrations and size distributions of different kinds of fluorescent aerosol.

Some regional variation could be observed. Type B fluorescent particles were frequently 20% the total, and they were not included in this analysis. The fungal-like fraction appeared to be larger in the West than in the East. In the future, incorporation of more data covering a wider range of geographic locations and longer times may reveal seasonal and/or regional variations. Furthermore, collection efficiency needs to be evaluated through comparison to PM2.5 and PM10 observations. We need to modify the program to accommodate minor changes to file format, and we are going to continue to develop sub-routines focused on instrument evaluation and data analysis.

1. Hernandez, M., Perring, A. E., McCabe, K., Kok, G., Granger, G., and Baumgardner, D.: Chamber catalogues of optical and fluo-rescent signatures distinguish bioaerosol classes, Atmos. Meas. Tech., 9, 3283–3292, https://doi.org/10.5194/amt-9-3283-2016, 2016.
2. Pöschl, U. 2005. Atmospheric aerosols: composition, transformation, climate and health effects. *Angewandte Chemie-International* Edition 44, 75207540.
3. Perring, A. E., J. P. Schwarz, D. Baumgardner, M. T. Hernandez, D. V. Spracklen, C. L. Heald, R. S. Gao, et al. "Airborne Observations of Regional Variation in Fluorescent Aerosol Across the United States." J. Geophys. Res. Atmos. 120, no. 3 (February 3, 2015): 1153–1170. © 2014 American Geophysical Union

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Kasey Chan (2021) **Concentration: Political Science**

Faculty Mentor: Robert Kraynak **Department: Political Science**

Title of Project: Study of the American and French Revolutions through the Eyes of Alexis de Tocqueville and the American Founders

Project Summary:

Over the summer I worked with the Center for Freedom and Western Civilization under Professor Kraynak of the Political Science department. Building on what I learnt in both my political science courses with Professor Kraynak - Foundations of Political Thought and American Political Thought - I decided to focus on Alexis De Tocqueville's works to understand why democracy succeeded in America when it had failed in the French Revolution. After researching Alexis De Tocqueville's works I summated everything I learnt into a paper that compared Aristocracy, Democracy at its best, and Democracy at its worst.

Alexis De Tocqueville is an important figure to American history, even though he was a French citizen, because he wrote a book titled *Democracy in America* which sought to explain why democracy was so successful in America when it had led to the Reign of Terror in France. De Tocqueville ascribes America's democratic success to its "peculiar and accidental" situation, established laws, mores/habits, and the lack of a landed aristocracy. Some important observations that De Tocqueville made was how democracy can be abused in the tyranny of the majority in addition to how the judicial courts act as one of the most important factors in deterring tyranny of the majority. Alexis De Tocqueville established a framework for how democracy is viewed and established prescriptions that still prove to be vital in ensuring a successful democracy.

A Portrait of Alexis De Tocqueville (1805-1859)

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Center for Freedom and Western Civilization
(James Madison Research Fund)

Research Fellow: Sandesh Chapagain (2020) **Concentration(s): Physics; Computer Science**

Faculty Mentor: Kenneth "Ken" Segall **Department: Physics and Astronomy**

Title of Project: Numerical Modeling of Superconducting Circuits

Project Summary:

Logic gates have been at the heart of digital computation for almost a century now. The few basic gates available can be used to build robust, logically complex circuits that solve the problem at hand. However, these gates, that use transistors as their fundamental building blocks, are not without flaws. As the problem gets bigger, the number of gates required to build a solution circuit rises exponentially – why a typical intel core consists of around half a billion transistors. This is not ideal since each of these transistors, due to the inherent resistance associated with them, dissipate power in the form of heat to the surroundings. The total loss of power due to a myriad of transistors is significant enough to motivate us to look for alternatives. Driven by this, Stephen et al. (2012) came up with an excellent idea of using oscillatory circuits, instead of transistors, to fabricate logic circuits. It has also been established that superconducting nanowires can be used to build an oscillatory circuit that mimics neuron behavior. These two ideas can be neatly merged to implement threshold logic, i.e. we can exploit the behavior of superconducting nanowires to successfully fabricate a power-efficient, linearly scaling logic circuit. In our research we attempt to simulate various configurations of superconducting circuits and find the right parameters such that the simulation mimics the behavior of logic circuits.

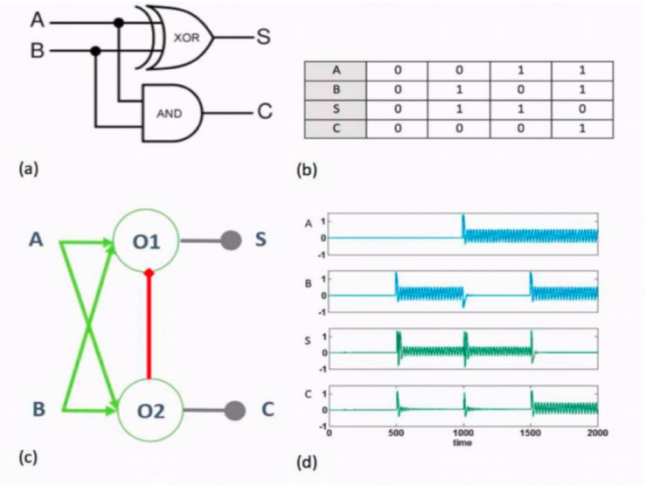


Figure 1: Binary half adders. (a) Schematic for a half adder using traditional logic gates. (b) Truth table for the half adder. (c) Schematic for a neuronal half-adder, where green arrows show excitatory synapses and red arrows shows inhibitory ones. (d) Output of an oscillatory half adder using the Fitzhugh-Nagumo models.

Nanowire neurons can be conneted to each other using synapses, and these connections can be modulated such that the neruons either inhibit or excited each other – as shown in Figure 2,3. This allows superconducting neurons to mimic logic circuits, as depicted in Figure 2. Using circuit simulating software (LTspice and Ngspice), we setup various parameter sweeps that would make the neuron system emulate adders, flip-flops and several other simple logical systems. Moreover, since this system is based on the behavior of biological neurons, they could be used to simulate the effects of certain drugs on neurons, and potentially provide insights into the human brain.

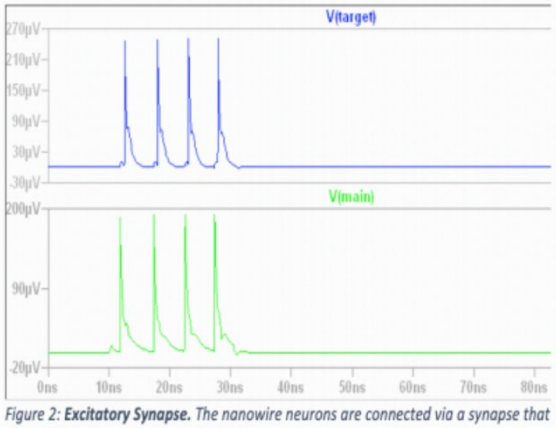


*Figure 2: **Excitatory Synapse.** The nanowire neurons are connected via a synapse that allows the main neuron to excite the target neuron whenever it fires.*

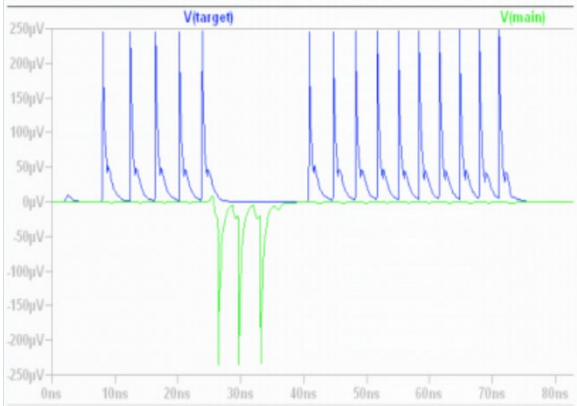


*Figure 3: **Inhibitory Synapse.** The nanowire neurons are connected via a synapse that allows the main neuron to inhibit the target neuron whenever it fires.*

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Justus '43 and Jayne Schlichting Student Research Fund

Research Fellow: Julia "JJ" Citron (2020) **Concentration: Peace and Conflict Studies**

Faculty Mentor: Julie Dudrick **Department: Upstate Institute**

Title of Project: National Abolition Hall of Fame and Museum "Community Engagement and Activism"

Project Summary:

This summer, I worked at the National Abolition Hall of Fame and Museum. NAHOFM was opened in 2005 by Dorothy Willsey and Norman Dann, and is the only museum in the United States solely devoted to abolition. The museum is a non-profit organization and is operated entirely by volunteers. In addition to the hall of fame, the museum contains exhibitions about the Abolition Movement and Women's Suffrage Movement. The museum hosts various programs and events throughout the year, including Peterboro Emancipation Days and Induction Weekend. The museum's mission reminds visitors of their duty to remember the past and change the future: "The National Abolition Hall of Fame and Museum honors antislavery abolitionists, their work to end slavery, and strives to complete the second and ongoing abolition: the moral conviction to end racism."

During my time at the museum, I have served as a docent. In addition to my host duties, I have assisted the museum in their educational programming efforts. I will participate in the 10th Annual Peterboro Emancipation Day as a program presenter on the life of Harriet Powel and her journey to freedom. Additionally, I have assisted the US Department of the Interior National Park Service in planning the annual Network to Freedom Training in Niagara Falls. NAHOFM is also planning a forum on reparations in relation to H.R. 40, which will take place on October 26, 2019 in the Hamilton College Chapel. The museum has invited all presidential candidates to participate in the forum. Additionally, the forum will include professors, historians, and activists from the Central New York area. I have also been able to participate in NAHOFM board meetings of the Cabinet of Freedom and Madison County Cultural Heritage Tourism Committee meetings. I met with Sarah Bormann, the District Director of Congressman Anthony Brindisi's Utica Office, to coordinate a museum visit for Congressman Brindisi.

The final portion of my summer was devoted to designing an installation of questions/answers in electronic exhibit in a thought-provoking exercise aimed to diminish racist attitudes. This survey will be exhibited at the New York State Fair. The survey will be conducted on iPads. I wanted the process of answering the questions to be informative and expedient. The two are not necessarily mutually exclusive! The questions seek to examine the social, economic, and political implications of race in the United States. Specifically, questions addressed racial disparities between whites and black people regarding incarceration rates, educational opportunity, income, job availability, and housing access. In addition to the New York State Fair, I will present the installation and my research at the National Park Service Network to Freedom Training, which will take place in Niagara Falls this September.

I am a Peace and Conflict Studies major and English minor. Last fall, I participated in the Cape Town study group, where I learned about racial subjugation and the way racism currently functions in in post-Apartheid South Africa. I had not learned about the history of slavery in the United States since high school, and I was eager to learn more about the significance of Central New York to the larger Abolition Movement. My work at NAHOFM has allowed me to consider the present functions of racism in the United States within the context of America's fractured past. This summer has taught me that community organization and activism begins at the local level. It begins with motivated individuals who are united by the shared goal to educate others. Museum visitors and volunteers share an interest in exposing past and present racial injustice in the United States. This process begins with self-education and transitions to educating those around us.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow: Jared Collins (2021) **Concentration: Biology**

Faculty Mentor: Julie Dudrick **Department: Upstate Institute**

Title of Project: Adirondack Center for Loon Conservation "Conservation Strategies in a Changing World: The Adirondack Loon"

Project Summary:

This summer, I conducted research for the Adirondack Center for Loon Conservation (ACLC) in Saranac Lake as part of the Upstate Institute's Adirondack Fellows Program. As its name implies, this nonprofit organization strives to maintain and improve local loon populations by running research, capturing and tagging loons, and answering calls to aid injured loons.

My research concerned the nesting habits of *gavia immer,* or the common loon. I collected data on the effectiveness of different designs of loon nest rafts at encouraging successful nesting. Loons have poor mobility on land and spend a majority of their lives in the water, so they nest on the shores of freshwater lakes and ponds. Because of climate change, the past years have seen more sporadic storms throughout the Adirondack region, causing a general decrease in nesting success as water levels remain high longer, preventing nesting, and wash out any nests already in place.

As a result, nest rafts have been implemented to a marginal degree in several locations throughout the Adirondack Park and in other places throughout the US that are home to loons. Loon nest rafts are human-made platforms used to provide a stable nesting area in lakes or ponds that are otherwise unsuitable. Because of this sporadic implementation, there are several different designs, ranging in size, materials, and other features like avian guards. I designed a survey to generate a database of information on loon nest rafts. I also determined which style of raft yields the best results for loon nesting and survival.

As a biology major and environmental studies minor, I am gaining important insight on field work — insight that only comes from working closely with an organization like the Adirondack Center for Loon Conservation. As a Fellow with the organization, I was given the opportunity to participate in many of the other activities the organization offers. Once a week, I kayaked in a nearby lake and monitored the loons that live there, which allowed me to learn more about their behavior and conduct field work. At the end of the summer, I helped to capture unbanded loons, and worked at community outreach events. Perhaps the most valuable part of my experience was seeing how selfless people are in their conservation efforts. ACLC staff members go out of their way to protect loons, while visitors and residents of Saranac Lake enjoy learning about these birds, and support the organization. It is refreshing to see a local community champion a cause, not because they seek any personal benefit, but because they genuinely care.

Conservation is an area of study that I am considering for a career, so I am very grateful for the chance to explore the field before graduating. As I complete this research, I hope to achieve a better idea of what I want to do after Colgate and to create new opportunities for the future.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow: Renee Congdon (2020) **Concentration: Spanish**

Faculty Mentor: Marta Pérez-Carbonell **Department: Romance Languages and Literatures**

Title of Project: Madrid in the Spanish Imaginary: Literature and the Remnants of the Past

Project Summary:

This summer, I spent 4 weeks on Colgate's campus followed by 4 weeks in Madrid researching the role that the city of Madrid plays in contemporary Spanish literature, as well as the ways in which that role has been shaped by Spain's recent history, which includes a bloody civil war as well as a 36-year-long dictatorship. The first phase of my research was based on a close textual analysis. I consulted with my advisor Marta Pérez-Carbonell in order to select 3 primary sources, all of which are Spanish novels published within the last 25 years—*Mañana en la batalla piensa en mí* by Javier Marías, *Instrucciones para salvar el mundo* by Rosa Montero, and *Riña de gatos* by Eduardo Mendoza. After this initial reading and analysis of primary sources, I worked with my advisor to find secondary sources to supplement my research, such as *El espectro de la herencia* by Isabel Cuñado, "Ciudades culturales, reales e imaginaries" by Sonja María Steckbauer, and *Imaginarios urbanos* by Néstor García Canclini. The majority of these secondary sources focus on the various ways in which urban spaces have been conceptualized in reality and in fiction, as well as the rules that govern these spaces.

While I continued this close textual analysis throughout the entirety of my project, searching out new secondary sources whenever possible, my research methodology changed when I arrived in Madrid. One of the first things I did in Madrid was to plot out the urban wanderings of Víctor, the main character in *Mañana en la batalla piensa en mí*. I was able to walk the same trajectories that he walked, passing the same buildings and street names and reaching, in this way, a deeper understanding of the role that the city plays in this novel. Additionally, I visited many of the locations mentioned in *Riña de gatos*, which was particularly enlightening because this novel is set in 1936, meaning that finding these places was a sort of scavenger hunt through the past that taught me much about how the city of Madrid has grown and changed in the last 90 years. For example, one famous theater, the Cine Europa (pictured to the left, from cinematreasures.org), was the site of many rallies of the Falange party in the years leading up to the civil war. In its heyday, this theater contained hundreds of sprawling cinema seats, and was a place of great importance and controversy. These days, as I saw when I visited the old building, it has lost its grandeur, converted into a small store that sells bathroom fixtures on the corner of a working-class neighborhood street (photo right).

Beyond my own personal investigation of the city, I was also greatly assisted in my research by various institutions in Madrid, such as the Museum of the History of Madrid, the Prado Museum, and the National Library. At the Museum of the History of Madrid, I visited an exhibition on cartography and was able to discuss with docents the way in which Madrid expanded in the early 1900s. This has proved especially useful for the article that I am currently writing, as it has informed my understanding of mapping an urban space and what it means to exist on the peripheries of a city like Madrid (my photo of 1920 aerial map of Madrid to the left, found in the museum). I also spent much of my research time in the Prado Museum, as *Riña de gatos* focuses on the art world in Madrid, and often makes explicit references to portraits in the Prado which still hang there today. I was also able to access some restricted documents at the National Library which allowed me to see city planners' maps of Madrid in the early 1930s, featuring street names that still exist today. Lastly, two very useful human resources were the art scholar Carmen Ana Sierra Echevarria and the cinema and history scholar Eugenio Suárez Galbán. I was able to personally interview both of them, and in doing so enriched my understanding of the subject matter at hand. Through the aforementioned deep textual investigation, personal exploration of the city and its monuments, museum and library visits, and in-person interviews with scholars, I was able to gain a fuller picture of the city of Madrid and the multifaceted realities and possibilities it lays claim to, which in turn has formed the foundation of the article that I am currently writing.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): J. Curtiss Taylor '54 Endowed Student Research Fund

Research Fellow: Evelyn Cox (2021) **Concentration(s): Sociology; Biology**

Faculty Mentor: Krista Ingram **Department: Biology**

Title of Project: Genetic Correlates of Seasonal Affective Disorder (SAD) in a Refugee Population in Upstate New York

Project Summary:

This summer, I studied Seasonal Affective Disorder (SAD) in Professor Ingram's biology lab. Seasonal affective disorder (SAD) is a type of depression that generally starts in the fall or winter and subsides in the spring or summer. Symptoms of SAD include hypersomnia, social withdrawal, low energy, feelings of hopelessness, overeating, and loss of motivation. SAD is hypothesized to be a result of decreased sunlight exposure and current research suggests that SAD is caused by a combination of genetic and environmental factors, such as changes in the internal circadian rhythm.

For our research, we focused on the genetic component of SAD, depression, and chronotype, a factor that is known to be related to the circadian rhythm system. By looking at both qualitative data (self-reported mood and sleep patterns) and quantitative data (mutations in each gene), we aimed to determine whether certain mutations in each gene of study increase one's chances of having SAD. To collect qualitative data, we surveyed participants using SPAQ, BDI, and rMEQ surveys to obtain participants depression score and severity, their chronotype (morning type, evening type, or neither), and their SAD diagnosis. To perform the quantitative analysis, we obtained hair samples from participants, extracted DNA from each sample, and used qPCR to perform SNP analysis.

Current knowledge of seasonal affective disorder and mood disorders in general relies on data primarily from Caucasian populations. Little is known about these disorders in individuals from diverse cultural backgrounds. Due to this, we conducted our research on a refugee population from Burma under the hypothesis that individuals from equatorial regions may be more likely to experience SAD when relocating to areas that experience harsh winters with limited exposure to sunlight, such as Utica, New York. We also conducted research on a Caucasian population based out of Hamilton, New York at Colgate University.

In conclusion of my individual research on the CLOCK gene, we determined that the Colgate and refugee populations had significantly different genotypic frequencies of CLOCK. This could suggest a difference in genotype by region. We did not find any genotypic correlations between CLOCK and SAD in the Colgate population, but we did find that the presence of a C allele makes a Colgate individual more likely to be a morning chronotype. In the refugee population, we found that the presence of a C allele makes the individual more likely to have SAD but did not find any relationship between CLOCK and chronotype. Lastly, we also determined that 28% of the variance in SAD can be explained by depression scores for all participants.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow(s):	**Francis Criscione (2021)**	**Concentration: Computer Science**
	Devin Ferri (2021)	**Concentration: Peace and Conflict Studies**
	Daniel Gathogo (2020)	**Concentration: Computer Science**
	Justin Mailom (2020)	**Concentration(s): Japanese; Physics**
	Tam Nguyen (2022)	**Concentration: Computer Science**
	Marie Pugliese (2020)	**Concentration: Biology**
	Elizabeth "Liz" Rasmussen (2021)	**Concentration: History**
	Eric Roels (2021)	**Concentration: Astronomy/Physics**
	Emily Weaver (2020)	**Concentration: Environmental Geology**
	Katherine "Katie" Weber (2020)	**Concentration: Biology**

Faculty Mentor(s):	**Joe Eakin**	**Department: Vis Lab**
	Karen Harpp	**Department: Geology**

Title of Project: Virtual Galapagos: An Innovative Science Outreach Project

Project Summary:

The Virtual Galapagos Project aims to create a web-based educational experience for children to learn about science through the lens of the Galapagos Islands. As they navigate through this educational resource, students from around the world will encounter concepts from multiple disciplines, with an emphasis on geology and evolutionary biology. Most importantly, the Virtual Galapagos project is designed to inspire students to pursue careers in science by leading users toward sophisticated scientific concepts, culminating in results from recent research efforts in the Galapagos and highlighting contributions from leading Galapagos scientists and conservationists.

The project blends a set of intersecting storylines that lead users through several scientific questions, each focused on fundamental concepts critical for understanding the development of the Galapagos Archipelago and its unique scientific opportunities. For instance, in one scientific mystery, students are able to explore how the endemic Galapagos marine and land iguanas could have diverged at a time when the current Galapagos Islands did not exist. Students are guided through several modules that explain the different elements needed to solve the mystery. During these modules students will learn how volcanic islands develop and subside, how species colonize the islands, the genetic relationship between land and marine iguanas, and how currents support Galapagos biodiversity. We employ many types of interactive mechanisms to engage users intellectually, as well as images and 360^{o} video collected two years ago in the islands, whiteboard animations, interviews with research scientists, and suggestions for experiments students can do on their own as complements to the resource's content. A set of narrators guide students as they make observations and create hypotheses in order to answer scientific questions. After the completion of each mystery, users are left with other, yet-to-be-answered questions in order to show that science is ongoing and the encourage them to continue in STEM. The project also incorporates input and assistance from children in the local area, involving them in every step of the process.

Over the course of the summer we continued to work on the pilot phase of this project through research and content planning, programming, and video creation. These videos include demonstrations of scientific concepts, whiteboard explanations, and scientist interviews. At this point we have two fully functional modules and several others well underway. Once this pilot phase is completed we plan to further integrate contributions from Galapagos naturalist guides and residents in an effort to make this outreach project a truly grassroots effort, built by people who work and live in the archipelago.

The Virtual Galapagos Project is funded through support from NASC, Colgate's Geology Department, and a collaborative grant from the Office of Science and Society at McGill University's Labs Without Borders.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Bob Linsley/James McLelland Fund;
Doug Rankin '53 Endowment-Geology Research;
Hackett-Rathmell 1968 Memorial Fund; Vis Lab

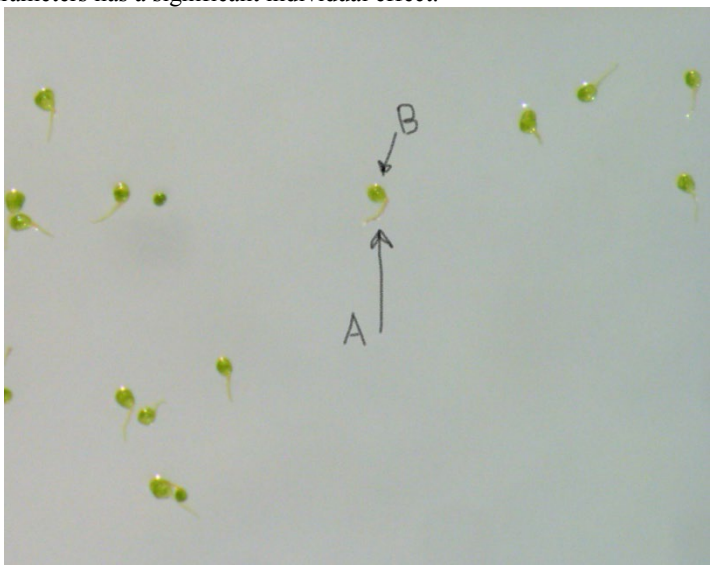
Research Fellow: Emma Cromwell (2020) Concentration(s): Art and Art History; Molecular Biology

Faculty Mentor: James "Eddie" Watkins Department: Biology

Title of Project: Ecophysiology of Reproduction in the Hybrid Fern Complex Dryopteris

Project Summary:

Introduction:
My summer research project centered around the germination rates of Osmundaceae within different temperatures and water potentials. Osmunda claytoniana (Interrupted fern), Osmundastrum cinnamomeum (Cinnamon Fern), and Osmunda regalis (Royal fern), are three types of ferns that grow near Hamilton, New York. These ferns all have green spores. Green spores are unique from other spores due to the presence of chlorophyll within the spore, giving them the unique green color. Because of the chlorophyll, the spores not only have a very limited window of viability, but they also germinate quickly. Spore germination is the initial growth of a rhizoid from the spore. The rhizoid has a similar function to the roots of most plants. This project focused on how well each of the fern species germinated at different temperatures and with differing availability of water. I found that while there is not an interactive effect between temperature and water availability, each of the parameters has a significant individual effect.



The image above shows many germinated spores, and a single ungerminated spore. The rhizoid (A) allows the spore (B) to gain nutrients.

Methods and Results:
To conduct this experiment, the spores were sown onto agar plates which were previously soaked in PEG and water solutions with concentrations of 0 g PEG/L, 250g PEG/L, 350g PEG/L, and 450g PEG/L. For each species, there were 3 replicates per set of conditions. The plates were placed in plastic boxes on temperature mats that maintained constant temperatures of 23 ℃, 25 ℃, 27 ℃, and 29 ℃. Percent germination was counted after 2 days, 3 days, and 5 days.

The data showed that each species had different preferences in terms of both temperature and water availability. While the Royal fern had the highest germination rates at 29 ℃, the Cinnamon fern had higher germination rates at 25 ℃. Moreover, while it was expected that the control level of PEG would result in the highest germination rates overall, the plates soaked in 250 g/L PEG solution did equally as well as the control group. This suggests that the spores do take environmental cues on when to germinate; however, these cues are different for each species. Furthermore, this experiment showed that germination of fern spores is possible in a wide variety of conditions, suggesting a high stress tolerance. This could be due to the spores evolving to germinate at different times of the year or in different micro-climates in order to gain the best possibility of survival with the least competition with other species.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Srecko Curkovic (2020) **Concentration: Physics**

Faculty Mentor: Kenneth "Ken" Segall **Department: Physics and Astronomy**

Title of Project: Low Temperature Testing of Superconducting Circuits

Project Summary:

In order to make advancements in building new and efficient computers, in machine learning, and in artificial intelligence, an elaborate and insightful exploration of neurons, inter-neuron dynamics, and neural networks needs to be done. As an attempt to do so, modern technologies are being used to simulate such networks and to learn about the brain in a way that overcomes the limitations of previous computational simulations. We are presenting superconducting circuits containing networks of Josephson junctions as an innovative way of modelling neurons.

Josephson junctions are nonlinear systems consisting of two layers of superconducting material surrounding a single layer of non-superconducting material. They can be arranged in large networks (ladders, for example), their parameters can be adjusted, and simple electrical measurements can be easily taken on them. When microchips containing networks of Josephson junctions are cooled down to temperatures near absolute zero, many characteristics of biological neurons are observed. These include firing thresholds, action potentials, and refractory periods. Such interconnected networks can easily be scaled to large sizes and can be used to investigate long-term dynamics.

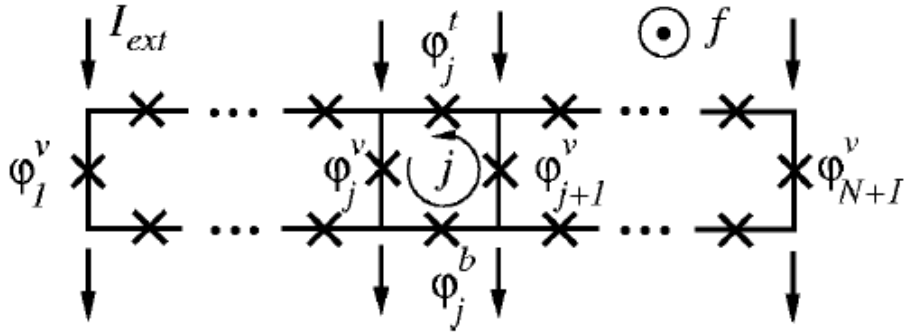


Figure 1: Josephson Ladder

Experimental side of the project involves taking measurements at low temperatures. The ladder used in the project consists of several Josephson junctions connected in parallel. An *array current* is sent to all junctions, while *breather current* is sent to only one of them. Moreover, there are a global magnetic field surrounding the entire ladder and a local magnetic field located between two of the junctions.

This set up leads to the creation of wave-like modes called *vortices* and localized modes called *breathers*. Breathers are created at the junction receiving the breather current. Vortices can propagate along the ladder and they can interact with breathers. By varying different parameters, properties and interactions of vortices and breathers can be studied. As junctions switch between voltage state and superconducting state, different events can be observed. Computer software called Igor Pro was used to record electrical measurements and to interpret the collected data.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Justus '43 and Jayne Schlichting Student Research Fund

Research Fellow(s): Tenzing Dakpa (2021) **Concentration: Molecular Biology**
Brianna "Bri" Jepsen (2020) **Concentration: Chemistry**

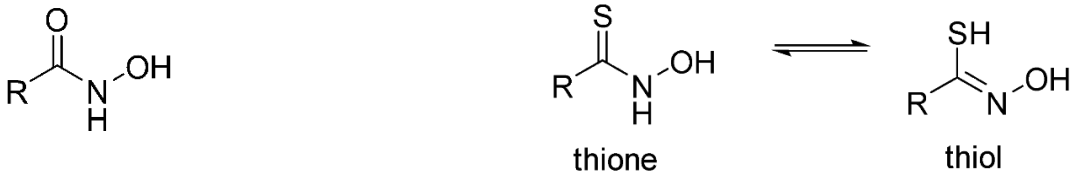
Faculty Mentor: Adaickapillai Mahendran **Department: Chemistry**

Title of Project: Synthesis and Structure-Activity Relationship of Novel Thiobenzohydroxamate Drug Candidates as Inhibitors of Histone Deacetylase (HDAC)

Project Summary:

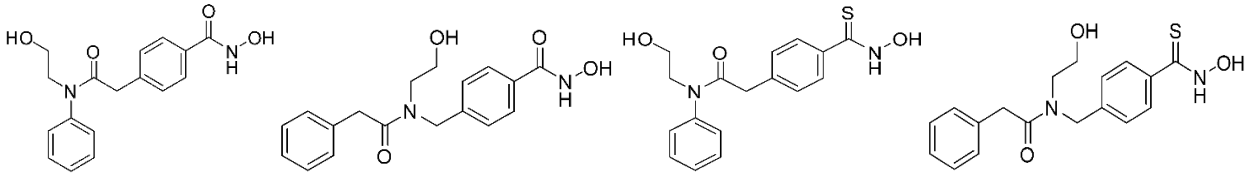
Pharmaceutical companies currently use the hydroxamic acid functional group to synthesize anti-cancer drugs, many of which are FDA approved, such as vorinostat (SAHA) and belinostat. Unfortunately, hydroxamic acids are extremely toxic and weak selective inhibitors of histone deacetylase 6 (HDAC 6), which is an enzyme present in the human body that is associated with cancer. Alternatively, our research this summer focused on investigating the thiohydroxamic acid functional group as potential cancer therapy drugs because it is less toxic and a greater HDAC 6 selective inhibitor.

Hydroxamic Acid **Thiohydroxamic Acid**



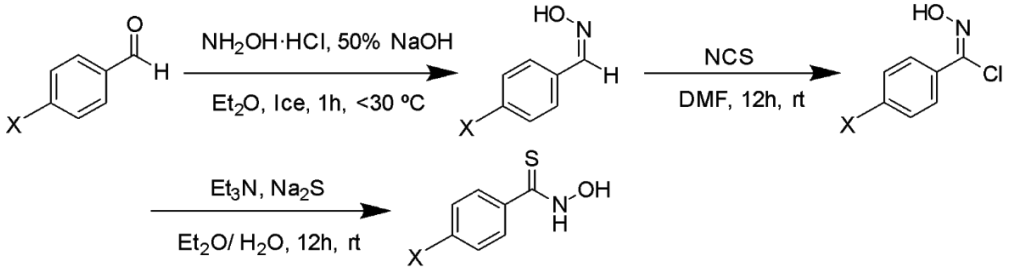
The long-term goal is to synthesize thiohydroxamic acid analogs as HDAC6 selective inhibitors. The lead compounds that we will be working with in the future are HPOB and HPB, as shown below, because they have demonstrated high selectivity and biological activity as HDAC6 inhibitors.

Lead Compounds: Target Compounds:



HPOB **HPB** **Thio-HPOB** **Thio-HPB**

The synthesis of thiohydroxamic acids is a 3-step synthesis, converting an aldehyde to an oxime, to a carboimidoyl chloride, and finally, to a thiohydroxamic acid. Various electron donating and withdrawing groups were used to test how that would affect its metal binding properties.



To better understand the potential of thiohydroxamic acids to be used for cancer therapy, we will explore the metal binding properties of this functional group to metal ions like zinc and copper. During the summer, we have synthesized a series of benzothiohydroxamic acids and thiophenethiohydroxamic acids to test their metal binding properties. All the products that were synthesized were characterized using ^{1}H NMR, ^{13}C NMR, IR Spectroscopy, and GC/MS.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Miller-Cochran Fund;
Science and Math Initiative-SMI (NASC Division)

Research Fellow(s): **Lily Davisson (2022)** **Concentration: Computer Science**
Nhiem Ngo (2021) **Concentration: Computer Science**
Chau Pham (2022) **Concentration: Computer Science**

Faculty Mentor: Joel Sommers **Department: Computer Science**

Title of Project: Automating Active Measurement Metadata Collection and Analysis

Project Summary:

Measurements of packet delay, packet loss, and throughput are widely used for a broad assessment of Internet performance characteristics. A study in 2000-01 by Zhang *et al.* evaluated Internet performance along three dimensions: mathematical constancy, when measured latencies can be described with a time-invariant model; operational constancy, when performance characteristics are stable and conducive to good application performance; and predictive constancy, when past measurements allow one to predict future measurements. In light of that study, our research reassesses the constancy of delays along Internet paths 19 years later by collecting and analyzing measurement data with respect to mathematical and operational constancy.

We used data from RIPE Atlas, a network of computers called anchors performing measurements between each other. We analyzed first-hop measurements to identify anchors with low-variability local networks in the same spirit as Sommers *et al*., 2017, choosing one from each continent: Almaty, KZ; Palo Alto, US; Frankfurt, DE; Belo Horizonte, BR; Johannesburg, ZA; Melbourne, AU. We collected ping measurement round-trip times (RTTs) of probe packets sent between these anchors.

In order to analyze mathematical constancy, we used the cpt.var function and PELT method within the R package 'changepoint' to determine points of change in variance within the dataset, as seen in Figure 1. Initially, we attempted to use detection techniques in Zhang *et al*. but found those to perform poorly.

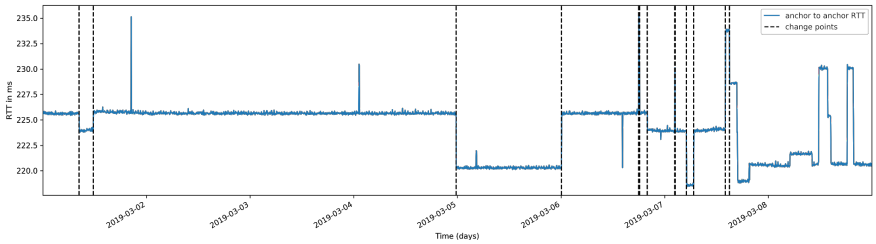


Figure 1. RTT over the course of 9 days between anchors in Belo Horizonte and Frankfurt, where change points are denoted by vertical dashed lines.

We used cumulative distribution function plots in order to visualize the cumulative likelihood of occurrence for periods of constancy in the connection between any pairs of anchors. We found that roughly 50% of constancy periods last up to 2-3 hours and about 10% of anchor-to-anchor pairs exhibit constancy on timescales of 24 hours or longer. In addition, there is a great discrepancy in the duration of constancy among different anchor-to-anchor measurements at several timestamps. (Figure 2)

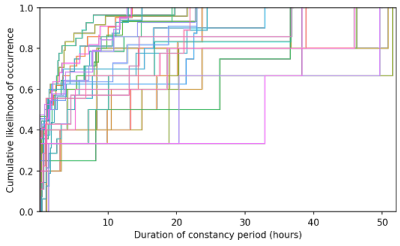


Figure 2. CDF plot of all anchors (each curve represents an anchor-to-anchor measurement).

For operational constancy, we conducted a longitudinal analysis of RTTs between Belo Horizonte and Frankfurt. A period of two weeks is selected every four months between 2017-2019. Analyzing the data revealed that RTTs between these two anchors generally remain within 200 - 300ms, suggesting that there is not a notable change in performance on this network. Therefore, this path is quite operationally constant. (Figure 3)

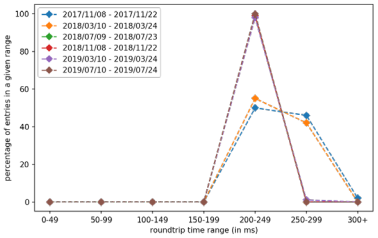


Figure 3. Longitudinal analysis of operational constancy.

Some of the most significant limitations that future work should address include the accuracy of durations of change-free periods being limited by probe frequency, the current method of change point detection (R package) inconsistently producing desired results, and inconsistent data availability provided by our current anchor selection.

Sources: Zhang Y., Duffield N., Paxson V., and Shenker S. On the constancy of Internet Path Properties. Proceedings of IMW, 2001.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): National Science Foundation Grant

Research Fellow: Alden DeBouter (2019) **Concentration(s): Anthropology; FMST**

Faculty Mentor: Julie Dudrick **Department: Upstate Institute**

Title of Project: Cornell Cooperative Extension of Madison County "Visual Storytelling for Farmers in Madison County"

Project Summary:

This summer I am fortunate to have the opportunity to intern with Cornell Cooperative Extension in Morrisville, New York. The office of CCE is dedicated to supporting the economic development of agriculture workers in Madison County. In partnership with CCE, I created short documentary videos for farmers and other agriculture workers in the area. The goal of these videos is to help improve the marketability of these businesses through the process of visual storytelling. By highlighting unique aspects of each agriculture worker's personal story and publishing them online, my intention is to help raise awareness for their brand and products within the local community. This work is important because it provides farmers with more tools for consumer engagement and connection in the digital world.

Very few people fully comprehend the impact that agriculture has on Madison County's economy, so educating people about where their food comes from is a key priority. Agriculture workers have a crucial impact on the economy of the county, so educating consumers about their products and personal stories helps increase sales and community engagement. Somewhat ironically, one of my favorite things about this work is learning more about nutrition and agricultural work. While my main purpose is to help these farmers tell their stories, I absorbed countless information about sustainable food practices that has carried over into my personal life. It feels great going to the farmers market in Hamilton and getting the chance to buy food from people with which I have developed a personal relationship. I enjoy helping them by purchasing their product, and it is reassuring to know exactly how that food is produced—something I can't say for Price Chopper or Wal-Mart.

I graduated from Colgate in May of 2019, so I was one of only a few graduating seniors who decided to stay in Hamilton after graduation to work with the Upstate Institute. I chose to stay here and complete this fellowship because the experience aligned well with my prior education and future career goals. I double majored in anthropology and film and media studies, and I find that my education in both disciplines has benefitted me throughout my work. Anthropologists are trained to be comfortable working and interacting with people from various different backgrounds. This position appealed to me because I didn't grow up with a background in agriculture and I thought this would be a great way to test my skills. Furthermore, ethnographic studies, such as anthropology and documentary work, tend to rely heavily on subject interviews to build the narrative. I conducted and recorded multiple interviews with farmers, using skills I've learned in anthropology courses to carry out the interviews, and skills I've gained from film courses to stage, record, and edit the footage. I believe that studying both anthropology and film and media studies pairs well for documentary production.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow: Andrea De Hoyos (2020) **Concentration(s): History; Anthropology**

Faculty Mentor: Santiago Juarez **Department: Anthropology**

Title of Project: A Look into Organizations that Provide Support to Undocumented Immigrants

Project Summary:

I have spent the summer working as a legal intern at a non-profit organization out of their office in Los Angeles, California. I chose to do this project because of my personal connection to the Hispanic population in the United States and my curiosity to know the truth about immigration policies. The office provides pro-bono attorneys to undocumented children who came into the country unaccompanied. Unaccompanied children (UAC) are children who came into the country without their legal guardian. I was there not only as an intern, but also as a researcher with the hopes of fulfilling the 'participant-observation' aspect of an anthropologist's work. This means that while I had my duties as an intern throughout the day, I also had to periodically write notes about my surroundings, my actions, and that of those around me.

In being here this past summer, I have not only learned more about immigration law than I ever would have otherwise, but I have also had the opportunity to get to know the amazing people who dedicate themselves to this line of work. This was an invaluable experience that taught me so much about how to conduct on-site anthropological research and what the fight for citizenship looks like. Many of the people who worked in this office were dedicated to the cause and were visibly upset when legislation or policies were made that would impact their clients. Most memorable is a policy that changed Asylum proceedings from the client going to an Asylum office to testify and talk about their experiences to the client having to go to court and testify in front of a judge and a state lawyer that is trying to dispute everything the child is saying. The border and immigration policies have been receiving a lot of media attention recently, but this summer I noticed it more than ever. There was a section in the office where newspaper clippings were posted, almost as if to encourage everyone to fight for what is right.

I had the opportunity to observe court proceedings, interview clients, go to trainings meant for law students, and visited a detention center. Everything I did and learned created a massive impact in my life, but I think what I enjoyed the most was interviewing clients. An intake is the initial interview with a potential client in which they are meant to talk about why they came to the United States. In doing so, they are meant to disclose every detail of their lives in their home countries in the hopes that one of those details will qualify them for the help that this organization provides. The organization primarily focuses on Asylum and Special Immigrant Juvenile Status cases. Asylum cases are for victims of violence from a gang, government, or any major organization where the child is now terrified to go back to their home country. Special Immigrant Juvenile Status (SIJS) cases are for children who have been abused, neglected or abandoned by their family members. In considering children for clients, I had to learn about some of the worst parts of their lives that made them come into the United States. In doing so, I learned pretty quickly that the children with the worst of stories tend to have a better chance of citizenship. This is because they have a better reason for coming to the United States illegally so their case is stronger. All cases are based on the child's testimony, with a few additions of any social media or photographical evidence. While the experience that I had is just a small introduction to immigration law, or law in general, it is one that has helped me realize my passion for helping others.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☒ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Aliyah Kennise De Jesus (2021) **Concentration(s): Molecular Biology; WMST**

Faculty Mentor: Julie Dudrick **Department: Upstate Institute**

Title of Project: Abraham House "A Community Effort: Exploring the Importance of Local Partnerships in Quality Hospice Care"

Project Summary:

This summer, I had the opportunity to work with the Abraham House in Utica. Abraham House is a non-profit comfort home serving Herkimer, Oneida, and Madison counties that providing a safe, loving environment for terminally ill guests and their families for as little as a few days to as long as three months. With the core values of compassion, dignity, and respect present in everything Abraham House does, it strives to deliver the end-of-life care and support its guests need. Because humanity is at the heart of its mission, Abraham House does not charge for services or receive insurance reimbursement. Instead, they rely on volunteers, donations, community grants, and fundraising to support their work.

Abraham House turns to individuals, families, and local businesses to find volunteers, collect donations, and raise funds. However, Abraham House must first overcome the formidable barrier posed by a general lack of knowledge concerning end-of-life care. Through partnerships with local establishments, Abraham House is able to maximize its presence and reach community individuals, families, and businesses. This in turn works to educate the public on end-of-life care and increase awareness that Abraham House exists as a viable option for the terminally ill. With a much larger audience, Abraham House can then appeal to the hearts of individuals, families, and local businesses to attract volunteers, collect donations, and raise the funds it needs.

My project focused on building partnerships with local businesses, restaurants, churches, attractions, grocery stores, gas stations, and convenience stores in Madison, Herkimer, and Oneida counties. Serving as a point of contact, I reached out to local establishments about housing Abraham House donation boxes. In addition, I contacted businesses and attractions throughout the state, including New York City, Utica, Lake Placid, Rome, Lake George, and Saratoga Springs for raffle and auction items for the golf tournament and gala fundraisers. I also solicited fundraiser sponsorships from local businesses, emphasizing those in Utica and Rome, which house Abraham House's two facilities. Additionally, I reached out to local churches to discuss features within their bulletins. Furthermore, I worked volunteer days where community members and businesses helped to prepare the new facility in Rome, New York for its opening. Finally, I spent a day on-site at the local Chanatry's Hometown Market greeting and asking customers to donate items or money. These mutually beneficial partnerships allow the partner to give back to an important cause while Abraham House is able to tap into their partners' customers to widen its own pool of potential volunteers, donors, and fundraiser attendees. Aside from working with local partners, I also utilized digital and social media platforms to boost community awareness. For example, I created and maintained a Facebook page for The Bird's Nest Vintage Boutique (Abraham House's thrift store), created postings on Facebook Marketplace for store items, and helped manage the Abraham House Facebook page. Moreover, I also contributed writing to the seasonal newsletter.

As a molecular biology and women's studies double major on a pre-medical track, this project has been a valuable opportunity for me to gain exposure to the administrative side of healthcare to which I had not previously been exposed. This perfectly complements the experiences I had shadowing physicians, helping me gain a more holistic view of healthcare and reinforcing my decision to pursue a career in medicine. Additionally, Abraham House's fully female three-member office leadership team fed my passion for female empowerment and interest in women's studies, and inspired me daily. Though I was initially drawn to this project for its focus on helping others, its promise to help me develop my communication and interpersonal skills, and its assurance to challenge my ability to be both self-directed and collaborative, it has far surpassed my expectations. I am incredibly grateful for this opportunity to not only develop my intellectual and professional interests, but to also leave behind a positive and meaningful contribution to the larger community.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow: Miguel De Los Santos (2022) **Concentration: Undeclared**

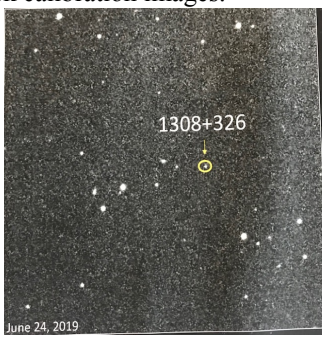
Faculty Mentor: Thomas Balonek **Department: Physics and Astronomy**

Title of Project: Optical Variability of Quasars and Stars at the Colgate Observatory

Project Summary:

For the summer of 2019 I was studying quasars at the Foggy Bottom Observatory. The objects (quasars) that we were looking at are billions of light years away from the Earth, so we had to use a CCD mounted on the 16-inch telescope in order to be able to get images that we can then analyze. Quasars are supermassive black holes in the center of active galaxies that are spewing out jets of relativistic plasma that emit electromagnetic radiation. Since we cannot see the black hole itself, we see the light from the jets that it is emitting to determine any outbursts or patterns.

That is how observing of quasars is done at the Foggy Bottom Observatory here at Colgate: To set the telescope to the exact locations of the quasar, we had a separate computer program that provided information about the quasar – particularly the declination, the hour angle, and the altitude of the quasar. The program also told us if the object was below the horizon or visible. After my peers and I determined if the quasar could be seen, we would go up to the actual telescope and align the declination and hour angle that we obtained from the computer. After we align the telescope we head back down stairs to the warm room and begin to try and locate the quasar. We would take 5-10 second exposures in order to first find the quasar. Referring to a jpg file that contains an image of the field where the quasar is, we then point the scope so that the quasar is located near the "sweet spot" (where the telescope provides the best image on the CCD detector). The "sweet spot" is where the quasar is about one-third away from the right side of the screen, adjusted slightly so that all comparison (comp) stars can be seen. Then we would increase the exposure time to 2 minutes to get the best image that we can. We use comp stars to measure the brightness of the quasar. Once we can see all the comp stars and the quasar itself, we begin to take multiple 2-minute exposures, which are then followed by a bias and a dark calibration images.



Raw 1308+326 field image before calibration

Bias frames and dark frames are just a few frames that are used for calibration. Biases capture the sensor electronics effect on the signal read-out, while darks capture the noise from temperature, gain setting, and exposure time. Furthermore, darks indicate the location of "hot pixels" that one may encounter. Together we use these types of frames to calibrate the image so we can properly measure the brightness of the quasar and then make a light curve of the quasar.

Depending on the brightness and activity of the quasar we may stay on it until it gets to 25-30 degrees altitude. This is what we did for quasar 1308+326, which was the most interesting quasar that we happened to observe this summer. It increased in brightness up to a magnitude of 15.2 that is up from a previous magnitude of about 17. Yet as interesting as 1308+326 was, we also observed 4-5 other quasars on each night. We had a list of quasars from most important to least important – our road map of quasars that we need to observe for that particular night. To get the best images that we can we repeat the same procedure of images and darks for every quasar that we manage to get for that night.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Science and Math Initiative-SMI (NASC Division)

Research Fellow: Luvna Dhawka (2020) **Concentration: Molecular Biology**

Faculty Mentor: Krista Ingram **Department: Biology**

Title of Project: Genetic Basis of Seasonal Affective Disorder (SAD) in Distinct Populations

Project Summary:

Seasonal affective disorder (SAD) is a depressive mood disorder manifesting in late fall and the winter, hypothesized to arise as a result of decreased light exposure. The symptoms include but are not limited to tiredness, feelings of hopelessness, overeating, and loss of motivation. Current research suggests that SAD results from a combination of genetic (circadian and circadian related genes involved in regulating circadian rhythms) and environmental factors. For instance, chronotype, the propensity of being alert and sleeping at specific times, influences light exposure, hence SAD susceptibility. Additionally, gender differences in SAD and non-seasonal depression, whereby females are more affected than males, have been shown to be similar. Noteworthy is that most of these SAD-related studies have focused on Caucasian populations.

For our research, we focused on the genetic component of SAD. My gene of interest was Cryptochrome 2 (CRY2). Single nucleotide polymorphism CRY2(rs rs10838524) has been significantly associated with SAD. However, studies have yielded contradictory results whereby the major A allele has been associated with SAD while the minor G allele has been linked to dysthymia. I aimed to compare the prevalence of SAD and depression and the distribution of CRY2 alleles in two distinct populations: a Karen/Burmese refugee population relocated to Utica, NY, and a group of mostly Caucasian Colgate University students and staff. I also wanted to verify for any association between genotypes and depression, SAD and chronotype. Finally, I looked for any association between gender and genotype, especially in relations to SAD and depression.

We obtained qualitative data about self-reported mood and sleep patterns using the SPAQ[1] (to screen for SAD), the BDI[2] (to screen for depression), and the MSF[3] (to determine chronotype). We also collected hair samples from participants for DNA extraction and genotyping for the CRY2 SNP.

Our results showed that SAD and depression have similar prevalence in both the mostly Caucasian Colgate sample and the Karen/Burmese refugee sample. Genotype distribution in both samples was different; the Caucasian sample had a significantly higher proportion of A homozygotes compared to the Karen/Burmese sample, which had a significantly higher proportion of G homozygotes. We found a strong positive correlation between GSS[4] and MSF scores in the Caucasian sample but not in the Karen/Burmese sample. In the Caucasian sample, heterozygotes had significantly higher BDI scores compared to A homozygotes. Furthermore, female Caucasians from the sample showed a significantly higher occurrence of depression than males. Lastly, the GG genotype occurred significantly more among females in the Caucasian sample than in the Burmese/ Karen sample. Our study thus supports previous research associating the G allele with depression (dysthymia), and also indicates that genetic differences exist between those two distinct populations. Further research is required to investigate whether those genetic differences could explain the propensity to SAD and depression.

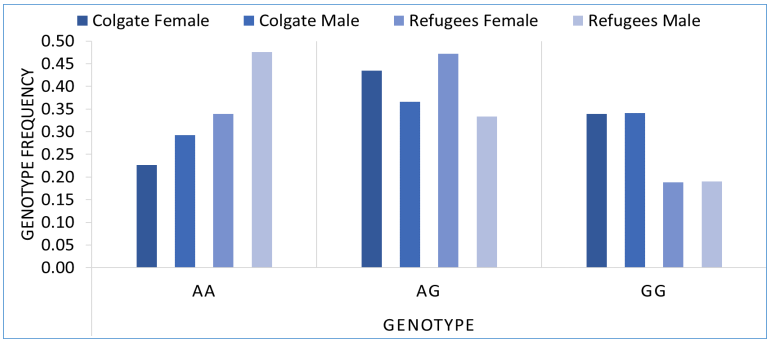


Figure 1: Genotype (AA, AG and GG) distribution across genders in both populations. The Colgate sample has a significantly higher proportion of homozygous GG females than the Refugee sample ($\chi 2=3.928$, $p=0.0475$). There is no significant difference between Colgate male and female individuals and Refugee male and female individuals for the AA and the AG genotype.

[1]Seasonal Pattern Assessment Questionnaire
[2]Beck Depression Inventory
[3]Munich Chronotype Questionnaire Short Form
[4]Global Seasonality Score obtained from the Seasonal Pattern Assessment Questionnaire

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Oberheim Memorial Fund

Research Fellow: Daniel Dougherty (2021) **Concentration(s): Philosophy; Astronomy/Physics**

Faculty Mentor: Thomas Balonek **Department: Physics and Astronomy**

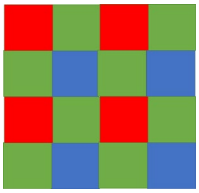
Title of Project: Astrophotometry with the Nikon D3500

Project Summary:

Our astronomy research group conducted two projects this summer: observing optically variable quasars and optimizing a digital camera--the Nikon D3500--into a useful instrument for astrophotometry (the study of the brightness of astronomical objects). My work focused on understanding the characteristics of the Nikon camera. In investigating the Nikon's viability for photometry, we learned about the physical makeup of images and how to understand uncertainty in a new instrument.

The Nikon is designed to produce aesthetically pleasing rather than photometrically useful images. To alter the photographs for science, we had to examine the makeup of the Nikon's sensor chip.

The sensor is made of an array of pixels--micrometer-scale 'wells' where light is converted into an electrical output. Each pixel has a red, green, or blue filter in a Bayer (red-green-green-blue) pattern displayed in the right figure. To do photometry, we had to separate the image into three distinct color channels. Our observatory's photometry program, MaximDL, collapses each 2x2 array into one pixel 'stacked' with four channels (red, blue, and the two green).

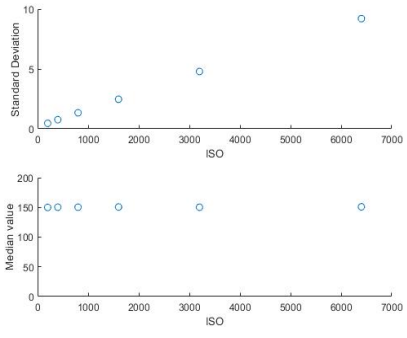


The pixel values on the freeware ImageJ didn't compare with the values found in the same image on MaximDL; ImageJ photos were four times their size. We discovered that in separating the color channels, ImageJ wouldn't collapse the array size by a fourth but keep the area of the monochrome image. ImageJ made superficial values in the pixels with filters that didn't correspond to the selected color channel.

We used the program Pixinsight to 'Superpixel' the images, collapsing the color array into separable color channels. We could then analyze the Nikon's images. Our next objective was to account for noise sources with *bias, dark,* and *flat* frames. My focus was on bias and dark frames.

The Nikon reads the sensor electronics as light, resulting in a random 'hum' of noise. I averaged 50 biases to make a 'master bias'. You can subtract biases from light exposures in ImageJ.

Dark frames show the electrons liberated by temperature effects; the Nikon reads them as light. We investigated how the dark's pixel values responded to changes in time, temperature, and ISO (the sensor's sensitivity to light). For instance, we compared the dark's median value as a function of the ISO. The median pixel value changed negligibly, but the standard deviation of the pixel value changed as a linear function. This gives us a sense of how uncertainty increases with ISO. The graph plotting these relationships is included to the right.



We need to investigate more about dark frames with respect to time and temperature. This should culminate in a profile of settings for the Nikon to operate with that produces the best data. This project taught us about the challenges of developing a form of data collection, such as a lack of referential literature and the process of investigating new kinds of uncertainty.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Justus '43 and Jayne Schlichting Student Research Fund

Research Fellow: Taylor Dumas (2020) **Concentration: Peace and Conflict Studies**

Faculty Mentor: Julie Dudrick **Department: Upstate Institute**

Title of Project: Mountain Lake PBS "Dissecting Rural Racism through Documentary"

Project Summary:

This summer I worked as a video editing intern at Mountain Lake PBS in Plattsburgh, New York. Located in the Adirondack region, Mountain Lake PBS serves an audience of over 4 million in New York, Vermont, Quebec and Ontario with high-quality digital media content in pursuit of its mission to "inspire and enrich people and communities through meaningful storytelling, entertainment, education and public engagement."

Since 2018, the production team at Mountain Lake PBS has been working on a documentary about racism in the North Country. Through the Upstate Institute, I was afforded the opportunity to work directly with Michael Hansen, associate producer of the film. Thematically, this documentary covers a wide range of topics including local and national histories of race relations and racism, personal experiences of racism, the U.S. prison system, and the relationship between race and space. The goal of this documentary is to dispel notions that racism is a thing of the past and to shed light on its persistence in our own backyards. To do so, the documentary contrasts the beauty of the Adirondacks with the ugliness of the racism that remains present in many facets.

Since the start of production, Hansen has conducted over a dozen multi-hour interviews with historians, artists, activists, and students who have studied or personally experienced racism in the Adirondacks. Given the scale of this project, a great deal of work is needed to transform the hours of interview footage and b-roll into a polished and compelling documentary. As such, the task that occupied the majority of my time at Mountain Lake PBS was to edit these interviews and combine the multitude of individual voices into captivating thematic sections. In order to complete my editing duties, I learned Adobe Premiere Pro, a video editing program that is used by many professional filmmakers. In addition to editing, I was able to gain invaluable experience in the various aspects of the production process by going on shoots, conducting interviews, operating professional video cameras, and learning technical skills such as how to light a subject. Furthermore, I was able to connect with people working across numerous departments, including production, marketing, and underwriting.

As a Peace and Conflict Studies major and an intended Film and Media and African Studies double-minor, working on this documentary amalgamated my interests in ways I could not have conceived. Coming into this summer, it was my hope to gain professional work experience in video production and to figure out if this is a path that I would like to pursue after graduation. Since taking a TV production class in high school, media production has always been something that I enjoy as a hobby but never truly considered as a viable career path. However, my time at Mountain Lake PBS has shown me the range of possibilities within the field, but also helped me develop some of the skills that will be integral to my success in this field in the immediate future.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow: Mary Festa (2020) **Concentration: Computer Science**

Faculty Mentor: Aaron Gember-Jacobson **Department: Computer Science**

Title of Project: Updating Computer Networks One Step at a Time

Project Summary:

Computer networks are designed to satisfy specific invariants (e.g. "no student computer should be able to communicate with President Casey's computer"), but many networks do not have an explicit record of these invariants. Nopticon is an in-progress framework designed to distill network invariants from observations of a network's forwarding behavior. So far, Nopticon has only been tested on synthetic networks that satisfy a known set of invariants, so the next step is to test it on real networks. However, the aforementioned lack of explicit records makes it difficult to know whether distilled insights are accurate, so we focus on generating router configurations from observed behavior as an alternative way to validate Nopticon's inferences.

Within a network, routers forward packets of data, and routing protocols determine their path from source to destination. In order to simulate real networks, we used GNS3, a graphical network simulator which allows the user to configure virtual routers as if they were actual routers. Using Colgate's core router configurations, I sought to reproduce the campus network in GNS3 (Figure 1). A challenge that arose was that some features used in the actual routers in Colgate's network were not supported by the simulated routers. In order to amend this, I wrote a program to edit configurations, removing unsupported features whilst preserving key aspects of Colgate's network. Once the network was up and running in GNS3, I could log router forwarding updates (i.e., changes to the paths packets traverse), programmatically parse this information into a format accepted by Nopticon, and produce a summary of invariant behaviors.

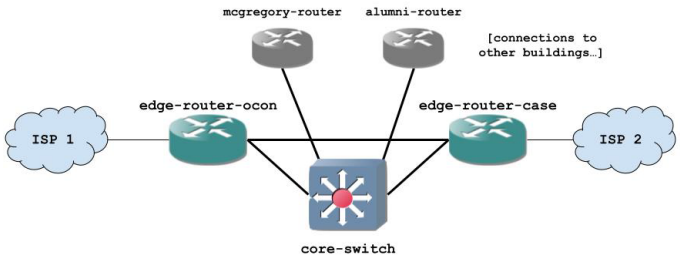


Figure 1: GNS3 simulation of Colgate's network

Another way that we can learn a network's intended behavior is by observing instructions given to routers in the network; if configurations can be generated from forwarding observations, this can give us new insights into a network's goals and potential bugs. In order to do this, I first configured a smaller, simpler network (Figure 2) using only the routing protocol BGP (border gateway protocol). Next, I analyzed the forwarding tables of its routers to develop a configuration inference algorithm which determined interface IP addresses, neighbor relationships, originated routes, filters, and local preferences. I wrote a Python program that implements this algorithm and produces Cisco router configurations from observations of a network's forwarding behavior.

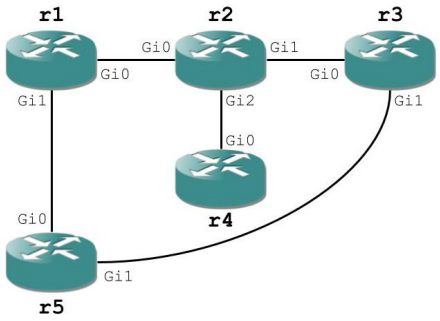


Figure 2: Simple BGP network

The initial configuration generator was very simplistic, and only used snapshots of a forwarding table rather than a forwarding summary such as the one produced by Nopticon. I adapted the previous program to take in a summary provided by Nopticon and produce configurations based on learned information, but this is still in progress. At this point, the program does not distill route policies which would filter out certain information based on different criteria (e.g. origin, neighbor, prefix). In the future, I intend to introduce functionality for determining the filter criteria in the hopes of producing more accurate configurations.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): National Science Foundation Grant

Research Fellow: Elena Forbath (2021) **Concentration(s): Geography; Biology**

Faculty Mentor: Michael "Mike" Loranty **Department: Geography**

Title of Project: Quantifying Spatial Variation in Vegetation Indices after Fire in Siberia Larch Forests

Project Summary:

In collaboration with the Geography Department, I researched the effect of disturbance, such as varying wildfire severity and vegetation removal, on the Normalized Difference Vegetation Index (NDVI) in field sites in northern Siberia. NDVI is the measurement of vegetation greenness in an area based on the amount of Near Infrared and Red light vegetation reflected by plants. Larch trees are prominent in the boreal forests of northern Siberia. Field sites consisted of forested areas, dominated by larch trees and different shrub species, which had suffered from wildfires ranging from thirty years ago to within the last few years. Each site included a section of the forest that had been untouched by fire as well as a larger section of burned forest. At each field site, we took drone photos, which included normal RBG as well as multispectral images, to determine NDVI.

To determine how NDVI differed in burned and unburned forests, we attached a multispectral camera called the Parrot onto a DJI Phantom 4 Advanced drone, which is originally equipped with only an RBG camera. We programmed the Parrot Sequoia to take images of the field site every second while the drone was in flight. In addition, we used the DJI Ground Station Pro (GSP) app to create flight plans for each field site, instructing the drone to take images of a certain area. We also then imported the multispectral images into a program called Pix4DFields to create a multispectral map of the area of interest. The RBG photos underwent a similar process except in a different program called Agisoft Photoscan.

In Siberia, we collaborated with other scientists, in particular Dr. Jennie DeMarco of Western Colorado University. Dr. DeMarco created a competition experiment to investigate the effect of removing a specific type of vegetation on larch recruitment. At the site of interest, she created forty plots, each of which was assigned a treatment: control, shrub removal, grass removal, and both shrub and grass removal. We then utilized these plots to determine how vegetation removal affects NDVI. We mounted the Parrot Sequoia camera onto a hand-held stick and took individual photos of each plot. Using Real Time Kinematic (RTK) GPS units called Emlid Reach, we obtained the precise GPS locations of each plot center. In addition, we took RBG and multispectral drone photos of the entire area of interest, which we used to create to make maps of the field sites.

Figure 1: Sample competition experiment plot photo.

After creating the multispectral maps with Pix4D, we wrote a script in RStudio to calculate and extract the NDVI values of each plot using the GPS points of the plot centers. As a result, we associated these NDVI values with each treatment and used them to determine if there was a significant effect of vegetation removal on NDVI. The multispectral maps also visually showed, through color contrasts, how NDVI differed in burned and unburned forests (as shown below).

Figure 2: RGB orthomosaic (map) of field site in Cherskiy, Siberia.

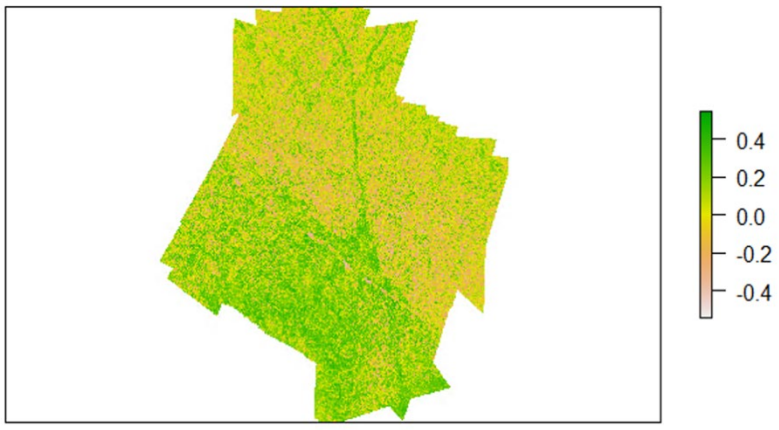


Figure 3: Multispectral map of field site in Cherskiy, Siberia, with a legend on the right demonstrating the range of NDVI values.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): National Science Foundation Grant

Research Fellow: Erika Fox (2021) Concentration(s): Film and Media Studies; Computer Science

Faculty Mentor: Alicia Simmons Department: Sociology

Title of Project: Extracting and Analyzing User Comments to Expose How Americans Respond to Gun Violence

Project Summary:

I am Erika Fox, a junior and Film and Media Studies/Computer Science double major. For this project, I enlisted the help of Professor Simmons (Department of Sociology) and Professor Hay (Department of Computer Science) for help with the sociological and computational parts of this project, respectively.

Framing is the process of selecting some aspects of reality and making them salient, while directing attention away from other aspects. This process has implications for audience members' understanding of and opinions about the world. During the fall 2018 Semester, I discovered just how present these frames can be in the American press system when I conducted a content analysis study as a part of the class "SOCI/FMST 375: Media and Politics" with Professor Simmons. For that study, I examined 25 news articles that covered the Las Vegas shooting at the Route 91 Harvest Music Festival of October 2017. The assignment inspired me to do this summer research project for which I used computational social science methods to extract and analyze user comments on online New York Times articles to see how the implications on news framing were reflected in the audience's response to articles that covered the Las Vegas shooting as well as the February 2018 shooting at Marjory Stoneman Douglas High School in Parkland, Florida.

For this project I sought to answer multiple related questions: a) "What is the nature of users' comments about online news articles about mass shootings? What topics are discussed?" and b) "How does the population of comments vary across case characteristics? How do discussion topics differ between the Las Vegas Massacre and the Parkland Shooting?" To answer these questions, I began by selecting a sample of 20 articles (10 from each event) from the New York Times using the NexisUni database. The next step was to develop a codebook using the software MAXQDA to analyze the frames in my articles. During this content analysis stage, I looked for frames from four main categories: Attribution of Responsibility, Conflict, Human Interest, and Morality. This stage in my project allowed me to get to know the articles I was working with and laid the groundwork for a later stage of the project, where I would be analyzing comment data to see how the article's frames might have influenced the commenters' responses.

Once I had my sample of articles selected and analyzed for frames, I needed to extract over 28,000 user comments using the New York Times Developer API and a Python program that I wrote to automate that process. I was then ready to start implementing my Latent Dirichlet Allocation (LDA) Topic Model. This statistical modeling tool allowed me to discover abstract "topics" that characterized my sample of articles and their corresponding comment sections. My LDA topic model used Python code and many of its packages, including Gensim, NLTK, Python Pandas, Numpy and Spacy to return five of these topics, which consisted of 10 keywords each. The program also returned charts that displayed the top 30 most salient terms. These topics and charts then became the data that I analyzed with hopes of finding some trends in how the implications of news framing were reflected in the comments.

The results of this study surprised in just how prominent the "gun" term was in the comments of the article sample in general, for both the Las Vegas and Parkland shootings. Out of 20 articles, 15 of them had "gun" appear as the #1 most salient term in the comment section even if it was not a prominent term in the actual article. Some of the articles didn't even mention "gun" at all. However, of the articles that did include the "gun" term on some level, 93% would have "gun" become the most salient term in the comment section, which makes the frames from mass shooting news coverage that reference guns seem the most powerful of the frames that were analyzed for this study. When taking a closer look at some of the few articles that did not have "gun" as the #1 most salient term in the comments section, I discovered that more focused articles (a.k.a. articles that contained only one frame category) were more successful in starting targeted conversations (i.e. an article that focuses on only the school security aspect of a school shooting is more likely to get commenters to discuss school security instead of only discussing their stances on guns). Other issues that are commonly associated with mass shootings such as mental health and the disputed power of the NRA showed up in the comment data as well, but they were significantly less prominent, and their trends were not as consistent. For instance, "NRA" appeared as a topic keyword for 17/20 comment sections, but the term was rarely highly salient, and it was difficult to pinpoint any patterns as of what caused the term to be more salient in some comment sections than in others after comparing the comment data to the article frames. However, these results do give us some valuable insights on the impact of this country's media routine when it comes to mass shootings on new consumers' public opinion. Studies like these could potentially help the American Press improve their informative processes by exposing the implications of some journalists' bias. Additionally, this research should make the public more aware of how news coverage impacts their understanding of gun violence. Perhaps the study of the implications of news coverage can someday get us all on the same page, to the point where we can address issues most efficiently.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☒ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow(s): Molly Frauenheim (2020) **Concentration: Chemistry**
Konrad McKalip (2020) **Concentration: Biochemistry**

Faculty Mentor: Anne Perring **Department: Chemistry**

Title of Project: Measurements of Primary Biological Aerosol in Upstate New York

Project Summary:

Primary biological aerosols (PBA), including fungal spores, pollen, and bacteria, are of growing interest due to their role as ice nuclei (IN) in cloud formation and precipitation. Simultaneous measurement of IN and PBA can help clarify these connections. Fluorescent aerosol is an often-used proxy for PBA, however it is not perfectly specific to biological aerosol, thus it is beneficial to pair this with more specific offline measurements of biomarkers. Here, we develop a methodology to measure IN and amino acids in size-segregated aerosol samples, collected using a Micro Orifice Uniform Deposition Impactor (MOUDI), which collects particles from 0.056 to 18 μm.

Quantification of ice nuclei in size-resolved aerosol samples can be helpful in identifying predominant INP sources and for modeling their transport and distribution in the atmosphere. A drop freeze apparatus to measure immersion-mode ice nuclei was constructed and tested. The apparatus consists of a copper disk on a cold plate, cooled to -35C using antifreeze as the circulating liquid. Aerosol is collected onto a substrate, extracted into water and ~50 drops of this liquid are placed on the copper surface using a syringe. The freezing temperature of each drop is visually detected and recorded with a MATLAB user interface coupled with an OMEGA thermocouple reader. Cumulative ice nuclei concentration per liter of air was then calculated at -15, -20, and -25 °C using the fraction of drops frozen, drop volume, and air sample volume.

Following initial laboratory tests, preliminary data was collected from MOUDI samples collected over three consecutive nights. These produced total cumulative IN concentrations around 10-2 L-1 at -15 °C and reaching up to 101 L-1 at -25 °C. A significant spike in IN concentration during and after rain, specifically in the 2-4 μm diameter range, was observed, which is consistent with observations in literature. Total IN concentrations were comparable to other non-arctic locations, but further sample collection and analysis is necessary to observe trends such as seasonal variability. In addition, future methodological development is necessary to automate the drop freeze apparatus and therefore produce more repeatable data.

Amino acids are produced by all living organisms and can be used to get a sense of biogenic sources of aerosols. The offline measurement of the amino acid concentration in aerosol was done using High Pressure Liquid Chromatography (HPLC) paired with a fluorescence detector (FLD). Due to the low concentrations of amino acids in aerosols the fluorescence of aerosols was enhanced using o-phthaldialdehyde mercaptoethanol (OPA-MCE) or o-phthaldialdehyde mercaptopropionic acid (OPA-MPA). A calibration curve for a standard with a known concentration of 17 amino acids was generated to determine the sensitivities of the amino acids when using the FLD paired with the HPLC. Additionally, the 17 amino acids were run individually to determine their specific retention times. A method was also developed to do an on-line derivatization that replaced the manual derivatization, streamlining the process of running samples.

The size-segregated samples from the MOUDI were analyzed using the HPLC/FLD to determine the amino acid content collected in each size range. Two size ranges showed increased numbers of amino acids including the 0.18 - 0.56 um and 1.8 -3.2 um. The 0.18 - 0.56 um, fine mode, enhancement agreed with other literature. The 1.8 - 3.2 um size range was the same range where enhancement of warm temp IN was observed. The results from this summer show promise for measuring amino acids at atmospheric concentrations. Future work for the project includes determining how to increase the signal to noise ratio for measurements and developing methods to measure other biomarkers.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Justus ’43 and Jayne Schlichting Student Research Fund

Research Fellow: Matthew "Matt" Freniere (2020) **Concentration(s): Sociology; Biology**

Faculty Mentor: Carolyn L. Hsu **Department: Sociology**

Title of Project: Investigating Online Media: Content Analysis of a Conservative YouTube Channel PragerU

Project Summary:

PragerU, a YouTube channel with 2.3 million subscribers that produces short lecture videos with a conservative viewpoint, has managed to get two billion views across all their videos combined. After finding their channel via a YouTube ad, I was surprised to learn about their popularity. This study investigates potential answers to PragerU's relative online success by performing content analysis on 93 of their videos. After doing some brief research, I determined what I thought to be three essential components to each video: the presenter, visual format, and logic structure. I took notes on the style of the video – that is, if it were just animated, only had a speaker, color scheme and so on – and then after data collection examined my notes to create categories of video formats. I examined logic format by recording when videos used logical fallacies. Lastly, I gauged a video's "success" by the number of views it received.

All videos had an incredibly consistent format. Panels [A] and [B] in Figure 1 demonstrate the typical video graphic design and color scheme. All but 3 videos from the 93 were speaker and animated graphics. Only 2 videos broke the typical graphic design and color scheme. One of these videos was produced in 2012, which partially explains its divergence, as PragerU had most likely not fully developed their standard video format. All video thumbnails were the same color scheme and format.

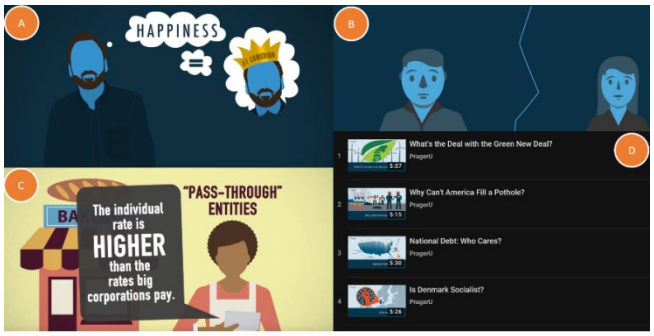


Figure 1 A selection of graphics in PragerU videos. [A, B] the "typical" color pallet and graphic design for any given video. [C] Example of when a video broke the typical format. [D] A selection of video thumbnails in the "Economics" playlist.

Similarly, logical fallacies were consistently present in videos. Figure 2 shows how weak analogies and "begging the question" fallacies were most common, present in 38.7% and 32.3% of all videos, respectively. In total, 77.4% of videos had some discernable fallacy. Videos that had no fallacies were typically shorter and were formatted with only animation and graphic. Lastly, the types of fallacies present did not influence views. The consistent format and logic of PragerU videos is a good indicator of their style. The "standard" video format for PragerU is some speaker sharing a conservative opinion presented as fact, supported by analogies often referencing the speaker's own experiences paired with simple graphics to provide an aesthetically pleasing visual component. This style is perhaps why their channel succeeds as a whole: providing predictable, easily digestible content might be important to draw a consistent crowd. However, this cannot explain why some videos get millions of views while others a few hundred thousand.

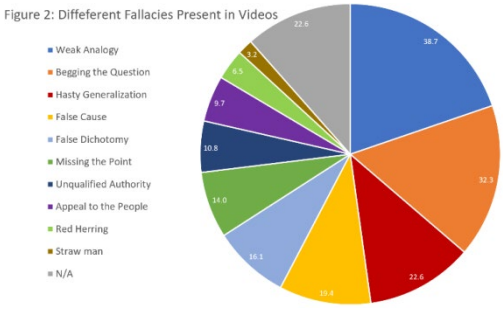


Figure 2 Recurring logical fallacies in PragerU videos. Each number represents the percent of videos that had at least one use of the given fallacy. Videos could have multiple fallacies, but multiple instance of the same fallacy were not counted. N/A represents the percentage of videos that had no discernable fallacy.

Videos with charismatic presenters earned more views. For instance, a video with celebrity Mike Rowe earner 6.4 million views (well above the roughly 500k view average from my sample). Additionally, two videos I sampled were presented by comedian Tom Shillue earned 1.8 and 1.1 million views. In comparison, with more personable, interesting, and comedic presenters, the audience is much more likely to enjoy, connect with, and share the video's content. There were a few factors that I did not investigate during my research that could influence video popularity. For one, the number of likes a video receives helps it do better in YouTube's algorithms for video recommendations. Mike Rowe's video earned 144k likes, compared to Tom Shillue's videos which had 24k and 58k likes. Secondly, the subject or title of each video appears to influence total views, as videos with the same presenter sometimes had drastically different view counts. Videos presented by Dennis Prager titled "Men and the Power of the Visual" and "He Wants You," both videos about male heterosexual attraction, earned 3.6 and 5.6 million views respectively, while other videos he also presented never managed to break one million. Consequently, it would be important to consider the intended audience in future study.

While I had initially expected video format and logic to impact total views, my research found that the presenter of each video in part determines how well it performs. After data collection I am now curious about potential factors I had not initially set out to study, including but not limited to video likes and video topic. These additional factors no doubt impact viewership and relate to the format, presenter, and logic of the videos.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Walter Broughton '63 Research Fund

Research Fellow: Emma Gaylo (2021) **Concentration(s): Educational Studies; Sociology**

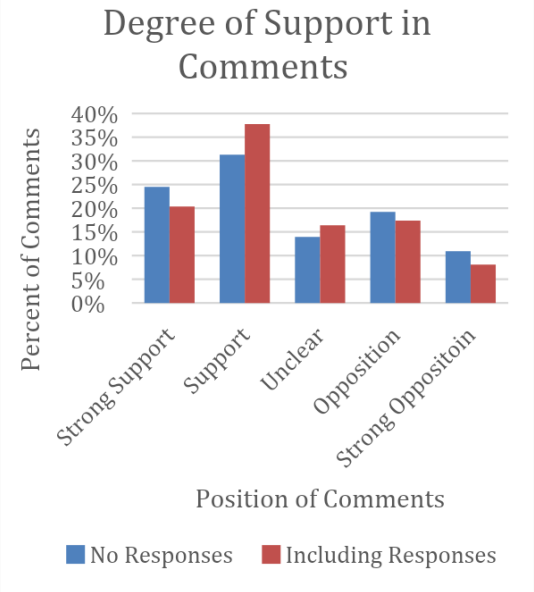
Faculty Mentor: Mark Stern **Department: Educational Studies**

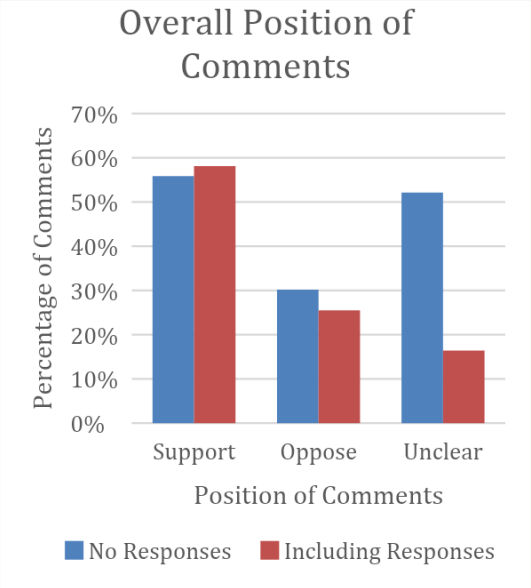
Title of Project: Teachers Strike Back: Organized Resistance and its Effectiveness

Project Summary:

In 2019 across the country teachers went on strike to protest their union contracts, as well as other issues in education such as high stakes testing and issues in the funding of high needs schools. This wave of teacher strikes came after years of education policy that villainized teachers and their labor. These teacher strikes are useful in raising awareness in the public, but what kind of awareness has been more difficult to measure. Understanding public opinion can require expensive polling and interviews, which can be very expensive when trying to understand these teacher strikes in their local contexts. However, for education reform there often needs to be community support for the strikes to change the state of education as shown by Chicago in 2012, when the participation of community groups allowed for change beyond just changing a single contract. In an attempt to understand the public response to these teacher strikes I focused on the West Virginia statewide teacher strike.

To attempt to assess the general public's response to the teacher strike I looked at Facebook comments on local news stories covering the strike. This was achieved by randomly selecting thirty comments from five articles from two different local news outlets, one newspaper and one television news station. These comments were then labeled as strong support, support, unclear, opposition, strong opposition, and irrelevant. Strong support and strong opposition were determined by the comment stating that they supported or opposed the strike while support and oppose were determined by contextual clues of support. Graphs were created showing the level of agreement both including and excluding replies to original comments as well as separating and grouping strong support with support and strong opposition with opposition. Overall there was more support for the teachers than opposition, however there were many more showing their position less explicitly and many unclear comments where their position was not solidly in support or in opposition. This research found that while there is public opposition to teacher strikes there is a much higher number of individuals who either support that strikes or support the teacher position but do not agree with the method as demonstrated by many of the unclear comments.





Source of Support: ☐ AHUM Div. ☐ NASC Div. ☒ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Anne Getz Eidelhoch (2020) **Concentration: Peace and Conflict Studies**

Faculty Mentor: Susan Thomson **Department: Peace and Conflict Studies**

Title of Project: Necklacing and White Genocide in South Africa

Project Summary:

Exploring the appropriation of an extrajudicial execution method, necklacing, used by Black South Africans during the anti-Apartheid movement, by white South African Afrikaner nationalist, this research explored both the usage of rhetoric and symbolism in both the Apartheid and in current right wing supremacist movements. Within the research necklacing was framed as a resistant response to dehumanization and erasure of the identity of Black South Africans which has been co-opted into a white supremacist controlled rhetorical and symbol device to further the ideology of white genocide and *swart gevaar* or 'black danger'.

Performed through the extensive literature review and archival analysis of newspapers, fliers, and private correspondences dated mostly within the 1980s and geographically situated within the Western Cape province of South Africa and also exploration of modern white supremacist message boards and forums, several themes were found to have continued across the time difference. While the means of presentation of white supremacist ideology in South Africa moved from the forefront of newspapers to private back stage conversations among whites, the symbols and now dog whistles for the inability of a Black ruled South Africa to thrive and the mythology of an incredibly dangerous abstraction of Blackness have remained the same.

Instead of the idealized rainbow nation of cultural cohesion occurring; the same supremacist ideologies exist and have been militarized into an imagined white genocide. Understood through a lens of white fragility, white genocide is the response to a no longer legislated federal policy of white supremacy and has become a rhetorical point to carry further the ethno supremist ideology of Apartheid and Afrikaner nationalism.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Lampert Institute for Civic and Global Affairs

Research Fellow(s): **Maria-Raluca "Raluca" Ghilea (2022)** **Concentration(s): COSC; PHYS**
Mariam Grigoryan (2021) **Concentration: Computer Science**

Faculty Mentor: Daniel "Dan" Zaleski **Department: Chemistry**

Title of Project: Development of Artificial Intelligence for Broadband Rotational Spectroscopy

Project Summary:

Artificial Neural Networks (ANN) are tools used in machine learning for identifying complex patterns that humans cannot solve or that require a large amount of time. Each network consists of an input and output layer, with one or more hidden layers in between. By adjusting the number of hidden layers and neurons, different models of decision making can be achieved. ANNs have been used for facial recognition, diagnostics, game playing (e.g. Chess, Go), stock market modeling, sequence prediction (e.g. Netflix suggestions), etc.

Historically rotational spectra were measured ~1 MHz at a time. Today they are measured ~30 GHz at a time. While data acquisition is faster, the individual rotational spectra ("patterns") are difficult to identify. Analysis generally requires specialized training (e.g. knowledge of quantum mechanics) and can take up to days or even weeks. For this reason, we want to leverage machine learning to identify spectral patterns in rotational spectra in real time. The goal of this research is to develop a completely autonomous software so that specialized training is not required.

This AI is a "network of networks" which utilizes both classification and regression (Figure 1). The AI first classifies molecules based on their symmetry and then based on their dipole moments (for asymmetric molecules). Once the molecule is properly classified, the spectrum is sent to a regression subnetwork that has been specifically trained for that Hamiltonian. The input of this network is a peakpick of a spectrum (e.g. individual frequencies), and the output is the spectral parameters (Hamiltonian coefficients) which model those frequencies. The spectral parameters can be used to identify molecules.

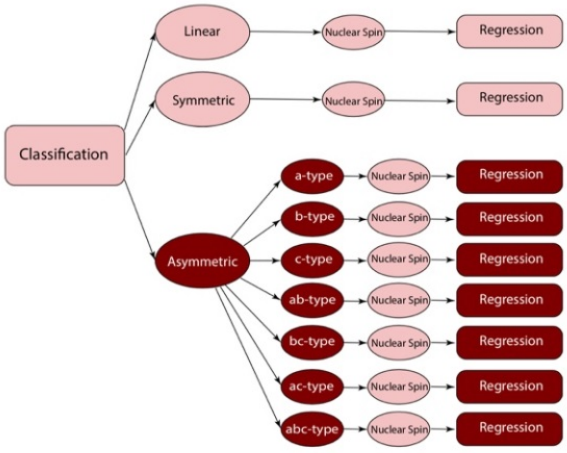


Figure 1. Schematic of our neural network. Dark red represents completed work. Nuclear spin is assumed to be zero.

The training sets were created by randomly generating rotational constants for imaginary molecules (with the only constraint being $A > B > C$, as required by nature) and sending them to SPCAT, a program that automatically generates all possible rotational transitions that lie in a given range. In practice, rotational spectra are not complete. Sometimes they have missing or overlapping transitions, which breaks or disrupts the signature patterns of rotational spectra. To account for these imperfections, we introduced the concept of pattern-breaking in our neural network. Examples include restricting the upper bound of K_{max} to simulate sensitivity limits, removing random transitions to simulate overlap, and varying the length of spectra to simulate bandwidth restrictions.

Currently, the Hamiltonian classification works with an accuracy of 94%. Frequencies predicted by the determined spectral parameters (from imperfect spectra) tend to fall within a few linewidths of the experimental value. Another interesting finding is that, counterintuitively, the network learned better when trained on a single training set containing all the possible permutations, rather than a mix of training sets containing each individual permutation separately. Most importantly, our network does not require any user interaction at any step, and completes its analysis in about 1 ms.

The AI will be further developed to include distortion parameters, nuclear spin, take into account the effects of internal rotation, and include intensity information. Furthermore, we want to create a recurrent neural network for separating complex mixtures (sequence prediction). It may also be worth ensuring that the rotational constants in the training sets come from physically meaningful geometries.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Justus '43 and Jayne Schlichting Student Research Fund

Research Fellow: Tai Goldstein (2022) **Concentration: Undeclared**

Faculty Mentor: Wan-chun Liu **Department: Psychological and Brain Sciences**

Title of Project: Hippocampal Mapping in the Zebra Finch

Project Summary:

In our research, we are trying to locate different subregions of the avian hippocampus using zebra finches. The hippocampus is involved with the consolidation and long-term storage of declarative and spatial memories. Several subdivisions of the hippocampus have been found in mammals. CA1 and CA3 are associated with spatial memory, CA2 with socio-cognitive memory processing, and the dentate gyrus with emotional memory. Our goal is to try and find analogous subdivisions between the avian and mammalian hippocampus. Zebra finches provide an excellent model for gaining insight into the function of the hippocampus, memory, and memory-associated behavior. Not much is known about the neural mechanism of episodic memory, and once the hippocampus is mapped then we can begin to understand this neural mechanism. To locate subdivisions within the zebra finch hippocampus we cloned one of the known hippocampal marker genes. Once this gene was cloned, we performed in situ hybridization using tissue samples and dig probes. In situ allowed us to identify the localization of gene expression within neuronal cells. We found the hippocampal marker mgll expressed in the pyramidal cells of CA3 and in granule cells. We also found the hippocampal marker calb2 expressed in the mossy cells of the dentate gyrus. We are still in the process of collecting data; however, our current findings are suggesting that subdivisions may exist within the hippocampus of the zebra finch.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Rebecca Gowen (2019) **Concentration: Molecular Biology**

Faculty Mentor: Krista Ingram **Department: Biology**

Title of Project: Chronic Cortisol, Chronotype, and the Epidemiology of Seasonal Affective Disorder

Project Summary:

Mood disorders, including anxiety and depression, affect greater than 20% of the global population and are commonly associated with sleep and/or circadian disruptions. Genes involved in the circadian clock, the molecular mechanism regulating daily rhythms, are implicated in moods disorders, including seasonal affective disorder (SAD). Seasonal affective disorder is a common type of depression that occurs during the winter as a result of short days with limited exposure to light. SAD is most commonly found in individuals who live in northern latitudes, and symptoms of SAD include depression, fatigue, and irritability. Given the global prevalence of SAD, it is critical to determine how circadian mechanisms influence mood in order to design more effective treatments.

In a year-long project, we examined the epidemiology of SAD in populations with diverse genetic backgrounds. We sampled two populations that may be at high risk for SAD: a Karen population that relocated from Myanmar to Utica, NY and a local population in Hamilton, NY of primarily Caucasian-European descent. We used a longitudinal study design with behavioral measures and molecular analyses to measure SAD, depression, and chronotype (a measure of morningness and eveningness tendencies) of individuals from the two populations, and compared these results to changes in cortisol levels across seasons. We hypothesized that participants with SAD will have higher chronic cortisol levels in the winter compared to the summer, if they are experiencing depressive symptoms in the winter.

The behavioral measures include the Seasonal Pattern Assessment Questionnaire (SPAQ), Beck's Depression Inventory (BDI), and the Munich Chronotype Questionnaire (MCTQ). Taken together, these behavioral measures provide insight into the relationship between seasonal changes, chronotype, and mood, as well as the prevalence of seasonal affective disorder in undergraduate and refugee populations. Chronotype is thought to play a role in the susceptibility of SAD, as evening types wake up later in the day and miss critical sunlight in the morning hours of the winter. We found that evening types had higher scores on the SAD survey compared to morning types. The prevalence of SAD was higher in the local (12.30%) and the Karen (12.82%) populations compared to the average prevalence in the US (2-9%, depending on geographic location). In our populations, SAD was correlated, though not entirely co-morbid with major depressive disorder (MDD).

For the molecular approach, we used hair samples to analyze chronic cortisol levels. Previous studies have tried to connect depression and cortisol through spit, blood, and urine samples but these short-term measures are confounded by circadian fluctuations and daily stressors. The cortisol taken from hair represents an average of the previous 3 months of chronic cortisol levels. We found that chronic cortisol levels are associated with depression and SAD in the Karen population, but not in the Hamilton population - potentially due to the increased use of anti-depressants or birth control in this population, both of which can lower cortisol levels.

Seasonal affective disorder is a common type of depression and has significant economic and social costs, yet little research has been done to investigate the role of chronic cortisol and circadian phenotypes on SAD. Our results provide insight into how depression and chronotype influence the susceptibility of SAD and may help develop prevention efforts and more effective treatments to improve the lives of those living with SAD. To help those affected by SAD in our study populations, each participant received educational materials and a light bulb to help mitigate SAD symptoms.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Beckman Scholar Program

Research Fellow: Keara Greene (2020) **Concentration: Psychological Science**

Faculty Mentor: Margaretha Haughwout **Department: Art and Art History**

Title of Project: Eco Arts in New York State

Project Summary:

I double minor in Environmental Studies and Art & Art History-- two disciplines I formerly thought of as quite separate and difficult to combine. However, working under Professor Haughwout for my summer research position has given me new insights into just how entwined these disciplines can be. Working with ecologies can be a highly creative endeavor, as it explores how to generate new sets of relationships between humans and nonhumans.

Because the position is interdisciplinary it has a multifaceted nature, meaning I work on many different projects. I first take care of a "food forest studio" outside of Schupf Studio, tending to the plants, but also developing it as a creative piece. I learn about the plants' cultivation, as well as their medicinal and edible uses, compiling and cataloguing the information together. This living studio also includes dwarf fruit trees, which directly links to one of Professor Haughwout's projects on grafting. Eventually, the studio will be an interactive space where individuals can make use of the edible plants and fruits, but also learn more about each plant and graft in the garden. To make this possible, I designed and produced wooden garden labels complete with QR codes that link to more information.

I also help bring life to the drab tunnels underneath Colgate by creating stencils of species in Adobe Illustrator for spray painting. These species are part of the changing ecologies of the local area in NY State and in the Susquehanna River watershed. These ecologies can be understood to be changing as a result of climate change, the 6th Extinction, and the Anthropocene. Again, I learn to combine studio art with ecological information to create something interactive.

Helping Professor Haughwout with her projects allows me to gain real world experience, an understanding of how environmental studies can be combined with art, what type of projects eco-artists are doing, and how these projects are developed. In addition to developing an expanded aesthetic sensibility, all these projects help develop my technical skills. I use various technology to help make these projects come to life, namely Adobe Illustrator and a laser cutter. The laser cutter allows me to engrave on wood to create labels for plants. I also work with WordPress and other business technology to help advance and organize Professor Haughwout's projects.

I was able to join Professor Haughwout and her collaborator to a site visit in Bennington, VT for one of her projects, APRIORI. This trip allowed me to participate in and learn about one of her collaborative projects more deeply. In preparation for the trip, I cut, designed, and laser printed garden stakes with some of the project's logos. Once at the site, I helped with plantings in preparation for the October show, and installed some of the stakes at the site. One example is pictures to the left, with Broom Corn plantings in the background.

Because I work so closely with Professor Haughwout, I am able to learn a lot from her wealth of knowledge of the environment, art, and how to combine disciplines into something meaningful that has far-reaching impacts on communities. The level of independence and involvement she allows me on these projects not only helps me actively learn the information, but also prompts me to take initiative and develop my own skills for these projects.

Source of Support: ☒ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Amogh Gupta (2021) **Concentration: Physics**

Faculty Mentor: Rebecca Metzler **Department: Physics and Astronomy**

Title of Project: Exploring the Multi-Scale Relationship between Structure, Composition, and Mechanical Properties in Calcium Carbonate Biominerals

Project Summary:

We focused our study this summer on learning more about how the exoskeleton functions by exploring the structure, composition, and material properties of the exoskeleton. The majority of my research was focused on finding the hardness values of four different species of barnacles as well as studying the chemical composition of their shells. The barnacles that we studied were, *Balanus Amphitrite, Balanus Eburneus, Chthalamus Stellatus,* and *Tetraclita Rubescens*. We wanted to further understand how the shells of barnacles form and what differences could account for the varying hardness of their shells. By learning these details and understanding their processes, the knowledge gained could advance biomimetic materials and allow for methods to be made in which barnacles can be removed from boats safely.

My major focus at the beginning of the research was to quantify the hardness of the different species of barnacles that we were studying. To do this, I used a machine called the microindenter to make small indents which I then took images of using the SEM (Scanning Electron Microscope) as seen in Figure 1. From there, using Photoshop to stitch the images together, which is shown in Figure 2, I used an image analysis software called ImageJ to measure the size of the indents and calculate the area. From there, we were able to calculate the hardness values for the four different species studied.

As I was collecting data to calculate hardness, I was simultaneously working on collecting data from our IR Spectrometer. This data after analyzed allows me to make conclusions on the composition of the exoskeletons of the barnacles. From this, we were able to further specify the specific chemical components of the barnacle. The IR Spectrometer also explores the composition and level of atomic disorder within the exoskeleton. By examining how the peak intensity changes as a function of particle size, we are not only able to identify composition with the spectral peaks, but the level of atomic disorder within the sample and this is shown in Figure 3.

With further research, we would collect more data on the barnacles to further quantify their hardness as well as get more IR Spectroscopy done. We would be able to narrow down the time at which the barnacle starts to grow calcite and this along with Raman Spectroscopy and more SEM imaging, will allow us to better understand the barnacle's composition.

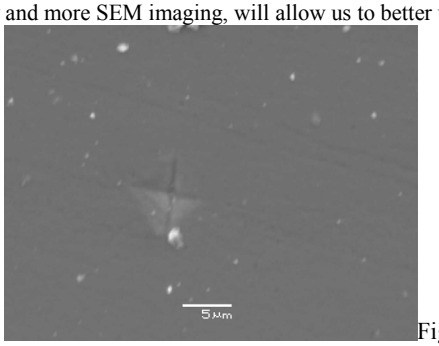


Figure 1

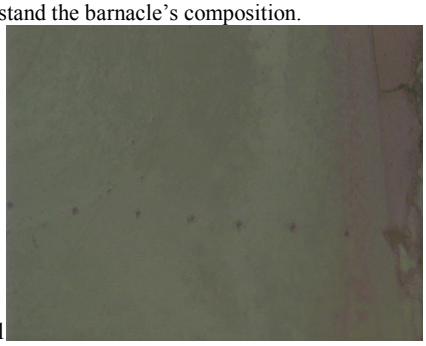


Figure 2

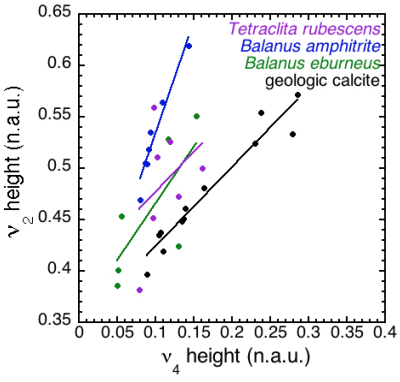


Figure 3

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Justus '43 and Jayne Schlichting Student Research Fund

Research Fellow(s): **Carina Haden (2021)** **Concentration: English**
Kathrine "Katie" Roell (2021) **Concentration: English**

Faculty Mentor: Jennifer Brice **Department: English**

Title of Project: Living Writers Research

Project Summary:

Living Writers is both a Colgate course (ENGL 360) and a self-paced, online literary learning experience that is free and open to all. Each fall semester, Colgate invites approximately ten authors to campus for discussion of one of their works. Students enrolled in the Colgate course read the texts, meet the authors, and participate in discussions with them. The authors, in addition to visiting the class, give talks that are open to all Colgate students, faculty, and staff as well as the surrounding community. Living Writers online provides a livestream and archives these events. Living Writers online also features podcasts featuring Jennifer Brice and an affiliated faculty member about each text, as well as resource pages with numerous reviews of the texts, interviews with the authors, and any other pertinent sources that may enhance readers' knowledge of the authors, texts, and content of the texts. This fall, ten authors will come to campus, one of which is a Colgate alum, and another who is currently an assistant professor of English.

As Jennifer Brice's research apprentices, we worked on a variety of projects to help launch Living Writers 2019. The core of our work involved research on the authors and the texts. We read each text and researched each author, compiling numerous sources for the Living Writers online resource pages for both the class and larger community to use. The research varied for each author, and the information we sought included but was not limited to interviews with the authors, reviews of the Living Writers texts, updated or additional research on the texts' content, biographical information about the authors, video or audio recordings of the authors, and reviews of the authors' other texts. These resources will give readers better context of each work, leading to a greater understanding of the text. Once Jennifer Brice reviewed this research, we uploaded the sources to the Living Writers site. Each week, Professor Brice met with us to discuss possible avenues of research and major themes within the primary texts that would be useful to focus on in each class.

In addition to this research about the authors and texts themselves, we performed various tasks for the Living Writers program. When needed, we communicated with faculty partners and colleagues in IT about the Living Writers site and content needed. With Professor Brice's oversight, we wrote summaries of each text and short biographies for each author for use on the Living Writers website and for marketing materials. We attended marketing meetings and offered feedback on effective marketing strategies and website language. For use on various social media platforms, we wrote marketing pitches such as "13 Days of Living Writers," leading up to the day the site launches. We also worked with Stephanie McClintick in proofreading designs and distributing Living Writers marketing materials such as postcards, posters, and stickers.

Our research for Living Writers included a wide variety of tasks aimed to help launch Living Writers 2019. In this apprenticeship, we gained research, marketing, analytical, and communication skills as well as proficiency in various administrative tasks, as well as a deeply enriched understanding of the Living Writers texts.

Source of Support: ☒ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Aidan Harrington (2021) **Concentration: Biology**

Faculty Mentor: James "Eddie" Watkins **Department: Biology**

Title of Project: Ecophysiology of Reproduction in the Hybrid Fern Complex *Dryopteris*

Project Summary:

Our summer in the Watkins lab consisted of several projects in plant physiological ecology. I worked on modelling spatial relationships of gametophytes of the tree fern *Cyathea multiflora.* Meanwhile, we worked on collecting spores and specimens of the ferns in the genus *Dryopteris* for upcoming experimentation on their gametophyte life stage. We also worked on desiccation tolerance in gametophytes of the species *Polystichum munitum*.

Some ferns have the unique ability to produce sporophytes through an extreme form of self-fertilization known as gametophytic selfing. In such cases, a gametophyte becomes a bisexual hermaphrodite that fuses its own sperm and egg, creating an inbred homozygous adult fern. In some situations, such a system may be advantageous. For example, a single spore can become a gametophyte, self-fertilize, and establish a new population. However, the ecological advantages of such a system are normally outweighed by the evolutionary consequences of such inbreeding. To avoid such mating, some ferns have evolved methods of controlling gametophyte sex expression using chemicals known as antheridiogens. These chemicals are released by female gametophytes and induce maleness in surrounding asexual gametophytes. Such a system can result in females surrounded by groups of males. While these clusters are readily observed in a laboratory setting, the structure of these clusters in the natural setting has been studied little, and never in *Cyathea multiflora*, a tree fern. The goals of this study were to examine these clustering patterns and describe the antheridiogen activity in *Cyathea multiflora* in nature. The results showed that male clustering around the female gametophytes is apparent in both populations which means that *Cyathea multiflora* female gametophytes structure gametophyte populations in significant and predictable ways. The behavior of natural antheridiogen systems is consistent with laboratory experiments and indicates the strength of antheridiogens and importance of outcrossing to *Cyathea multiflora*.

For *Dryopteris*, we were mainly focused on collecting specimens for spores and DNA validation from around the US. *Dryopteris* is a genus known for producing hybrids with multiple copies of the parent genomes. This is known as polyploidy, and means that hybrids have several copies of each gene. Our work is trying to understand how the ecology of these hybrids differs from the parent species who are usually diploid (having only two copies of each gene). Specifically, we want to know how these differences are expressed in the gametophyte life stage of each species by studying their responses to a variety of growth conditions. Because the gametophyte (the sexual life stage of the fern) and the sporophyte (the vegetative plant you see) are independent, they must have their own unique suite of adaptations in order to survive. Gametophytes are only a single cell layer thick and have no ability to regulate gas and water exchange with their environment. Therefore, they must be able to deal with a wide variety of conditions and have been shown to be remarkably resistant to drought and temperatures. Thus, by using the hybrid species and their parents as a study system, we are able to experimentally determine how these adaptations have evolved in the gametophyte stage as hybrids arose and differentiated from their parents.

Finally, we worked on desiccation tolerance in the gametophytes of the fern *Polystichum munitum*. This fern is common along a climatic gradient in California that has striking differences in temperatures and precipitation. We hypothesized that the gametophytes of ferns from sites along this gradient would be locally adapted to the conditions found at that site and would therefore grow best in those conditions. We set up an experiment where we grew gametophytes from spores for each site at a range of temperatures and measured their size. We found that the gametophytes from the coolest sites did the worst in the warmer growth temperatures and the gametophytes from the warmest sites did the worst in the coolest growth temperatures. Analysis of this data is ongoing, but we think we have found some evidence for local adaptation in the gametophyte life stage.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): National Science Foundation Grant

Research Fellow: Tianyi "Mike" He (2019) **Concentration(s): Philosophy; Chemistry**

Faculty Mentor: Anthony Chianese **Department: Chemistry**

Title of Project: Dehydroalkylative Catalyst Activation of Ruthenium CNN- and PNN- Pincer Catalysts for Ester Hydrogenation

Project Summary:

With the rising consumption non-renewable energy sources and the environmental problems that follow, the search for a clean, renewable energy source has never been more dire. In particular, hydrogen is an exceptionally promising candidate - it has a high energy density and generates only water as "waste." However, dihydrogen is particularly difficult to store and transport as it is a highly flammable and reactive gas. One promising alternative to working directly with dihydrogen is to utilize a transition-metal catalyst that reversibly hydrogenates/dehydrogenates polar substrates such as aldehyde, ketone, and esters so that hydrogen could be reversibly stored/extracted from organic compounds. The holy grail of polar bond hydrogenation catalysis, therefore, is to establish a catalyst that not only exhibits high turnover, but also exhibits high stability over time. To establish these goals, it is therefore important to investigate the mechanisms of the catalytic cycles so that further optimization studies could be conducted. In this project, we are particularly interested in the catalyst activation of the seminal Milstein **RuPNN^{HCl}** and **RuPNN^{dearom}** catalyst (Fig. 1) and our **RuCNN-R^{HCl}** and **RuCC-R** analogs. In this project, we studied the unconventional dehydroalkylative activation of CNN- and PNN- precatalysts upon heating that yields five-coordinate Ru(0) complexes that contain an imine functionality. Time-course studies revealed that the Ru(0) imine complexes are at least as active as their Ru(II) precursors – in particular, **RuPNN^{imine}** was demonstrated to be a highly active ester hydrogenation catalyst, achieving as high as 16,000 turnovers at *room temperature*.[1]

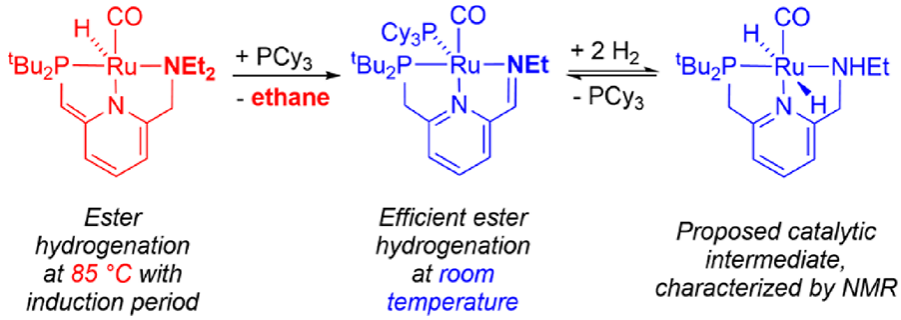


Figure 2 Transformation of the Milstein RuPNN catalyst to a 5-coordinate Ru(0)-imine species[1]

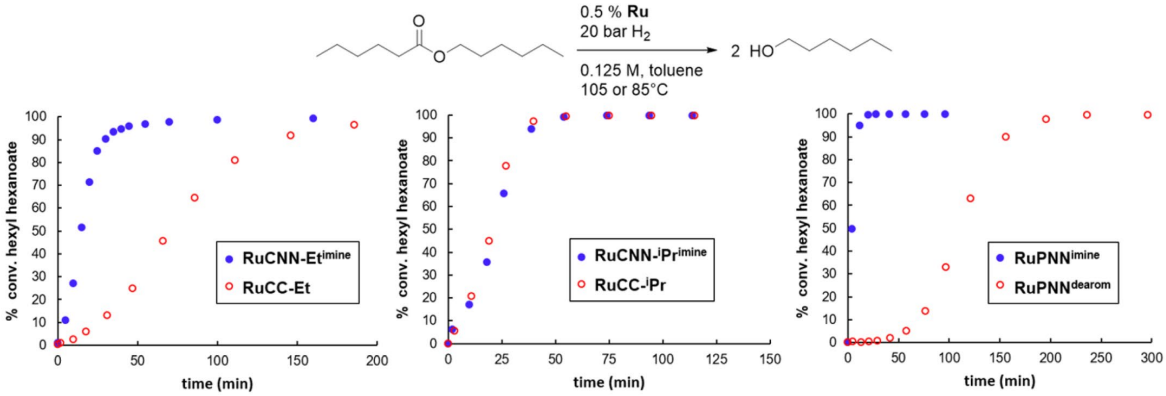


Figure 3 Time-course monitoring of ester hydrogenation experiments. Note the exceptional high activity of RuPNN-imine[1]

[1]He, T.; Buttner, J. C.; Reynolds, E. F.; Pham, J.; Malek, J. C.; Keith, J. M.; Chianese, A. R., Dehydroalkylative Activation of CNN- and PNN-Pincer Ruthenium Catalysts for Ester Hydrogenation. *J. Am. Chem. Soc.* **2019**, *141* (43), 17404-17413.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): National Science Foundation Grant

Research Fellow: Erin Hendry (2020) **Concentration: Neuroscience**

Faculty Mentor: Julie Dudrick **Department: Upstate Institute**

Title of Project: Chenango United Way "Volunteerism: Visualizing Change through Innovative Readiness Training"

Project Summary:

This summer through the Upstate Institute, I partnered with the Chenango United Way to research volunteer engagement and satisfaction at the 2019 Innovative Readiness Training (IRT) event. The IRT was a health care mission organized by the Department of Defense in conjunction with local Chenango County organizations like the Chenango United Way. The mission has two goals: to improve deployment readiness of the armed forces and provide health care services to a medically underserved population in the United States. During the IRT, approximately 190 servicemen and women came to Norwich to provide no-cost medical, dental, vision and veterinary services. Over the course of ten days, 1,131 patients were served. Approximately 175 volunteers primarily from Chenango County assisted with the mission in roles including but not limited to helping with patient check-in, directing service members and patients through the site, and distributing water and food during the event. At the event, the 175 volunteers had collective completed 1,398 hours of volunteer work.

The Chenango United Way leaders wanted me to investigate why so many volunteers sign up to be a part of the IRT event and what they can do as leaders to increase the volunteer return rate. Having a dedicated base of volunteers is critical for organizations like the United Way to successfully manage and run large scale non-profit events like the IRT. During my interviews with local nonprofit leaders, many of them spoke about the difficulty they faced in recruiting volunteers to their projects. The absence of local volunteers has caused some organization operations to slow or stop projects all together. The IRT, however, has remained an extremely popular event at which to volunteer. Within the first day of volunteer sign-ups, approximately half the spots were filled. Over the next couple of weeks, the volunteer spots steadily filled up until 92% of suggested volunteer spots were taken. I wanted to investigate who was drawn to the event, why or why not they enjoyed their work, and whether or not they would consider volunteering again at the IRT.

For my research, I spoke to volunteers during the event and created a volunteer satisfaction survey for each volunteer to complete at the end of their shift. The survey included questions such as: Did you feel as if there was a strong community component to your volunteer work? Did you feel valued as a volunteer? Did you feel like your role was utilized well as a volunteer during the event? 108 volunteers completed the survey leaving me with a 61.7% response rate. Based on the survey results, 90.7% of survey respondents always had or usually had a positive experience when working at the IRT event, 91.6% of respondents reported feeling highly valued during the event, and 99% of respondents reported that they would volunteer at another IRT.

In addition to collecting quantitative data on the level of volunteer satisfaction, I included qualitative, open-ended response questions about what the volunteers specifically enjoyed or did not enjoy about the event. The volunteers tended to emphasis the social aspect of the job by stressing components like getting to know members of the military and meeting other volunteers from their community as highlights of their volunteer work. Most of the negative responses centered on the absence of socialization at some of the volunteer stations. Ultimately, I concluded that volunteers sought out service opportunities at the IRT event due to the social component of the event. If other local nonprofit organizations want to improve the volunteer attendance for their events, they should emphasize the social aspects of their volunteer projects in addition to the social change aspect of their work.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow(s): **Jackson Hoit (2022)** **Concentration: Undeclared**
Johna Joseph (2022) **Concentration: Chemistry**
Daniel "Danny" Zelmanovich (2022) **Concentration: Undeclared**

Faculty Mentor: Eric Muller **Department: Chemistry**

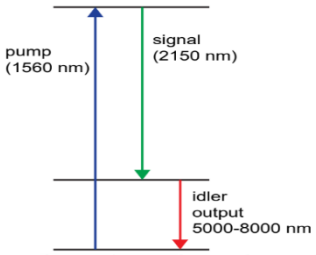
Title of Project: Mid-Infrared Tip-Enhanced Spectroscopy and Nanoscale Imaging

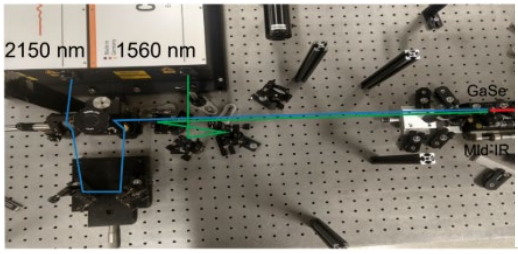
Project Summary:

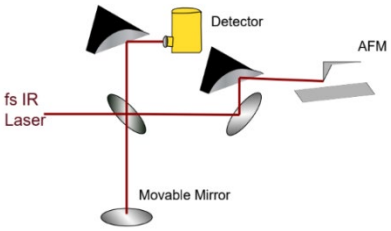
The Muller 2019 Summer Research group worked on the topic of Mid-Infrared Tip-Enhanced Spectroscopy and Nanoscale Imaging, specifically, building the scientific apparatus required for research to get underway in the following semesters. The basis of the research revolves around the concept that vibrational energy levels in molecules are quantized. This means that the interaction of light with matter provides vibrational information which can be used for chemical identification and analysis. This summer focused on the construction of three main components. The first was a source for the beam that would be used for the imaging in question, the second, a way to detect information received from the Atomic Force Microscope (AFM), and finally, an avenue for signal reception. The last two parts take the form of an asymmetric Michelson interferometer.

The diffraction limit of light defines achievable spatial resolution. Our lab develops tip-enhanced spectroscopy in order to overcome the diffraction limit. In tip-enhanced spectroscopy, a sharp metallic tip enhances and localizes incident light at the tip apex. This provides nanometer scale spatial resolution and near single-molecule sensitivity. For the purposes of this project; the desired spatial-resolution is 20 nm.

We produced mid-IR light by difference frequency generation. We overlapped the two outputs of the Er fiber laser (pump at 1560 nm and signal at 2150 nm) in space and time within an angle-tuned GaSe crystal. Difference frequency generation between pump and signal beams produces broad-band tunable femtosecond mid-IR (4,000-8,000nm) pulses with 0.6 mW average power. This mid-IR laser will serve as the illumination source for our IR s-SNOM apparatus.







We use an atomic force microscope (AFM) to position the metallic tip within a few nanometers of the sample and within the near-field of the tip-sample interaction distance. Tip-scattered spectra provides chemical information about the sample directly at the tip apex. The AFM tip moves around the sample, and allows the construction of a two-dimensional image. We have modified the AFM in order to focus infrared light from our laser onto the tip and return it into the interferometer.

The asymmetric Michelson interferometer will detect near-field optical signal scattered by the AFM tip. A movable mirror will be used to manipulate the interference between the tip-reflected light and the DFG in accordance with the Fourier transform. Once the signal is detected, the apparatus will be used to measure and understand the local chemical environment of small ensembles in heterogeneous and partially ordered molecular materials in lab samples.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Justus '43 and Jayne Schlichting Student Research Fund

Research Fellow(s): Isobel Hooker (2021) Concentration: Russian and Eurasian Studies
Yang Zhang (2021) Concentration(s): Russian and Eurasian Studies; POSC

Faculty Mentor: Jessica Graybill Department(s): Geography; Russian and Eurasian Studies

Title of Project: Arctic Storytelling – Teriberka, by way of Earlville

Project Summary:

Located on the Northern shore of the Kola Peninsula in Arctic Russia, the village of Teriberka exists as the only open access point to the Arctic and Barents Seas on Russia's Northern Coast. This once-booming fishing town is now a shrinking village of 900, the number increasing only seasonally by the presence of international tourists, festival-goers, and Russians looking to explore areas of their country that were for years inaccessible.

Figure 4Teriberka, Murmansk Oblast, Russia. (Google Maps 2019)

The research project: *Arctic Storytelling – Teriberka, by way of Earlville* seeks to understand the change in small, rural communities faced with shrinkage and the influence of changing economic base on local communities. The project conducts a local study of Earlville, New York, before field studies in Teriberka, Russia, to gain practice in examining issues of small, rural places. The study of Earlville provided necessary theoretical frameworks about shrinking and declining towns. It also provides the chance of understanding how the decline of pillar industries, which is agriculture in Earlville's case, influences the outlook of the town. Such theories and analytical frameworks provides a foundation for understanding Teriberka's shrinkage as the fishing industry declines. It also sheds light on Teriberka's economic and social potential as a tourist destination. On the technical front, the project creates an immersive experience that allows audiences to understand Teriberka and Earlville visually, including both the spatial and social aspects of the places. It also seeks to develop a protocol for conducting Digital 360 storytelling, which provides a narrative of places using the VR technology, in a classroom setting.

Our project in Teriberka started with a focus on Earlville as an initial case-study of a shrinking rural population and helped us grow accustomed to using different human geography research methods to inform our storytelling about a remote area. Professor Graybill's students from a previous Geography Research Methods class had written reports on Earlville, and we were informed both by their observations of the town, as well as online research and our own observations in person. Guided by Sarah Kunze in Colgate IT, we used a GoPro Fusion 360-degree camera and the VR viewing software from multiple websites (ie. Roundme and SeekBeak) in order to capture images that would aid in telling a story about Earlville and compiled them using SeekBeak and Roundme in a self-directed, narrated tour of the town.

While the story in Teriberka was much different than that of a Central New York village, we were still able to employ the same methods of Human Geography research to the Arctic Russian village.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☒ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow(s): **Lauren Horstmyer (2022)**
Adam Zaharoni (2021)

Concentration: **Undeclared**
Concentration(s): **Geology; Classical Studies**

Faculty Mentor: **Rebecca Ammerman**

Department: **Classics**

Title of Project: **North Urban Paestum Project 2019: Researching the Geology and Archaeology of Ancient Paestum in Southern Italy**

Project Summary:

Our research project this summer consisted of field work and continued research on an archaeological dig at the UNESCO World Heritage Site of Paestum in Italy. In addition to enhancing our knowledge of Paestum's northern urban sanctuary (dedicated to the goddess Athena) through archaeological excavation, the primary goal of the project was to reconstruct the volume and composition of the man-made mound of travertine masses on which the temple of Athena stands. Prior to Colgate's research at Paestum, scholars had not recognized the artificial nature of the low mound on which the temple was constructed. We began our work by opening a pair of two by three meter trenches in which we would progressively dig throughout our time at Paestum. As the excavation continued, one trench was expanded six additional square meters. We first dug using hoes, picks, and shovels to remove about 40 cm of disturbed topsoil from each trench. We then shifted to trowels and brushes to remove underlying layers of volcanic ash, soil, and masses of travertine rock. Students carefully sieved the earth removed from the trench to ensure that nothing of importance slipped through our grasp. Throughout the digging process we took care to document our finds and keep track of the exact locations of important artifacts. For each stratigraphic unit, we took soil samples and recorded the measurements of the travertine masses. Many daily photographs documented the progress of the excavation. While we both contributed to the dig in all the ways listed above, we also specialized in certain tasks and had different overall experiences:

Lauren: I worked extensively in the documentation of the different objects we recovered from the trenches. One job was to record the dimensions of the travertine rock masses that made up a large portion of the artificial mound. Each rock that was larger than 20 cm was recorded in a notebook with its stratigraphic location and its length, width, and height. Once photographed, the rocks were transported to the "rock cemetery" where they remained until they were transported from the excavation site to a shed where they will be studied further by geological specialists. I also recorded all of our artifactual and ecological finds from the dig — including everything from pieces of marble to ancient coins — by hand into a notebook which I would later convert into a spreadsheet back at Colgate. The finds were listed in order according to the date they were discovered and their stratigraphic location was also noted. There were multiple different categories that I worked to sort and document including travertine masses, ceramics, roof tiles, and special finds, such as worked stone, glass, bone, and shell. In addition to compiling digital spreadsheets to begin the process of cataloguing the artifacts and faunal finds back at Colgate, I also sorted through and organized into a digital archive several thousand photographs taken throughout the approximately 6 weeks of digging. The photographs were separated by date, trench, and whether it was a shot of people working, the stratigraphy of the trench itself, travertine rocks, or artifacts.

Adam: At the site my work involved drilling and studying geological cores as well as collecting and examining soil samples. The drilling of the cores was done by hand using a Dutch soil auger. I took cores at various sites: an offsite farm, the corner of an excavation trench, and the western side of the temple. I examined the stratigraphy and soils obtained from the cores, identifying topsoil, volcanic ash layers, paleosols, mound rock, and bedrock. The cores helped in our understanding of the stratigraphy outside of the trench as well as in deeper parts of the trench that we could not reach by means of excavation. Back at Colgate, I took the rock data that Lauren had collected in the field and organized the material in a series of tables and graphs categorizing the mound masses by size to work out the structure of the artificial mound and how the mound was constructed. My research entailed the study of not only the masses that measured over 20 cm in length but also the smaller masses measuring less than 20 cm in length. A chart that I constructed summarizing data on the travertine masses of the mound will be published in the catalogue of an exhibition, *Poseidonia, Città d'Acqua. Archeologia e Cambiamenti Climatici*, that opens at the Paestum Museum on October 4, 2019.

Source of Support: ☒ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Wyman Huang (2022) **Concentration: Geography**

Faculty Mentor: Daisaku "Dai" Yamamoto **Department(s): Asian Studies; Geography**

Title of Project: Community Response to Nuclear Power Plant Closures

Project Summary:

Nuclear energy was once an industry with high hopes and more recently seen an answer to climate change. But ever since 1979 Three-Mile Island accident, 1986 Chernobyl disaster, and 2011 Fukushima Daiichi meltdown, the glory of its carbon-free emissions doesn't seem to outweigh the health hazards and expensive costs that come with it. Nuclear power generation still accounts for a sizable portion of global energy supply, but it's losing its prominence in the U.S. mostly due to competition with fast-growing renewable energy and cheaper natural gas. With the decommissioning of nuclear plants, host communities are bound to experience turbulence. Closures of nuclear power plants can have substantial socioeconomic effects in the host communities, including the migration of highly skilled workers. My research with Professor Dai Yamamoto aims to understand how these host communities cope with the closure of nuclear power plants.

In the first half of my research, I focused on 10 nuclear power plants around the U.S that were decommissioning or have already completed decommissioning, and examined over 40 fact-checking questions regarding the host community and the nuclear power plant. The preliminary work was conducted by Professor Yamamoto's senior seminar in Spring 2019; however, it needed to be supplemented by additional work and extensive fact-checking and reorganization. I took up the task, and completed a large tabulated dataset that enables comparison of factors that may have contributed to different decommissioning outcomes across the plants. This dataset provides novel and useful materials for further research.

In the second half of my summer research, I conducted a case study of Pilgrim Nuclear Power Station in Plymouth, Massachusetts. I read newspaper articles and scholarly journals in hopes to answer research questions about the historical context of the plant, current status of the nuclear plant, and how it affected the host community. During my research, I found that Pilgrim experienced many incidents during its 47 year existence as blizzards keep causing emergency scrams and its faulty cooling system killed thousands of fish, prompting citizen groups to petition a shut down of the plant. Since Pilgrim power plant had just started decommissioning, not much information regarding the immediate repercussions of the plant's shutdown is available. To alleviate the transition of the diminishing power plant, the town manager has set aside a healthy balance of money and the owner of the power plant, Entergy, continues to pay in lieu of taxes until 2021, totalling $19 million. This case study provides foundational information for the analysis of the upcoming decommissioning at the plant.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☒ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Fairuz Ishraque (2022) **Concentration(s): Astrogeophysics; Applied Math**

Faculty Mentor: Thomas Balonek **Department: Physics and Astronomy**

Title of Project: Optical Variability of Quasars and Stars at the Colgate Observatory

Project Summary:

Quasars or quasi-stellar radio sources are supermassive black holes in the centers of active galaxies spewing jets of relativistic plasma that emit electromagnetic radiation. This summer we regularly observed about five quasars at the Foggy Bottom observatory. Our observations were made with a CCD module attached to a 16-inch optical telescope in the visible spectrum of light. A considerable amount of information from astronomical objects can be obtained in the visible spectrum of light as well as in the radio wavelengths. Several physical properties of a quasar can be determined from its brightness and brightness variability.

One of the quasars we were observing this summer, 1308+326, started getting exceptionally bright around late June. Our first observation of this behavior was on June 24 and since then we have made observations of 1308+326 nearly every clear night. The quasar kept getting brighter and brighter until it reached its brightest since 2002 on June 28. This flaring event continued all through July and into August. Observing this flaring of the quasar meant collecting large amounts of photometric data. Before this data could be analyzed, it had to go through several steps of processing which reduced it to a collection of information-dense CSV (comma separated values) files.

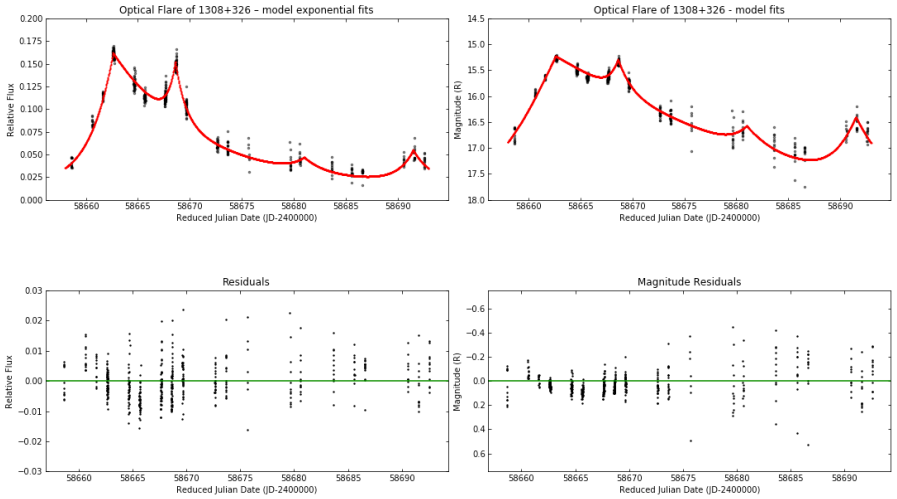


Figure: The relative flux and apparent magnitudes light curves of the quasar 1308+326 with their best fit curves(red lines)and residuals of the fit(green lines)

My research project was primarily concerned with the extraction and visualization of the necessary data from the CSV files. The eventual goal was the maximum automation of the data extraction and visualization workflow. For this purpose, I chose to use Python as my programming language. More specifically, I used the Pandas module in Python to do the data reduction and the Malplotlib module for data visualization.

Another important aspect of my project was to make model fits of the collected data to model a light curve of the quasar timeseries data we had collected. The relative flux vs. time data (pictured in the upper left plot) could be fitted by a collection of exponential curves, given the parameters, with surprising accuracy. One upside of this curve-fitting procedure is that the relative flux curve can be used to estimate the relative energy released during an event by integrating the area under the curve. The graphs above show the model-fits applied on the 1308+326 brightness data collected during the summer along with the residual plots to visualize how accurate these model-fits are.

Future work will include the deployment of a program capable of doing time-series analysis of similar light curves from within a GUI as well as automating the data reduction and the curve-fitting workflows to be parameter-independent using the principles of machine-learning.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Justus ’43 and Jayne Schlichting Student Research Fund

Research Fellow(s): **Tamar Japaridze (2021)** **Concentration:** **Neuroscience**
Fanyi Mo (2020) **Concentration(s):** **Psychological Science; COSC**

Faculty Mentor: **Bruce C. Hansen** **Department(s):** **NEUR; Psychological and Brain Sciences**

Title of Project: **Mapping the Neuroelectric State-space Geometry of Natural Scenes**

Project Summary:

Our research aimed to understand how the brain organizes early visual information gathered from the environment. To achieve this goal, we analyzed steady-state visual evoked potentials (SSVEPs, a form of electroencephalography) from human participants while they viewed a variety of natural everyday stimuli (e.g., landscapes, indoor spaces, buildings, etc.). However, instead of looking at connections between particular image features and corresponding neural responses, we took a global, "state-space" approach, whereby all responses, each corresponding to one stimulus, were projected in the same metric space. This state-space approach allowed us to take all the responses into account at once and build a geometric representation of the neural response to each image. Previous work in the Hansen lab has shown that the geometry of the neural state-space could be represented by computational models of neuron response characteristics in the visual system. However, there are a number of nonlinearities in the visual system, and that work did not attempt to capture those. Therefore, we used nonlinear computational models to simulate the neural responses to the natural stimuli and analyzed the resulting model state-space with the neural state-space.

In the first half of the summer, we constructed a sparse coding model based on Olshausen and Field (1996)'s sparse coding network. This computational model learned response characteristics based on natural scene images and produced highly selective, sparse responses. This process was modeling neural populations within the brain that code for, and respond with high selectivity to, particular statistical features of the environment. We regressed the state-spaces of the sparse responses at each pixel location with the larger neural state-space. We found that the correlation strength varied differentially across the image, with a bias toward the center of the image. This implied a retinotopic organization biased toward the center of the visual field (i.e., neural processes arising from the fovea). Interestingly, we observed this bias with nonlinear as well as linear models.

Next, we used a linear version of the sparse coding network to further investigate the apparent retinotopic relationship between the two state-spaces. We used signals from electrodes that covered brain regions responding to either the central or the peripheral visual field of the stimuli. Reflecting earlier findings, foveal-favoring brain regions showed biases toward the center of the stimuli, whereas those from peripheral-favoring brain areas showed biases toward peripheral areas of the stimuli. Refer to Figure 1 for further detail.

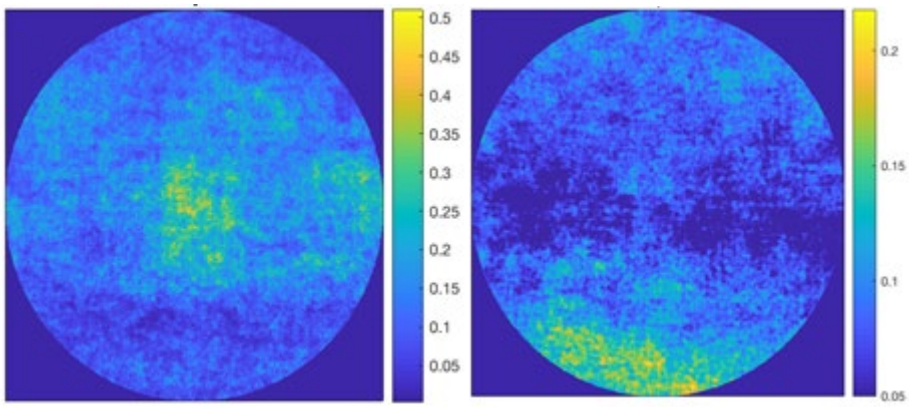


Figure 1: Left: Regression coefficient maps between our model state-space and the state-space of responses generated by foveal-favoring brain regions. Right: Regression maps between our model state-space and the state-space of responses generated by peripheral-favoring brain regions.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Nathan "Nate" Jeffries (2020) **Concentration: Biology**

Faculty Mentor: Julie Dudrick **Department: Upstate Institute**

Title of Project: Young Scholars Liberty Partnerships Program at Utica College "The Parent Engagement Challenge: Overcoming Barriers to Parental Involvement in Education"

Project Summary:

This summer, I had the opportunity to work at Young Scholars, an educational non-profit based out of Utica College. Young Scholars identifies sixth grade students who would benefit from academic support services and works with them in grades seven through twelve to ensure that they graduate high school and, hopefully, pursue a college diploma. These services include mandatory summer programming for rising seventh, eighth, and ninth graders, in-school tutoring, and a large array of volunteer opportunities, among other things.

The effectiveness of Young Scholars in achieving their mission is immense: the past several years have seen a 100% high school graduation rate, with 86% of those students matriculating at 2 and 4-year colleges following their graduation. As impressive as those figures are, Young Scholars' directors continually work to find ways they can improve their program and increase the number of students enrolling in college after high school. My job this summer was to do exactly that, specifically by improving parent engagement at Young Scholars.

Parent Engagement refers to interaction between parents and educators with the mutual goal of student success. Effective parent engagement is critical to the success of students. The benefits of good engagement practices include, but are not limited to, better grades and attendance, reduced violence and alcohol use, and similar levels of achievement between middle class and disadvantaged children. The importance of parent engagement is becoming increasingly recognized by many schools and educators, and organizations like Young Scholars are moving to bolster their parent engagement initiatives as a result.

As a first step in attempting to improve parent engagement at Young Scholars, I examined some of the barriers to engagement faced by the Utica community. Utica has a high refugee population; almost 20% of Utica's population is foreign-born, creating a unique set of challenges which inhibit effective parent engagement. Among the most significant are language, parent income, and education level. Parents and families who do not speak English, fall below the poverty line, or have not completed high school are much less likely to attend school events or volunteer on committees.

In order to improve parent engagement at Young Scholars, I came up with solutions to the unique challenges faced by Utica parents. I organized and held a Parent Day during our summer program, during which we took down the names and numbers of parents who may be willing to serve on the YS parent advisory board or as translators at Young Scholars events. I also put together a Young Scholars e-newsletter and translated it into some of the languages commonly spoken by YS parents.

Through my Upstate Institute fellowship this summer, I had the opportunity to clarify my career goals and learn the skills associated with working in an office, all while contributing to a valuable cause.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow: Katrina Judicke (2020) **Concentration(s): Psychological Science; Geography**

Faculty Mentor: Caroline "Carrie" Keating **Department: Psychological and Brain Sciences**

Title of Project: Improving Confidence and Performance in Women Faced with Gender Stereotype Threat

Project Summary:

Stereotype threat is one factor that can decrease one's confidence. "Stereotype threat...is...felt in situations where one can be judged by, treated in terms of, or self-fulfill negative stereotypes about one's group" (Spencer, Steele, & Quinn, 1999, p. 6). The fear of being negatively judged can in turn lead to a decrease in confidence and performance (Spencer et al., 1999; Chapman, Sargent-Cox, Horswill, & Anstey, 2016; Kray, Galinsky, & Thompson, 2002).

For women, stereotype threat leads to confidence declines and performance decreases in stereotypically masculine domains of expertise, including mathematics (Spencer et al., 1999), negotiation (Kray et al., 2002), and even the ability to drive a car (Yeung & von Hippel, 2008). The effects of stereotype threat have important societal implications for the underrepresentation of women in STEM and at high levels of leadership. What might inoculate women against stereotype threat?

One possibility is identification with feminism. The feminist movement provides an identity and potential source of confidence for women. Little is known about feminism's potential to help women overcome stereotype threat. We tested whether 'priming' feminist identity (by bringing ideas about feminism into conscious and nonconscious awareness) improved women's performance and confidence on a novel pattern recognition task presented as one in which males typically outperform females.

Thinking of oneself as an individual can also alleviate the effects of stereotype threat (Ambady, Paik, Steele, Owen-Smith, & Mitchell, 2004). We tested this second possibility by adding a second treatment group: individual agency. In this condition, ideas about self-agency were made salient through 'self' primes. A third, control group was primed to think about bottled water (a topic unrelated to gender).

Participants were drawn from a national sample via Amazon's Mechanical Turk platform. Participants (N = 300) were randomly assigned to be primed with feminism, individualism, or bottled water (as a control). They completed a pattern recognition task we developed and introduced as "best performed by males" (in order to induce stereotype threat). We measured participants performance in terms of correctly identifying patterns they saw as well as their confidence in whether they were correct or not.

We predicted that participants who were primed with feminism and who indicated they were highly identified with it would perform better and report higher confidence in their performance compared to controls or participants who were primed with individual agency.

Results showed no statistically significant results for either confidence or performance as a result of feminist or agency priming, regardless of the strength of feminist identity. Recent studies have also failed to find evidence of stereotype threat (e.g., Pennington, Litchfield, McLatchie, & Heim, 2018). In the future, we plan to refine our methods to strengthen both threat and primes before drawing any conclusions about the role of feminism in inoculating women against gender-based stereotype threat.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Emma Kaminski (2022) **Concentration: Undeclared**

Faculty Mentor: Margaretha Haughwout **Department: Art and Art History**

Title of Project: Eco Arts in New York State

Project Summary:

This summer 2019, I spent eight weeks from May through July, working as a research assistant for Professor Haughwout in the Art and Art History department. In this job I would assist Professor Haughwout in her various eco-arts projects and management of the "Food Forest" Garden at Shupf Studios. These eco-arts projects presented themes of conservation, technology, nature, and sustainability. The First of these projects which I worked on was the "6th E Street" Project, an effort to redesign the tunnel system beneath Colgate's academic campus. On one side of the tunnel walls, there were spray painted depictions of individual species and ecological communities which are currently flourishing, and on the other side were similarly-styled depictions of species and communities which have "bad" prospects for the future. There are also several other designs showing abstract questions on the topic of our environmental future, and past leaders of environmental change. All of the work put up on these walls was created by students of Professor Haughwout.

Student Art on the Colgate Tunnel Walls

Another of the projects I assisted on was The APRIORI project, the project's self-description is as follows: "APRIORI is a techno-botanical coven whose mission is to track and encourage emerging revolutionary ecologies of work between plants and machines". The project works out of Bennington, Vermont, and makes interactive, living art.

My work as a research assistant this summer was an opportunity for growth and learning about the process of research, eco-art, and my own interests and skills. I found myself challenged by the concepts of some of these projects thinking about how ecosystems have changed even in the most natural of settings, how technology becomes one with nature in the 21st century, and how ways of thinking dictate action toward a place. I learned in my research about the history of local lands and the practices of indigenous communities in modifying those same lands, while at the same time becoming more familiar with the art world surrounding eco-art and Professor Haughwout's projects. As an environmental geography major, I was especially appreciative of the interdisciplinary nature of this work, and my eight weeks here only deepened my interest in the ways in which we address and perceive nature.

Source of Support: ☒ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Abigail Kelly (2021) **Concentration: Neuroscience**

Faculty Mentor: Julie Dudrick **Department: Upstate Institute**

Title of Project: BRiDGES: Madison County Council on Alcoholism and Substance Abuse, Inc. "Harm Reduction as a Tool in the Opioid Crisis"

Project Summary:

This summer, I had the opportunity to complete a Field School Fellowship with BRiDGES, the Madison County Council on Alcoholism & Substance Abuse through the Upstate Institute Summer Field School. BRiDGES is a nonprofit organization that focuses on providing services to people struggling with substance use and inspiring change and hope in the community. One of the newer programs at BRiDGES is the Central Region Addiction Resource Center (CRARC). The CRARC, run by Lauren Davie, is part of a state-wide program of regional addiction resource centers funded and monitored by the New York State Office of Alcoholism and Substance Abuse Services (OASAS). The central region includes five counties: Onondaga, Cayuga, Madison, Oswego, and Cortland. The CRARC serves these counties by helping people who may be struggling to find and connect with regional addiction services. The efforts of the CRARC include community Narcan training, tabling at local events, a comprehensive app listing local addiction resources and more. These efforts rely heavily on connections and collaboration with other regional leaders.

For my specific project this summer, I worked on conducting a needs assessment in an effort to prepare BRiDGES for applying for a new grant this year. The new grant targets rural populations, providing funding for these communities to increase their prevention, treatment, and recovery services for opioid addiction. I worked through the grant and determined which of their recommended "core activities" Madison County currently does, and which areas are lacking. After working through the grant, I surveyed pharmacists in Madison County to determine what weaknesses in the county needed to be addressed in their opinion. This surveying process gave us insight into how we could better support pharmacists through community action and looking at policy. In addition to the needs assessment project, I worked working with Lauren and the CRARC to create marketing content for community events and conduct research for a harm reduction conference that will be held this fall. Hopefully, this conference will bring together regional providers and help facilitate the chipping away of the stigma surrounding people who suffer from Opioid Use Disorder.

While the research was an important part of what I did this summer, a lot of what my day to day work schedule looked like was variable. I tried to make myself as useful as I could, and was able to ask for tasks when I felt like I had hit a wall with my work. Although I wasn't originally supposed to do anything besides the needs assessment, I was able to work on other projects because I moved quickly. I ended up doing a lot of graphic design work. Though I have done graphic design on minimally in the past, I realized that I actually really enjoyed it. I was also able to attend a lot of community coalition and task force meetings where I interacted with prominent figures in the community such as the Madison County Sherriff and the County Emergency Management Services Director. These meetings gave me insight into the rural health system, and into the importance of community partnership in rural healthcare, which was the most valuable lesson I took away from my work with BRiDGES this summer.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow: Meaghan Kendall (2021) **Concentration: Natural Sciences**

Faculty Mentor: Amy Leventer **Department: Geology**

Title of Project: Diatoms from Subglacial Lake Mercer

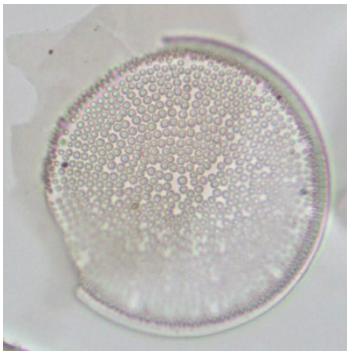
Project Summary:

This summer I conducted research with Professor Amy Leventer on sediment cores collected from Subglacial Lake Mercer (SLM) located under the West Antarctic Ice Sheet. Out of the more than 400 subglacial lakes located under the ice, SLM was only the second to be sampled directly. These samples were collected by the NSF-funded SALSA (Subglacial Antarctic Lakes Scientific Access) team during December 2018 and January 2019. The primary objectives of the SALSA project were to understand the geologic and biologic history of SLM, specifically in regards to ice sheet cover and sediment deposition, and to determine the primary source of nutrients, especially carbon, for microbial communities in SLM.

Professor Leventer and I worked with samples taken from four sediment cores that were collected. I sieved all the samples and prepared over 200 slides. Our goal was to examine and identify any diatoms, silicoflagellates, or other siliceous microfossil present in the samples. Many diatoms are restricted to specific geologic time periods and environments. Through this process, we are able to identify the approximate age of the sediment and hypothesize its source. The primary diatoms in our samples were *Stephanopyxis* spp., *Paralia sulcata*, and *Stellarima microtrias*. However, these are all long ranging taxa, and not helpful in determining the age of the sediment. Our samples also contained several age diagnostic taxa including *Thalassiosira oliverana* var. *sparsa*, *Thalassiosira torokina*, *Actinocyclus fryxellae*, and *Fragilariopsis praecurta*. The coincident range of these taxa is the late Miocene. We were not able to identify any species whose restricted age was younger than the late Miocene. These data suggest that a marine seaway existed in the interior of Antarctica during the late Miocene, when the ice sheet retreated far enough inland to expose SLM and permit diatom growth in the area and upstream of the region. This theory was supported by the presence of silicoflagellates that would normally be found in waters warmer than current temperature of the Ross Sea, indicating a warmer climate.

The specimens that we found were in good condition. Most of the valves were complete and well-preserved, and we often found diatoms in which both valves were still connected. Colonies of *Paralia sulcata*, in which the valves of multiple diatom cells are stuck together, were still intact. Normally during transport, diatom valves become detached and fragmented. Based on these observations, we infer that the diatoms were not transported long distances before deposition in SLM.

We will continue working during the academic year to better understand the distribution of the diatom species within the sediment and identify any corresponding stratigraphy among the cores that would aid in our interpretation of how and when the sediment was deposited.



Left: *Thalassiosira oliverana* var. *sparsa*, approximately 30 micron diameter
Right: *Actinocyclus fryxellae*, approximately 35 micron diameter

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Norma Vergo Prize

Research Fellow: Dipesh Khati (2022) **Concentration: Undeclared**

Faculty Mentor: Julie Dudrick **Department: Upstate Institute**

Title of Project: Partnership for Community Development "What's Next for the Hamilton Farmers' Market?"

Project Summary:

I worked with a local non-profit called Partnership for Community Development (PCD) through the Upstate Institute this summer. The PCD has been working to accelerate business in the village of Hamilton with financial support, and to enhance the standard of living through housing plans. Through the PCD I worked with the Hamilton Village Farmers Market and the PCD Community Incubator.

I developed and administered two surveys for the Hamilton Village Farmers' Market. Through a survey given to vendors at the market, I learned more about their preferred medium of marketing, the feedback they had about the market, the resources they wished they had to become successful in their trade and the level of satisfaction with their location in the market. Through a survey given to customers at the market, I collected data about from where customers visiting the market were coming, what goods they bought at the market, how they came to know about the market, and ways to make their shopping experience better.

The data were collected for 5 weeks through the use of Qualtrics and one on one interviews. They were then analyzed with Excel. The customer survey and the vendor survey were analyzed individually, and also collectively, drawing connections on questions that touched similar areas about the market. The analysis brought on some very interesting conclusions, some of which are highlighted below:

1. Almost all the vendors surveyed were happy with their location in the market (27 out of 29 vendors who responded).
2. Almost all the customers valued that goods sold in the Farmers' market were locally produced (59 out of 61 customers who responded).
3. Social media was the most popular medium of marketing among vendors.
4. Approximately half of the customers who responded to the survey came from the village of Hamilton.
5. One of the most popular customer suggestion was to increase the number of fresh food and fast food vendors in the market.
6. Vegetable produce was the most often purchased goods in the market.
7. Only 50% of the customers of the Farmers' Market visited the downtown business district in Hamilton at the same time.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow: Jun Yuan "JY" Khoo (2022) **Concentration(s): History; PCON**

Faculty Mentor: Robert Nemes **Department: History**

Title of Project: No Longer Dragon Tooth Gate: Shaping Singaporean Chinese Identity through Sites of Memory

Project Summary:

Singapore, like most other former colonies, is a relatively young nation that only emerged 54 years ago. As a Chinese-majority country, Singapore has engaged in the construction of a Singaporean Chinese identity (alongside the simultaneous construction of a national identity) that distinguished its Chinese citizens from their peers in other Chinese-majority territories.

My project examines how the state has utilized Chinese-oriented sites of memory in pursuit of these goals. I visited nine sites in Singapore and found that their usage by the state could be described by two methods: either the state imposed their own values upon existing sites, or it created entirely new monuments and memorials. I chose two of these sites, the Thian Hock Keng temple and the Civilian War Memorial, as an example of each method and conducted deeper historical research and display analyses about them. Analysis of the remaining sites supplemented my findings, especially in relation to other components of the Singaporean Chinese identity.

Naturally, the imposition of this state-sponsored identity and its replacement of the existing ethnic Chinese one, while largely successful, has caused some tensions amongst the local Chinese community. I sought to pinpoint how the state has not been able to achieve all its objectives with these sites, particularly in how locals do not interact with them as intended, and how the state attempts to address such situations in response.

My study of these sites also traces the developments in Singapore's cultural and political schema. Culturally, the two sites symbolize different aspects of local Chinese identity: the continuation of indigenous Chinese religion and the memory of a wartime Chinese massacre. Their contrasting treatment by the state emphasizes the differences between the Singaporean Chinese identity and the ethnic Chinese identity it supplanted, highlighting which aspects of the latter the state has either maintained, recontextualized, or suppressed.

Politically, the two sites represent the exertion of related state ideologies: religious pluralism and multiracialism. They in turn are underpinned by the overarching ideology of pragmatism, which primarily arose as a result of historical and geopolitical forces and continues to guide Singapore's actions today. The inherent contradictions behind this ideology of seeming non-ideology helps explain related contradictions in simultaneously conservative and progressive attitudes towards sites of memory, such as the closure of the first Chinese-medium university outside China less than a year after it launched the Speak Mandarin campaign, and in foreign policy: the state, after distancing itself from the Middle Kingdom in the 60s to assuage regional neighbors' fears, began to pivot itself towards a rising China in the 90s.

In conclusion, the core cultural differences between the two competing identities underscore the state's political need for a distinct Singaporean Chinese one. This need is still highly relevant today and can even be argued to be essential to Singapore's sovereignty. As such, state management of the Singaporean Chinese identity is very much an ongoing project, and as a corollary, the usage of sites of memory to do so will only continue.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Lampert Institute for Civic and Global Affairs

Research Fellow: Kelly Knickerbocker (2021) **Concentration: Molecular Biology**

Faculty Mentor: Krista Ingram **Department: Biology**

Title of Project: Genetic Correlates of Seasonal Affective Disorder (SAD) in a Refugee Population in Upstate New York

Project Summary:

This summer, I studied seasonal affective disorder (SAD), which is defined as a depressive mood disorder usually affecting individuals in the winter and late fall. SAD is hypothesized to be a result of decreased sunlight exposure. The symptoms of SAD include but are not limited to tiredness, feelings of hopelessness, overeating, and loss of motivation. Current research suggests that SAD is caused by a combination of genetic and environmental factors, such as changes in the internal circadian rhythm. For my research, I mainly focused on the genetic component of SAD, as I was assigned to study the circadian rhythm gene, Cry1. By looking at both qualitative data (participant-reported chronotype, mood, and sleep patterns) and quantitative data (mutations in each gene), I aimed to determine whether certain mutations in each gene of study increase one's chances of having SAD. In my research, two populations of interest were studied: a Caucasian population residing in Hamilton, NY and a Burmese population residing in Utica, NY. Through qualitative data analysis, we found that the two populations had very similar frequencies of SAD.

Cry1 is a protein-encoding gene that is a key component of the circadian rhythm oscillator complex. This summer I studied a specific SNP in Cry1, rs2287161 (major allele G, minor allele C), which has previously been found to be associated with bipolar disorder and depression. This SNP has not previously been found to be linked with SAD, so we sought to investigate whether a connection exists or not.

Main Results

One of our most significant findings was that individuals in the Caucasian population with the CG genotype were 3 times more likely to have SAD. In the Burmese population, having the CG genotype increased the risk of individuals having depression by six-fold. These findings support the theory that there is a genetic component of SAD and depression, which allows us to better understand the underlying causes and predispositions of these diseases.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Michael J. Wolk '60 Heart Foundation

Research Fellow(s): **Lily Kuentz (2021)** — **Concentration:** **Environmental Geology**
Paul Nugent (2021) — **Concentration(s):** **Geology; Music**

Faculty Mentor(s): **Dianne "Di" Keller** — **Department:** **Geology**
William Peck — **Department:** **Geology**

Title of Project: **Mineral Weathering and Passive Carbon Sequestration at an Abandoned Wollastonite Mine**

Project Summary:

Wollastonite is a splintery, white, calcium-silicate mineral mined in the Adirondacks as a replacement for short fiber asbestos and is used in ceramics and plastic production. The mining process helps break down the rock, which then undergoes the following model reaction: $CaSiO_3$ (wollastonite) + CO_2 = $CaCO_3$ (calcite) + SiO_2 (quartz). For this project, wollastonite samples were gathered at the Lewis and Fox Knoll mines in Lewis, NY and Willsboro, NY respectively. The research goals of this project were to characterize the wollastonite weathering process and to determine the source of the carbon dioxide taken up in the reaction. To do so, the surface textures of the wollastonite grains were studied using a scanning electron microscope. The SEM imaging revealed a variety of microstructures, such as calcite rims forming like crusts around grains of wollastonite, which helps support the model reaction mentioned previously. Likewise, patterns resembling spiderwebs or ribcages of alternating silica-mineral and calcite were present in many of the cemented masses. Several of these microstructures are still unidentified, but can be described as radial growths of bladed transparent crystals, expanses of crystal growths resembling coral reefs, and many other organic shapes distributed randomly throughout the samples. Some organic features have been identified as pine pollen, grass pollen, mites, diatoms, and nematodes. Many of the samples contained blankets of unidentified, smooth film, the most substantial of which was found coating root structures in the cemented, wollastonite-rich sediments. The samples in this project were taken from several different types of locations within each mine. Some were close to the treelines, some were taken from cemented boulders, some were taken from piles of loose sediment which may have been disturbed within the past year, and others remained relatively undisturbed for decades. Given these conditions, one might expect an increase in the presence of organic matter in the samples located closer to the treeline, and less organic matter in the samples taken from the bottom of the pile of sediments. Similarly, one might expect a higher concentration of complex microstructures in the boulders, which are more cemented than the loose piles of sediment. However, in order to form more concise trends in the qualitative data, duplicates of these samples should be studied in the SEM.

This research also builds off of the thesis work from Victoria Arnold '19 and Faith McDonald '19. In search of the source of the carbon dioxide in the wollastonite weathering, we quantitatively analyzed the samples for their mineralogic composition and their isotope ratios. Quantitative mineralogy determined that on average, the Fox Knoll samples had higher percentages of both calcite and silica minerals than the Lewis samples, which further supports the model reaction described above. The isotope ratios that were calculated for the Lewis mine samples from this study were consistent with the low $\delta^{13}C$ values found in Arnold '19 and McDonald '19, which at one point was thought to be evidence for a biotic source of carbon dioxide. However, the $\delta^{13}C$ values calculated for the Fox Knoll mine deviated from the trend. The Fox Knoll samples were calculated to have much higher $\delta^{13}C$ values than the Lewis samples, but nothing apparent in the mines points to why this difference would occur. More work on the matter is required to better constrain the mechanism of carbon dioxide fixation through calcite formation and what led to the isotopic differences observed in these samples.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Doug Rankin '53 Endowment-Appalachian Research

Research Fellow: Sahil Lalwani (2022) **Concentration: Undeclared**

Faculty Mentor: Julie Dudrick **Department: Upstate Institute**

Title of Project: Village of Hamilton Airport Commission "Estimating the Economic Impact of the Hamilton Municipal Airport"

Project Summary:

This summer, I had the privilege of working with the Hamilton Municipal Airport/ Airpark Commission on a Community Based Research (CBR) project through the Upstate Institute Summer Field School. This commission, comprised of five community members, acts as an advisory to the Village's Board of Trustees and the mayor. They review airport finances, resolve legal, operational and financial concerns related to the airport, and discuss strategies to incentivize more visitors to arrive at the airport. Increased airport activity fosters local economic growth and development by bringing revenues through hangar rentals and the sale of fuel and aircraft maintenance services. Higher air traffic also enhances visitor expenditures locally, primarily under the categories of food, tourism, lodging and transportation. The Commission, thus, works with the primary objective of maximizing the value of the airport to the village and the surrounding community.

I undertook a study with the Commission to estimate the local economic impact of the airport. The purpose of this study is two-fold. Firstly, it aims to raise awareness among the Commission members on specific areas of economic impact of the airport. This would guide the Commission's future policy decisions by helping them identify strategic areas of focus to further enhance the economic value of the airport. Secondly, the Commission also desires to disseminate the results of the study through local media and the airport's website in order to communicate the value of the airport as an economic asset to the local community.

As part of my project, I used past studies and a wealth of literature available on economic impact studies to guide my efforts in developing a methodology for my research project. Using an FAA approved approach, I categorized economic impact into four distinct categories. Direct impact includes economic value generated by revenues from on-airport businesses and capital improvement projects at the airport, and was calculated using data available from monthly airport logs and grants approved for airport development and reconstruction by federal as well as state aviation agencies. Visitor impact is a quantitative estimate of local economic activity that may be directly linked to users of the airport. I conducted a survey among visiting pilots and passengers at the airport to estimate the average expenditure per visitor at the airport. The results of the survey, along with the number of annual transient pilots and passengers at the airport, were used to estimate the visitor impact of the airport.

I included indirect impacts created as a result of spending throughout the national economy which, in turn, are generated by the local direct economic activity of the airport. I also conducted extensive panel interviews and individual interviews to identify qualitative economic impacts that may not be reducible to a dollar value but are vital in enhancing the health, safety and overall well-being of local residents. For example, not-for-profit organizations like PALS and Angel Flight NorthEast utilize the airport for volunteer medical flight operations throughout the country for patients in need of air transportation but lacking financial means. This resulted in a written and comprehensive summary of the history of the airport that can be used as a marketing tool for the airport, and included on the airport's website to highlight the marvelous trajectory of growth that the airport has seen since the time it was purchased.

I plan to continue collecting data on visitor expenditure via the on-airport survey to assess year-round activity, which will help the Commission set goals and objectives to attract even more visitors to the airport. Overall, this project has helped me use my analytical and communication skills to contribute something valuable locally, fully explore all that central New York has to offer and gain significant research experience. I hope to continue sustaining the relationships I have made over the summer, and hone the communication, leadership and research skills I have gained in my future work.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow: Bailey Larson (2019) **Concentration: Educational Studies**

Faculty Mentor: Julie Dudrick **Department: Upstate Institute**

Title of Project: Madison County Department of Social Services "The Need for Long-Term Supportive Housing in Madison County"

Project Summary:

My research project gave me the opportunity through the Upstate Institute to work with the Department of Social Services (DSS) on a continuation of a project dealing with long term supportive housing in Madison County. I worked with Michael Fitzgerald, Commissioner of the Madison County Department of Social Services, and Tricia Platt, Deputy Commissioner for Financial Assistance. This project was unique because previous Upstate Institute Fellows and students in Colgate's ENST 390: Community-Based Study of Environmental issues class provided background information that allowed me to propel this work forward.

From their data, I was able to research funding options for this project. I was also able to consider what a housing project would look like, given Madison County's homeless population, and what this project must include to meet the various county needs. was able to interview regional housing experts such as Stephanie Hutchinson and Steve Darman, town/village/county officials such as Codes Enforcement Officer Don Forth and County Planning Director Scott Ingmire, and non-profit members such as Gary Mann from the Auburn Rescue Mission and Antara Mitra from the Madison County Community Action Program. From these meetings and by working with DSS, I learned that Madison County's homeless population consists of single male individuals who mostly have some type of mental health or substance use issue. By incorporating data from the Auburn Housing Authority and the Rescue Mission, I developed a project concept.

I found that the optimal solution for long term supportive housing needs in the county would be a project which will include a mix of temporary, emergency, and permanent housing. Madison County experiences 8-10 homeless individuals a month, so a 40 bed unit isn't needed in this community. Location is more important than size, and the projects needs to be near mental health facilities so that our population not only has a roof over their head, but is able to receive the help they need as well. We focused a likely location to either Oneida or Canastota because of the access to health-related care, along with proximity to places like grocery stores for pedestrians. We also found that locations such as the villages of Hamilton or Wampsville will likely not work for this project due to zoning laws and lack of access to transportation, along with other reasons. I also learned that to fund this project, the county would need to look at multiple sources, such as the OTDA-Homeless Housing and Assistance Program, the Empire State Supportive Housing Initiative, and tax credit funds. A combination of funds from these three sources will allow the county to construct the facility and operate it.

At the end of the summer, I was able to present my 90 page report to the Madison County Board of Supervisors Health and Human Services Committee Meeting, and my data was given to a housing developer considering implementation of a project such as this in the county, so it is likely that this research will have an impact on housing options in the community in the future.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow: Marlene Lawston (2020) **Concentration: Molecular Biology**

Faculty Mentor: Jason Meyers **Department(s): Biology; Neuroscience**

Title of Project: Changes in Progenitor Populations Lead to Expanded Mechanosensory Lateral Line in Cavefish

Project Summary:

Sensory compensation is the ability of the body to respond to sensory loss through heightening of remaining senses. It is observed in humans that have lost their sight at a young age as they tend to exhibit enhanced auditory performance compared to those with normal vision. The processes underlying sensory compensation, however, are not well understood. Blind cavefish (e.g. *Astyanax mexicanus* - Mexican tetra) display sensorineural adaptations as a result of visual stimulus loss – adult populations isolated inside caves have lost their eyes. Surface populations of *A. mexicanus* retain their eyes, pigmentation, and neural structures similar to other tetra. Compared to surface populations, adult cavefish populations display a significant overproduction of lateral line (LL) sensory organs. The LL system consists of an extensive network of mechanoreceptive organs called neuromasts (NM) that are located just below the epithelium and allow for the detection of vibration in water. This network of NMs allows fish to navigate, find food, and escape predators. In adult cavefish, these NMs are greater in number, size and in number of centrally located mechanosensory hair cells.

Cavefish initially develop an eye; however, apoptosis originating in lens tissue ultimately prevents neurogenesis. The cavefish eye then continues to degenerate for the following 2-3 months. Interestingly, the cavefish LL develops identically to that of zebrafish and surface fish during embryogenesis. By adulthood, the cavefish LL exhibits the overproduction of sensory organs described above. Evidently, there is a compensatory mechanism that leads to this massive change in the cavefish LL system by the time the fish reaches adulthood, but the timing and mechanism have not yet been elucidated. To begin to identify this timeline, I began working in spring 2018 to determine the period of time during which cave and surface fish development begins to substantially diverge.

So far, my research has identified a putative population of progenitor cells hyperactive in cavefish that lead to growth and expansion of the LL system in early larval stages. Characterization of the LL of the cave and surface fish morphs at different development stages with antibodies and confocal microscopy revealed that substantial differences in the cavefish LL are apparent in early larval stages. I hypothesized that these differences may arise from differences in cellular proliferation; therefore, I compared proliferation in NMs within cave and surface fish populations using immunocytochemical detection of a cellular proliferation marker bromodeoxyuridine (BrdU). In early larval stages, cellular proliferation was significantly increased around the perimeter of cavefish NMs - a location suggested to have cells with stem cell-like behavior in zebrafish.

My ongoing research focuses on pharmacological manipulation of pathways and in situ hybridization of genes I hypothesize underlie these changes in the cavefish LL. These findings are important in gaining a better understanding of sensory compensation and also allow for insight into mechanisms of sensory organ regeneration. Fish have the ability to regenerate sensory hair cells while mammals cannot. Loss of homologous mechanosensory hair cells in the human inner ear causes hearing loss and therefore permanent deafness as humans do not regenerate hair cells. Given the homology between the LL and the inner ear, it is hoped that by understanding the signaling mechanisms that control progenitor cells during growth and regeneration we will gain a better understanding of sensory compensation and potential mechanisms that could stimulate regeneration in the mammalian inner ear.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Beckman Scholar Program

Research Fellow: Linh "Christine" Le (2019) **Concentration(s): ECON; International Relations**

Faculty Mentor: Julie Dudrick **Department: Upstate Institute**

Title of Project: Mohawk Valley Resource Center for Refugees "Secondary Migration in Utica, New York and the Mohawk Valley Resource Center for Refugees"

Project Summary:

This summer, I contributed to multiple projects in my capacity as an Upstate Institute Summer Field School Fellow at the Mohawk Valley Center for Refugee Resources (MVRCR) in Utica. The MVRCR is a not-for-profit corporation that provides services for refugees and immigrants in Central New York. These include resettlement, interpretation and translation, citizenship counseling, cultural competency training, English classes for non-native speakers, and employment consulting, among other services.

My first project involved developing a database on secondary migrants. Secondary migrants are refugees who are initially resettled in one state, and then subsequently move to another at the end of their resettlement period. Many of those secondary migrants end up in Utica. The MVRCR had been providing them with many services without keeping track of demographics or service outcomes. With valuable guidance from the MVRCR staff, I revised the existing fragmented data intake process into one that is applicable across all departments of the agency. Then, I imported archival data, while the new form was circulated right away to capture new clients' information. This dataset will eventually help the MVRCR assess its performance, identify enhanced cultural orientation topics, and provide more targeted services. This, in turn, will not only attract more funding for the MVRCR, but also more immigrants to the city, helping to rejuvenate Utica's labor market.

My second project was a community conversation hosted by the MVRCR's employment department and the Office for New Americans. The goal was to provide newly arrived immigrants and refugees with tips and suggestions on how they could learn and practice English beyond the classroom. It also entailed introducing them to the diverse resources available online, and within the Utica community. I gave this talk alongside the MVRCR employment manager and an interpreter in front of a dozen Burmese and Karen refugees, and addressed their questions. The event received great feedback, and hopefully contributed to the refugees' effort at becoming self-sufficient and integrated into their new life as fast as they can.

In addition to this research, my last major project was to cover all front desk operations for two weeks. I answered all phone calls and walk-ins, sorted mailings, directed clients to appropriate departments, registered appointments for over ten different MVRCR offices, coordinated all activities to ensure a smooth operation within the agency. This experience allowed me to connect with all the staff members in the MVRCR, learn about their daily responsibilities and challenges, and the ins and outs of the refugee center as a whole. I have gained a tremendous appreciation for the noble work done by the agency, and I am incredibly grateful for the opportunity to make my small contribution to the MVRCR and Utica's refugee and immigrant community at large.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow: Carly Leifken (2020) **Concentration(s): Political Science; English**

Faculty Mentor: Julie Dudrick **Department: Upstate Institute**

Title of Project: Fiver Children's Foundation "Fiver Children's Foundation: Central New York Community Engagement"

Project Summary:

Fiver is a children's foundation which has a 20 year legacy of changing young people's lives. They serve children from both New York City and the Central New York area. Fiver makes a 10-year commitment to its students, which not only serves as a support system throughout the children's lives, but also helps prepare them for school, college, and their careers. Each life stage is approached in a specialized way, with programs that build upon one another. Kids are empowered to work towards the best version of themselves, while always receiving a helping hand along the way.

In addition to the year round programming of education, advocacy, and mentorship, each year students are offered the transformative experience of summer camp. They get to spend two weeks at the 129-acre camp in Poolville, which manifests the beauty of Central New York. In addition to participating in traditional camp activities, Fiver kids take classes such as character education, public speaking, leadership development, health, environmental education, and college prep. Each age group also gets to go on various trips such as camping and college visits. The experiences that Camp Fiver creates for children make lasting impacts. Fiver fosters an environment of safety and inclusion so that kids can cultivate their character and build meaningful relationships. Fiver is a place that is described as "magical" and yet simultaneously described as "home." A camper in her last year summarized her time with Fiver in one sentence: "Fiver can make you believe in yourself again and give you a whole new outlook on your future."

Most of my work with Fiver has been centered around Central New York (CNY) community engagement. While Fiver has a strong team working in New York City, there is a clear difference in the resources they have for the Central New York children. I have mainly worked on making a push towards informing the local community about what Fiver is, and how they serve children in the community. One of the most important fundraisers for CNY is the Fiver Fall Festival. For this, I have facilitated outreach to local sponsors by organizing contact with the steering committee and previous sponsors of Fiver. Together with my supervisor, we extended Fiver's relationships with new partners. I also researched the benefits of programs such as Fiver for children in terms of mentorship and poverty. This research shows that extended mentorships, such as the Fiver model, is proven to be strongly beneficial in many areas of child development on the premise of psychological, academic, and behavioral outcomes. It is important for Fiver to continue to support their mission with analytical data to promote their work and the change they create in kids' lives. I also created a timeline for Fiver for their future events, which will serve to assist them in staying on task for productive fundraising in years to come. Finally, I helped to draft narratives about Fiver programs that the organization can use when applying for grants.

The beauty of working with a community partner such as Fiver is that you get to see the inner workings of a place that has a substantial impact on so many people's lives. It is truly amazing to see what Fiver has done for kids, and to get a chance to talk with people who have grown up through the program. This place has not only increased my desire to pursue nonprofit work, but it has taught me the necessity of programs such as this.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow(s): **William "Will" Leiter (2020)** **Concentration: Chemistry**
Colin Miller (2022) **Concentration: Undeclared**
Weiyu "Jessica" Zhong (2022) **Concentration: Chemistry**

Faculty Mentor: Ephraim Woods **Department: Chemistry**

Title of Project: Photochemical Pathways to the Production of Secondary Organic Aerosol

Project Summary:

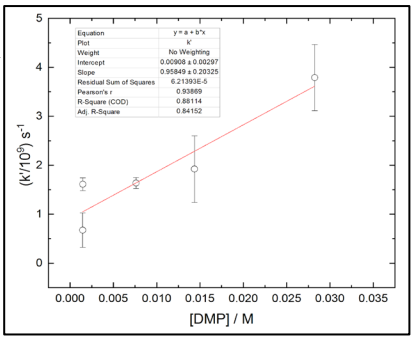
Aerosols are particles in the atmosphere that can be from 10 nanometers to 10 micrometers in diameter. They consist of mixtures of ionic compounds and organic molecules that can be aqueous at high enough relative humidities. Because of their complex chemical compositions, aerosols are sites for many of the chemical reactions that take place in the atmosphere. One important class of reactions is referred to as 'photochemical', or light-initiated, reactions. High-energy photons from the sun can promote molecules into an excited state that allows them to react with other molecules present in an aerosol particle or even gas-phase compounds near the surface of the particle.

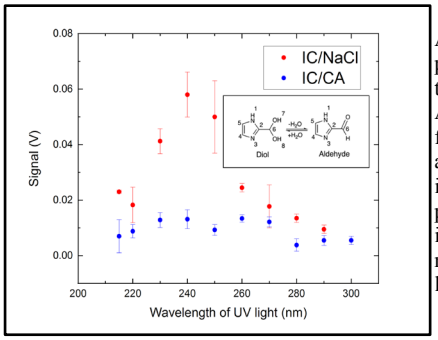
Imidazole 2-carboxaldehyde (IC) is a known photosensitizer that may be involved in photochemical reactions to produce secondary organic aerosol (SOA). That is, IC is excited by high-energy photons and reacts with other species in or at the surface of aerosol particles to produce organic compounds that were not initially present in the aerosol. The main class of compounds that IC reacts with to form SOA are volatile organic compounds (VOC). SOA compounds are lower in vapor pressure and lead to aerosol growth , which ultimately has a measurable effect on the climate, as aerosol particles influence the scattering of radiation and serve as sites for cloud condensation.

The reaction pathways and kinetics of IC reactions that result in SOA formation have been primarily studied under aqueous conditions, which are not representative of the chemical systems of interest in the atmosphere, namely aerosols. As such, the goal of our research is to identify possible reactions between aerosol-phase IC and other chemical species and quantify the rates of these reactions. As an ancillary project, we also designed an experiment to further our understanding of the ionization pathways of IC and the composition of the aerosol particles used in our experiment.

In our main experimental setup, we used two lasers to create and then ionize triplet-state IC (^{3}IC). Using an electrometer, we measure the voltage from ionized aerosol particles following both laser pulses and plot this data against the delay between the two pulses. We selectively detect the triplet excited state through the photoemission of electrons from the surface of the aerosol particles. As the delay between the lasers is increased, more ^{3}IC molecules either relax to the ground state or react with other chemical species in the aerosol particle before the second laser pulse. As a result, fewer IC molecules are ionized and we read a smaller signal. The plots of signal as a function of laser delay decay exponentially and by fitting an exponential decay function we can determine the lifetime of ^{3}IC.

From experiment to experiment, we vary such things as the chemical composition of our aerosol particles, the laser delay increments between each data point, and the relative humidity of our aerosol flow. Which of these experimental parameters we vary depends on what relationship we are trying to establish. Most of our work this summer was focused on determining the rate constants for reactions between IC and other organic compounds, such as citric acid and 2,6-dimethoxyphenol (DMP). In the plot to the right, each point is a value of a pseudo first-order rate constant for a given concentration of DMP. The pseudo first-order rate constant corresponds to the triplet lifetime that we determine from the biexponential decay plots. The slope of the best-fit line for this plot gives the second-order rate constant for the reaction between ^{3}IC and DMP. Similar plots can be made for other reaction partners once we have gathered enough data.





As a secondary research project, we also studied the effects of acidity on the ionization pathways for IC. As there is no UV-vis absorbance spectrum for aerosol-phase IC, it is difficult to pin down what wavelengths of light we should use for our excitation and ionization lasers. Another difficulty is that IC has a hydration equilibrium between its aldehyde form and its diol form, as shown in the inset of the figure to the left. Our ionization scheme is based on the aldehyde form of IC, so it is important that we know how much of that form is actually present in our aerosol particles. To the left is an action spectrum comparing a citric acid solution (low pH) to an NaCl solution (neutral pH). This particular spectrum suggests that IC is efficiently ionized at around 240 nm, when there is a substantial amount of its aldehyde form present (i.e. neutral pH). In contrast, in the low pH citric acid solution, where we would expect there to be little aldehyde form present, IC is not ionized efficiently at any wavelengths over this range.

Moving forward, we plan on shifting to the use of 4-benzoylbenzoic acid (BBA), which is another known photosensitizer, as well as determining more rate constants for model organic species.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Justus '43 and Jayne Schlichting Student Research Fund; National Science Foundation Grant; Warren Anderson Fund

Research Fellow: Emily Lencyk (2021) **Concentration: Biology**

Faculty Mentor: Barbara Hoopes **Department: Biology**

Title of Project: Molecular Genetics of Body Size in Dogs

Project Summary:

This summer, my research focused on the genetic factors that affect birthweight in toy poodles. Across dog breeds, individuals are known to vary greatly in size; variation in body size can also occur within individual breeds. Unfortunately, this variation can result in health complications for mothers and neonates among the smaller breeds of dogs, such as toy poodles. For instance, a 6 ounce toy poodle puppy may be too large to be birthed naturally, and a C-section would be required to ensure that the mother and her puppies survive. On the other hand, a 3-4 ounce puppy might require its diet to be supplemented with formula in order to gain weight and avoid fatality. Variation in birthweight can occur even within a single litter, which suggests that birthweight is influenced more by genetic factors than by environmental factors. Ultimately, the goal of this research is to create a predictive model that can help breeders reduce neonatal mortality rates.

Previous research by Hayward et al. (2016) had already identified 17 loci significant to body size across many breeds of dogs. Of these 17 loci, we specifically looked for genes that had genotype variation within the toy poodle breed. Based off their function in other well-researched model organisms, we also factored in the genes that are likely related to embryonic development and, subsequently, birthweight. By using this criteria to focus on a handful of genes, we could determine those that have an effect on the variation observed in birthweight, as well as how significantly these genes impact birthweight and whether or not the size of the mothers play a role in birthweight determination. We identified seven genes as being variable in toy poodles and likely to be associated with development before birth: SMAD2, IGF1R, STC2, LCORL, TBX19, MITF, and IGF2BP2. Using DNA sequencing, Melt-MAMA (Mismatch Amplification Mutation Assay), and qPCR, we genotyped a sample size of 63 toy poodles at specific, known single nucleotide polymorphism (SNP) sites, otherwise known as mutations. At these sites, individuals could have ancestral, heterozygous, or derived genotypes, with the derived being the mutated versions of the ancestral alleles. A new assay, known as Melt-MAMA, was adapted from Birdsell et. al (2012) and performed in order to genotype individuals. This assay was carried out using 2 forward primers and 1 common reverse primer, which were deliberately mismatched in order to create a difference in the melting temperature of the qPCR products so that ancestral, heterozygous, and derived individuals could be clearly identified from the qPCR analysis.

Once all the individuals and their mothers were genotyped, a linear regression allowed us to find that the mother's height plays little role in explaining the variance in the birthweight of toy poodles. Additionally, we determined that SMAD2, IGF1R, the mother's SMAD2, and the mother's IGF1R demonstrated statistically significant differences ($p<0.05$) in average birthweights among ancestral, heterozygous, and derived genotypes, and thus help explain as much as 39% of birthweight variance. Although there is not a statistically significant difference in average birthweight among the different alleles in IGF2BP2, linear regressions with and without IGF2BP2 show that it does contribute to birthweight variation. Finally, we determined that dogs with higher average birthweights frequently had ancestral genotype combinations, while dogs with lower birthweights often had derived genotypes. With this in mind and knowing the genotypes of the dams and sires being bred together, dog breeders can be better prepared to ensure the delivery process goes smoothly and the neonates remain healthy.

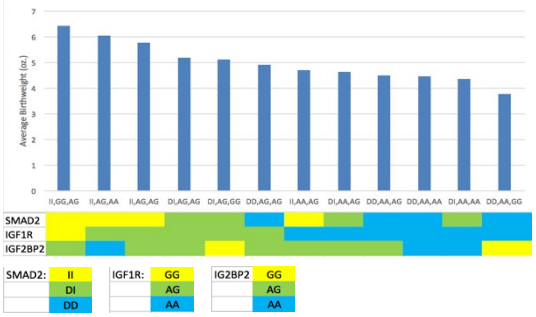


Figure 1. Dogs with higher birthweight averages frequently have more ancestral alleles. This figure shows various combinations of genotypes identified within a sample size of 63 dogs, organized from highest to lowest average birthweight. With ancestral alleles being shown in yellow, derived alleles shown in blue, and heterozygous alleles shown in green, it is apparent that the average birthweight of dogs that had mostly ancestral alleles for SMAD2, IGF1R, and IGF2BP2 was higher than that of dogs with mostly derived alleles. Dogs with heterozygous genotypes generally had intermediate birthweights.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Brynn Lewis (2020) **Concentration: Biochemistry**

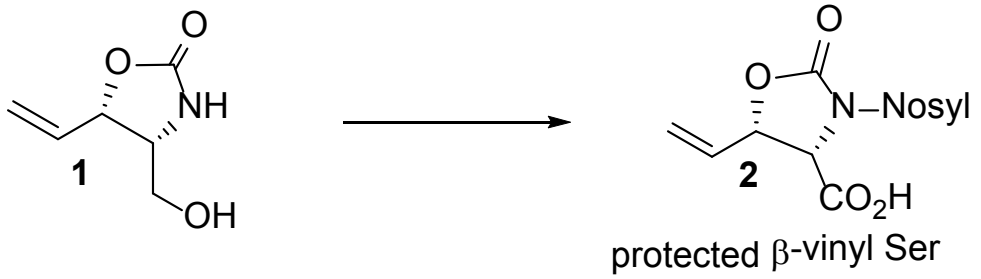
Faculty Mentor: Ernie Nolen **Department: Chemistry**

Title of Project: Synthesis of Glyco-Amino Acids for Biomedical Studies

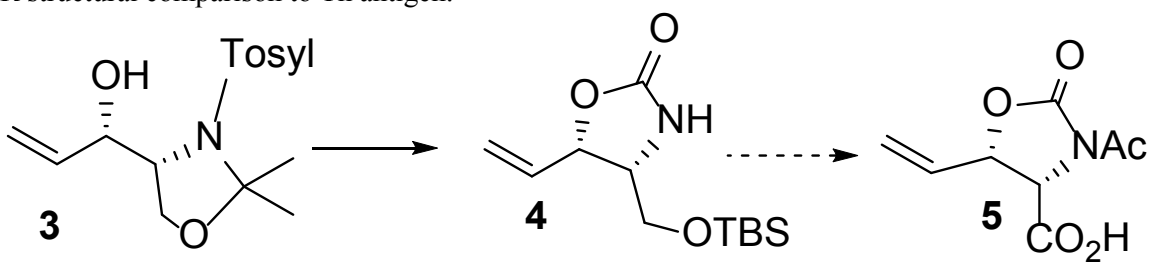
Project Summary:

O-mucins are proteins that are attached to complex carbohydrate chains and line the surface of epithelial cells. The attached carbohydrate chain helps denote the function of the protein, such as movement, differentiation, or growth among others. Tn antigen is a truncated version of *O*-mucin containing only one carbohydrate as opposed to having a chain and is present in many forms of cancer. Unfortunately, this antigen does not produce a strong immune response, in part because it is not totally foreign and has limited metabolic stability. The goal of the Nolen lab is to produce a mimic of Tn antigen with a carbon link with an attached hydroxyl group instead of the natural oxygen link in order to prevent degradation while maintaining the same general structure and hydrogen bonding capabilities.

During the summer I worked on making the amino acid portion of the Tn antigen mimic. My initial task this summer was to take an oxazolidinone **1**, put a protecting Nosyl group on it, and oxidize the terminal alcohol to a carboxylic acid. This was accomplished by first placing a silyl protecting group on the terminal alcohol (so that the Nosyl would be unable to bind to this site), putting on the Nosyl protecting group, removing the silyl group, and oxidizing the resulting terminal alcohol into a carboxylic acid **2**. Ultimately the Nosyl protected amino acid was unable to perform a desired esterification, but alternative methods are planned to make use of this protected β-vinyl Ser for the Tn antigen mimic.



Currently I am in the process of producing a differently protected β-vinyl Ser **5**, that will be used for NMR structural comparison to Tn antigen.



In this process I am using a new pathway to form the Ser derivative. This route started from the highly selective Grignard product **3** and requires four steps to produce the oxazolidinone **4**. Notably, the deprotection of the Tosyl group from the nitrogen was accomplished. If the early trials are reproducible, then this is a more efficient pathway to reach this product than the alternatives currently being used.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): National Institutes of Health (NIH) Area Grant

Research Fellow: Zhongwen "Kevin" Lian (2020) **Concentration: Computer Science**

Faculty Mentor: Yukari Hirata **Department(s): EALL; Linguistics**

Title of Project: Design a Way to Better Help Mandarin Native Speaker's Distinguish and Pronounce English Vowels and Consonants

Project Summary:

During summer 2019, my main focus centers on bilingual research. Literatures I have read introduce two models of bilingual language acquisition: SLM and L2LP. SLM claims that two languages develop one shared phonetic inventory and L2LP believes that two languages are developed with distinct representations of their own phonetic inventories. The major conflict between the two models is the debate on whether different languages can influence each other or are independent of each other. In order to contribute to this ongoing debate, I plan to include priming effect as a means to measure the extent to which different languages influence each other. Priming effect is a technique whereby "exposure to one stimulus influences a response to a subsequent stimulus, without conscious guidance or intention." Through this way, we have the means to examine the two opposing language models. Below, I present two most critical literature to my project and in the end a proposal for my fall independent study.

Phonetic adaptation in non-native spoken dialogue: Effects of priming and audience design

Hwang et al. (2015) demonstrate the effects of priming on improving accent. In experiment 1, Korean native speakers are either exposed to English vowels (produced by either native English speakers or Korean-accented speakers) that they are going to produce right after the exposure or different English words. The results demonstrated a lifting effect of Korean native speakers' pronunciation of English vowels by the priming by native English speakers while no effect if primed by either Korean-accented speakers or different English words. This experiment gives evidence to the influence of priming effect on Korean speakers' English pronunciation. On the other hand, the evidence that priming effect is only shown when Korean participants received the vowel production from native English speakers; Priming effect did not have an effect when the Korean speakers were primed by English produced by Korean-accented speakers (Pronunciation of Korean speakers did not shift toward Korean accented English compared to their baseline performances). This evidence suggests that priming in spoken dialogue is not automatic. Priming can be flexible (This implies a high-level awareness). The lesson here is that we do not want to involve a pragmatic factor in our unconscious priming design.

A novelty effect in phonetic drift of the native language

Chang (2013) investigate a novelty effect in phonetic drift of L1. In Chang (2012) paper, he found that the L1 (native tongue) of a bilingual can be altered by the acquisition of L2 (phonetic drift). In this paper, he investigates the intensity of such phonetic drift. Phonetic drift of L1 following recent L2 experience is reduced as a consequence of familiarization with the L2. Alternating usages between L1 and L2 tend to minimize the magnitude of L1 phonetic drift by way of allowing the L1 system to recover from the influence of recent L2 experience. Chang (2013) offers strong evidence to support SLM model that the language system of bilingual is dynamic and easily influenced by each other. My object of fall 2019 priming project is to give further evidence to Chang's claim.

Fall 2019 Proposal

I would like to conduct research on the priming effect between L1 and L2. The subjects of the study are Colgate's Mandarin-English bilinguals. In the first experiment, we will use L1 to prime L2 and vice versa by using the paradigm discussed in Hwang et al. (2015). For example, we may use Mandarin to prime English (by using Mandarin and English words that are similar to each other apparently but still differ in phonetics realization). There are two ways to prime participants: production or perception. For production, we ask the participants to first produce a word in Mandarin, and immediately follow that we ask the participants to pronounce the phonetically similar English word. For perception, participants will perceive a Mandarin word, for example, and try to produce the phonetically similar English word. The theoretical importance of this research is aiming to contribute to the debate between SML and L2LP. The hypothesis is that the priming of English to Mandarin will generate a stronger effect than the priming of Mandarin to English since participants' L1 are Mandarin.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☒ UNST Div.
☐ Other (specify):

Research Fellow: Joshua "Josh" Liberman (2022) **Concentration: Astronomy/Physics**

Faculty Mentor: Thomas Balonek **Department: Physics and Astronomy**

Title of Project: DSLR Astrophotometry of the Eclipsing Binary Star Beta Lyrae

Project Summary:

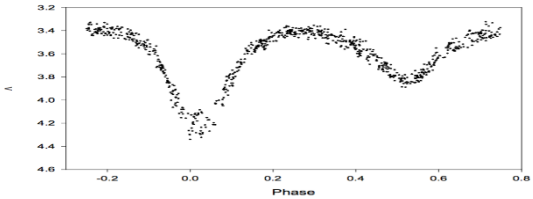
This summer, we conducted research on astrophotometry--the study of the brightness of astronomical bodies. Our goal was to perform astrophotometry using Nikon D3500 DSLR cameras. This project was challenging in that DSLR cameras have been traditionally used to capture "pretty" images. In order to use DSLR cameras for science, we developed a procedure that would preserve as many pixels from our original image as possible.

The first step in this data preservation process was to save our camera images in the RAW file format instead of the JPEG file format. Whereas JPEG images are processed and compressed, reducing the file size and the number of pixels in the image, RAW images are completely unprocessed. The next step of the process was to interpret the information present in our RAW image.

The CMOS sensor built into our DSLR camera has one layer of pixels that measures the intensity of light in monochrome and, above that, a layer of filters that separates out red, green and blue light. We found that the computer, and the image processing software, displaying our image cannot tell which pixels have which filter. Therefore, we must assign red, green, and blue filters to each pixel in a process called "debayering." Using the software PixInsight, we found a debayering algorithm that is ideal for conducting photometry called SuperPixel. While many image softwares employ debayering algorithms that interpolate, getting rid of pixels or creating superficial ones, the SuperPixel algorithm preserves all pixel information.

After debayering, we focused on taking calibration frames. My work was centered largely around flat calibration frames. Flat frames are images of a smooth surface that is uniform and color and brightness. These images are meant to compensate for any dust, smudges, or darkened corners (vignetting) that appear on the lens. I took 24 flat frames using the sky as my "smooth" surface. Due to the natural gradient caused by the sky, appearing as lines running across the image, I rotated the camera 90 degrees after every picture. By averaging the rotated flats, I obtained a master flat frame that had no gradient.

To test the viability of our image processing techniques, we took images of Beta Lyrae and plotted its light curve. Beta Lyrae is an eclipsing binary star--a system of two stars orbiting around their center of mass. The eclipsing of Beta Lyrae, caused by one star passing in front of another as viewed from Earth, results in a periodic brightness variation. This light curve was expected to be wave-like in motion with one large dip in brightness caused by the larger star eclipsing the smaller star and one small dip caused by the smaller star eclipsing the larger star. At the bottom is our expected light curve showing visual magnitude vs. phase--fraction of the way through Beta Lyrae's orbit. The data was taken from telescopes at Villanova University and Mount Hopkins, Arizona.



To calculate the uncertainty due to the DSLR camera's electronics, we used flat calibration frames to calculate the gain of our cameras. The gain told us how many photons the camera's sensor can store before reaching full capacity. Knowing the gain allowed us to determine our cameras' signal to noise ratio.

Unfortunately, the Beta Lyrae data we collected with our DSLR cameras was not usable, as all of our images were saturated or too bright for the camera's sensor. This was very disappointing, however, our research in astrophotometry helped lay the groundwork for future research in this field. Our procedure for preserving pixels in astrophotography images can be used when someone wants to measure the optical variability of a star that is lower in magnitude than that of Beta Lyrae.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Justus '43 and Jayne Schlichting Student Research Fund

Research Fellow: Amanda Lue (2022) **Concentration: Undeclared**

Faculty Mentor: Linda Tseng **Department(s): Environmental Studies; Physics and Astronomy**

Title of Project: Monitoring Nutrients and Trace Chemicals in Local Waters

Project Summary:

Hamilton, New York is a unique place to test water quality because it is located at the start of the Susquehanna River Watershed and so there are few upstream contaminants. Ultimately, this water empties into the Chesapeake Bay accumulating substances such as metals, nutrients and pharmaceuticals along the way, and can have adverse impacts on the Chesapeake ecosystem as a whole. This study aims to understand the relationship between wastewater and the water content of the local water because treated wastewater empties into the Payne Brooke that flows through the town. Furthermore, Hamilton is an agricultural area so runoff nutrients such as phosphorus and nitrogen from fertilizers are of concern because this can lead to eutrophication of waterways throughout the system, thus decreasing the oxygen content of the water and killing organisms essential to the ecosystem. In order to investigate which sites were contributing to the nutrient load, we collected water samples from 7 sites along the Payne Brook and flow data from sites where the stream was accessible.

The water samples were analyzed using standard methods of total suspended solids (TSS) and volatile suspended solids (VSS), and using instruments gas chromatography/mass spectrometry (GC/MS) and ion chromatography (IC). TSS measures the total mass of organic and inorganic particulate and the VSS measures the mass of organic particulate in the water. 0.45-µm filters were weighed in aluminum weighing dishes and then 20 mL of the sample was passed through the filter and this was repeated for 3 filters. The dishes and filters were then placed in an oven at 105°C for one hour and the difference in mass before and after was taken to be the TSS. The dishes were then placed in a furnace at 550°C for one hour and the difference between mass after the oven and mass after the furnace was taken to be VSS. A 40-mL aliquot of the sample was filtered through a 0.2-µm filter and a portion of this was diluted in a 1:20 ratio with Milli-Q water to be analyzed on the IC which produces information the concentration of various ions in the sample water. The remainder of the sample was filtered through another 0.45-µm filter and then run through a solid phase extraction (SPE) cartridge filter, and then the cartridge was eluted with 5 mL of methanol into a glass vial. An aliquot of 0.5 mL of the concentrated sample is transferred into the GC/MS vials to be analyzed on the GC/MS which provides information on the concentration of various drugs in the sample water.

Flow rate data was measured using Flow Mate at 20%, 60% and 80% depth at three points across the river width. Using this data, we calculated average velocity and cross sectional area (fig. 1) on Matlab in order to find the load of substance per day. We also fit a surface to the approximate velocity data over the cross section of the river using the riverbed as a boundary condition at which the velocity of the river approaches zero (fig. 2).

We found that wastewater content actually contributes very little to the mass load per day of ions in the water of the receiving sites even though the concentration of the wastewater was much higher than that of the various sites. The concentration seemed to actually depend more on the flow rate of the particular site since the flow rate of the wastewater was so low. For example, the effluent had flow rate of 1495.2 m^3/d flow and the sampling site SILO had a flow rate of 16718.8 m^3/d. Consequently, if a site had a high flow rate, it would also have a high concentration of ions. Additionally, most chemicals such as BPA were inconsistently found in detectable but low concentrations that followed no particular pattern going downstream, (fig. 3) which led us to believe concentration had more to do with factors such as groundwater than wastewater. In the future it would be interesting to test the concentrations of other pollutants like anions such as phosphates which also contribute to eutrophication.

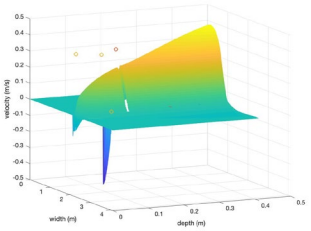


Fig 1. 2D river velocity profile.

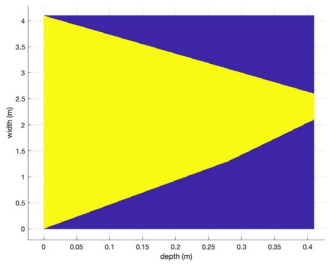


Fig 2. 3D river velocity surface

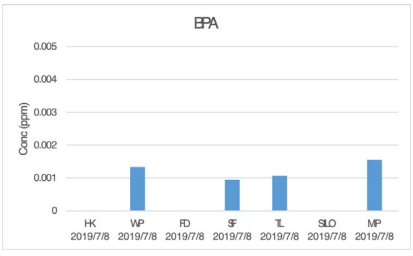


Fig 3. BPA concentration at various test sites

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☒ UNST Div.
☐ Other (specify):

Research Fellow: Caileigh Lutz (2020) **Concentration(s): Biology; Educational Studies**

Faculty Mentor: Krista Ingram **Department: Biology**

Title of Project: Genetic Correlates of Seasonal Affective Disorder (SAD) in a Refugee Population in Upstate New York

Project Summary:

This summer, I studied seasonal affective disorder (SAD), which is defined as a depressive mood disorder usually affecting individuals in the winter and late fall. SAD is hypothesized to be a result of decreased sunlight exposure. The symptoms include but are not limited to tiredness, feelings of hopelessness, overeating, and loss of motivation. Current research suggests that SAD is caused by a combination of genetic and environmental factors, including changes in the internal circadian rhythm. There were two distinct populations that were studied. The first was primarily Caucasian that were associated with Colgate University, while the second was comprised of Burmese refugees located in Utica, NY. By looking at both qualitative data and quantitative data we aimed to determine whether certain mutations in each gene of study increase one's chances of having SAD. The qualitative data was collected by having each of the participants participate in a few surveys that measure chronotype, seasonality, depression, and general demographics. Quantitative data was measured by examining the DNA taken from the participants hair follicle through the use of qPCR to identify their genotype.

The gene that I focused on this summer is G-protein beta 3 subunit (GNB3). The single nucleotide polymorphism (SNP) that was analyzed is rs5443, better known as C825T variant. The possible genotype variations are C,C, C,T, and T,T. C,C has the most common frequency and less risk of metabolic conditions while variations that contain a T allele have a higher risk for metabolic conditions, diabetes, and hypertension. GNB3 is interesting to study because it does not deal directly with circadian rhythms, like the other three genes that were being observed this summer. A previous study showed a positive correlation between carriers of the T allele and global seasonality score, as well as body weight. Although there are few studies of GNB3 and its association with circadian-related disorders, this gene could affect outcomes of SAD, body weight, energy level and appetite. Interestingly, variants of GNB3 also appears to show greater effects in females than males (Nam et al., 2018).

Interestingly there was a negative correlation found between the reduced Horne-Ostberg Morningness-Eveningness Questionnaire (rMEQ), which measures diurnal preference and Munich Chronotype Questionnaire (MSF), which measures sleep-wake chronotype. This was one of the more interesting correlations we found. Unfortunately, when rs5443 was analyzed using qPCR, most blanks were amplified. This means that they were contaminated. Therefore, formulating any conclusions was difficult since we could not rely on the genotypes that the qPCR was producing.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Connor Madalo (2020) **Concentration(s): Molecular Biology; Economics**

Faculty Mentor: Barbara Hoopes **Department: Biology**

Title of Project: Molecular Genetics of Body Size in Dogs

Project Summary:

My research this summer was on the study of dog growth genes. As a species, dogs exhibit extraordinary variation in size, with breeds varying from a 4lb Chihuahua to a 180lb Great Dane. By applying techniques in molecular biology to explore the expression of these genes, researchers can begin to explain some of this incredible variation in size. With this information, scientists can better understand how these genes operate not only in dogs, but across a wide variety of mammalian species.

My project this summer explored a gene called TBX19. TBX19 is a key transcription factor in the production of adrenocorticotropic hormone (ACTH), which helps maintain body weight, form muscle, and regulate blood sugars. In 2016, a genome wide association study (GWAS) of over 700 dog genomes found TBX19 to be highly associated with dog size. However, the mechanisms that explain this association in dogs is still unknown.

The expression of genes is greatly controlled by a region on the gene called the promoter, which regulates the binding of transcription factor proteins. Mutations in the DNA sequence at these regions can significantly impact a transcription factor's ability to effectively bind, causing variation in the expression of the gene. Differential expression of TBX19 may therefore explain the gene's association with dog size.

In dogs, no previous studies have investigated the promoter region of TBX19. It is for this reason that this summer I took up the task of sequencing this region in dogs to search for a mutation that may explain differential expression that potentially causes growth variation. To accomplish this, a sample of small poodles were selected, half having one genotype for the gene and half having the other. I then identified suspected transcription factor binding regions by using the University of California Santa Cruz Genome Browser. Finally, I sequenced these regions and compared the sequences to look for mutations in the DNA (Figure 1).

During sequence analysis, a single cytosine insertion was found in the GATA2 region in GG dogs but was absent in AA dogs. This insertion in GATA2 may affect transcription factor binding and, therefore, TBX19 expression. However, further research using binding prediction computer software is needed to investigate where specifically the GATA2 protein may be binding on the sequence.

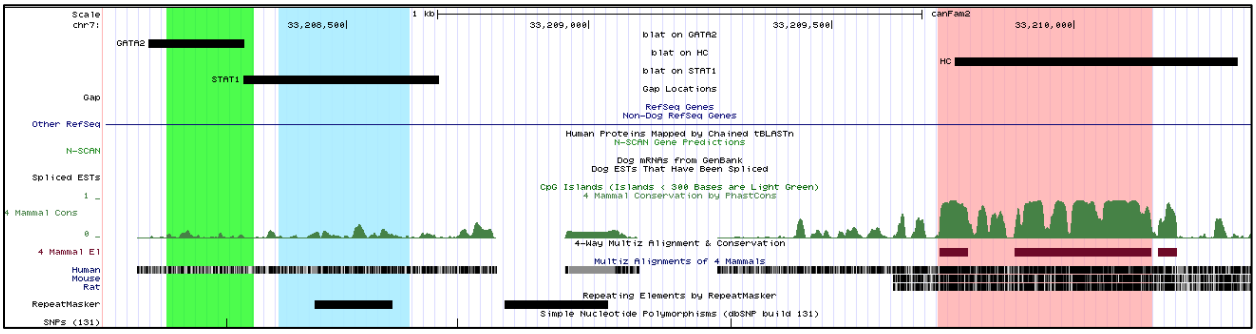


Figure 1. Sequence Coverage of Promoter Region of TBX19 Gene. Highlighted regions represent suspected binding sites of transcription factors GATA2 and STAT1 as well as a highly conserved (HC) region in the dog genome. Black labelled bars indicate where sequence was obtained. A single cytosine insertion was found in the GATA2 region in GG dogs but was absent in AA dogs.

The results of my project demonstrate that much remains unknown about TBX19 in dogs. I used whole genome sequences data for the TBX19 region and did not find any mutations in the exons of the gene, suggesting that a mutation in a regulatory region in the sequence may explain the gene's association with growth.

With more research into this gene and others suspected to be associated with size in canines, scientists hope to better understand growth across a large variety of mammalian species and make major advancements in both genetics and medicine.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Eric Matt (2022) **Concentration(s): German; Physics**

Faculty Mentor: Beth Parks **Department: Physics and Astronomy**

Title of Project: Analyzing Airborne Particulates to Determine Sources of Ugandan Air Pollution

Project Summary:

Airborne particulates (pollution) cause 4.2 million deaths worldwide each year, according to the World Health Organization. Most of these deaths are in developing countries, where air quality is not regularly monitored. Over this past summer I worked with Professor Parks on analyzing particulates to determine the sources of Ugandan air pollution. Uganda is a country that is experiencing rapid industrialization, and, as is common in many developing countries, this industrialization leads to unhealthy levels of air pollution. Despite there being numerous consequences of poor air quality, few measurements have been done to test the quality of Ugandan air and thus the major sources of pollution are unknown. This is where my work done over the summer becomes relevant. The goal of Professor Parks's project is to develop a method with which the elemental composition of airborne particulates can be reliably determined. With accurate elemental data, it becomes possible to trace particulates back to their sources and as a result, determine which pollution sources need to be addressed most urgently in Ugandan policy.

Professor Parks, alongside a Ugandan PhD student, collected particulates from the air at three different sites in Uganda. The chosen sites (Mbarara, Kyebando, and Rubindi) represented a wide range of urbanization. The particles collected were selected to have diameters less than 10 micrometers (μm), so they are small enough to be inhaled and reach the lungs.

The technique I used to analyze elemental composition is total reflection x-ray fluorescence spectroscopy (TXRF), which works by exciting electrons via an x-ray radiation source (molybdenum), causing a transition in their energy levels. This energy level transition releases a photon with an energy that is characteristic of a specific transition for a specific element. This process is known as fluorescence and it allows us to quantify concentrations of many elements by comparing the detected element to a known internal standard. I used this technique alongside various methods of sample preparation to find a way to reliably detect concentrations for silicon. Silicon accounts for roughly 25% of the Earth's crust and so it is imperative for this project to be able to accurately detect silicon's concentration. However, it is very challenging to detect using TXRF because it is such a light atom.

Over the course of the summer we had a few interesting thoughts and observations that eventually led us to being able to detect silicon more accurately than we have ever before. At first we were suspicious of the silicon precipitating out of the solution via other elements that we added in; however, as we got further into the project we became more confident that the silicon was, in fact, not precipitating out of the solution. We then went on to try different methods of sample application including our self-invented "double-dry" method. This seemed promising at first, but we eventually found that the results were not consistent and thus this method was abandoned. Near the end of the summer we began playing with the concentration of the sample that we were analyzing, and it was with this change that we were able to finally reach our goal of detecting silicon. We found that in samples where the concentration of silicon is greater than 5 mg/L, silicon will only be detected at around 50% (or less) of its known value.

I learned a great deal over the timespan of this project, but perhaps the most important was me learning to think independently. Professor Parks gave me a lot of guidance throughout this project, but I also had to draw conclusions and generally think for myself. It is a skill I have not had to use much of before, but also one that I fully intend on developing in the future. I am very grateful to have had the chance to work on this project as it combined two of the most wonderful things; physics and the environment!

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Justus '43 and Jayne Schlichting Student Research Fund

Research Fellow: Patrick Matulka (2019) **Concentration: Astrogeophysics**

Faculty Mentor: Joseph "Joe" Levy **Department: Geology**

Title of Project: Exploring Martian Climate through Mapping of Glacial and Permafrost Landforms

Project Summary:

This summer I primarily worked on the Titan Tumbler project, which involved expanding on previous experiments along with continued analysis of past and current results. The Titan Tumbler is a roller mill used to round ice clasts and measure their mass and circularity under specific conditions such as temperature, initial clast shape, and distance tumbled. Results from this laboratory analog will allow for a more quantitative understanding of the mechanisms responsible for creating the rounded cobbles of ice seen on the surface of Titan, a moon of Saturn, from the Huygens lander. Images from that mission depict cobbles – up to several centimeters in length along an axis – that resemble cobbles found on Earth in a riverbed, for example. Satellite images of Titan also reveal channels with similar characteristics to terrestrial river channels. Radar images of these channels suggest that the size of clasts contained within them decrease in size down channel, comparable to river systems on Earth.

Figure 1 The Titan Tumbler during a tumble. Liquid nitrogen (LN2) was pumped into the bin holding the barrel from the container behind the Tumbler labelled "Nitrogen." Steam is seen coming from the bin as the LN2 cools the surrounding air, condensing water vapor. The tower behind the barrel shows the chain powering the rotation of the barrel as a constant rate. In front of the Tumbler, a thermocouple extends from a hole in the lid of the barrel and connects to a reader, not pictured.

My initial goal with this project was to establish a data set of clasts tumbled over several km at temperatures close to that on the surface of Titan (~100 K). These previous experiments with the Tumbler generally indicated that ice clasts rounded rapidly over the first km before levelling off at a certain circularity value for the remainder of tumbling. Ice clasts tumbled at colder temperatures (~100 K) rounded slower than those tumbled at warmer temperatures (~190 K) and to lower circularity values – 0.9 at 100 K compared to 0.95 at 190 K. Additionally, nonequant clasts rounded more rapidly over the first km of tumbling than equant clasts before assuming similar rounding rates for the remainder of tumbling. Igneous ice clasts, made of frozen water, and sedimentary clasts, made by refreezing ice grains in a water cement, rounded at comparable rates.

In order to expand on these data, I studied the distribution of fine grains produced by the comminution of the tumbling ice clasts. Several trials were necessary to ensure accurate measurements of the mass of the sieved clasts. The small quantities, as well as small size, required scale precision on the order of 0.1 g. This proved to be problematic while working in a well-circulated, walk-in freezer, which kept the temperature at -20 °C. Once measurements of the fine grain debris began with greater precision, I found that finer grains were produced by the collisions of larger clasts. The implications of this are that these tumbling clasts round and so could produce cobbles as seen on the surface of Titan. Another consequence is that these cobbles may be a source for fine grains, such as ice sand, that could be blown and accumulate in dune fields observed in other regions of Titan. While further work is needed to analyze the specific quantities of the fine grains, I helped to establish data that will assist in understanding the geologic processes of Titan, which may have many similarities to Earth despite numerous differences.

Another part of my summer research involved assisting other students working for Professor Joe Levy with mapping lobate debris aprons on Mars using ArcGIS. These features consist of boulders on the surface of glaciers that originate along steeper topography and flow towards lower elevations. The boulders, which appear in clusters or bands, may contain information on the depositional environment in that region of Mars at the time they were deposited there. Thus, mapping these features could assist with uncovering the geologic history of Mars.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): NASA Mars Data Analysis Program

Research Fellow(s): David Maynard (2021) Cameron "Cam" Patrick (2022)
Concentration(s): Molecular Biology; Spanish
Concentration: Undeclared

Faculty Mentor: Jason Meyers
Department(s): Biology; Neuroscience

Title of Project: Mantle Cells as Progenitors in the Regeneration of Zebrafish Neuromasts

Project Summary:

Zebrafish (Danio rerio) are excellent model organisms due to strong retention of genetics, development, and physiology with humans (Meyers 2018). Like many fish, they have a mechanosensory lateral line system which detects the pattern of water movement over their bodies (Chitnis 2011). The lateral line is composed of a collection of organs called neuromasts. These organs contain several mechanosensory hair cells surrounded by populations of internal and peripheral support cells (Head et al., 2013). These hair cells are similar to hair cells found in the human ear. Neuromasts also contain mantle cells which form an outer ring around hair and support cells (Seleit et al., 2017). Unlike in humans, the sensory hair cells of the zebrafish regenerate (Romero Carvajal et al., 2015). It is known that support cells give rise to hair cells, but the transition between mantle cells to support cells has not been sufficiently explored (Pinto-Teixeira et al., 2015).

In order to determine if mantle cells function as progenitors in neuromast regeneration, selective laser ablations were performed on hair and support cells of larval zebrafish. The ablations were performed on fish that had been exposed to Hoechst nuclear dye (0.5 ul per 1 mL of media), which binds to DNA. Hoechst dyed cells exposed to the highest intensity UV light on the confocal experience cell death due to the DNA damage caused by the excitation of the nuclear dye. With the confocal's ability to set boundaries for the high intensity UV light, only targeted cells experienced cell death, allowing for selective lesioning of different cell populations in individual neuromasts (A).

After lesioning the hair and support cells while preserving the exterior mantle cells, still images were taken at various time points to document regeneration. Within 24 hours, mantle cells were observed to be fully filling in the region left by the lesioned hair and support cells. Within 3 days, neuromasts returned to a completely normal morphology with the ALPL red fluorescing mantle cells only found peripheral to support and likely hair cells at the center of the neuromast.

Once a system for selective ablation and the regenerative potential of the mantle cells were established, the attention of the project turned to the pharmacological manipulation of signaling pathways. The Wnt/B-catenin pathway is commonly conserved in development and regeneration, and Wnt signaling has been shown to induce proliferation in lateral line neuromasts (Head et al., 2013). In order to determine the effect of this pathway on neuromast regeneration from mantle cells, chemicals functioning to upregulate and inhibit Wnt signaling were included in media and exposed to fish immediately after the ablation of hair and support cells. Fish exposed to media containing 10 µM IWR-1 (a Wnt-blocking drug), had significantly smaller neuromasts three days post ablation than the control (419.45 µM2vs. 1113.69µM2), while fish exposed to media containing the Wnt upregulating drug Azakenpallone-1 had neuromasts far larger than the control (2326.38 µM2vs. 1113.69µM2). This data suggests that the Wnt/B-catenin pathway plays a role in the activation and robustness of neuromast regeneration from mantle cells.

Summarily, our research and observations indicate that mantle cells can function as progenitors for hair and support cells in accord with the proposed linear model by Pinto-Teixeria, with mantle cells serving as progenitors for support cells and those cells ultimately yielding hair cells. Additionally, our manipulation of the Wnt/B-catenin pathway supports the notion that Wnt signaling is essential for mantle cells to function as progenitors, evinced by the lack of proliferation in IWR-1 treated neuromasts.

Figure 1 Figure 2 Figure 3

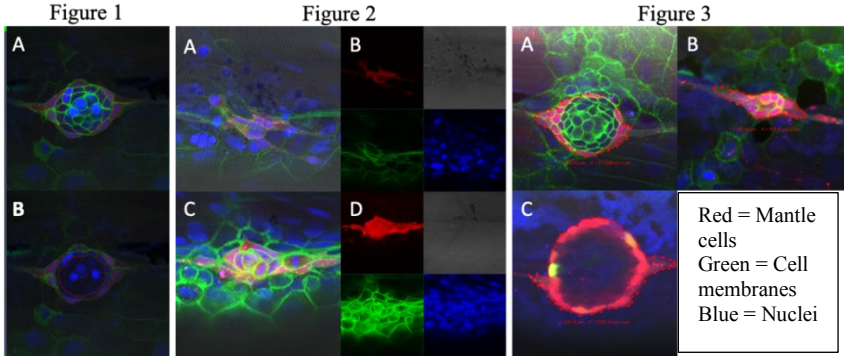


Figure 1: Zebrafish neuromast before (A) and after (B) laser ablation of hair and support cells. Figure 2: Neuromast regeneration after ablation of hair and support cells. A) Neuromast 3 hours after laser ablation. Mantle cells have migrated to the center of the organ. B) Split image view of neuromast 3 hours after ablation. Same neuromast as found in Figure 2-A. C) Neuromast 24 hours after laser ablation. D) Split image view of neuromast 24 hours after ablation. Same neuromast as found in Figure 2-C. **Figure 3: Pharmacological manipulation of regenerating neuromast after ablation of hair and support cells.** A) A control neuromast, fully recovered, 3 days after ablation. B) Neuromast treated with IWR-1 drug immediately following ablation. 3 days after ablation. C) Neuromast treated with Azakenpallone-1immediately following ablation. 3 days after ablation.

References: 1) Meyers, J. R. (2018). Zebrafish: Development of a vertebrate model organism. Current Protocols Essential Laboratory Techniques, e19.doi: 10.1002/cpet.19 2) Chitnis, A.B., Nogare, D.D., Matsuda, M. 2011. Building the Posterior Lateral Line system in Zebrafish. *Dev Neurobiol* 72(3):234-55. 3) Head, J. R., Gacioch, L., Pennisi, M., & Meyers, J. R. (2013). Activation of Canonical Wnt/b-Catenin Signaling Stimulates Proliferation in Neuromasts in the Zebrafish Posterior Lateral Line. Developmental Dynamics,242, 832-846. 4) Seleit, A., Krämer, I., Riebesehl, B. F., Ambrosio, E. M., Stolper, J. S., Lischik, C. Q., . . . Centanin, L. (2017). Neural stem cells induce the formation of their physical niche during organogenesis. *ELife,6.* doi:10.7554/elife.29173 5) Romero-Carvajal, A., Navajas Acedo, J., Jiang, L., Kozlovskaja-Gumbrienė, A., Alexander, R., Li, H., & Piotrowski, T.(2015). Regeneration of Sensory Hair Cells Requires Localized Interactions between the Notch and Wnt Pathways. 6) Pinto-Teixeira, Filipe et al. "Inexhaustible Hair-Cell Regeneration in Young and Aged Zebrafish." *Biology Open* 4.7 (2015): 903–909. *PMC*. Web. 10 July 2018.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Michael J. Wolk '60 Heart Foundation; Oberheim Memorial Fund

Research Fellow: Dylann McLaughlin (GR) **Concentration: English (MAT)**

Faculty Mentor: Julie Dudrick **Department: Upstate Institute**

Title of Project: Yleana Academy "Design-Thinking and Entrepreneurship in a Leadership Academy Curriculum"

Project Summary:

This summer I had the privilege of working with the Yleana Leadership Academy through the Upstate Institute. Yleana Leadership Academy is a not-for-profit organization whose mission is to close the achievement gap through their intensive SAT preparation program and continuous support of low-SES students from urban areas. Yleana holds two three-week sessions of camp every summer— the first at Colgate and the second at Mount Holyoke. The students take classes to support their learning of SAT strategies as well as self-advocacy, organization, and college readiness. They study hard each day and take five practice SATs during their time at camp. They also get to experience a small part of what a residential college can offer them: living in the dorms, eating at the dining hall, and taking advantage of the many resources that the two campuses have available. Their day outside of class is filled with games and activities that provide opportunities for the students to bond and put their academic skills to work in a fun and creative way.

In addition to their SAT preparation, Yleana campers take a course of ten sessions that culminates in a "One-Day Startup Fair" on the final day of camp. In the past, this class focused solely on entrepreneurship. Students worked in groups to develop a product or service that they pitched to a panel of "investors" (made up of teachers and volunteer entrepreneurs) on the day of the fair. This year, I was tasked with changing the course to design-thinking, or "d.thinking" for short. We decided to focus more on building critical thinking skills that would support students' exploration of entrepreneurship. I developed activities that ranged from abstract thought experiments to visual thinking strategies to critical media literacy. We explored the phenomenon of fake news, how data can be used and skewed to support an argument, the elements of visual representation, and strategies for thorough and effective research.

At the same time, students learned about entrepreneurship and created their own ventures, applying their critical thinking skills to the task. An important part of my job was recruiting entrepreneurs to volunteer their time for the One-Day Startup Fair. It was incredibly beneficial to have real entrepreneurs serve as positive role models for the students and provide them with advice on their presentations and future endeavors. Many students made connections with these volunteers and expressed how grateful they were to have met them.

This summer was an experience like no other, and I'm so thankful for the opportunities that the Upstate Institute has given me to be able to work with great organizations like Yleana. I made meaningful connections with campers and was able to design a curriculum that was important to the work of the camp, the lives of students, and my own teaching career.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow: Braden "Brady" Mediavilla (2020) Concentration(s): Chemistry; Neuroscience

Faculty Mentor: Anne Perring Department: Chemistry

Title of Project: Measurements of Black Carbon Aerosol in Fire Plumes

Project Summary:

The FIREX-AQ campaign aimed to improve understanding of biomass burning emissions for health, modeling, and climate applications. The collaborative project integrated satellite, aircraft, mobile lab, and ground measurements to provide a thorough, multivalent understanding of these events and their impacts. Black carbon (BC) particles are a component of atmospheric aerosol with both significant health effects and climate-forcing potential that is, by some estimates, second only to that from CO_2. Biomass burning is the largest source of BC on a global scale (Bond et al., 2013) yet the production, optical properties, transport and transformations of these emissions remain poorly understood. Upon emission, black carbon cores begin accumulating coatings of other plume components through various chemical and physical processes and these internally mixed materials can enhance the BC light absorption through lensing (Lack et al., 2012). Measurements of coating thickness and other black carbon optical characteristics can give insight into how these processes differ in various types of plumes.

The NOAA single particle soot photometer aboard the NASA DC-8 aircraft was the primary method for measuring these particles as it flew through these plumes ejected into the atmosphere by biomass burnings. During the deployment to Idaho, I worked with professor Perring and the NOAA team to operate and maintain the instrument, including periodic calibration, laser alignment and adjustments to detector placements. I flew with the instrument occasionally to adjust instrument parameters in real time to facilitate quality control of our data and to optimize detection under flight conditions. I also began looking at the evolution of BC coating thickness in the sampled plumes and presented my findings at an afternoon science team meeting.

Figure 5: A pyrocumulus cloud generated by convective instability and a significant vertical emission profile of the Ridge Top Fire in Montana as seen from a window of the DC-8. Taken 02 August, 2019 by Bernadett Weinzierl, University of Vienna.

My preliminary analysis showed consistent increases in coating thickness with atmospheric processing but with interesting variability between fires. I also looked at BC mass median diameter and found moderate variability but less clear trends with aging. In the coming year I will continue my analysis, incorporating a wider array of data products including reports of fuel types from fire-fighting teams on the ground, measurements of fire behavior from satellite overpasses and aircraft data from other groups measuring various aerosol and gas phase species. I am developing other metrics by which to determine the speed of atmospheric aging so that we can better determine the processes which control BC emission and evolution and to facilitate comparison of starkly different fire plumes. The goal of the research is to gain understanding of the factors that modulate black carbon emissions from wildfire, to what degree, and how they modulate the effects of other factors. From this, the atmospheric science community can develop more accurate emissions models to better predict the transport and transformation of biomass burning aerosols and their associated climatic and health effects.

Bond, T. C., et al. (2013), Bounding the role of black carbon in the climate system: A scientific assessment, J. Geophys. Res.-Atmos., 118(11), 5380-5552, doi:10.1002/jgrd.50171.

Lack, D. A., J. M. Langridge, R. Bahreini, C. A. Brock, A. M. Middlebrook, and J. P. Schwarz (2012), Brown Carbon and Internal Mixing in Biomass Burning Particles, Proc. Natl.Acad. Sci., submitted, doi:10.1073/pnas.1206575109.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Yan "Molly" Meng (2021) **Concentration: History**

Faculty Mentor: Jing Wang **Department: East Asian Languages and Literatures**

Title of Project: "Middle" as Method: Chinese Worldview of Heaven, Earth, and Human

Project Summary:

The research project I participated in this summer focused mainly on building up epistemological approaches in order to conduct East-West comparative studies in constructive ways, instead of the current norm of one-sided adoption of Western perspectives. In this 10-week period, the various kinds of work I did - taking notes, organizing notes, discussing notes with the professor, interacting with the professor on specifics of her project - provided me with critical perspectives on my disciplinary concerns as a history major and my academic directions toward East Asian studies, particularly in consideration of how to develop more useful and usable language to talk about the East, China in particular, in today's fast-changing and multi-center world. In the process I have gained insights on methods to do Chinese studies with more awareness of Western lenses and of the need to engage basic worldview of the Chinese civilization, including views, values, and ways to knowledge as embedded in the Chinese language.

One special thing I want to emphasize is our methodological approach to the received sources. Instead of only summarizing and discussing the specific details, theories and arguments, we paid special attention to the intellectual framing and overall direction for the works we interpreted. When going through the general framing of specific sources, we checked the validity of works' logical reasoning, in terms of whether the perspectives could remain reasonable and inspiring in a larger content, in a global intellectual knowledge system, which is not being narrowed or limited by the Western-centered way of reasoning. Simultaneously, we tried to stay aware of the vocabularies used to describe Chinese views and values, along with categories and perspectives that the author tended to ignore.

The professor and I did what had been planned, with creative flexibility. We met every day most days of the week, occasionally on Sunday afternoons.

Source of Support: ☒ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow(s): **Emily Metzger (2021)** **Concentration(s): Molecular Biology; German**
Camila Napuri (2021) **Concentration(s): Molecular Biology; Spanish**
Katherine Pasterczyk (2021) **Concentration: Molecular Biology**

Faculty Mentor: Priscilla Van Wynsberghe **Department: Biology**

Title of Project: Molecular Analysis of Development in *C. elegans*

Project Summary:

We investigated the effects of plasticizers on behavior, reproduction, and growth of *Caenorhabditis elegans* over multiple generations. Plasticizers are organic compounds used in plastics to increase their flexibility. They are prevalent in many everyday items such as plastic utensils, and because of this easy exposure it is imperative to understand the effects that they may have on humans. We identified three plasticizers that have been commonly used in plastics, DEHP, ESBO, and Mesamoll, to use for the purposes of this study. DEHP, or di-2-ethylhexyl phthalate, is one of the most widely used plasticizers. Not only can it be found in everything from garden hoses to blood bags, it is banned in the EU as prolonged exposure has been shown to have adverse effects on fertility, making it a possible carcinogen. There has been considerably less research performed on ESBO (epoxidized soybean oil) and Mesamoll (a general purpose plasticizer), but both have been used as alternatives to DEHP, so it is prudent to discover if they have similar effects. To better understand the impacts in humans, our lab utilized the model organism, *Caenorhabditis elegans*. *C. elegans* serve as an incredible model organism because their entire genome has been sequenced, they have fast reproduction, short lifespans, and a high similarity to humans. Over the course of the study, the characteristics that we observed were neurological function, locomotive behavior, reproduction, and growth. In order to do this, the parent generation, F0, was grown on media containing a range of DEHP, ESBO, and Mesamoll that corresponded to levels found in the environment. Those nematodes were then subjected to tests on neurosensitivtiy (through touch response), chemical aversion, fertility, and growth. Once all the appropriate assays were performed, the plates were washed, and eggs from that generation were plated onto new plates with media that did not contain the presence of a plasticizer. The same assays were performed on this F1 generation. The process of washing, plating, and performing assays was repeated for the F2 and F3 generations in order to observe the effects of the plasticizers in subsequent generations without constant exposure to identify any long-lasting detriments. Overall, we found that the plasticizers had minor effects on neurological function and fertility at high concentrations, which is somewhat contradictory to the current knowledge. Of significance, we found that there was a substantial decrease in growth of the nematodes for each of the plasticizers. Future studies will focus on analyzing altered gene expression patterns in *C. elegans* after plasticizer exposure over multiple generations. Altogether, this work will potentially demonstrate the unknown, harmful side effects that these plasticizers have on *C. elegans* and their implications in humans.

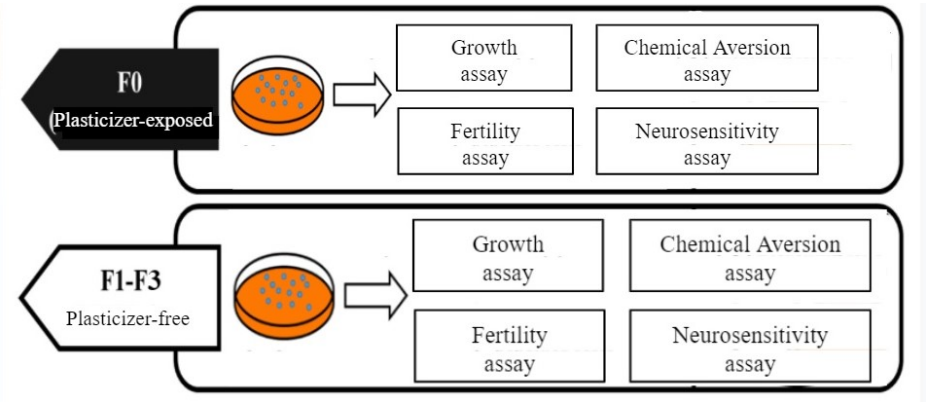


Figure 1: Overview of multi-generational study. The parental (F0) generation was exposed to one of the three chemicals: DEHP, ESBO, or Mesamoll, then assays on neurosensitivity, chemical aversion, growth, and fertility were performed. Each subsequent generation (F1-F3) was allowed to grow on plates without the presence of plasticizers, and the same assays were performed.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Michael J. Wolk '60 Heart Foundation;
Science and Math Initiative-SMI (NASC Division)

Research Fellow(s): **Rachel Meyne (2021)** **Concentration: Geology**
Grace Schreiber (2021) **Concentration: Natural Sciences**

Faculty Mentor: Amy Leventer **Department: Geology**

Title of Project: Characterizing the Biological Signature of Deglaciation

Project Summary:

The primary objective of this project was to characterize the biological signature of deglaciation as recorded in continental shelf sediments from Antarctica. High resolution marine sediment cores from several regions of both the West and East Antarctic margins record a period of rapid change, lasting for a few years to centuries, when ocean conditions resulted in unusual and highly productive marine ecosystems, persisting for the time period over which glacial ice streams rapidly retreated. This project examined this time interval recorded in two sediment cores recovered from the Sabrina Coast of East Antarctica, during cruise NBP1402 aboard the research vessel and icebreaker *N.B. Palmer*. The Sabrina Coast was chosen as our location as it lies at the outlet of the Totten Glacier, one of the most rapidly changing glacial systems in East Antarctica. The Totten Glacier drains through the Aurora subglacial basin, an overdeepened basin whose geometry could potentially foster instability. This is significant in light of modern-day warming, as scientists evaluate the potential for sea-level rise as a consequence of glacial ice melt in Antarctica.

In order to characterize the conditions of the ocean in the past, our lab focused on diatoms, photosynthetic unicellular organisms encased in glass-like siliceous skeletons. Diatoms are sensitive to a variety of environmental variables including nutrient concentration, sea surface temperature, salinity, and the presence or absence of sea ice. Changes in diatom assemblage through a sediment core reflect changing oceanographic conditions over time.

Specifically, we analyzed absolute diatom abundances and assemblage composition in deglacial sediments as a way to infer the paleoceanographic conditions associated with retreating glacial ice. Quantitative slides were made from 2 jumbo piston cores - NBP1402 JPC57 and JPC43 - via a random settling technique. JPC57 is more oceanward while JPC43 is more shoreward. The cross-examination of these two cores allowed us to investigate how deglaciation rates and impacts can vary spatially. This focus on the last deglaciation provides a window through which to understand present-day Antarctica, where atmospheric warming and changing oceanographic conditions appear to be driving ice retreat.

Asteromphalus hookeri

Rhizosolenia sp.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Norma Vergo Prize

Research Fellow: Aleksandra "Sasha" Mikus (2020) **Concentration(s): NEUR; ENGG**

Faculty Mentor: Joseph "Joe" Levy **Department: Geology**

Title of Project: Where is the Limit of Life on Earth? Spoilers: In Antarctica

Project Summary:

This summer I assisted Professor Joseph Levy with his project on Martian Boulder Halos. Boulder halos are rings of rocks, found in mid- to high-latitude flat-lying areas on the surface of Mars (figure 1). The halos are smaller than regular impact craters, but are thought to come about in a similar fashion. Boulder halos are observed on surfaces covered by Latitude Dependent Mantle (LDM), which is an icy mantle layer generated during the last ice age on Mars. An impact excavates and ejects boulders from a boulder-generating substrate underlying the icy mantle. The generated crater is then filled in with ice-rich soil over time, leaving rings of boulders lying on a flat surface.

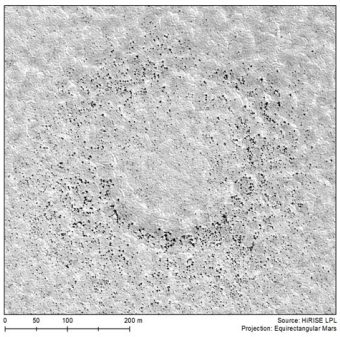


Figure 1. Example of a Martian boulder halo

The similarity between boulder halo and crater generation could suggest similar ejecta characteristics. Boulders around fresh impact craters have a distinct distribution pattern, with larger boulders appearing closer to the impact site. As craters age, boulder distribution becomes more uniform, possibly due to surface processes (i.e. weathering) and their impacts on boulders. A comprehensive dataset is needed to determine whether this pattern holds true for boulder halos.

Current halo mapping technique includes identifying four cardinal transects around the halo, and manually mapping every boulder in ArcMap. Any given halo can have over 2'000 boulders surrounding it, which takes up to two days to map. During the summer, I developed a workflow that allows for automatic boulder detection, reducing mapping time to 3 0 minutes.

Boulder halo images were accessed from the HiRISE (High Resolution Imaging Science Experiment) database at Arizona State University. The images are black-and-white, with a 25x25cm resolution. The workflow presented in figure 2 involves segmenting the image based on spectral detail, spatial detail, and minimum pixel cluster size. The cluster size was set at 4 (minimum boulder size of 1m), the spatial detail at 19, and the spectral detail varied depending on the contrast and pixel characteristics of the image. Following segmentation, training samples were created for boulders, shadows, and relief. The image was classified using 'Train Support Vector Machine Classifier' ArcMap algorithm.

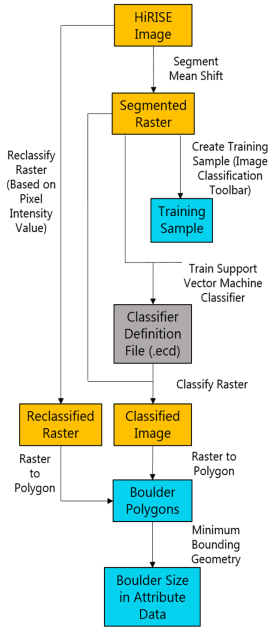


Figure 2. Automatic boulder detection workflow

Class	Boulder	Dark Relief	Light Relief	Total	User Accuracy
Boulder	7290	0	49	7339	**99.33**
Dark Relief	555	10000	2	10557	94.72
Light Relief	2155	0	9949	12104	82.20
% Accuracy	**72.90**	100	99.49		

Figure 3. Confusion matrix for classification workflow

Following classification, boulder detection was assessed using a confusion matrix. Results of manual boulder classification were taken as ground truth data, and compared to classified areas (figure 3). There was a low incidence of false positives and a high incidence of false negatives (0.66%, 27.1%).

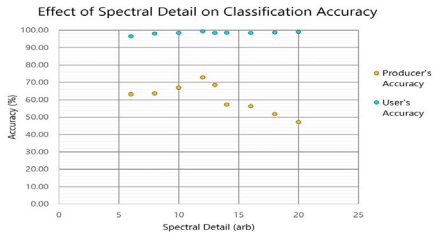


Figure 4. Assessment of spectral detail sensitivity

Lastly, assessment of spectral detail (figure 4) segmentation on classification accuracy showed that increasing spectral detail sensitivity during segmentation increases boulder detection accuracy. After a plateau, subsequent increases in spectral detail sensitivity cause a reduction in boulder detection accuracy.

In conclusion, the boulder detection method needs to be properly fitted to the unique characteristics of each image (such as contrast, resolution, and pixel intensity). Overall, the automatic boulder detection method is effective at correctly identifying boulders, but omits a significant number of data points. Further research is needed into ways of reducing the incidence of false negatives.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Hackett-Rathmell 1968 Memorial Fund

Research Fellow: Elizabeth "Lizzy" Moore (2020) **Concentration(s): PCON; Geography**

Faculty Mentor: Julie Dudrick **Department: Upstate Institute**

Title of Project: Farmers' Museum "Museum Engagement: Utilizing Technology and Participatory Experiences for Young Audiences"

Project Summary:

This summer, I conducted research with the Farmers' Museum and Historic Village in Cooperstown, New York. The mission of the museum is "cultivating an understanding of the rural heritage that has shaped our land, communities and American culture." The goal of this research was to find ways that the museum can engage more effectively with teenagers and young adults. My research involved collecting information on studies of youth engagement in museums and relating this information to the issues facing the Farmers' Museum. My research also included traveling to other museums in the area and conducting interviews with directors to understand how their museum is tackling this issue.

My research focused on three main areas of concentration for improving museum experiences for young audiences: participatory experiences; technology in the museum; and social media. I found that the primary focus of the museum should be to create participatory experiences for its guests. Technology can be used to facilitate participation and social media can be used to document participation, but the experiences are the building blocks. Interpreters should be more encouraging to guests about participating and documenting their participation. As a participatory institution, the museum should allow visitors to create, share, and connect with each other around participatory content.

The Farmers' Museum was originally very interested in developing an app for its visitors. However, my research showed that the museum should not develop an app for the museum, but should redesign their mobile website to be more user-friendly and to include audio that can augment the experience of a guest in spaces where interpreters are not present. Statistically, museum visitors are more likely to use mobile websites than to download mobile apps for their visit. My research indicated that audio can provide a valuable multisensory element to otherwise stagnant exhibits. I recommended that the audio in the mobile website should tell a first-person narrative about life in the time period of the museum and invite guests to participate.

My research indicated that social media can be an effective way to reach young audiences who are accustomed to being digitally connected in nearly every aspect of life. I recommended that the museum should dedicate more resources to their social media presence and design posts to be more similar to the types of posts young audiences see daily. Furthermore, the museum should focus on creating spaces in which visitors can take "Instagrammable" photos that will fulfill the need for the younger audience to document their experience and also strengthen the museum's presence on social media platforms.

I visited The Strong Museum of Play, Old Sturbridge Village, and the Genesee Country Village and Museum. These museums vary widely in their histories, visitor numbers, and institutional goals. However, each placed a high value on participatory learning and enriching the experiences of their visitors. All three museums are investing in programming for all ages and abilities that give attendees the chance to build new skills and to connect with those around them. The Strong Museum designs every exhibit with the intent to facilitate participation and conversation while also displaying artifacts and providing interpretation. Old Sturbridge Village and the Genesee Country Village are both living history museums, so their focus is on how to train their interpreters to encourage participation from visitors and engage in more meaningful conversations about the exhibits. I recommended that the Farmers' Museum take inspiration from these museums to improve the visitor experience for young audiences.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

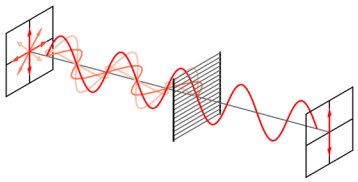
Research Fellow: Anupama "Annie" Motee (2020) **Concentration: Physics**

Faculty Mentor: Enrique "Kiko" Galvez **Department: Physics and Astronomy**

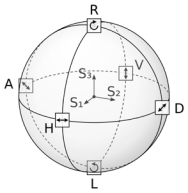
Title of Project: Topological Singularities in Light Beams

Project Summary:

We aim at creating light beams with spatially variable polarizations. Polarization refers to the direction of oscillation of a wave (perpendicular to the direction of propagation of the wave for a transverse wave). Unpolarized light (e.g. light from the sun) contains waves that oscillate in different directions and the process of polarization filters out one specific direction for the light wave to oscillate in. There are several states of polarization (horizontal, vertical, circular, etc.) which can be superposed to create a different state. For example, superposing two beams with horizontal and vertical polarizations respectively creates a beam with diagonal polarization. The Poincaré sphere below illustrates all the different states of polarizations possible.

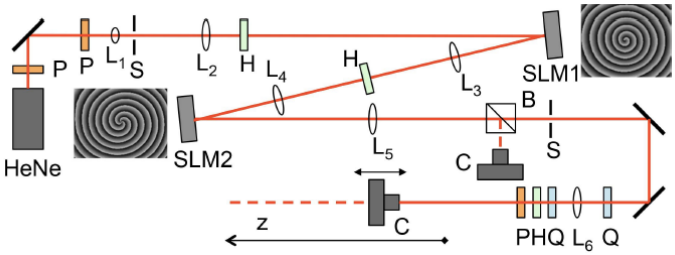


Polarization



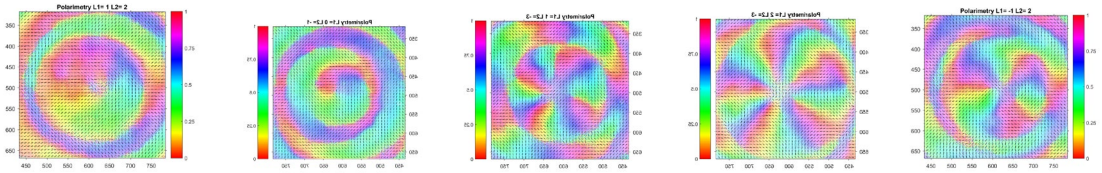
Poincaré Sphere

Our setup consists of a HeNe laser (of wavelength 632.8 nm) which was sent through a half-wave plate to make the light diagonally polarized so that it would have equal amplitudes of horizontally and vertically polarized light. The horizontal part was phase-modulated by a Spatial Light Modulator (SLM) to produce a Bessel beam with topological charge l_1. The beam then goes through another half-wave plate set to 45° which would flip the horizontal and vertical components, and then through a second SLM which would then phase modulate the other component to produce a Bessel beam of topological charge l_2. A quarter-wave plate then converts the two polarization components into circular polarizations and hence produces light encoded according to the equation. The beam then goes through a quarter wave plate, a half-wave plate, a polarizer and finally, a camera which enable us to get images of all six components of polarizations so that a polarimetry measurement can be performed.



Schematic of Apparatus (Photo courtesy of Brianna Holmes '19)

We investigate the different patterns of polarizations produced by different combinations of the topological charges l_1 and l_2. We also verify the patterns against theoretical predictions. We found that the polarization patterns of the beams agreed with theory. Additionally, at a distance of two focal lengths away from the lens, we found that the beam focuses into a ring, which we also imaged. In future work, we aim to investigate the change in pattern of polarization of as a function of distance.



Examples of beam polarization patterns with different combinations of l_1 and l_2

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): National Science Foundation Grant

Research Fellow: Leonardo "Leo" Motta-Zacks (2021) **Concentration: Neuroscience**

Faculty Mentor: Wan-chun Liu **Department: Psychological and Brain Sciences**

Title of Project: Social Influence on the Development of Vocal Learning and Brain Circuits

Project Summary:

In Dr. Wan-chun Liu's lab I examined the social influence on the development of vocal learning and brain circuits within *Taeniopygia guttata*, the zebra finch. My goal for the summer was to add to the existing literature of genes for mapping out subregions of the hippocampus, a brain structure involved in the consolidation of information from short-term to long-term memory. Although the hippocampus has been mapped within rodents, we are interested in using the zebra finch as it provides an excellent visual model for behavior concerning spatial and episodic memory. In order to map these different subregions, genes of known function within the mammalian hippocampus were cloned within the genome of the zebra finch. These genes express in certain known areas of the mammalian hippocampus, and by comparing the two we can identify specific subregions of the hippocampus. After the genes had been successfully cloned, we were able to visualize where clusters of cells that expressed them were found in the hippocampus. Once we are able to map all of these subregions successfully, we can begin to understand the neural mechanism behind episodic memory.

The genes that were cloned and mapped were the hippocampal genes Ptpn5, Calb2, and Mgll. Ptpn5 is a gene expressed in the CA2 region of mammals, while Calb2 is a gene expressed in mossy cells of the dentate gyrus of mammals, and Mgll is a gene expressed in pyramidal cells of the CA3 region and in granule cells of mammals. The different regions of the mammalian hippocampus can be seen in Figure 1. To being cloning, cDNA was made from the zebra finch RNA. Appropriate primers were used and a gel was run to isolate the strands of interest. These DNA strands were extracted from the gel, and then ligated. The ligated DNA was transformed in E. coli, and miniprepped to isolate the plasmid DNA of interest. After the plasmid was cut using an EcoR1 digest, a PCR fragment was made, it was run through a gel, and then extracted to be used as the base for a probe for in situ hybridization.

Coronal brain sections of the zebra finch hippocampus were taken and put onto slides. Once the in situ hybridization probe was successfully synthesized, the slides were then treated with it, and the probe bound to the mRNA targets of the expressed genes of interest. The locations of the fluorescent probes were then visualized through use of microscopy once it bound to the mRNA targets (Figure 2). Further studies must be conducted with more known mammalian hippocampal genes in order to provide further evidence for confidently identifying avian hippocampal subregions.

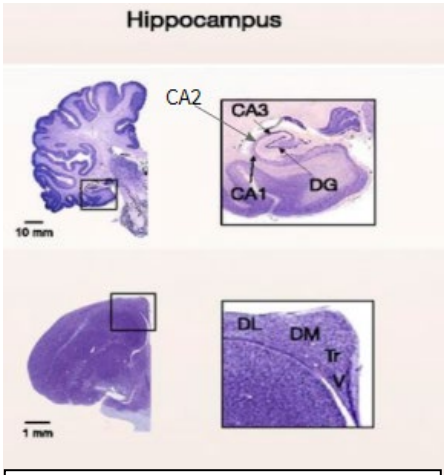


Figure 1: The top image is a coronal section of a human brain, with different known subregions of the hippocampus labeled. The lower image is a coronal section of a zebra finch brain.

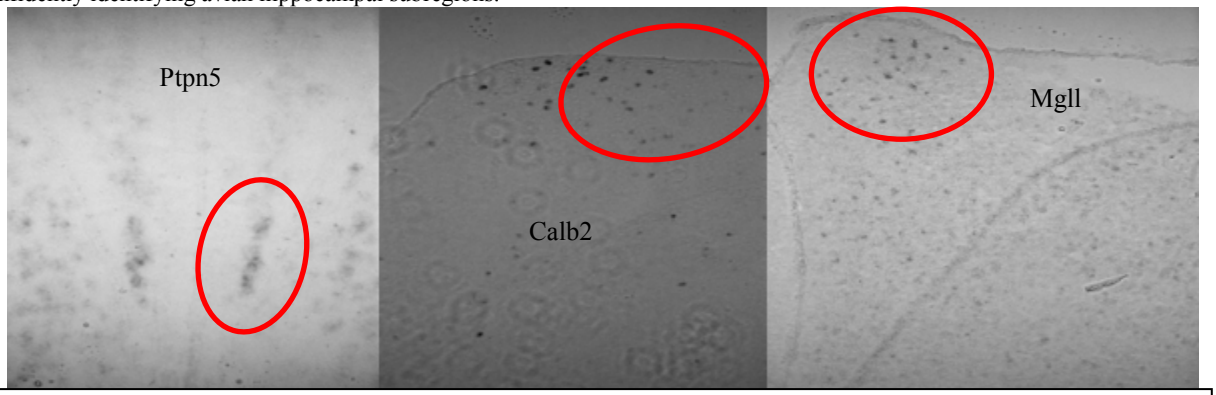


Figure 2: Three coronal slices of hippocampal brain tissue are shown. The first portrays both brain hemispheres of *Taeniopygia guttata*, with the expressed region of Ptpn5 located in the posterior portion of the hippocampus. The second and third images are of the left hemisphere of the brain, both showing expression of Calb2 and Mgll localized in the top portion of the hippocampus located adjacent to the midline of the brain.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Laura Mucha (2020) **Concentration: English**

Faculty Mentor: Christina "CJ" Hauser **Department: English**

Title of Project: Launching a Novel: Assisting an Author with the Publication of Her Second Book

Project Summary:

The course of book publication never did run smooth, or so Shakespeare might have said had he tried to publish *The Merchant of Venice* in 2019. The publishing industry is difficult to crack – first-time authors often struggle to get their manuscript in the right hands and, once their books have been purchased by a publishing house, writers often lose creative control of the final product. As an avid reader, I think it is important to understand the "life cycle" of a book and analyze the mechanisms by which new books are made accessible to the general public. Our understanding of the world is inextricably tied to the ideas put forth in books, and many writers rely on the works of their predecessors to create new stories. Imagine if *Lolita* had never been published, or if *The Lord of the Flies* was rejected by that fateful 21st publisher. How altered might our cultural landscape be?

"You sure you want to go the self-publishing route?"

This summer, as a publication assistant for Prof. CJ Hauser's second novel *Family of Origin*, I was able to learn more about the publication process, particularly how a book and its author are marketed. At the direction of Prof. Hauser and her publication team, I arranged the *Family of Origin* book tour, sought opportunities for readings and events, conducted research on potential outlets for Hauser's essays in the weeks leading up to publication, and developed connections with her "people" at Doubleday. In addition to my work on Hauser's novel, I was tasked with various research projects, such as a foray into Jim Belushi's exhumation, an analysis of Booker Prize politics in preparation for Hauser's course this fall, and a delightfully strange examination of the creation and practice of the Scole Experiment.

Over the course of the summer, I learned a great deal about the publication process, but I was often met with disappointment. Women are significantly less likely to be published by a major magazine or publisher or, once their work is published, it is delegated to the "second shelf." The Paris Review, where Hauser published her essay "The Crane Wife" this July, The New Yorker *and* Harper's Magazine essentially published two men for every one woman.[1] There is a distinctly gendered dialogue that places female writers (and their readers) at the bottom of the literary heap – even Virginia Woolf was once told to "acknowledge the (authorial) limitations of her sex." Although the literary establishment's derision of female writers is now more covert, it still rears its ugly head. Women who write about race, sex, or domesticity (among others) are derided for their "small-time stories," while the same subjects are lauded in the hands of male authors. Organizations such as VIDA, from which I learned the statistics listed in this paragraph, conduct annual reviews of major publications and alert the public to the palpable gender disparity. It is difficult to close these gaps without first addressing the gendered understanding of literature present in classrooms and living rooms across the world, but the truth of the matter is, in the worlds of Francine Prose, "there is no male or female language, only the truthful or fake, the precise or vague, the inspired or the pedestrian. If, in the future, some weird cataclysm should scramble or erase all the names of authors from all the books in all the libraries, readers may have trouble telling whether Emma Bovary and Hester Prynne were created by women or men. The only distinction that will matter will be between good and bad writing."[2]

[1]King, A., Clark, S., "The 2017 VIDA Count." VIDA: Women in Literary Arts. https://www.vidaweb.org/the-2017-vida-count/ July 24, 2019.
[2]Prose, Francine, "The Scent of A Woman's Ink." Harper's Magazine https://harpers.org/archive/1998/06/scent-of-a-womans-ink/7/ July 24, 2019.

Source of Support: ☒ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow(s): Tam Nguyen (2022) **Concentration: Computer Science**
Hezhong "Williams" Zhang (2021) **Concentration: Computer Science**

Faculty Mentor: Michael Hay **Department: Computer Science**

Title of Project: Exposed! Attacking Online Data Repositories to Infer Sensitive Information

Project Summary:

Before sharing sensitive personal data, such as student education records, the data is typically modified to prevent the disclosure of personal information. The goal of this project is to demonstrate that conventional disclosure limitation techniques, including de-identification and cell suppression**,** fail to offer adequate privacy protection.

Aggregated data about student performance in public schools is currently being shared online. One website reports statistics on two statewide tests, Math and English Language Arts (ELA). The site lets users aggregate at varying organizational levels (school, district, county) and filter by conditions on gender, race, age, and other attributes. To protect privacy, the site suppresses statistics for any small group (five or fewer students) and suppresses the next smallest group (what is known as complementary suppression).

We demonstrate that it is possible to circumvent cell suppression. Our ***database reconstruction attack*** combines aggregate statistics to extract suppressed data and ultimately reconstruct individual records.

Attack Strategy: The key idea behind our attack strategy is to ask about large *but overlapping* groups of students. Because the groups are large, they exceed the suppression threshold. We can then use subtraction to determine the size of subgroups that would otherwise be suppressed. For example, suppose we request counts of *Math Performance Level* by *Race* and the number of students of Asian race is below threshold, so it is suppressed. The attack would request the following statistics:

(1) Count: *Math Performance Level* by *Any Race*

Total	Level 1	Level 2	Level 3	Level 4
39	7	13	15	4

(2) Count: *Math Performance Level* by *Any Race except Asian*

Total	Level 1	Level 2	Level 3	Level 4
35	7	12	14	2

Both (1) and (2) are not suppressed, so we subtract (2) from (1) to obtain the suppressed data

Total	Level 1	Level 2	Level 3	Level 4
4	0	1	1	2

This simple idea can be extended to a more general attack strategy using the tools of linear algebra and numerical optimization. Our attack strategy is guaranteed to work as long as at least one group of students is above the threshold for suppression.

Empirical study: We applied our attack to a random sample of 23 counties and all suppressed cells were reconstructed. Our attack also uncovers 163 students who are **unique** -- no other reported student has the same combination of *identifying characteristics* (school, age, gender, ethnicity/race). For these students, our attack reveals information that is confidential and sensitive, including exam scores, socio-economic status, and other properties such as whether the student is a native English speaker, has a disability, or comes from a migrant family.

Mitigation: A next step in our research is to design safer ways of sharing data using advanced methods of privacy protection such as differential privacy.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): National Science Foundation Grant

Research Fellow: John Pham (2020) **Concentration(s): Chemistry; Applied Math**

Faculty Mentor: Anthony Chianese **Department: Chemistry**

Title of Project: Understanding and Engineering Ruthenium Catalysts for Hydrogenation Reactions

Project Summary:

This summer, with the guidance of Professor Chianese, I first synthesized the PNN-Ru-Imine catalyst. This catalyst was then used in several experiments in order to learn how well the catalyst performs in ester hydrogenation. These experiments consisted of the catalyst being tested on several different esters at different loadings in hopes to see high conversion rates and high yields.

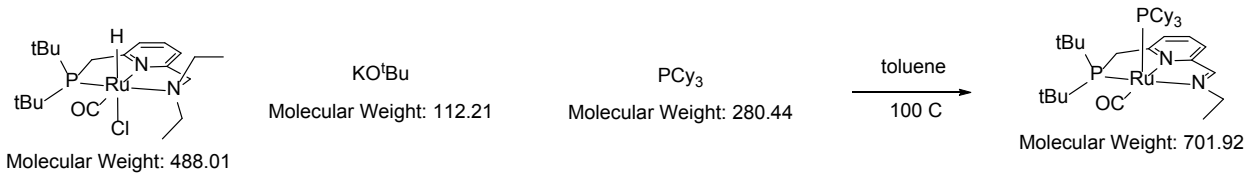


Figure 1. Synthesis of PNN-Ru-Imine

Unlike many pincer catalysts that are synthesized in the lab, the synthesis of the PNN-Ru-Imine catalyst does not take several steps. The starting material, specifically the Milstein catalyst precursor, is readily available and does not need to be synthesized in the lab. The reaction between the Milstein catalyst precursor, potassium tert-butoxide, and tricyclohexylphosphine then form the imine. NMR spectroscopy was very useful in confirming the formation of the imine and seeing that the reaction went to completion. Once the Imine pincer was formed, it was then used for ester hydrogenation.

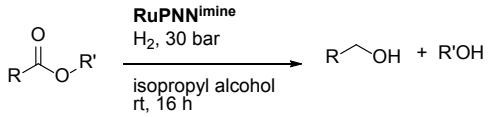


Figure 2. Ester Hydrogenation using Ru-PNN-Imine catalyst

Many of the substrates had R groups mainly containing methyl, ethyl, cyclohexyl, and benzyl groups. These substrates were then tested in isopropyl alcohol at several different loadings in order to see how well the PNN-Ru-Imine catalyst worked. A Parr reactor was used to run the ester hydrogenation. Using gas chromatography to measure the reactants and products once the reaction was done, the yield was able to be calculated.

The Ru-PNN-Imine catalyst showed good results with many of the yields being close to 100%. However, the Imine catalyst should be further studied. Several more experiments can be done varying loadings, solvents, and temperatures. There are still many questions that can be answered in order to better understand the mechanism of ester hydrogenation.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Annina "Anna" Pluff (2020) **Concentration: History**

Faculty Mentor: Andrew "Andy" Rotter **Department(s): History; Peace and Conflict Studies**

Title of Project: Study of the Foreign Policy of the American Founders

Project Summary:

Through the James Madison Fellowship, which is funded through the Center for Freedom and Western Civilization, I researched the *Pacificus-Helvidius* Debate between Alexander Hamilton and James Madison. The debate emerged during America's first foreign policy crisis and held major implications for executive authority in foreign affairs. The debate was initially sparked by President George Washington's 1793 Neutrality Proclamation, which some Americans argued was not only unconstitutional, but placed the United States in a position in which it could not support its ally France in its Wars of the French Revolution. Many Americans saw France as a deserving ally for its assistance in the American Revolution. France's declarations of hostilities in 1793 against Britain, the United Provinces (the modern Netherlands), and Spain caused the US to think critically about its precarious position in international affairs. Realizing the US was too weak to support a major power in the war, Washington unilaterally declared neutrality.

Hamilton, one of Washington's key allies, jumped to Washington's defense when the Neutrality Proclamation was attacked. By writing *Pacificus,* which means "Peacemaker," Hamilton defended not only the constitutionality of Washington's neutrality, arguing that it was the job of the president to preserve peace until Congress declared war, Hamilton also argued against the position that the US owed France any sort of gratitude. By declaring gratitude as an irrelevant principle in international affairs, Hamilton went as far to suggest that the earlier Treaty of Alliance that the US had made with France should also be suspended as well. Hamilton's distaste for the French and his realization that Great Britain was a key source of support for his financial plan for the US surely influenced his beliefs. However, Madison, who was inspired by Thomas Jefferson, saw something more dangerous in the *Pacificus* essays.

As two close friends, Jefferson and Madison were in communication when *Pacificus* was published. Jefferson feared that Hamilton was using the Neutrality Crisis to expand executive authority. Madison agreed that Hamilton had gone too far and, after much pleading from Jefferson, wrote *Helvidius* in response. The name was chosen after a Roman senator who was against the aggrandizement of imperial power. *Helvidius* mainly dealt with the constitutionality of the Proclamation and tried to smear *Pacificus.* The debate showed just how intense the issue had become for the US as it tried to deal with how to best proceed with the ongoing crisis.

An important aspect of the debate, as well as foreign affairs in general, is the role of emotion in guiding political actors. Many Americans felt a profound sense of attachment to France, making this debate all the more emotionally charged. Even though we tend to view foreign policy as dictated by realist notions and rarely as being guided by emotions, our actors are humans. Incorporating an analysis of the emotional tensions surrounding foreign policy issues invites a richer understanding of the motives behind policies and the effects, both intentional and unintentional, such policies can create. My research worked to think critically about the role of emotion in the debate, as both men were influenced by intense public opinion.

Furthermore, my research sought to analyze how the constitutionality of the Proclamation was understood by both Hamilton and Madison. Though the role of emotion in the debate is important, the larger consequence is how to perceive of the nature of the debate itself. By interpreting the constitutional arguments that were put forth by both men, it is interesting to see how they interacted with one another. Most astonishingly is the degree to which both men were actually in agreement. This is an issue that scholars have glossed over in the past, often choosing one debater over the other in the attempt to find the "right answer" between the two men. The issue was not necessarily over neutrality, which both sides realized was indeed essential, but over how the role of the executive in foreign policy was to be perceived. The Constitution was vague on such matters and seeing how two of the greatest constitutional thinkers grappled with issues gives us an important precedent for the role of the executive in foreign affairs today. With the ever growing power of the executive, it is important to see how this evolution of power emerged and how such divisions were intended to be conceived.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Center for Freedom and Western Civilization
(James Madison Research Fund)

Research Fellow: Andrew Pratt (2020) **Concentration: Physics**

Faculty Mentor: Linda Tseng **Department(s): Environmental Studies; Physics and Astronomy**

Title of Project: Monitoring Nutrients and Trace Chemicals in Local Waters

Project Summary:

The goal of this research was to understand the load of nutrients and trace chemicals in the local natural water and in the wastewater throughout treatment. We explored temporal variability of chemicals, source of these chemicals, and the efficiency of the wastewater treatment process. To achieve these, water and soil samples were taken and the flow was measured whenever feasible from sites along Payne Brook before the wastewater treatment plant (WWTP), in the WWTP, and after. Upstream includes the corner of Hamilton and Kendrick (HK), the overflow of Taylor Lake (TL), the Hamilton Central soccer fields (SF), the fire department (FD), and not pictured: Woodman Pond (WP) (Fig. 1). At the WWTP, samples were taken from the influent (IN), the mixed liquor (ML), and the effluent (EF). After the WWTP there were samples from a dairy farm (SILO), and a bridge along Middleport Road (MP). Samples were taken on two different days from all locations as well as one 24-hour sampling at the HK location. To study the sample sites, three analyses were performed: the amount of solids (both total suspended solids, TSS, and volatile suspended solids, VSS), the amount of ammonia (an indicator of fertilizer), and the amounts of trace pollutants such as drugs (ex., fentanyl) and plasticizers (ex., bisphenol A) in the water. Ion chromatography (IC) was used to discern the quantity of ions within our water samples. Gas chromatography/mass spectrometry (GC/MS) was used to analyze the samples for trace pollutants.

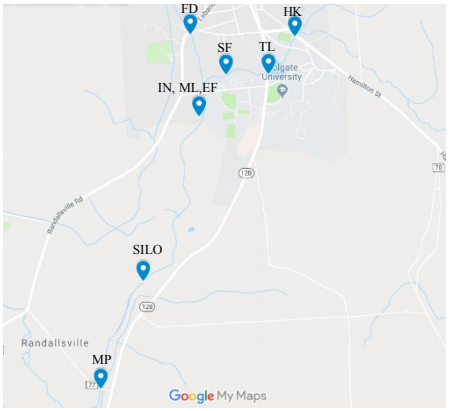


Figure 6 – Sampling Site Map

IC – Briefly, each sample of 40mL was filtered through a 0.2-µm filter for sterilization and stored in a glass vial until ready for testing. Before analysis, the sample in duplicates was diluted with a 20:1 ratio. The sample was processed through the IC along with a set of standards with known concentrations of lithium, sodium, ammonium, potassium, magnesium, and calcium ions.

All ions showed the same patterns with FD having high concentrations compared to other sites; HK, WP, SF, and TL all having very similar lower concentrations; and SILO and MP having the highest concentrations perhaps due to being after the WWTP. It seems ions are added at the WWTP as the water is treated as IN showed low levels of ions while ML and EF showed much higher levels.

During the 24-hour sampling, there was a visible diurnal pattern within the magnesium and calcium ions. This could be due to the sprinkling cycle of the golf course as it waters once a day in the morning which would match the diurnal pattern. The spike in magnesium and calcium would also make sense if the golf course is using local ground water as the local groundwater is very hard and high in both of those minerals.

TSS/VSS – Triplicates were run for every sample. A pre-weighed 1.5-µm glass fiber membrane filter was used to filter a 20-mL aliquot of the sample. The filter was placed in its respective pre-weighed aluminum dish and dried in an oven at 105°C for an hour. They were then weighed again to find the TSS. Then they were placed in a furnace at 550°C for another hour. The sample was then taken out and reweighed to find the VSS. Control tests were ran using Milli-Q water to find the amount of filter that was burnt off after the oven and furnace.

The concentration of TSS around the town of Hamilton (FD, SF, TL, HK) ranged from 20-35 mg/L, however after leaving town TSS dropped to an average of 13.2 mg/L at MP. We hypothesize this is due to the area around SILO having a very slow flow rate allowing for much of this sediment to settle.

GC/MS – To prepare the sample for analyzation in the GC/MS, the rest of the sample (about a liter) was filtered through the 1.5µm glass fiber filter. After filtering, the sample was extracted with a solid phase extraction (SPE) cartridge under vacuum and eluted with 5 mL of methanol, and was stored in a glass vial. An aliquot of the extracted sample were transferred to three glass GC/MS vials for analysis. 16 trace pollutants were tested in the GC/MS, however there were very few quantifiable amounts as they exist in trace amounts. Ibuprofen was found in low amounts through almost all samples tested, and there was a slight drop in concentration after the WWTP. Another pollutant consistently found in samples was mercaptobenzothiazole and is a common ingredient in tires which is most likely the cause of it appearing in all water samples. Atenolol, 4-acetaminaphenol, and methadone, and fluoxetine were also all detected, but in at least half of the samples their quantities were unquantifiable.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☒ UNST Div.
☐ Other (specify):

Research Fellow: Cheeranjeev Purmessur (2020) **Concentration: Physics**

Faculty Mentor: Kenneth "Ken" Segall **Department: Physics and Astronomy**

Title of Project: Numerical Modeling of Superconducting Circuits

Project Summary:

Understanding neuron systems allows us to have a deeper insight as to how the brain functions. This understanding has the potential to help us replicate such functions in our current technology to form supercomputers. In this project we aim to understand the behavior of neuron systems using Josephson junctions. A Josephson junction is a circuit component used to create superconducting circuits. It is essentially a layer of non-superconducting material between two layers of superconducting material. There are three parts to creating our model (the JJ synapse) for better understanding the neuron system. The first part is called the Learning Gate. It outputs a signal to the second part of the model (the Memory Cell) if the delay between two neuron pulses is short. The Memory Cell stores a flux based on the output signals from the Learning Gate. The third part, the Variable attenuator, varies the size of the pulse from one neuron to another based on the size of the flux stored in the Memory Cell.

Learning Gate and Memory Cell

To build our model we made use of a circuit simulator called WRspice. The circuit on the right is the Learning Gate and the Memory Cell. The x's represent the Josephson junctions, R's are resistors and L's are inductors. I_{N1} is the pulse from the first neuron while I_{N2} is the pulse from the second neuron. Using WRspice, we carried out several simulations to test whether the Learning Gate and the Memory Cell worked as expected.

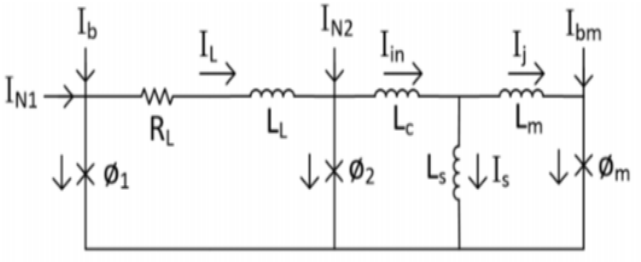


Figure 7 Learning Gate and Memory Cell

For the first simulation we input I_{N2} right after I_{N1}. That is, the delay between the signals was very short. Figure 2 shows the results. The red line represents the first pulse, the green line represents the second pulse and the blue line represents the flux in the Memory junction. As shown in Figure 2, there is indeed a flux stored in the Memory junction when the delay is short. The flux changes from 0 to about 2π. In the second simulation we input the two pulses further apart to create a longer delay. From Figure 3 we can see that there was no flux is stored. The flux remained at 0 after the second pulse was inputted.

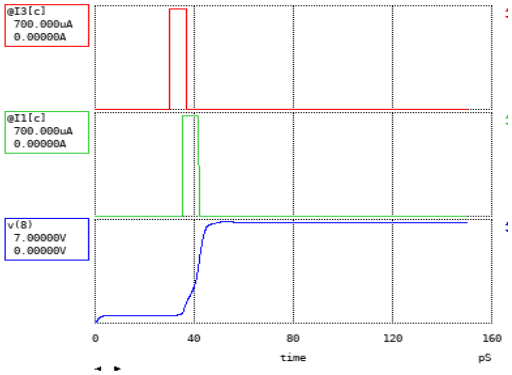


Figure 8 Short delay

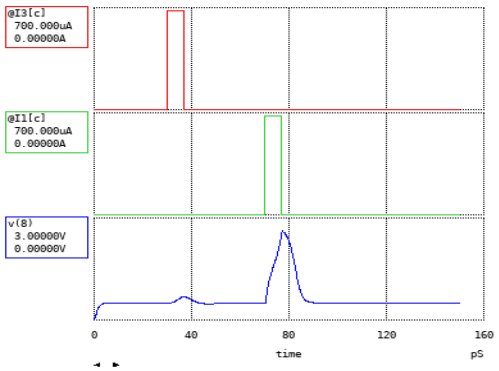


Figure 9 Long delay

Variable Attenuator

The project also consisted of building the Variable Attenuator on WRspice. The simulations were not as we expected, and we are still working towards perfecting this part of our model. Once the three parts of the JJ Synapse is built, we will combine them together to properly allow us to observe the behavior of neurons via Josephson junctions.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Justus '43 and Jayne Schlichting Student Research Fund

Research Fellow: Natalie Ramirez (2019) Concentration(s): Art and Art History; Classical Studies

Faculty Mentor: Rebecca Ammerman **Department: Classics**

Title of Project: Classical Archaeology in Italy: The Excavation of Trench 6 of the North Urban Paestum

Project Summary:

I returned to the Temple of Athena in Paestum, June of 2019 to begin my second summer of excavations in the Northern Urban Sanctuary under the direction of Professor Rebecca Miller Ammerman. The goal of the excavation this summer was to survey the extent of the artificial mound that the Temple of Athena was built upon as well as to assess any material finds for evidence of religious practice or habitation near the temple. As a recent graduate of Colgate University, I was tasked with supervising Trench 6, the sixth trench opened in the project and the second trench opened in the summer of 2019. Trench 6, the northern-most trench in the excavation thus far, would consist of twelve 1 x 1 meter squares by the end of the season. This trench was placed at what was believed to be the edge of the artificial mound, as suggested by GPR (ground penetrating radar) survey and both handmade and machine-drilled cores. The material finds discovered in Trench 6 offer insight into the frequentation and use of the area around the temple.

In regard to the main focus of the NUPP excavations, which is to better understand the extent, shape, and make-up of the artificial mound, it is worth noting that the composition of the mound within the limits of Trench 6 is unlike the mound excavated in any other trench so far in the project. The area investigated by Trench 6 continued to be expanded over the course of the 2019 excavation season. As a result, Trench 6 covered a total of twelve square meters which allowed more geological features and finds to be documented. In sum, Trench 6, located on the edge of the mound, confirmed that the artificial hill extended quite a distance, more than 20 meters, to the north of the Temple of Athena. This archaeological investigation helped to shed more light on the shape and components of the mound which took account of the position and irregular surface of the natural bedrock that builders of the mound attempted to even out. The material finds that were discovered above and below the mound also opened new windows for understanding human activity in the northern sanctuary and at the Temple of Athena, including construction practices, trade networks, and the performance of religious rituals.

The Excavation of Trench 6 of the North Urban Paestum Project 2019

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Center for Freedom and Western Civilization
(James Madison Research Fund)

Research Fellow: Alyssa Kryzelle Reyes (2022) **Concentration: Undeclared**

Faculty Mentor: Philippe Duhart **Department: Peace and Conflict Studies**

Title of Project: From Rebel to Partners in Peace: Understanding the Moro Islamic Liberation Front's Role in Building Peace in Bangsamoro, Philippines

Project Summary:

The violent conflict between Moros and the Philippine government is rooted in the struggle over preserving Moro identity against the state-sponsored Filipino national identity. Moro rebels have been seen as radical antagonists of the Filipino national identity and power of the state, while the Philippine government represents itself as a unifying peacemaker, justified in its subjugation of Mindanao and its people. The Moro people who have faced dispossession and disenfranchisement in their land exacerbated by state-sponsored massacres and terrorism. As a result, the Moro Islamic Liberation Front was established in 1977 as one of the champions of the Moro people. Over fifty years, there have been numerous peacemaking attempts between the government and the Moro people. In 2014, the Comprehensive Agreement on Bangsamoro was signed and subsequently enacted into law in 2018. This will create the new Bangsamoro Autonomous Region in Muslim Mindanao (BARMM) which will be led by members of the Moro Islamic Liberation Front along with local Moro politicians. Through my research, I sought to address the following: How did the Moro Islamic Liberation Front become a stakeholder in peacemaking? How did the framing of the MILF's identities shift from terrorists to peacemakers? How is this shift in representing the MILF's identities shaping the prospects of sustainable peace?

In analyzing the MILF's shifting identity from rebels to peacemakers, I sought to understand the nuanced transition from being aggressors to peace holders. I found that the MILF became the main champions of the Moro people after the fracturing of the Moro National Liberation Front, which was claimed to be the representative of the Moro people from 1972-2003, and the fall of MNLF's leader, Nur Misuari. However, before this, the MILF was seen as violent and extremist rebels with ties to international terrorist groups. They have also declared a jihad against the government. As a response, the Philippine government enacted an "all-out war" against the MILF, which led to an impasse in negotiations. Ultimately, once MILF renounced terrorism and sought to be part of the negotiation which resulted in the creation of BARMM, they were no longer seen as terrorists but as peacemakers. With MILF leadership, Bangsamoro is focused on maintaining peace and development to resolve the effects of war, economic underdevelopment, and disenfranchisement.

I was fortunate enough to be able to conduct my research project in the Philippines where I had access to archives that contained government and Moro documents detailing the conflict and peacemaking attempts, starting with the 1976 Tripoli Agreement during the fifty-year turmoil. As well as speeches, publications, news reports, and other primary documents from Moro activists, government officials, and academics that were directly impacted by the conflict. As a Peace and Conflict Studies major, I was able to expand what I have learned at Colgate and apply it to an ongoing peace process. This research allowed me to delve into the long-misunderstood conflict of Mindanao, which is often reduced to mere "terrorism." By looking at Bangsamoro and the MILF, I was able to better understand the effect of identities and representations on the primary stakeholders on the escalation and de-escalation of conflict. In looking at the long history of grievances, shifting identities, and peace negotiations, I came to further understand the necessity for sustainable and holistic peace focused on addressing the underlying problems that first ignited the conflict. Failing to address these, the peacemaking process can be hindered and collapse. I plan to continue and expand this research into my senior thesis and extend this study as Bangsamoro undergoes its transitional period by further investigating the lived experiences of Moro people and those affected by the conflict.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☒ UNST Div.
☐ Other (specify):

Research Fellow: Eamon Reynolds (2020) **Concentration: Chemistry**

Faculty Mentor: Anthony Chianese **Department: Chemistry**

Title of Project: Understanding and Engineering Ruthenium Catalysts for Hydrogenation Reactions

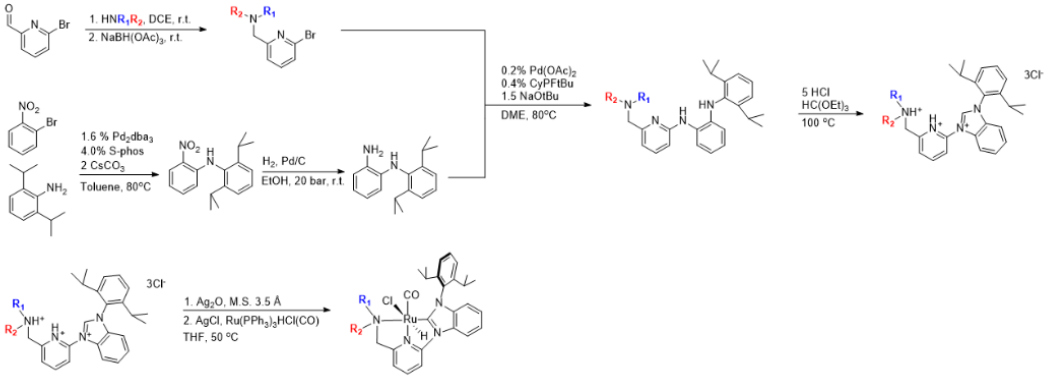
Project Summary:

Hydrogenation reactions that students learn about in organic chemistry often involve either palladium or nickel-based catalysts. Unfortunately, these reactions require stoichiometric amounts of such reducing agents thus producing significant inorganic waste, which is often costly and hazardous. Recent efforts, however, have led to the advancement in metal-organic catalysts that add molecular hydrogen directly to unsaturated compounds. In 2005, David Milstein published results of a hydrogenation using a Ruthenium-based catalyst with an organic tridentate ligand. Since then, many analogues to the Milstein catalyst have been created and numerous computational studies have predicted the mechanisms by which these catalysts add hydrogen to certain molecules. The Chianese group focused on understanding the hydrogenation of esters using both the Milstein catalyst and analogous catalysts first crafted and studied by members of the Chianese group that have a different organic ligand structure and connectivity to the metal center than Milstein's catalyst.

When studying the catalysts of interest, it was discovered through structural analysis such as NMR and x-ray crystallography that a dehydroalkylation occurred releasing ethane in the case of the diethyl substituted amine on the organic part of the catalyst and releasing propane in the case of the diisoproyl substituted amine. Further, the ethane and the propane were both detected under catalytic conditions and qualitative kinetic studies of their evolutions were performed. This result is important, because it had not been shown before, and it suggests that the commercially available and well-studied Milstein catalyst is in fact a precatalyst, and further that all the proposed mechanisms by which the precatalyst operates are fundamentally flawed.

Insightful mechanistic studies often include a computational effort to show the specific dynamics of the reaction, but they must also include experimental data that confirms the proposed mechanism. Much of the work this summer was focused on a kinetic study of the Milstein catalyst, in order to draft a rate law that will verify a future proposed mechanism. The kinetic studies can also elucidate important properties of the reaction such as energy barriers to various transition states along the reaction coordinate, which may or may not agree with future computational studies. In addition, we showed, at least qualitatively, that the dehyroalkylation of the precatalysts occurs roughly on the same time scale as the induction period and that the dehyroalkylated catalysts have a much smaller (if any) induction period than the precatalysts. These data provide further evidence that the true catalyst is not what has been proposed in the past by many groups. More catalysts need to be studied to see if this process is general and applies to more than the few catalysts we observed.

The actual mechanism of the dehyroalkylation of the precatalysts is not known, but it will doubtless add important mechanistic information to the study of these catalysts. One hypothesis is that a beta-hydrogen on one of the amine substituents is needed for the dehyrdoalkylation to occur via elimination. To test this hypothesis, the Chianese group is synthesizing analogues to their original CNN catalysts that cannot undergo elimination either because they lack beta-hydrogens or because of bond strain. The overall reaction scheme we followed is shown below.



Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): National Science Foundation Grant

Research Fellow: Emily "Emmy" Ritchey (2020) **Concentration: English**

Faculty Mentor: Julie Dudrick **Department: Upstate Institute**

Title of Project: Mohawk Valley Resource Center for Refugees "Utica's Refugees: Empowered in Entrepreneurship"

Project Summary:

This summer, I was privileged to have the opportunity to work with the Mohawk Valley Resource Center for Refugees (MVRCR). MVRCR serves refugees, immigrants, and limited English speakers living in the Mohawk Valley region. Based in Utica, New York, MVRCR strives to help refugees integrate and eventually become self-sufficient in the United States and provide a welcoming, supportive community for them. MVRCR provides many services to the community: resettlement, traffic safety information, job placement, entrepreneurship development, translation, interpretation, ESL classes, and citizenship classes. My project focuses on the Welcome Center, a new program that will provide refugees with entrepreneurship development tools.

Last summer, I was a Field School Fellow at the Midtown Utica Community Center (MUCC), which serves as a gathering space for the refugee community. I enjoyed my time learning about the refugee community of Utica in that capacity so much that I chose to work at MVRCR this summer to learn more about the specific services provided to the refugee community. Coming into this position, I had background knowledge of the Utica refugee community, but I have learned so much about what MVRCR provides that helps the refugee community with what they need. This summer, I feel like I have a much better understanding of the community that MVRCR serves after visiting refugee-run businesses and local faith-based organizations while postering for different MVRCR events.

The Welcome Center is a new initiative that aims to provide refugees with the necessary resources to start their businesses. There are significant barriers for refugees trying to gain traditional American employment. Many have skills and qualifications from their native countries, but those certifications do not necessarily transfer once they arrive in the United States. Entrepreneurship gives refugees an empowering chance to be their own boss and to take control over their work. Entrepreneurship is a valuable option to help refugees move forward. My research consisted of finding refugee-based entrepreneurship programs within the United States and worldwide and examining what made them work. Following the research phase, my supervisor and I planned a business roundtable. We extended invitations to local refugee-and-immigrant-owned businesses. Our goal was to find out how these entrepreneurs started their businesses and what sort of entrepreneurship resources would serve their community best.

My duties were not limited to entrepreneurship programming. I also created social media campaigns for MVRCR's World Refugee Day and Match Grant Program. My campaigns received great responses from the community, and I am very pleased to see that my first attempts at creating social media content for a non-profit were successful. I also spent time developing new success stories for MVRCR's website. I developed questions and conducted interviews with refugees; I then wrote these interviews into a story format to highlight the successes and triumphs of these people.

I am an English major with an emphasis in creative writing, and my work at MVRCR has been writing heavy. Instead of writing fiction and essays, I worked on focusing my writing to advertise events and to inform readers in profiles of successful refugees; I feel like this has broadened my ability as a writer, for which I am truly grateful. I also enjoyed seeing another side of the Utica refugee community and have learned so much about the many moving pieces that go into helping the refugee community thrive. Last summer, I enjoyed being a Field School Fellow, and I could not be happier with my decision to come back and learn more about and help the communities that surround Colgate.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow: Kathryn "Kate" Robinson (2022) **Concentration: Philosophy**

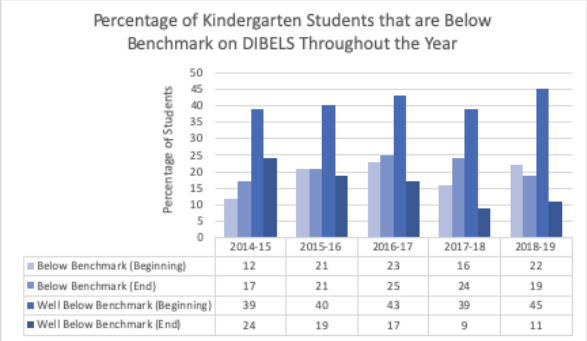
Faculty Mentor: Jessica "Jesi" Buell **Department: University Libraries**

Title of Project: DCMO BOCES Grade Level Reading Campaign

Project Summary:

For the Delaware, Otsego, and Chenango counties and parts of Madison county, BOCES is looking to assess literacy and reading proficiency through three major aspects of the learning experience that help to determine future success: summer learning, school readiness, and attendance. The main goal is to gather data to create a baseline to better understand the counties and the communities to assess steps to take in the future to promote literacy and increase reading proficiency. For the research conducted here, a focus was placed on pre-kindergarten, kindergarten, and third-grade students. Schools, libraries, and other organizations within the community provided data to illustrate the current situation in the region served by the DCMO BOCES branch. The data ranged from conducting qualitative interviews and statistical gathering and analysis.

By working with schools and other organizations in the area, data on school readiness and reading habits were gathered and aggregated as best as possible. Four out of the sixteen schools served by DCMO BOCES sent in testing data for two types of literacy assessments (DIBELS and Fountas and Pinnell). Interviews and surveys were conducted with parents of incoming kindergarten students to assess at-home reading habits to generate an idea of what skills students possess when entering school. In addition to this, data for the ELA assessment given by the New York State Department of Education was collected for the schools in Delaware, Chenango, and Otsego counties and then compared against the state average for the assessment.



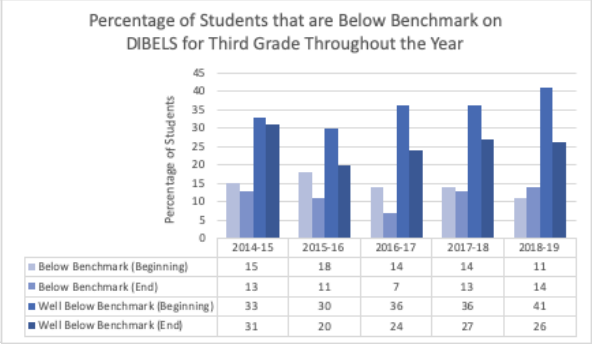


Fig. 1 and 2: Charts showing the percentage of kindergarten and third-grade students at a DCMO BOCES school that scored below or well below benchmark on DIBELS through the year.

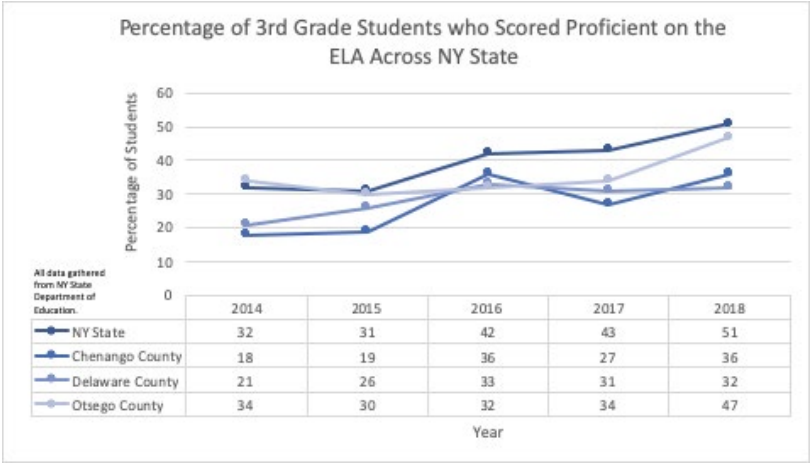


Fig. 3: Chart showing the percentage of students that scored proficiently on the ELA exam administered by the NY State Department of Education in NY State, Chenango County, Delaware County, and Otsego County.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☒ SOSC Div. ☐ UNST Div.
☐ Other (specify):

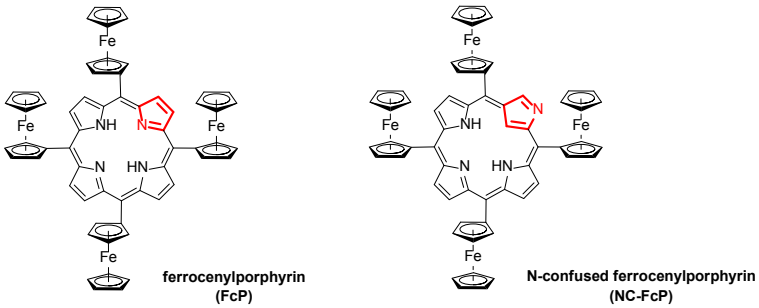
Research Fellow: Sara Robinson (2020) **Concentration: Chemistry**

Faculty Mentor: Rick Geier **Department: Chemistry**

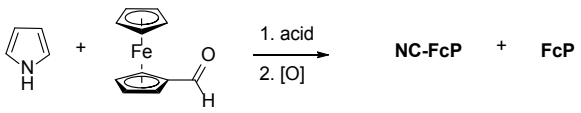
Title of Project: Investigation of the Synthesis of N-Confused Ferrocenylporphyrin

Project Summary:

A porphyrin substituted with redox-active ferrocene groups has been reported to display interesting electrochemical properties. Tetraferrocenylporphyrin (FcP) displays multiple, well-defined redox potentials indicative of electronic communication between the ferrocenyl substituents. This behavior can have applications in molecular electronics. An isomer, N-confused ferrocenylporphyrin (NC-FcP), differs by the orientation of one pyrrole ring (highlighted in red) which decreases the symmetry of the molecule relative to porphyrin. The effect of this lower symmetry on the redox properties of NC-FcP has yet to be investigated as the synthesis of the compound has not been reported. The goal of our work is to prepare NC-FcP.



A previous student made a preliminary attempt to synthesize NC-FcP using a procedure adapted from the published synthesis of an N-confused porphyrin with phenyl substituents. The student was able to isolate and characterize FcP from this reaction, but not the targeted NC-FcP.



Last summer, we verified these results, and conducted further analytical-scale reactions that investigated the choice of oxidant, different acid catalysts, acid concentrations, and reaction times. We observed FcP under a wide range of reaction conditions, but we did not identify a promising product with TLC and UV-vis characteristics consistent with those expected for NC-FcP.

This summer, we conducted several preparative-scale reactions adapted from the literature that are known to produce high yields of FcP, N-confused tetraphenylporphyrin, or N-confused pentafluorophenylporphyrin. These reactions were monitored via TLC, and the product mixtures were further examined using column chromatography. The purified products were characterized by TLC and UV-vis spectroscopy. We have been able to identify and isolate FcP from these reactions, but we have yet to identify NC-FcP. It remains to be determined whether the reaction conditions examined so far have failed to afford the target compound or whether the NC-FcP has evaded detection and purification.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Miller-Cochran Fund

Research Fellow: Caio Rodrigues Faria Brighenti (2020) **Concentration(s): PCON; COSC**

Faculty Mentor: William "Will" Cipolli **Department: Mathematics**

Title of Project: Language-Based Fake News Detection: Towards an Interpretable Approach

Project Summary:

Propaganda has always been a tool of political influence, but recently it has taken a new dominant form: fake news. Fake news is *the* buzzword of the last two years of politics. After the term gained prominence in the United States during Donald Trump's campaign to become president, it exploded into a worldwide phenomenon. Fake news is not only politically significant, but also dangerously tempting. Studies have shown false content is propagated faster through social media than real content. Falsified rhetoric also can go as far so as to provoke violent action, as demonstrated by the "Pizzagate" incident in which a man stormed a D.C. pizzeria with an AR-15 under the belief that a pedophile ring operated out of the location. Fortunately, scholars of machine learning and natural language processing have devoted significant attention to the problem of fake news classification. However, these approaches have typically relied on highly complex models that lack interpretability, and thus do not allow us to reach new conclusions about the nature of fake news. In order to close this gap, this research adopts an interpretable approach, with the overall objective of producing a highly accurate fake news classification model, without compromising on interpretability.

While many fake news classification approaches have relied on article metadata such as the reputation of the publishing source and author, this strategy can be problematic as it awards large, established news sources a monopoly on truth. Instead, this research begins from the assumption that fake news can come from anywhere and focuses solely on modelling the text present in an article. To this end, three approaches were taken to allow for model fitting using text content: word vectors, document-term matrices (DTM), and text features. The word vector approach is concerned with using pre-trained models to calculate numerical vector representations for each word present in the dataset. The DTM approach treats each unique word in the corpus as a predictor, measuring how often each word appears in each document. Finally, the text feature approach uses a combination of different techniques to hand-craft predictors that describe different properties of the text such a sentiment, complexity, and syntactic structure. Each approach was used to fit a binary logistic regression model, maintaining interpretability.

All three approaches yielded similar results with respect to accuracy, sensitivity, and specificity, with values ranging between 0.7-0.8 for all three statistics. However, the word vector and DTM approaches were prone to overfitting, showing significant differences between train and test performance. The text features approach, on the other hand, showed slightly lower values for all three statistics than those achieved by the other two approaches, but nearly no difference between train and test performance. Because of this as well as the superior interpretability of the text feature predictors, this approach was focused on for coefficient interpretation.

Predictor importance analysis leveraging coefficient magnitude, significance level, and relative variable importance calculated by performing ROC curve analysis on each individual predictor was conducted in order to identify the best indicators of fake news versus real news. False articles in the dataset were found to have higher usage of 3rd person pronouns (she/he), social words relating to friends or family, express more certainty, use more quotation marks, and have a higher focus on the present. Real news, on average, had a higher usage of first and second person pronouns (i/we/you), male and female referents, higher text complexity and lexical diversity, as well as more interrogatives.

Despite reaching several conclusions about the textual properties of fake news, this research opens many doors for future work. Due to time limitations, no variable interactions, transformations, or more complex yet still interpretable models such as decision trees were applied to the calculated text features. This research has shown that the deep learning approach is not the only way to address this problem by demonstrating that hand-crafted text features provide a highly accurate and extremely descriptive avenue for fake news detection.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

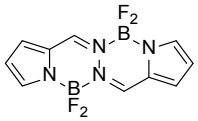
Research Fellow: Valerie Rome (2021) **Concentration: Biochemistry**

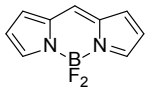
Faculty Mentor: Rick Geier **Department: Chemistry**

Title of Project: Refining Reaction Conditions for the Synthesis of BOPHY

Project Summary:

Fluorescent chromophores have broad applications in fields such as medical imaging and light harvesting. A new fluorescent chromophore, BOPHY, was recently discovered by the Ziegler group. However, others have found that the synthesis of BOPHY can also produce a monoboronated side-product that can complicate the purification of BOPHY. We are interested in refining reaction conditions to decrease the amount of monoboronated side-product.


BOPHY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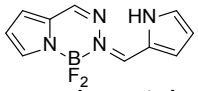
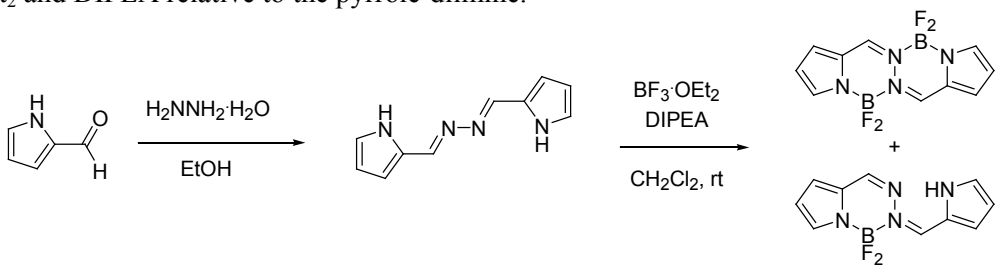

monoboronated

Previous students successfully prepared the pyrrole-diimine precursor to BOPHY. Upon preforming the BOPHY synthesis, they observed a mixture of BOPHY and a monoboronated species. An HPLC method for monitoring analytical-scale reactions for the distribution of BOPHY and monoboronated products was developed. Last summer, I worked to refine the reaction conditions by systematically varying the amounts of $BF_3{\cdot}OEt_2$ and DIPEA relative to the pyrrole-diimine.



Using the best condition identified last summer, the synthesis of BOPHY was attempted on a preparative scale. In our first attempt, we encountered a purification issue due to the formation of an insoluble sludge that entrained some of the BOPHY product. The purification procedure was improved, and a crystalline product was obtained. The isolated BOPHY contained a trace level of monoboronated compound. The purity of the BOPHY crystals was sufficient for calibration of the HPLC detector response. Using the HPLC response factor, data collected last summer was reprocessed to estimate percent yields of BOPHY and the monoboronated compound.

To obtain BOPHY devoid of detectable monoboronated side-product, we examined further changes to the reaction conditions. These changes included adding a booster of $BF_3{\cdot}OEt_2$ and DIPEA after the reaction was underway, and using a different amine base. These further studies are ongoing.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow(s): **Grant Ruback (2021)** — **Concentration:** **Molecular Biology**
Morgan Wynkoop (2021) — **Concentration(s):** **Spanish; Molecular Biology**
Flora Zhang (2022) — **Concentration:** **Undeclared**

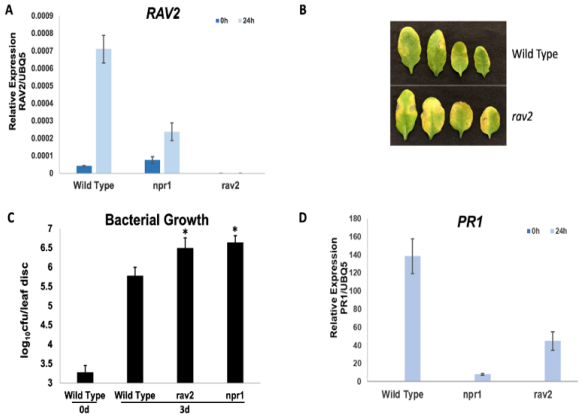
Faculty Mentor: **Rajinikanth "Raj" Mohan** — **Department:** **Biology**

Title of Project: **Stress Hormone Signaling Crosstalk in Arabidopsis**

Project Summary:

The survivorship of plants is constantly under threat from a wide array of pathogenic microorganisms. Necrotrophic pathogens kill host cells for nourishment, while biotrophic pathogens keep the infected plant alive to feed off of it. Hemibiotrophic pathogens initially keep the host alive, but eventually kill the infected host cells. In Arabidopsis, a model plant for researchers, the stress hormone salicylic acid (SA) is produced and mediated by NPR1, a transcriptional coactivator. NPR1 is able to bind to SA, as well as interact with other transcription factors known as TGAs, in order to activate the transcription of pathogenesis-related (PR) defense genes that can fight the infection. The RAV (Related to ABI3 and VP1) family consists of 13 genes for transcription factors in Arabidopsis, functions in flowering, growth, and hormone response, as well as immune response. RAV2, in particular, is primarily studied in flowering but seems to play a role in the NPR1-dependent SA-mediated defense pathway, as it can positively regulate PR expression, and therefore contribute to the defense response in plants infected with some hemibiotrophic pathogens. However, the role of RAV2 in this defense pathway is not well studied. Our lab aimed to further examine the role of RAV2 in immunity, as well as to propose a model for the interaction of RAV2 transcription factors with the rest of the defense pathway.

Results: Arabidopsis RAV2 is required for immunity to bacterial pathogen. A Quantitative RealTime PCR (qPCR) showing pathogen-induced expression of RAV2 in wild type, *npr1-2* (*npr1*), and *rav2* mutants at both 0 and 24 hours post-infiltration with *Pseudomonas syringae* hemibiotrophic pathogen demonstrates that RAV2 is substantially upregulated in WT (wild type) plants. This induction is also reduced in the *npr1-2* mutant, indicating that NPR1 is required for the induction of RAV2 in response to pathogen infection (Figure A). Since RAV2 is induced by pathogen, we hypothesized that the *rav2* mutants would exhibit more susceptibility to disease. Three days post-inoculation with virulent *P. syringae* confirmed the role of RAV2 in disease resistance, as the *rav2* mutant exhibited more pronounced disease symptoms compared to WT plants (Figure B). To confirm that this disease phenotype resulted from increased bacterial growth, bacterial growth assays were performed for wild type, *rav2,* and *npr1-2* plants. *rav2* plants showed significantly increased bacterial growth, suggesting that disease susceptibility of *rav2* may be the result of a defect in expression of defense genes (Figure C). Furthermore, examining relative expression of PR1 defense genes in WT, *npr1,* and *rav2* plants showed reduced PR1 expression in *rav2* mutants 24 hours post-infiltration (Figure D). This suggests that RAV2 plays a role in induction of PR1.



Conclusion: Altogether, these results indicate that RAV2 is an NPR1-dependent regulator of plant immunity, whose function is to stimulate PR1 expression after pathogen infection and confer resistance to virulent *Pseudomonas*.

Future Directions: As shown in Figure A and Figure D, relative RAV2 and PR1 expression were quantified only at 0h and 24h. In the future, it will be interesting to additionally observe RAV2 and PR1 expression at earlier time points such as 6h and 12h to further validate that this model is true.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Michael J. Wolk '60 Heart Foundation;
Science and Math Initiative-SMI (NASC Division)

Research Fellow: Victoria Rykaczewski (2020) **Concentration: Political Science**

Faculty Mentor: Julie Dudrick **Department: Upstate Institute**

Title of Project: Madison County Department of Health "Using Health Information to Improve Community Health Outcomes"

Project Summary:

In an increasingly complex and data driven world, information collection and distribution is often one of the most powerful tools health workers have to address community health issues. As a Fellow with the Upstate Institute at the Madison County Department of Health (MCDOH), I had the opportunity to work with the Prevent team and their community partners to collect and disseminate health information to improve community health outcomes within Madison County. My work this summer illustrates the different ways that public health workers can use health information by gathering data from community members and key stakeholders and then administering public information campaigns.

One of the most important tools local health departments use to gather data is the Community Health Assessment. A Community Health Assessment (CHA) is a highly collaborative process designed to bring together community stakeholders, health networks, providers, public officials, non-profit organizations, and everyday citizens to evaluate the state of health within their community. This information is then used to create a Community Health Improvement Plan (CHIP), designed to leverage the community's strengths to better address ongoing health challenges. This summer, MCDOH conducted a county wide phone survey and several focus groups with community members to hear directly from Madison County residents. I was responsible for creating all materials necessary for the focus groups including the discussion guide, question line, and facilitator training, at the direction of the Madison County CHA steering committee. I also facilitated a focus group within my own community in Hamilton and helped to compile and analyze the resulting data.

I also worked on a lead poisoning prevention program this summer at the department. Once a health department has identified a problem, they then need to leverage the given information, medical research, and state policies in order to solve it. Often this means reaching out to the public directly through public information campaigns, like the ongoing lead poisoning prevention program that I helped update this summer. Children need to be tested for lead in their blood at age 1 and 2 because lead poisoning, especially in young children, can lead to permanent health and developmental problems including stunted growth and impaired cognitive abilities. However, it can sometimes be difficult for parents to take their young children to get their blood drawn. Often the experience can be traumatic for both the child and parent, and it can be even more difficult for families that don't have access to reliable transportation or have an unpredictable work schedule. This summer, I worked to identify some of the barriers that prevent parents from taking their child to get tested and then address them. This included reaching out to local blood draw locations to inquire about making their facilities "child-friendly" and helping lab technicians get trained in pediatric phlebotomy. I also created new materials that speak to parent's fears, help them prepare for the challenges of taking a toddler to get blood drawn, and remind them to get their child tested at age 1 and 2.

During my time at the Madison County Department of Health, I learned firsthand how local health departments turn state and federal law into action that makes a real difference in the lives of the people they serve and how they use health information to effect positive change within their community. After studying abstract theories of law and governance at Colgate for the past three years, this hands-on experience at my local health department as left me more knowledgeable about the public policy process and better prepared for the day when I too can change our laws for the better.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow: Gillian "Gill" Schutt (2020) **Concentration: Neuroscience**

Faculty Mentor: Wan-chun Liu **Department: Psychological and Brain Sciences**

Title of Project: Attentive Listening Behavior and Song Learning in *Taeniopygia guttata*

Project Summary:

The zebra finch is an excellent model for vocal learning, as both the brain circuitry and developmental timeline are analogous to those found in humans. Zebra finches have two major pathways for vocal learning, including the anterior forebrain pathway, which functions in learning and modifying song, and the song motor pathway, which functions to produce song. These pathways are analogous to pathways in the human brain, which involve nuclei known to be involved in speech learning including Broca's area. In relation to development, juvenile zebra finches develop song similarly to how babies develop speech. They display similar babbling behaviors during early song learning as babies display during early speech learning. During the summer of 2019, we investigated the impact of attentive listening on successful song learning in the zebra finch. Understanding the effect of social behavior on song learning could help to understand the impact of social interaction on human speech learning, and even to how the social deficits characteristic of autism could contribute to the vocal deficits of autistic individuals.

Previous research in the Liu lab has found administration of a dopamine agonist increased attentive listening behavior, possibly indicating that motivation is a factor affecting song learning. Attentive listening has previously been found to improve song learning. An interesting observation found in this study was that attentive listening behavior included an approach behavior of juvenile finches to a father tutor immediately following the father tutor's song. Interestingly, this behavior only occurred during a very narrow period during the sensory-motor phase of song learning. This behavior has not been investigated previously in the field. This summer, data was collected in relation to the timeline of the peak approach behavior during song learning. Data was collected via manual tracking from recorded video collected in the early morning, when the birds appeared to be the most active. The approach behavior peaked around 45-50 days post hatching.

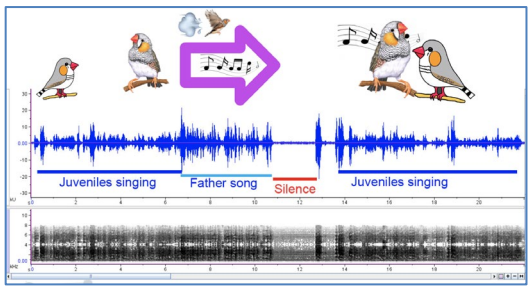


Figure 1: Juvenile finches approached the father tutor in response to song and were silent while listening attentively.

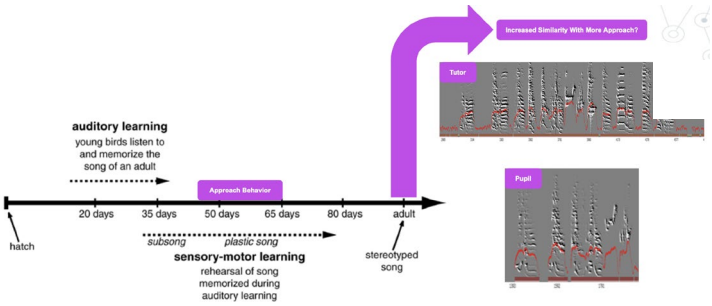


Figure 2: Approach behavior was found to peak during the sensory-motor phase of song learning. Current research is being done to see how the level of approach behavior affects song similarity to the tutor.

Further research is currently being conducted to see how increased approach behavior affects song learning, that is to say, whether increased approach behavior will increase the similarity of the pupil's adult song to that of the tutor. If the approach behavior shows a positive correlation with song similarity scores, it could prove to be both useful metric for attentive listening behavior and a key phase in the song learning process, further supporting the importance of social interaction in song learning. Furthermore, future research could include in-situ hybridization of brain tissue collected from juveniles during the peak of their approach behavior to investigate which brain regions show increased activity as a result of this attentive listening, providing a neuroanatomical context to this behavioral activity.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Emily Schwartz (2021) **Concentration: Environmental Studies**

Faculty Mentor: Julie Dudrick **Department: Upstate Institute**

Title of Project: Adirondack Council "How is Climate Change Impacting Adirondack Farmers?"

Project Summary:

The Adirondack Park was created in 1892 by the State of New York after concerns for the water and timber resources of the region. Today the Park is protected under the "Forever Wild" clause in the state constitution and is the largest publicly protected area in the contiguous United States. However, climate change poses a serious threat to the Park. Impacts will threaten water bodies, ecosystem composition, wildlife and plant species, local communities, and farms throughout the region. Therefore, the Adirondack Council has decided to conduct research on climate change and how it will threaten different sectors of the Park.

I assessed how climate change is impacting farmers in the Adirondacks by researching the existing efforts in place to adapt to climate change and reduce emissions, and by considering action needed to strengthen the resilience of local farms. The Council recognizes that local Adirondack farms are pillars of local food access, human health, open space preservation, and community vibrancy, thus more data must be collected to better understand how to support them.

The project was divided into three sections: the first was background research on current and projected climate change impacts in the Adirondacks, including temperature, precipitation, and severe weather. This is where the data gaps became noticeable, as this region was not well represented in climate change data. The research on climate change in the state was helpful; however, New York represents an array of geographic landscapes and state-wide averages do not help create a clear understanding of how the Park is being impacted. Understanding this reality will help the Council know where to invest their time and where further research is necessary.

The next section delved into the correlation between climate change and farms within the Park. I used various governmental reports, science research, first-hand accounts, and expert input to understand how farmers will be impacted by climate change. I then researched what strategies, technologies, practices, or policies are being implemented in the Adirondacks and similar regions to address climate change and encourage climate resilience. The final section was an interview project, in which we held structured conversations with local farmers. These interviews helped us learn what, if any, climate change impacts their farm is experiencing, and how they have worked to combat those impacts. I reached out to approximately forty farms and received responses from twelve. The overall reception from the survey was positive—participating farmers have been active in adaptation and mitigation efforts. There was an overwhelming desire to understand how climate change will impact farms within the region in decades to come and adaptation strategies that will develop climate resilience, as well as to have organizations such as the Adirondack Council expand consumer education. These farmers spend their lives working to bring sustainable food to the region, so it is important for consumers to remember to eat local! As farmers prepare to combat climate change in the future, they will need the support of consumers to create new infrastructure, manage their land differently, and become climate resilient.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow: Carolyn Senneca (2020) **Concentration(s): Neuroscience; English**

Faculty Mentor: Wan-chun Liu **Department: Psychological and Brain Sciences**

Title of Project: Social Influence on the Development of Vocal Learning and Brain Circuits

Project Summary:

We aimed to investigate the interactions between vocal processes and movement behavior in zebra finches. We are looking to answer the question, "Do birds who move more learn better?"

Throughout development, juvenile zebra finches undergo a "sensitive period" in which they are primed to learn their father tutor's mating song. The mating song consists of many unique syllables in a specific order. This is remarkably similar to how babies learn to speak from their parents, and songbirds are a unique model species for studying social vocal learning. Additionally, zebra finches have many similar brain structures to human speech areas. The juvenile zebra finch song memorization process is outlined in Figure 1. By 60 days post-hatch, juveniles transition from subsong to plastic song, which is analogous to the transition from babbling to using full words. Our study aimed to investigate whether the flight movement of juvenile zebra finches is correlated with this transition.

In order to study movement and song production at the same time, juvenile zebra finches were placed in cages with the top replaced with Plexiglas so that a camera could record their movement in 12-hour intervals. The heads of the zebra finches were painted and a novel program was used to automatically track their movement. Simultaneously, the number of syllables produced by the zebra finches was recorded using a microphone. We recorded them starting around 30 days post-hatch, or when they were able to feed on their own. On days where the juveniles were not recording, they were reunited with their father tutor to limit any possible effects of social isolation. Our sample size is currently two subjects, so we are unable to make any concrete conclusions, but preliminary data shows a peak in movement around 50 days post-hatch.

Further directions for the study include increasing sample size, as well as comparing stereotyped adult song to that of the tutor. We are also hoping to answer our main research question and see whether or not increased flight movement between individuals correlates to improved song learning ability. Together, we hope these efforts will elucidate the connection between motor movement and song learning, and eventually help translate this concept to human models to understand the development of speech.

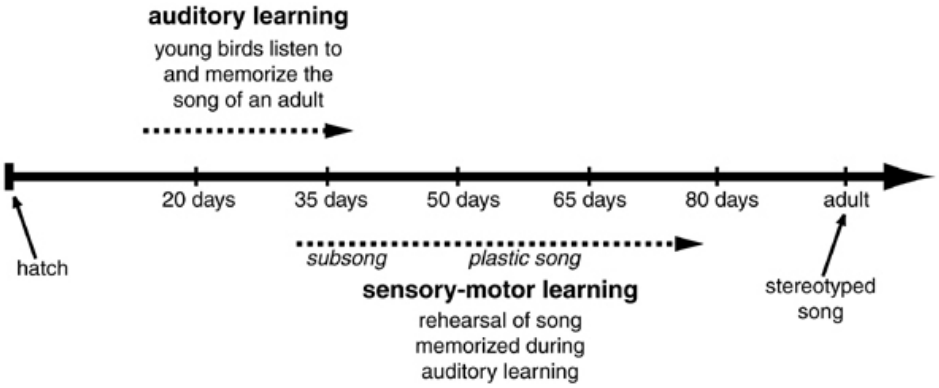


Figure 1: Outline of the sensitive period of juvenile zebra finches.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Elizabeth Shaw (2022) **Concentration: Anthropology**

Faculty Mentor: Julie Dudrick **Department: Upstate Institute**

Title of Project: Fenimore Museum "Heroines of Abstract Expressionism"

Project Summary:

This summer, my research for the Fenimore Art Museum in Cooperstown focused on the development of interpretive aids for an upcoming exhibit on the women of Abstract Expressionism. This exhibit will be the first display of modern art at the Fenimore, and thus provided many unique challenges. Most of our visitors are not very familiar with abstract art, which will make the docent-led tour particularly impactful. However, many of our docents are also not comfortable interpreting abstract art.

My task was to write a docent guide which would help them feel comfortable teaching visitors how to interpret abstract art. I chose to orient the tour starting from the least abstract pieces and moving towards the most abstract.

The entirety of the tour focuses on the theme: "the women of abstract expressionism have gone under appreciated despite the profound impact their innovations had on the movement." In addition to the docent guide, I created an audio tour of the exhibit consisting of recordings of quotations by a selection of artists. I chose quotations that emphasize how their painting style is a reification of their perspective on the world, and some that address the specific struggles women artists faced at the time. These aids will ideally allow visitors to appreciate a new genre of art and, if successful, this exhibit will allow the Fenimore to continue displaying fresh and innovative exhibits.

Apart from my work with the "Heroines of Abstract Expressionism" exhibit, I helped the curatorial staff on a few occasions. I helped with the installation of an exhibit of face jugs and an exhibit on the "Floating Palaces of the Hudson" which opened in conjunction with the Glimmerglass production of *Showboat*. I also helped photograph and accurately catalogue the paintings in the Iroquois Storage Facility. I also helped the Education Department with some programming for children and adults, and chauffeured two honored guests to the annual gala. These extra opportunities helped me understand how each division of the Fenimore works together for a common goal.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow(s): **Ruchit Shrestha (2020)** **Concentration(s): Mathematics; Computer Science**
Xiaolin "Owen" Sun (2020) **Concentration(s): MAEC; Computer Science**

Faculty Mentor: Aaron Gember-Jacobson **Department: Computer Science**

Title of Project: Updating Computer Networks One Step at a Time

Project Summary:

Computer networks are composed of multiple routers running certain algorithms that determine how data flows through the network. The routers are driven by thousands of lines of specialized instructions that indicate how devices in the network communicate. Unfortunately, these configurations are painstakingly difficult for network operators to update and repair due to the complexity and massiveness of these configurations. Our research focused on developing a tool to automatically localize the errors in these complex configuration files.

We developed a configuration error localizer (CEL) that identifies configuration segments which contribute to the violation of one or more forwarding requirements. CEL's key insight is to identify incompatibilities between configuration statements and forwarding requirements using proofs of unsatisfiability generated by satisfiability modulo theories (SMT) solver [1]. CEL starts with a system of SMT constraints that encode a network's configurations, control plane logic, and forwarding requirements [2, 3], and then checks if the constraints are satisfiable under all failure scenarios of interest. If the constraints are unsatisfiable under some failure scenario, indicating the forwarding requirements cannot always be satisfied by the current configurations, then CEL asks the SMT solver to produce a correction set: i.e., a subset of the constraints whose removal from the problem would make the initial formula satisfiable. The configuration-based constraints contained in these correction sets are used to flag configuration statements that contribute to the violation of the forwarding requirements.

Accurately identifying configuration errors using correction sets of an SMT-based network model requires addressing several challenges. First, a forwarding requirement may be satisfied under some conditions (e.g., no link failures) and violated under others. CEL must identify the circumstances under which a forwarding requirement is violated in order to identify incompatible configuration statements. Second, the absence of configuration statements can also be a cause of forwarding requirement violations, but existing SMT-based network models only encode the present configuration statements. Finally, configurations may contain multiple errors whose impact varies across failure scenarios and forwarding requirements.

To overcome these challenges, CEL enhances the SMT formulation and relies on multiple invocations of the SMT solver. First, CEL explicitly encodes the absence of certain configuration statements—namely, those related to the establishment of routing adjacencies—using additional SMT constraints. Second, CEL employs an iterative solving process to identify all circumstances (e.g., sets of link failures) that lead to the violation of a forwarding requirement. In particular, after the solver identifies a set of circumstances that lead to a violation, CEL adds an additional constraint to bar the solver from finding another violation under the same circumstances. Third, CEL solicits multiple, minimal correction sets (MCSes) from the SMT solver using an efficient MCS generation algorithm [4]. Finally, CEL combines correction sets across circumstances and forwarding requirements to precisely identify all erroneous configuration statements.

References:

[1] The z3 theorem prover. https://github.com/Z3Prover/z3.
[2] Beckett, R., Gupta, A., Mahajan, R., and Walker, D. A general approach to network configuration verification. In *SIGCOMM* (2017).
[3] El-Hassany, A., Tsankov, P., Vanbever, L., and Vechev, M. NetComplete: Practical network wide configuration synthesis with autocompletion. In NSDI (2018).
[4] Liffiton, M. H., Previti, A., Malik, A., and Marqes-Silva, J. Fast, flexible MUS enumeration. Constraints 21, 2 (2016), 223–250.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Holden Endowment Fund; National Science Foundation Grant

Research Fellow: Annalise Simons (2021) **Concentration: International Relations**

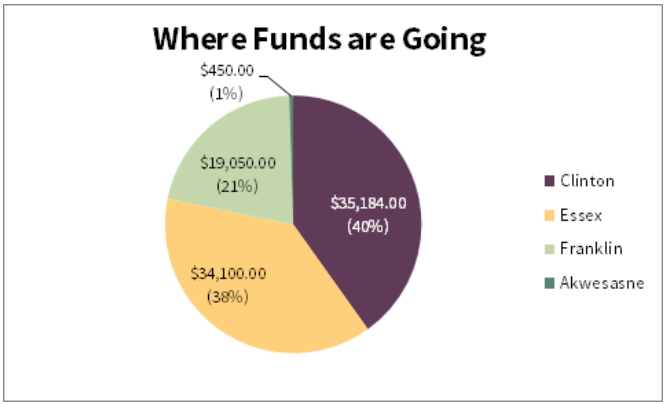
Faculty Mentor: Julie Dudrick **Department: Upstate Institute**

Title of Project: Adirondack Foundation "Measuring Foundation Impact"

Project Summary:

This summer, I worked as a Field School Fellow for Adirondack Foundation. This experience introduced me to nonprofit work on a local level. The Adirondack Foundation tasked me with measuring their direct impact, by attending meetings and conducting site visits, and with communicating these results.

Measuring the impact of Adirondack Foundation is not a simple task, as the foundation holds over 250 charitable funds, and no one fund is the same. Therefore, my supervisor and I determined that measuring impact on a fund-by fund basis made the most sense. I first examined the data gathered from the grant applications, created visualizations of the data, and then I put the data in perspective. I followed this process for the Small Grants for Small Children Fund, Adirondack Foreign Language Enhancement Fund, and the Generous Acts Fund.



This chart is an example of the data visualizations that I created to reveal impact. The chart on the left indicates that Franklin County received substantially less funding through Small Grants for Small Children. Still, Small Grants for Small Children has given grants to 96% of applicants, revealing that the disparity in funding is due to fewer applicants from Franklin County. Examining the data for these funds raises interesting questions to think about in the future.

I still had to put the data into perspective. For the fund analyses, I researched the fund purpose that Adirondack Foundation provided as well as the issues that prompted the funds on a regional and national basis, such as with the national and regional child care crisis. It is impossible to understand the impact of a fund without understanding the circumstances under which the fund was created.

To accompany these fund analyses, I was also tasked with measuring the impact of the Adirondack Nonprofit Network (ANN), which is a network in which regional nonprofits convene at retreats, workshops, and meetings on a yearly basis. The impact of ANN is difficult to measure with quantitative data, so I focused on qualitative data to tell the story of ANN. I interviewed 6 founding members and 2 newer members of ANN to understand what ANN means to them, which aspects are the most beneficial, and how ANN can evolve in the future to better support organizations in the region. To accompany the interview, I created and sent out a survey to all ANN members on the list-serve to create graphs and charts that measure the effectiveness of ANN. Through the survey and the interviews, the value of relationships stood out as distinct and invaluable. Most ANN members emphasized that, before ANN, they had few relationships with other nonprofit leaders and staff in the Adirondacks outside of their field. However, some workshops could be more specific in order to engage both new and experienced members.

Through this project I gained an understanding of the importance of both quantitative and qualitative data. Without quantitative data, it is more difficult and time-consuming to analyze impact. Without qualitative data, it becomes difficult to put numbers into perspective.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Upstate Institute

Research Fellow: John Slater (2022) **Concentration: Astronomy/Physics**

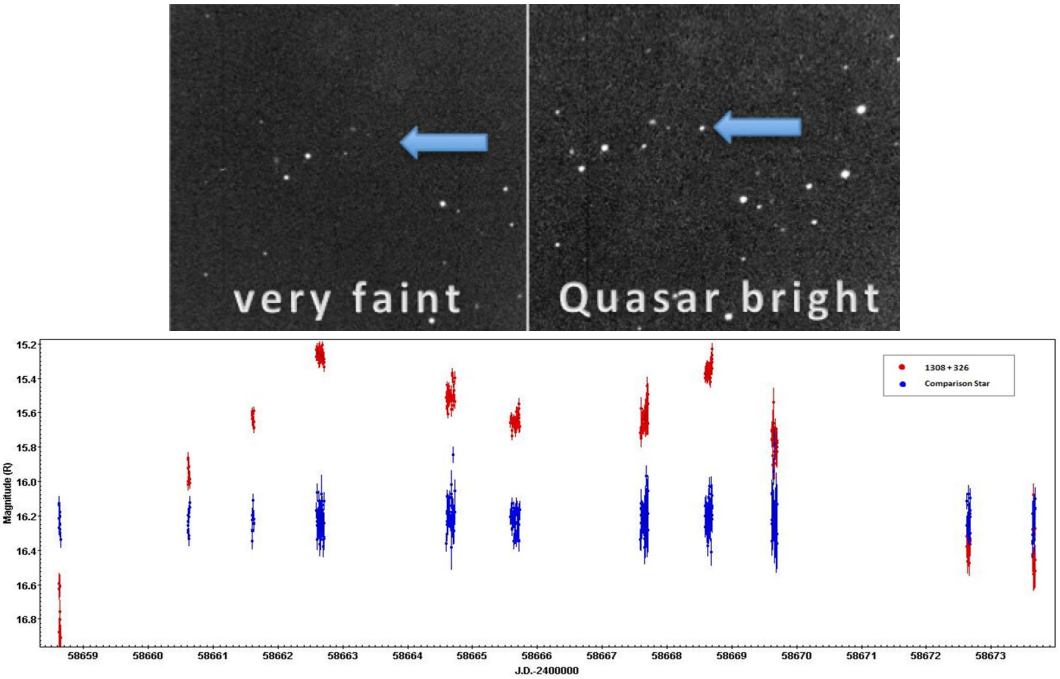
Faculty Mentor: Thomas Balonek **Department: Physics and Astronomy**

Title of Project: The Recent Flare and Possible Pattern of Outbursts of Quasar 1308+326

Project Summary:

Quasars, a subset of active galactic nuclei (AGNs), are the brightest objects in the universe. Their physical structure and emission processes remain a huge mystery to astronomers even after roughly sixty years of study after their identification. To better understand the optical emission from quasars, our research kept track of the variability of a set of quasars – continuing years of observing at Colgate's Foggy Bottom Observatory. It is believed that the optical light we observe comes from a relativistic jet of electrons ejected from near a supermassive black hole. We hope to find some possible pattern of optical variability to help uncover information about how these objects function. Outbursts are particularly helpful because these peaks in brightness bring important information for the possible establishment of a pattern. However, many quasars vary on multi-year patterns, if these patterns are even there.

After weeks of observing nights this summer, we were lucky enough to observe an outburst in the quasar 1308+326, which increased in brightness by around 3 magnitudes from when last observed. Once we detected this outburst, we observed for multiple weeks.



Above is the graph of our data. In red, we see our quasar experience an exponential increase in brightness, which appears as a linear increase in magnitude (a logarithmic scale). The blue shows the brightness of a comparison star. Comparison stars are non-variable and enable us to measure the quasar's brightness against something constant. As seen in the graph, there are two maximums almost reaching magnitude 15.2 in the R filter. The quasar also shows an exponential brightness decline (linear in magnitude).

Although we continued data collection after this point, we shifted our focus from just the analysis of the data to understanding the light curve. From analyzing past data sets obtained at Colgate's Foggy Bottom Observatory, we saw that this particular quasar has had similar outbursts in a near 17-year cycle. However, the light curve above includes the only data we have in this cycle, so our conclusions are not completely certain. Some internet searching revealed that there might have been major outbursts in the 1960's and 1940's as well, which would further the conclusion above. There are also less significant outbursts that have happened in recent years. Small-scale flares in 2012 and 2014 indicate that variability can occur between major outbursts. In a recently published paper, the radio jets were shown to follow more of a helical shape that precesses every 16.9 years, which happens around the time we see outbursts.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Justus '43 and Jayne Schlichting Student Research Fund

Research Fellow: Ethan So (2021) **Concentration: History**

Faculty Mentor: Alicia Simmons **Department: Sociology**

Title of Project: News Framing of Police Killings of Unarmed Blacks

Project Summary:

This summer I researched with Professor Alicia Simmons investigating the media framing of police killings of African Americans. The goal was to discover patterns in how news media reports these events: What primary sources do they interview the most? How are they reporting the events? What function do these articles serve? Analyzing these questions allows us to better understand what topics news media focuses on, which in turn reflects what its audience will believe about these issues.

To perform this research, we drew on the efforts of previous research assistants who assembled 2000 articles worth of materials covering over 30 shootings. The sources targeted six news agencies—three major newspapers and three major television news channels. We then narrowed down the material to five cases: Amadou Diallo, who in 1999 was shot at 41 times and hit 19 times in the Bronx; Sean Bell, who was shot at his bachelors party in 2006; Freddie Gray, who had his spinal cord fractured while in Baltimore Police custody in 2011; Michael Brown, who was shot in Ferguson in 2014 by Officer Wilson; and Eric Garner, who asphyxiated after an officer put him in a chokehold in 2014.

Professor Simmons generated a code book and then we coded and discussed several sandboxes. Each sandbox allowed us to clarify the definitions of each code, until we could code articles with an 80% rate of consensus. The goal of this process was to ensure intercoder reliability—to check that we each understood what certain codes meant and how to accurately place them. Throughout this process, we also adjusted certain codes, as some either did not fit and weren't used, while others had unclear meanings which made them impossible to place.

After this, we had a functioning final codebook consisting of the following areas: Topic, which explained the core focus of the article; Style, whether the article was a short episodic story or more in-depth thematic one; Function, which highlighted what role the article plays in democracy (Informing citizens, Scrutinizing power, Debating issues, or Representing voices); Generic Frames, a list of five commonly used frames which articles tend to be directed towards (Conflict, Attribution of Responsibility, Human Interest, Morality, and Economic Consequences); and Sources, reflecting where the media obtained information from.

We then spent the final few weeks of the summer reading approximately 775 articles, coding each one with these codes in the program MAXQDA. There are still a few more hundred articles to code before analysis can be done. This summer research project has taught me a great deal about the importance of research methods in sociology. Much of the work we were doing needed to be recorded, so that the project was both transparent and replicable by other sociologists. We had to be as consistent as possible, with a data set which varied wildly. The project demonstrated how much rigorous planning and thought needs to be done to do meaningful research, and I look forward to attempting my own work in the future.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☒ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Dvorah Southland (2021) Concentration(s): Russian and Eurasian Studies; IREL

Faculty Mentor: Jessica Graybill Department(s): Geography; Russian and Eurasian Studies

Title of Project: Russian Eyes on the North

Project Summary:

This summer, for my project Russian Eyes on the Arctic, I explored the strategic and cultural importance of the Arctic and, more specifically, the Lomonosov Ridge, to the Russian Federation. Under the guidance of Professor Jessica Graybill, I conducted a literature review of government documents, online news articles, and international sources, with the goal in mind of writing a comprehensive paper on the subject and creating a visual companion to the text in the form of a timeline of events.

The paper examined the importance of Arctic territory to Russia from multiple perspectives in order to provide as much insight as possible into Russia's strategic decisions in the region, and to possibly predict future events. First, background was provided on the Lomonosov Ridge, an internationally contested undersea ridge which Russia among other states has laid claim to. Under the purview of the United Nations Convention on the Law of the Sea, multiple states are rushing to prove that the Lomonosov Ridge is a natural extension of their borders. If such a claim were successful, the state that made it could then include the Lomonosov Ridge in their exclusive economic zone, potentially gaining access to untapped petroleum resources and securing shipping routes through the Arctic as sea ice melts rapidly. Secondly, the paper looked at the history of Russian and Soviet intervention in the Arctic, viewing it as possible precedent for current and future actions of the Russian Federation in the Arctic. Another item which may be viewed not only as precedent but as policy is the Russian Federation's ARCTIS 2020 and 2030 visions for the Arctic. These documents, released by the government, detail plans for Russian development of the Arctic in various sectors, including military and economic. Another facet examined in my paper is the importance of Russia's self-image, and the self-image it wants to convey to its citizens and to foreigners. Naturally, the media plays an important role in the curation of this image, so the ways in which the Arctic is consumed by the public through news and art can provide a foundational understanding of how Russians see themselves and their country's destiny in the Arctic, and how they want to be seen. Inseparable from this is, of course, Russia's political goals for the future. In order to further understand this, I turned to political science and economics. I followed the story of Russia from Soviet times to the collapse of the Soviet Union, the trauma and uncertainty that created, and the present day which has been undeniably shaped by those events. The Arctic plays a pivotal role in the Russian Federation's response to the shock of the 90s and early 2000s. Finally, I examined Vladimir Putin as an individual and as a politician, trying to gain an understanding of his *modus operandi* and how the conquest of the Arctic suits his own self-image.

The conclusion of the project includes a timeline of Russian political and territorial events directly related to the Arctic, and a timeline of correlated events such as oil crises, other nations' claims to the Arctic, the fall of the Soviet Union, the rise of Putin, and nuclear events in the Soviet Union and Russian Federation. As the summer was wrapping up, more contentious events occurred, such as a mysterious radioactive explosion in Northern Russia, and the launch of Russia's floating nuclear power plant (named for the Lomonosov Ridge). The story is not over, and I plan on incorporating further developments in the Russian Arctic into my ongoing work with the subject.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☒ UNST Div.
☐ Other (specify):

Research Fellow: McKella Sylvester (2021) **Concentration: English**

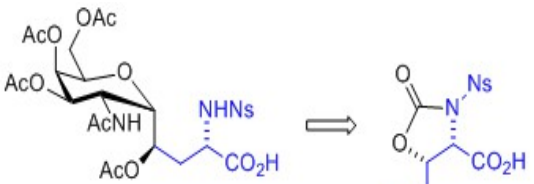
Faculty Mentor: Ernie Nolen **Department: Chemistry**

Title of Project: Synthesis of Glyco-Amino Acids for Biomedical Studies

Project Summary:

T nouvelle or Tn antigen plays a significant role in the progression of tumors. The Tn antigen is a truncated version of an O-mucin which is a glycosylated protein that is found on mucosal membranes. Since the Tn antigen is not expressed on normal adult cells, these carbohydrate-based molecules have given insight on tumor metastasis. In some immunohistochemical studies, it is been shown that the T antigen is expressed on a variety of different tumors, especially epithelial ones.

Our group's aim this summer is to successfully produce the amino acid end of the Tn antigen mimic. This β-vinyl serine can be prepared from an analogue of the well-known Garner's aldehyde. In the past, with toluenesulfonyl (Ts) protection, the synthesis has been achieved in nine total steps with a 20% overall yield. This itself is an improvement over literature procedures. However, when it was time to remove the Ts-protecting group, it did not occur.

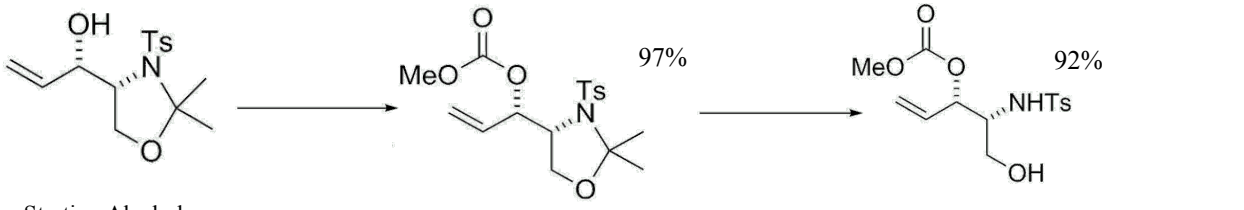


Tn antigen mimic for glycopeptide synthesis

β-vinyl serine

My main concern this summer was to shorten the synthetic pathway of the Ts protection sequence by two steps while also improving overall yield. Even though the Ts group is not easily removable, this synthesis would be practice for related work currently being conducted by Blair Boyles '21.

The first two steps in the synthesis were easily achievable with methyl (MeO) carbonate formation and acetal removal. The starting alcohol was made by Brynn Lewis '20. The overall yield of these two steps was 89%.



Starting Alcohol

MeO Carbonate

MeO Carbonate with Removed Acetal

The next step in the synthesis was to produce a carbamate through base-catalyzed cyclization shown below. Despite multiple attempts with different conditions, a 1,3-diol was made instead of the desired carbamate. We reasoned that the carbonate needs a better leaving group than methoxide (MeO), so we have turned to the preparation of aromatic (ArO) carbonates.

Desired Carbamate

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): National Institutes of Health (NIH) Area Grant

Research Fellow: Michelle Tebolt (2019) **Concentration: Astrogeophysics**

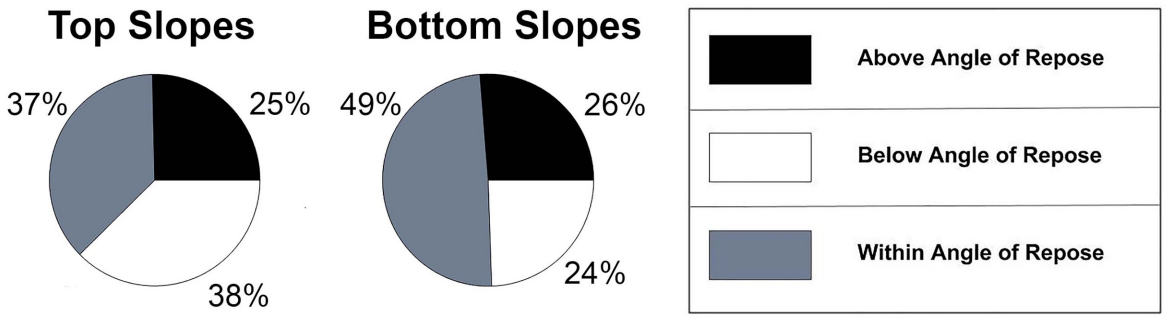
Faculty Mentor: Joseph "Joe" Levy **Department: Geology**

Title of Project: Exploring Martian Climate through Mapping of Glacial and Permafrost Landforms

Project Summary:

This research project focuses on various surface processes that occur on the surface of Mars. These included two different processes: Recurring slope lineae (RSL) which appear as dark streaks on sandy martian slopes that lengthen downslope over time, and debris-covered glaciers that behave similarly to glaciers on earth with downslope viscous flow. The data was collected and examined through remote sensing using high-resolution images and digital elevation models (DEM) created from linked High Resolution Imaging Science Experiment (HiRISE) and Context Camera (CTX) images of the surface of Mars. Although RSL and debris-covered glaciers are two different surface processes, they both have the potential to reveal information about current and past climate conditions on Mars, which in turn has astrobiological and habitability implications.

RSL are dark linear features that appear annually on the surface of Mars. They grow incrementally during warm seasons and fade during cold seasons at lower temperatures. Some of the characteristics of the RSL appear similar to the behavior of water moving through a porous medium, including seasonal temperature dependence and the incremental advancement of RSL downslope which has led some to hypothesize that liquid water is involved in their formation. Alternatively, RSL may be caused by annually recharged dry grain/dust flows. Both the wet and dry models make predictions about the physical characteristics of the RSL including the slope on which they form. When dry sediment tumbles downslope, there is a range of slopes called the static angle of repose where the slope is steep enough for the grains to begin and continue moving downslope between 35^{o} and 42^{o}. There is also a range of angles where the slope is too shallow for the dust to continue tumbling at the dynamic angle of repose between 28^{o} and 35^{o}. If RSL are formed by the flow of dust and cohesionless grains, it is expected they will begin and end within these ranges of slope values. We mapped the initiation and termination points of ~12,900 individual RSL across 16 confirmed RSL sites in the midlatitude and equatorial regions of Mars. We found that although a little over a third of the RSL begin within the static angle of repose, over half do not and over half of the RSL fall outside of the dynamic angle of repose. Whatever mechanism, or combination of mechanisms, that is used to explain the formation of RSL must account for these observations.



Debris-covered glacial landforms populate the midlatitudes (±30-60˚) of Mars. They are composed of mostly ice and are covered by a 10m thick rocky debris layer. These landforms are similar to terrestrial glaciers in appearance, with apparent down-slope viscous flow and geologic features such as lobate structures. We found that the boulders on the debris-covered glaciers appear to be clustered together in bands of high and low population. This may be an indicator of a local or global change in climate, as a change in ablation rate could cause an accumulation of boulders. This is an ongoing project, the next step will be to compare these high and low boulder population bands across multiple debris-covered glaciers at various sites across Mars.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): NASA Mars Data Analysis Program

Research Fellow: Rachel Thompson (2020) **Concentration: Sociology**

Faculty Mentor: Alicia Simmons **Department: Sociology**

Title of Project: News Framing of Police Killings of Unarmed Blacks

Project Summary:

This research conducted by Professor Simmons focuses on the cases of unarmed black men killed at the hands of police officers. The study focuses on five high profile cases that the media has chosen to put in the spotlight. The names Amadou Diallo, Sean Bell, Eric Garner, Michael Brown, and Freddie Gray are the central foci for the research. The delivery of information to the public is a focal point, along with the audience's perceptions of the data. The media has proven to be a vital part of shaping the views and beliefs of nations. In knowing that, we are digging into the themes, frameworks, and patterns of agenda-setting that appear in news articles and transcripts.

Through this research, there are various methods of how social and formal media outlets influence the presumed perception of these tragic events over the past three decades. The type of language the authors or news correspondents use while telling these stories affect how we, as their consumers and audience, analyze their words. Information in our society works as a continuous cycle that never ceases to exist. People are always articulating these newsworthy stories from their perspective as opposed to taking on a different voice. Part this research, we have to distinguish is the angle from which they are telling the story. What is the purpose that the author is trying to portray to their readers?

Similarly, how are they framing the events in the story? We have to look at the content that each piece of data is telling its audience. The group had to think critically about how we want each article or news transcript to be distinguished. With each piece of data, we had to decide between the five frameworks: conflict, attribution of responsibility, human interest, morality, and economic consequences.

In the first couple of weeks working on this project, we focused on solidifying the codebook. We focused on three primary codes: Reporting Style, Function, and Generic Frame. These three are the first in the codebook. By focusing in on three systems instead of tackling all six principal codes, it allowed us to focus on the complete depth of each one. We started by breaking up the data, previously acquired through other research assistants in the past years, into groups that we called sandboxes. The amount of data in each sandbox increased as the codebook became more solidified. With sandbox #1, we learned familiarized ourselves with the codebook and the sub-codes that were attached to each significant code. Our goal in completing all six sandboxes was to create a codebook so specific and easy to read and understand. We wanted to be able to have a random person with no prior knowledge of data analysis to code this data compiled of news articles and transcripts. With the specific definitions for each code and sub-code in the book, we wanted it to be as accurate as possible for future researchers.

Below are the final sub-codes for Function and Generic Frames, along with their definitions for Professor Simmons research.

12	FUNCTION	What is the primary purpose this article? How does it serve the interests of democracy?	Article may only receive one code. Articles often have elements of all four; select the function that predominates. Headline is an important clue. Process of elimination can help. Apply code to the headline.
	Informing	Enabling citizens to be knowledgable about issues/events.	Title is concrete and clearly conveys the main point of the article. Article focuses on a direct (and often current) issue/event. Typically dispassionate. Frequently applies to articles that are early in a timeline of events. All articles inform. If the article devotes substantial attention to another function, code as such. Often characterizes Episodic articles. Rarely characterizes Opinion articles.
	Scrutinizing	Monitoring sources of power. Typically focuses on officials (e.g., police, courts, politics).	Investigative. Asks and answers a question. What are powerful actors doing when we can't see them? Does not include articles discussing someone else's scrutinizing (e.g., oversight reports). Typically a negative tone. Almost always Thematic. Often characterizes Opinion articles.
	Representing	Enabling groups to be heard by those in power.	A monologue by a person/(generously defined) group. Quotes and sourcing patterns are key clues. May provide more than one point of view, but they are not in conversation with one another (e.g., public opinion poll reports). Differs from debate in that the focus is largely about one point of view or coming from a single person/(generously defined) group. Often characterizes Human Interest articles. Often characterizes Opinion articles.
	Debating	Providing a forum for discussion. Presenting a range of voices therein.	A dialogue between parties. Quotes and sourcing patterns are key clues. Features sustained attention to at least two points of view. Differences might occur across factions or within them. Differs from representing in that there is a disagreement between parties about facts, interpretations, etc. Typically Thematic. Often characterizes Conflict articles. Rarely characterizes Opinion articles.
13	GENERIC FRAMES		Article may only receive one code. Articles often have elements of all four; select the function that predominates. Headline is an important clue. Process of elimination can help. Apply code to the headline.
	Conflict	Reflects diagreement between at least two parties/individuals/groups.	Refers to two sides. Refers to winners/losers. Quotes and sourcing patterns are key clues. One group reproahes another. Includes disputes about facts, processes, strategies, tactics, etc. Often applies to articles about Criminal Justice Process and Elections.
	Attribution of responsibility	Suggests who is responsible for a problem and who has the ability to address it. Suggests strategies for rehabilitation/retribution.	Involves action: an actor (generously defined) has/is/needs to do something. Asks what happened? Why did it happen? Includes articles about Apologies. Applies to stories about Charges, Verdicts, and Civil Suits. Often characterizes Scrutinizing articles.
	Human interest	Gives a human face to an issue. Generates feelings of outrage, compassion, etc. Emphasizes how individuals/groups are affected. Discusses personal lives.	Tightly zooms in on one or a few actors. Quotes and sourcing patterns are key clues. Typically Thematic. Often characterizes Representing articles.
	Morality	References socially prescribed or prohibited attitudes/behavors/conditions. i.e., respect for autonomy (self-rule), beneficence (bring about good), non-maleficence (do not harm), justice (equality, fairness, and impartiallity)	Moral message should be explicit. Quotes and sourcing patterns are key clues. Moral message is often found at the end of the article. Includes articles that substantial focus on religion or healing. Often found in Opinion articles.
	Economic consequences	Refers to finacial losses/gains. Refers to costs.	Often characterizes Demonstration articles.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☒ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Jack Tregidga (2021) **Concentration: Physics**

Faculty Mentor: Rebecca Metzler **Department: Physics and Astronomy**

Title of Project: Exploring the Multi-Scale Relationship between Structure, Composition, and Mechanical Properties in Calcium Carbonate Biominerals

Project Summary:

At small scales, the composition and structure of mollusk shells are exceptionally complex. In this project we set out to investigate the African freshwater mussel. African freshwater mussels (*Etheria Elliptica*) are a species of bivalve mollusks found in rivers and lakes throughout Africa. Like other bivalves, it has a two-part shell consisting primarily of calcium carbonate. In order to adhere to substrate and other mussels, it produces a solid adhesive, similar in composition to the shell, however containing a lower concentration of calcium carbonate. This material has been studied in other bivalves, such as the Eastern oyster, but it had not been previously studied in the *etheria elliptica*. In order to investigate this, we mounted small sections of shell in epoxy, which were then polished down to expose a flat cross-section. We found that its shell and adhesive have compositions and material properties are similar to other bivalves, however certain aspects of the calcium carbonate crystal structure appear to be significantly different.

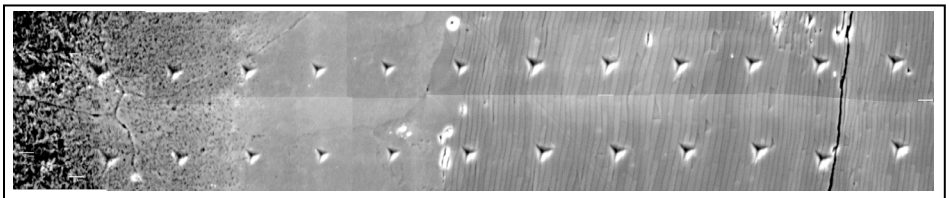


Fig 1: A scanning electron microscope image of a nano-indented region of the shell

We measured the shell's hardness using nano and micro-indentation (a small needle is pushed into the shell with a known force, by measuring the indent area hardness is determined), and used both Raman and EDS spectroscopy to investigate its composition. Through imaging, composition and hardness analysis we found that the shell and adhesive are mostly discrete regions, with the adhesive being characterized by its lower hardness and lower calcium carbonate content. Figure 1 is a secondary electron SEM image of the adhesive and shell, with the adhesive being the darker region on the left (due to its porosity). We further characterized the shell into two layers; the nacre (on the right in figure 1) made up of many thin calcium carbonate tablets, and the blocky shell, a relatively small layer between the adhesive and nacre. Our results suggest that the blocky shell has slightly higher calcium carbonate content and hardness, although further work on more samples would be valuable.

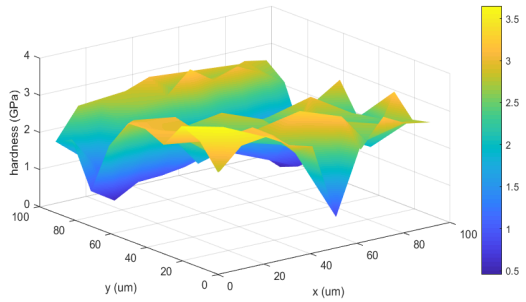


Fig 2: A two-dimensional hardness map, showing a band of lower hardness in the adhesive region

Results from preliminary Raman spectroscopy are interesting. As expected, strong signals for calcium carbonate are seen, and intensity is lower in the adhesive relative to the shell. In similar marine bivalves (eg. Eastern Oyster) both the shell and adhesive would be expected to contain significant amounts of calcite (a calcium carbonate polymorph). In contrast, our results suggest that almost all of the calcium carbonate in the *etheria elliptica* shell is aragonite. This is surprising, and more work is needed to fully understand the calcium carbonate crystal structure throughout the adhesive and shell.

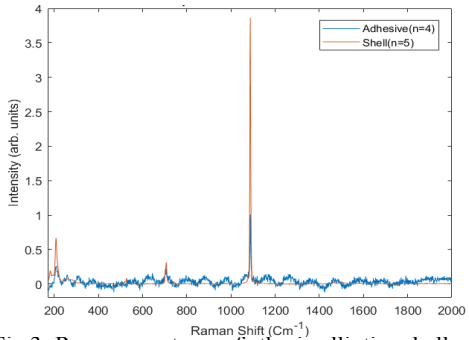


Fig 3: Raman spectrum of etheria elliptica shell and adhesive. Peaks near 200 cm^{-1} suggest that almost all calcium carbonate is aragonite

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Justus '43 and Jayne Schlichting Student Research Fund

Research Fellow: Desmond Tuiyot (2020) **Concentration(s): Japanese; Computer Science**

Faculty Mentor: Hiva Samadian **Department: Computer Science**

Title of Project: Dynamic Programming Algorithm for Conflict Resolution in Access Control

Project Summary:

Information systems often handle very sensitive data and hardware resources; some of these include financial information, health information, or certain medical devices. These systems make use of *authorization modules*, which are part of a security feature called access control, to regulate access to certain hardware or data resources by entities within an organization. These modules use pre-defined access control policies to make decisions, and must be able to detect and resolve contingent conflicts that arise from conflicting policies; there is a need for an efficient approach that can handle as many contingent conflicts as possible. An existing work has presented an exponential algorithm for conflict resolution; our work applies a dynamic programming approach to develop a polynomial-time algorithm for the same.

Access control data can be represented in a table, aptly named *access control matrix*, whereby each row represents a subject within an organization and each column represents an object. Each table of this kind represents a certain access right. The intersection of a row *s* and a column *c* represents has the value 1 if, for a certain right, subject *s* is allowed to access an object *c*. It is often impractical for policymakers to compose explicitly fill such tables. Instead, they decide on the permissions of only some subjects, for some objects, for all rights; the authorization module uses these explicit authorization values to automatically determine the rest of the authorization modes, in a process we call *propagation*. In order to achieve this, the authorization modules make use of the organization's subject inheritance hierarchy, represented as a *Subject SDAG*. Nodes in the SDAG represent subjects within an organization, and arrows represent the hierarchical relationships between the subjects. Subjects within an organization inherit rights from their ancestor nodes that either have explicit authorization values or are root nodes in the SDAG.

Therefore, in order to determine the authorization value for a node *s*, we need to perform a search for all paths leading up to *s* and then filter out paths that do not originate from either root nodes or explicitly valued nodes. Since this process needs to be repeated for all subjects in the SDAG (at least those that don't have explicit authorization values), the problem closely models a search for all paths in a graph. A brute-force search for finding all paths in a graph with *n* nodes takes $O(n^n)$. A naive recursion search for all paths leading to a node *s* takes O(m!) time. Since the subject node *s* might, in turn, appear in the paths of other nodes in the SDAG, we will need *s*'s pathslist in order to construct pathslists for those nodes. In this way, the problem lends itself well to dynamic programming; we store the pathslists for each subject node that we encounter and use them to construct pathslists for consequent subject nodes. Afterward, we remove the paths that do not originate from either a root node or an explicitly valued node.

For any subject in the SDAG, the paths in its pathslist represent potential authorization values that it can inherit. Therefore, a subject could inherit both positive and negative authorization values, leading to a conflict. To resolve these conflicts, a previous work has proposed a *Unified Conflict Resolution Framework*, which uses 4 major conflict resolution policies to form 48 meaningful combinations; each of the combinations is considered a different conflict resolution policy. These 4 major policies are Default, Locality/Globality, Majority, and Preferred policies.

The main contribution of this paper was already articulated in a previous work by my faculty mentor, Professor Samadian, before I started working on it. I started this research by learning about access control from reading his and many other related papers. For this, I used various databases, most of which were available through the Colgate network. During this time, I conducted a literature review of various recent works on the topic, some of which presented interesting alternative solutions to the problem of conflict resolution. I also learned how to write in the style of a scientific paper, worked with Mendeley (a bibliographical management tool), and got familiar with some interesting dynamics often at play in choosing a venue or journal in which to submit a scientific paper.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Research Council

Research Fellow: Xin Wang (2021) **Concentration: Molecular Biology**

Faculty Mentor: Geoffrey "Geoff" Holm **Department: Biology**

Title of Project: Cellular Responses to Mammalian Reovirus Infection

Project Summary:

I worked with Dr. Geoff Holm during the summer of 2018. My project focused the stability of the protein Mu2 in mammalian reovirus. Mu2 is a structural protein that is located in the inner capsid of the virus. The protein has been found to play a role in the formation of replication factories, RNA replication, RNA transcription, and more. In previous studies, different strains of reoviruses had been found to have different replication complex morphologies based on their Mu2 protein. Type 1 Lang (T1L) Mu2 was found to have more of a filamentous morphology while Type 3 Dearing (T3D) Mu2 was associated with a globular morphology. Since reovirus infects mammals, the normal temperature range is around 37˚C. Studies have also found that at lower temperatures (31˚C), both strains displayed the filamentous morphology. Even with the morphological difference between the two strains, reovirus is still able to effectively infect host cells. Therefore, my research looks to determine the cause behind the structural difference. Using immunoprecipitation and immunoblotting, I look to measure the levels of ubiquitination on Mu2 between the strains. My results indicate that there are higher levels of ubiquitin found in T3D samples compared to T1L.

During the process, I also made plasmids that had various point mutations at lysine residues of the reovirus plasmid. Once theses plasmids are transfected into the cells (293T), the samples can be analyzed through immunoprecipitation and running the samples on a Western blot. By comparing the results to the control samples (transfected with nothing, T1L, and T3D), one can determine any irregularities in ubiquitination based on lysine point mutations. Another project that I worked on was infecting L cells with P2 (passage 2) reoviruses with the different lysine mutations. From this, the next step would be to tag Mu2 with a fluorescent tag and look at differences in morphology using immunofluorescent microscopy.

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Science and Math Initiative-SMI (NASC Division)

Research Fellow: Jacob Watts (2021) **Concentration: Biology**

Faculty Mentor: James "Eddie" Watkins **Department: Biology**

Title of Project: The Physiological Response of an Australian Epiphytic Fern (*Asplenium nidus*) to Climate Change

Project Summary:

This summer I worked as a Beckman Scholar on the beginning of a fifteen month independent research project. My project aims to understand the stress physiology and nest forming morphology of the epiphytic fern *Asplenium nidus* i.e. The Bird's Nest Fern, which grows abundantly in Australia and South East Asia. Epiphytes are plants that grow on trees, disconnected from the soil. As one might imagine, epiphytes require a suite of adaptations to survive attached to the bark of a tree, without access to the abundant nutrient and water pools provided by the soil. The epiphytic environment is drier, hotter, brighter, and more nutrient limited than the forest floor and as the climate changes, the epiphytic environment will become even more stressful for the diversity of plants that grow there. Adaptations to the epiphytic environment include increased drought tolerance, increased nutrient uptake efficiency, increased root mass, and morphological adaptations to the epiphytic environment. *Asplenium nidus* invests heavily in the formation of nests, as implied by its colloquial name, which trap falling leaf litter and rain, buffering the plant from the harsh conditions in the canopy. My fifteen month project, which just began this summer, aims to illuminate the intricacies of exactly how this fern survives in the epiphytic environment and use this understanding to predict how climate change will affect its ability to survive in the near future.

Aspenium nidus with basket morphology being measured for photosynthesis and stomatal conductance by the Li-Cor.

I spent a large portion of my summer gathering preliminary data on the organismal physiology of *Asplenium nidus*. Using a variety of methods such as microscopy, the Li-cor portable photosynthesis system, Chlorophyll fluorescence meter, and a pressure bomb I gained insight into their physiology in an attempt to discover the mechanism by which they survive drought. I droughted a subset of genetically identical, young *Asplenium nidus* for 22 days and 62 days and periodically measured their photosynthetic capacity and chlorophyll fluorescence to measure their physiological response to drought. Because small *A. nidus* have not yet formed a nest, I hypothesized that they would be very drought tolerant, even more so than larger *A. nidus* plants. Large *A. nidus* can buffer their conditions for longer during drought. I found that even before their leaves experienced decreased water health, they began to close their stomata and decrease their photosynthetic rates in response to drought. At day 22, the photosynthetic rate is about one third of its maximum, but its internal water potential is not significantly different from a fully hydrated leaf. This suggests that *A. nidus* avoids drought stress for as long as possible by downregulating photosynthesis to save internal water. At day 62, the water stress within the leaves is approximately 15 times that of fully hydrated plants, the leaves are heavily wilted, and all photosynthesis has stopped. Yet, three days after being rewatered, most of the fronds are enlivened again and continue photosynthesis. This suggests that small *A. nidus* are extremely drought avoidant and drought tolerant.

In the future, as a part of my Beckman Fellowship, I would like to compare the drought tolerance of larger *A. nidus* to smaller *A. nidus* to understand how the two fundamentally different parts of their life cycle respond to drought in different. I also plan to study the desiccation tolerance of *A. nidus* gametophytes, which also use a fundamentally different strategy to survive life in the harsh epiphytic environment. As a capstone to the entire study, I plan to predict how the distribution of *A. nidus* will change as the climate changes in the near future, with particular focus on how Australia's populations will be affected.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Beckman Scholar Program

Research Fellow: ChanJu "Zoe" You (2022) **Concentration: Undeclared**

Faculty Mentor: Linda Tseng **Department(s): Environmental Studies; Physics and Astronomy**

Title of Project: Microplastic Chemical Retention

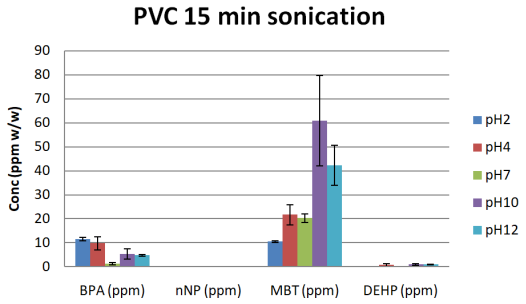
Project Summary:

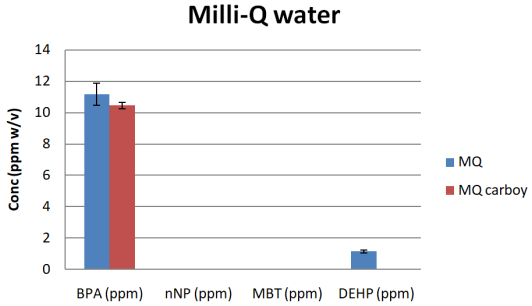
Plastics are synthetic polymers that are in popular use due to its strong durability and convenient production. Nowadays plastics are used in great numbers, and the consequential increase in plastic debris has caused serious pollution issues in marine, terrestrial, and freshwater ecosystems around the world. Among different types of plastics, microplastics are defined as plastics that have a diameter size less than 5mm. Due to its small size, microplastics easily enter into the ecosystem, and both chemical additives in plastic and toxic compounds that it accumulates throughout time pose a great threat to the environment.

Our purpose of the research was to see how different conditions of the water would affect the leaching of plasticizers and additives from the microplastics. The differing conditions were the pH of the water, ranging from pH_2 to pH_12. For the experiment, we used PVC microplastics and plastic additives and plasticizers such as bisphenol-a (BPA), 4-nonylphenol (nNP), 2-mercaptobenzothiazole (MBT), and bis(2-ethylhexyl)phthalate (DEHP).

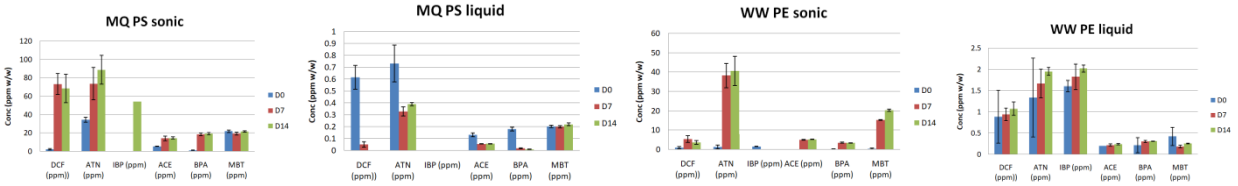
To create the samples, we made buffer solutions for each pH value and weighed approximately 1_g of PVC microplastics into the buffer solutions in an amber glass serum bottle. Triplicates of the buffer solutions were made for sonication times of 5, 10, and 15 minutes and only the solutions were extracted using SPE cartridges. We transferred 0.5-ml aliquot of each sample extract to be analyzed by the GC/MS (gas chromatography mass spectrometry) to obtain the peak areas of each chemical compounds. Then we correlated the peak areas to the parts per million (ppm) concentrations of each chemical. The results indicated a lowest release of chemicals in pH_7, and an increase followed by a decrease of concentration as the pH values move towards both the alkalic and acidic ends (figure below, left). More amounts of BPA were leached in acidic conditions whereas more MBT were leached in alkaline conditions.

To verify the source of the plastic additives observed, we analyzed the Milli-Q water stored in the laboratory plastic carboy container and directly from the Milli-Q water machine for plasticizers. We detected BPA and DEHP in the Milli-Q water from the machine and only BPA in the carboy container, but the concentrations were very low for both cases (figure below, right).





To test whether microplastics would accumulate trace chemicals commonly detected in human-impacted natural and wastewater, we also conducted an experiment concerning the adsorption of chemicals by two different types of plastics. The two types of plastics were polystyrene (PS) and low density polyethylene (PE), and for each we tested the adsorption rate in Milli-Q water and in wastewater. For both waters, the six different chemicals (DCF, ATN, IBU, ACE, BPA, and MBT) showed a migration of chemicals from the bulk liquid to the plastics in 14 days in Milli-Q water (two left figures below). On the other hand, the chemicals in wastewater showed an increase in both the sonicated plastic and the bulk liquid (two right figures below). We suspect that the microplastics that might have passed through the SPE filters contributed to the large error bars in our results.



There are also ongoing projects regarding plasticizers in large polystyrene plastics, temperature and solar irradiation effects on chemicals in PET water, and chemical adsorption of large and microplastic PVC.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☒ UNST Div.
☐ Other (specify):

Research Fellow: Lijun "Karen" Zhang (2021) **Concentration: History**

Faculty Mentor: Monica Mercado **Department: History**

Title of Project: Looking for Women's Voice: The Portrayal of Revolutionary Women in Contemporary Chinese Museums and History Textbooks

Project Summary:

Women's political activism in pursuit of gender equality is an understudied feature of twentieth century Chinese history. Influenced by global feminist thought that challenged the existing patriarchal dynastic rule and oppressive practices in feudal society, groups of educated Chinese women actively published journals and started girls' schools to disseminate new thoughts on gender equality, as well as organized uprisings and protests against the existing system that oppressed women in the first half of twentieth century. These women organized numerous women's rights organizations and worked closely with the Nationalist and the Communist Parties to pursue equal rights with men. However, the vibrant past of women's activist movements remains largely absent in the official Chinese historical narrative and unknown to the masses of the Chinese public. While the official narrative sometimes acknowledges women's role as patriotic citizens in the revolutions, almost no traces of feminist commitments and women's liberation can be found. The absence of these activist voices has important political implications, since it naturalizes men's monopoly of political power, while women were, and simply remain, the passive receivers of the rights and benefits offered by men. Moreover, the silences of the feminist past in China also deprives present feminists of the past legacy that could serve as empowerment and inspiration. My research project, "Where is Our Past," thus explores the visibility of women of the revolutionary era (1895-1949) in the contemporary Chinese official historical narrative, which I define as museums, historic sites, and history textbooks.

In my research, I analyze the reasons for, and the political implications of, both the presence and absence of women's voices in official Chinese historical narratives, with attention to the interaction of public history with public policies that have reinforced gender inequality and the emerging feminist movement in China. To do this, I spent the summer of 2019 traveling to different cities in China, including Shanghai, Beijing, and Xi'an. I assessed the museums and historical sites that accounts the broader narrative of the revolutionary era; I examined the visibility of women's voices and experiences in secondary and high school history textbooks; and I explored the portrayal of women of the revolutionary era in museums that specifically focus on women's voices and experiences. I argue that, although there has been some progress in incorporating women's voices into the official narrative in the recent years, women's voices and experiences still remain absent in the broader official historical narratives. While some museums that address specifically women's experiences present a better portrayal of women in the revolutionary era that reclaims their agency, the political purposes of the museums still lead to intentional framing of the narrative and exclusion of certain women's voices in the exhibitions. The political purposes of national education thus limit the possibility of presenting an accurate portrayal of women's voices in the revolutionary era in Chinese official historical narrative.

Qiu Jin Monument, Photograph by Karen Zhang

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Lampert Institute for Civic and Global Affairs

Research Fellow: Saiyang "Sylvan" Zhang (2019) Concentration(s): ASTR/PHYS; Applied Math

Faculty Mentor: Cosmin Ilie Department: Physics and Astronomy

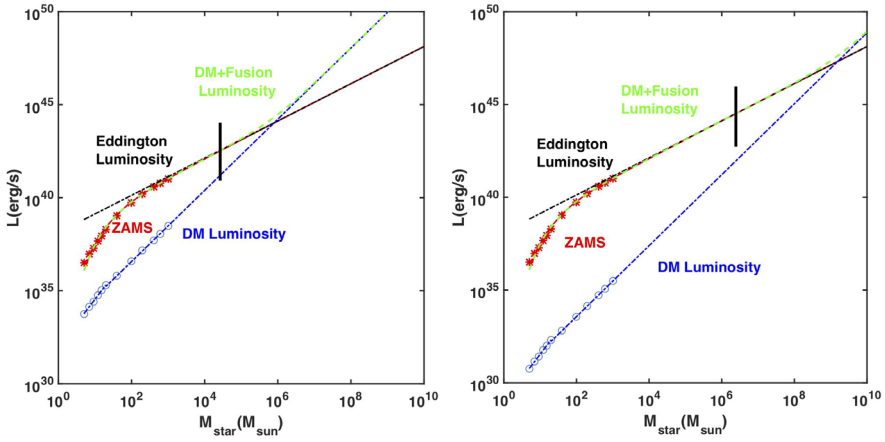
Title of Project: Effects of Capture of non-WIMP Dark Matter by the First Stars

Project Summary:

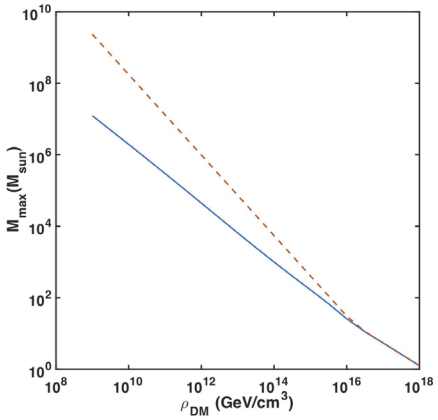
Dark matter particles drifting from far away in the dark matter halo, are accelerated through the gravitational field of the star. They enter the surface of the star, slowed down by collisions with the nucleons inside the star. Eventually, when the speeds of dark matter particles are smaller than the escape velocity of the star, they can no longer escape the gravitational well of the star and get captured.

Dark matter(DM) can self-annihilate and produce detectable particle flux through its capture in stars. For the case of super heavy dark matter ($m_x \geq 10^8 GeV$), a large number of scattering events is necessary to slow down the dark matter particles below the escape velocity of the stars to be trapped inside the stars. We investigate the effects of captured DM annihilations by Pop.III stars, which were formed in the early stage of the universe mark the end of the dark ages. Using the multiscatter capture formalism developed in the previous work, we estimated that the total capture rate for DM with masses in the following range: $10^8 - 10^{15} GeV$. Using current limits on the nucleon-DM cross section, and assuming that the captured DM self-annihilates and deposits a fraction of the energy inside the star, we find upper limits on the masses of the Pop.III stars.

Without DM heating, Pop.III stars powered by fusion will end up with masses typically up to ~ $1000 M_\odot$. Fragmentation of the collapsing gas cloud and feedback effects on accretion being the main limiting factors on the final mass. Including the effects of heating due to captured WIMP Dark Matter by Pop.III stars can further limit the maximum mass they can attain. We obtain similar results for the case of Superheavy Dark Matter, as shown in the following figure.



Luminosity from different sources with respect to the mass of the stars. $\rho_x = 10^{12} GeV/cm^3$ **(left panel) and** $\rho_x = 10^9 GeV/cm^3$ **(right panel).**



DM density vs. M_{max} **. When DM annihilation serves as a stable power source which can prevent the star from growing too massive. The maximum value is also related to DM density. The dashed line is given by the condition** $L_{DM} > L_{Edd}$ **while the solid line corresponds to using the following criterion**: $L_{DM} + L_{nuc} > L_{Edd}$

Source of Support: ☐ AHUM Div. ☒ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☐ Other (specify):

Research Fellow: Zhelun Zhou (2020) **Concentration(s): History; Philosophy and Religion**

Faculty Mentor: Alexander "Xan" Karn **Department: History**

Title of Project: "The grass must bend, when the wind blows across it": British Colonial Hong Kong's Education Policy, 1967 to 1978

Project Summary:

In this research project, I focused on the Hong Kong education policy from 1967 to 1978. Using archival records from the Hong Kong Public Records Office (HKPRO), I hope to understand government's intentions of implementing the education policies it proposed, Hong Kong people's public discussions of education and identity within their debates of education policy. Furthermore, as a history-oriented research, I also wish to use the Hong Kong education policy as a lens to understand the popular discussions of Hong Kong identity surrounding colonialism. This research is framed as a continuation and complement to the independent research and thesis project I conducted in London during spring 2019, as part of the history department's London History Study Group.

HKPRO contains abundant materials on Hong Kong education policy from 1967 to 1978. I took extensive notes on the archival materials during my ten archival visits in two weeks. In the ten-day archival visits, I viewed twenty-eight folders, and took pictures of documents from five folders and prepared roughly sixty-page of notes for the research, as for me to map out the debates of Hong Kong education policy during that time. Those preparations help me to keep track of the records I engaged with, but also to have a chance to take a second look at them later. In those ways I spared no efforts during my archival visits to the HKPRO in my two-week stay in Hong Kong. Additionally, I also bought a new scholarly edited volume, published by the Chinese University of Hong Kong (CUHK) Press that addresses some of the keywords in both Hong Kong's contemporary landscapes and academic Hong Kong studies.

My research findings are rewarding. In some respects, they demonstrate a similar story pattern and some differences compared to what I found in my London research. On the difference side, my research in Hong Kong discovered more Hong Kongese' voice in debates of Hong Kong education policy at HKPRO than archives in London. Through my research, I also found materials addressing government's reforms on secondary school examination system, vocational school programs, and its language policy, which were not covered in the materials at archives in London.

As on the similar patterns, first, when designing the education policy, the Hong Kong government heavily stressed their legitimacy and public image. The government viewed education policy as a public relation to alleviate people's criticism and to satisfy their demands. Hence the government has conducted survey on people's views on education policy. The other officials and other members of the Hong Kong society, noticing this trend of government, equally evoked the abstract "people's will" to persuade the government to execute reforms on education policy. In addition, obsessed with its legitimacy, the Hong Kong government also tried to use police force to dissuade public dissensions about education policy in their everyday life. Second, in discussing the education policy, Hong Kongese, from the youth, the college student unions, the Urban Council leaders such as Henry H. L. Hu and Dr. Denny M. H. Huang, to different neighborhood associations and social pressure groups, also tried to navigate through a vision of their identity. With different people debating education policy from different backgrounds, the HKPRO records presented a polyphony of voices about the vision of Hong Kong identity, ranging from call of a citizenship, to appeal for more universal, liberal human rights, the petition to a better democratic polity and self-government, as well as an anti-colonialist stance, a localist standpoint and also a possible endorsement of a quasi-nationalistic viewpoint. All this polyphony of voices illustrates Hong Kongese's own grasp of their own identity as the polemics of Hong Kong education policy raged on. To make themselves heard, they organized numerous protests and looked for international supports in urging the government to take reforms seriously. Those findings on education policy facilitate me to see a decolonizing process that is unique on Hong Kong's own conditions. The process started haphazardly about potential political self-government in Hong Kong but was stalled before it was completed.

I thank Professor Xan Karn, my faculty sponsor, for his encouragement and help provided for my research. I equally thank Professor Nam, the Director of Lampert Institute, for approving my research project. I also thank my friends, especially Allan Tak Fung Pang for all the conversations we had. I thank Prof. Lutman at Writing Center for helping me editing the draft. Most of all, my appreciation and indebtedness go to my parents' affection and support. I could never achieve my work without them.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Lampert Institute for Civic and Global Affairs

Research Fellow: Ziyu "Vicky" Zhou (2020) **Concentration: Political Science**

Faculty Mentor: Stanley Brubaker **Department: Political Science**

Title of Project: Study of Fake News in the French and American Constitutional Systems

Project Summary:

Fake news has become ubiquitous in today's political discourse. Even though fake news is not a new phenomenon, today's fake news is categorically different in its magnitude of influence from its historical predecessor as it is spread faster and impacts a much larger audience. Due to the frequent reference to "fake news" by President Trump as well as the perceived impact of fake news on the 2016 US election and Brexit referendum, the term "fake news" was named as Collins Dictionary's word of the year for 2017. The detrimental impact of fake news has also urged some states to take the initiative to carry out regulations of fake news, among them are Russia, Germany and Singapore. In November 2018, the French legislature passed a new law against misinformation, which was the first attempt in western Europe and in the liberal society to ban false information during the three months preceding elections. In the meantime, the US continues to employ its "hands-off" approach to fake news, with little regulations on falsity except for extremely narrow cases. This research aims to study the potential danger fake news poses to democracy. Due to the vagueness of the definition of "fake news," as well as the difficulty to determine the malicious intent of the creator of the news, this study deals with a broader category—misinformation—fabricated information that has no or limited veridicality. In particular, it focuses on misinformation designed to affect election outcomes. What's more, it compares, contrasts and assesses, within their constitutional contexts, the recently enacted French law against manipulation of information with the US tradition of reliance on a free press and private regulations to address misinformation.

Fake news can be challenging to democracy as democracy needs a good information environment in order to survive. Not only does the prevalence of fake news undermine legitimate news sources, but also fake news impact citizen's ability to gain information and their misperception can hardly be changed even after the misinformation itself is discredited. When citizens believe the false reports, their judgements can be affected and their voting choices can also be changed. However, fake news is hard to regulate as bans on fake news have serious unintended effects that can lead to self-censorship of the media and impair freedom of speech. Considering technological development and the way information is spread today, there is an inherent tension between protecting freedom of speech and regulating misinformation. What makes it even more difficult to solve this problem is the lack of practical and measurable impact of different solutions to misinformation. None of the existing solutions seems to be a panacea to all problems generated by misinformation.

The new legislation in France targets misinformation intended to affect election outcomes. It is envisioned to enhance transparency of sponsored content and to decrease foreign interference in national elections. However, as it grants new power to judges and to a new bureaucracy called the Higher Audiovisual Council to halt the dissemination of misinformation, it has encountered many criticisms and oppositions, fearing that this law can be turned to a tool of government censorship of speech. Compared to France's strict law against misinformation, the US has a more lenient approach to free speech. With the constitutional principle that the debate on public issues should be kept "uninhibited, robust and wide open," the US in fact protects errors under the First Amendment. Nevertheless, "the marketplace of ideas" theory, which serves as the theoretical foundation of the First Amendment jurisdiction, is not without controversies and the presence of misinformation does not seem to contribute to the discernment and reflection over the truth.

Provided the differences in constitutional traditions and the imperfections of the two approaches, this comparative study still provides insight for both countries to reflect upon its own ways of dealing misinformation. Even though it seems impossible for the US to make any legislative moves for the upcoming presidential election, in the long run, it is necessary to reflect upon its fundamental principle of the "counterspeech" method as the assumptions and conditions that used to hold it have significantly changed. The French also needs to reflect upon the scope of its legislation and think about the best possible ways that it can protect freedom of speech and decrease governmental interference under this existing structure. As various states begin to test different solutions to misinformation, more research and empirical studies may also help to further examine better ways to deal with misinformation in the future.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Center for Freedom and Western Civilization
(James Madison Research Fund)

Research Fellow: Jailekha Zutshi (2021) **Concentration(s): MAEC; Psychological Science**

Faculty Mentor: Ashley Taylor **Department: Educational Studies**

Title of Project: The Effects of a Common Braille System on Urdu and Hindi Speakers in India

Project Summary:

In high school, I channeled my years of dance experience to teaching dance to blind female high school graduates. As part of this, I learned to write Braille to make certificates for my students. When I indented the patterns for each letter, readers would touch the resultant protruding dots on the other side of the sheet, which were in the mirror image of the pattern I'd traced. While I eventually memorized the patterns for writing out each letter, I could not understand anything I'd written since it was directionally reversed. As a sighted person, it was disorienting to be able to write but not comprehend a script. This motivated me to explore blind individuals' experiences with Braille acquisition, and whether these might differ based on their first spoken or written language.

India has the second highest number of languages in the world, stemming from multiple linguistic families.[1] Colonial India had ten different Braille codes that were relatively tailored to the languages they conveyed. In 1951, independent India implemented a single unified code called Bharati Braille, doing away with the specificity of previous codes. I wanted to examine the effects of a common system on blind Hindi and Urdu speakers, drawing on theoretical frameworks from feminist disability studies and linguistics. These languages are of particular interest since they are read and written in opposite directions from one another, and since speakers are divided along religious lines - Urdu is spoken predominantly by Muslims, and Hindi by Hindus. Because Bharati Braille is based on the Hindi script, I hypothesized that it might systematically benefit Hindi speakers, who experience political, cultural, and religious privileges in India. I was especially interested in the different experiences of blind female Hindi and Urdu speakers as they acquired Bharati Braille since they are oppressed based on gender and ability, and in the case of my Urdu speaking sample, religion. Was it easier for Hindi speakers to learn Bharati Braille because it is based on the Hindi script? Were users' educational and communicative experiences affected by whether or not they had been sighted?

My research involved multiple sources of qualitative data collection within a Hindi speaking and Urdu speaking sample and an analysis of my findings using theoretical frameworks from transnational and postcolonial feminist disability studies. The themes that emerged in the process of interviewing participants, speaking with experts, reading official documentation, and then analyzing these data using an intersectional lens reveal a far more complex set of assumptions that underlie the development and linguistic mechanisms of Bharati Braille. In general, while Bharati Braille's linguistic bias in favor of Hindi speakers seemed to hold, it manifested in unexpected ways. Specifically, it was easier for my Urdu sample to learn the code because they were familiar with languages running in opposite directions, similar to how the reading and writing in Braille were directionally reversed. These findings are of particular significance since this Braille code is in the process of being revised to make it more equitable across linguistic and regional groups. I found that the current code fails to account for the intersection of internalized ableism and sexism, as well as linguistic chauvinism and Islamophobia, resulting in a system that reflected the priorities of a privileged minority within the blind community. By locating the creation and development of the code within a colonial framework, I was able to bring a more humanistic and holistic approach to studying something as technically charged and historically debated as Bharati Braille.

[1] Seetharaman, G. "Seven decades after Independence, many small languages in India face extinction threat." The Economic Times, 3 August 2017, https://economictimes.indiatimes.com/news/politics-and-nation/seven-decades-after-independence-many-small-languages-in-india-facing-extinction-threat/articleshow/60038323.cms.

Source of Support: ☐ AHUM Div. ☐ NASC Div. ☐ SOSC Div. ☐ UNST Div.
☒ Other (specify): Lampert Institute for Civic and Global Affairs

Statistics

Please note the total number of participating students is the number of student projects. Students working on two different projects with different faculty are counted twice. Students with double-majors are counted twice in the Distribution of Students by Concentration table.

In addition, the total number of participating faculty is the number of faculty supervising student research projects. Faculty holding joint appointments are listed by the department/program which most closely matches the subject of the research project supervised (source of funding consulted for interdisciplinary projects). Faculty in different departments jointly supervising one student research project are both counted in the Distribution of Students by Faculty Division and Department table.

Total number of participating students: 183

Distribution of Students by Concentration (students with double majors are included twice)

Anthropology	3
Applied Math	4
Art and Art History	2
Astrogeophysics	3
Astronomy/Physics	5
Biochemistry	8
Biology	14
Chemistry	15
Classical Studies	2
Computer Science	20
Economics	3
Educational Studies	5
English	9
Environmental Geography	2
Environmental Geology	2
Environmental Studies	2
Film and Media Studies	3
French	1
Geography	6
Geology	3
German	2
History	11
International Relations	4
Japanese	2
Mathematical Economics	2
Mathematics	1
Middle East and Islamic Studies	1
Molecular Biology	16
Music	2
Natural Sciences	2
Neuroscience	11
Peace and Conflict Studies	8
Philosophy	4
Philosophy and Religion	1
Physics	14
Political Science	8
Psychological Science	6
Russian and Eurasian Studies	3
Sociology	5
Spanish	6
Undeclared	17
Women's Studies	1

Arts and Humanities	**31**
Art and Art History	2
Classical Studies	2
English	9
French	1
German	2
Japanese	2
Music	2
Philosophy	4
Philosophy and Religion	1
Spanish	6
Natural Sciences and Mathematics	**124**
Applied Math	4
Astrogeophysics	3
Astronomy/Physics	5
Biochemistry	8
Biology	14
Chemistry	15
Computer Science	20
Geology	3
Mathematical Economics	2
Mathematics	1
Molecular Biology	16
Natural Sciences	2
Neuroscience	11
Physics	14
Psychological Science	6
Social Sciences	**45**
Anthropology	3
Economics	3
Educational Studies	5
Geography	6
History	11
International Relations	4
Political Science	8
Sociology	5
University Studies	**22**
Environmental Geography	2
Environmental Geology	2
Environmental Studies	2
Film and Media Studies	3
Middle East and Islamic Studies	1
Peace and Conflict Studies	8
Russian and Eurasian Studies	3
Women's Studies	1
Undeclared	**17**

Distribution of Students by Faculty Division and Department:

(Number is greater than total number of participating students due to jointly supervised projects)

Arts and Humanities	**11**
Art and Art History	2
Classics	3
East Asian Languages and Literatures	1
English	3
Music	1
Romance Languages and Literatures	1
Natural Sciences and Mathematics	**109**
Biology	20
Chemistry	31
Computer Science	9
Geology	17
Mathematics	1
Neuroscience	7
Physics and Astronomy	17
Psychological and Brain Sciences	7
Social Sciences	**24**
Anthropology	2
Educational Studies	3
Geography	5
History	6
Political Science	4
Sociology	4
University Studies	**10**
Environmental Studies	4
Film and Media Studies	2
Linguistics	1
Peace and Conflict Studies	2
Russian and Eurasian Studies	1
Other	**45**
Center for Freedom and Western Civilization	6
Ho Tung Visualization Laboratory	3
Lampert Institute for Civic and Global Affairs	7
Research Council	1
University Libraries	1
Upstate Institute	27

Distribution of Students by Funding Source

Internal	**112**
Center for Freedom and Western Civilization	6
Division of the Arts and Humanities	9
Division of Natural Sciences and Mathematics	39
Division of Social Sciences	13
Division of University Studies	8
Ho Tung Visualization Laboratory	2
Lampert Institute for Civic and Global Affairs	7
Research Council	1
Upstate Institute	27
Endowed	**51**
Bob Linsley/James McLelland Fund	2
Doug Rankin ’53 Endowment-Appalachian Research	2
Doug Rankin ’53 Endowment-Geology Research	2
Hackett-Rathmell 1968 Memorial Fund	2
Holden Endowment Fund	1
J. Curtiss Taylor ’54 Endowed Student Research Fund	2
Justus ’43 and Jayne Schlichting Student Research Fund	19
Michael J. Wolk ’60 Heart Foundation	9
Miller-Cochran Fund	2
Norma Vergo Prize	3
Oberheim Memorial Fund	2
Walter Broughton ’63 Research Fund	1
Warren Anderson Fund	4
External	**21**
Beckman Scholar Program	3
NASA Mars Data Analysis Program	2
National Institutes of Health (NIH) Area Grant	3
National Science Foundation Grant	13

Total Number of Participating Faculty: 71

Distribution of Faculty by Division and Department:

Arts and Humanities	**7**
Art and Art History	1
Classics	1
East Asian Languages and Literatures	1
English	2
Music	1
Romance Languages and Literatures	1
Natural Sciences and Mathematics	**39**
Biology	7
Chemistry	10
Computer Science	4
Geology	5
Mathematics	1
Neuroscience	3
Physics and Astronomy	6
Psychological and Brain Sciences	3
Social Sciences	**18**
Anthropology	2
Educational Studies	2
Geography	3
History	5
Political Science	4
Sociology	2
University Studies	**6**
Environmental Studies	1
Film and Media Studies	1
Linguistics	1
Peace and Conflict Studies	2
Russian and Eurasian Studies	1
Other	**17**
Center for Freedom and Western Civilization	6
Ho Tung Visualization Laboratory	1
Lampert Institute for Civic and Global Affairs	7
Research Council	1
University Libraries	1
Upstate Institute	1

Distribution of Faculty by Funding Source

(Faculty with more than one funding source are counted multiple times)

Internal	**58**
Center for Freedom and Western Civilization	6
Division of the Arts and Humanities	6
Division of Natural Sciences and Mathematics	24
Division of Social Sciences	7
Division of University Studies	5
Ho Tung Visualization Laboratory	1
Lampert Institute for Civic and Global Affairs	7
Research Council	1
Upstate Institute	1
Endowed	**34**
Bob Linsley/James McLelland Fund	1
Doug Rankin ’53 Endowment-Appalachian Research	2
Doug Rankin ’53 Endowment-Geology Research	1
Hackett-Rathmell 1968 Memorial Fund	2
Holden Endowment Fund	1
J. Curtiss Taylor ’54 Endowed Student Research Fund	2
Justus ’43 and Jayne Schlichting Student Research Fund	9
Michael J. Wolk ’60 Heart Foundation	6
Miller-Cochran Fund	2
Norma Vergo Prize	1
Oberheim Memorial Fund	2
Walter Broughton ’63 Research Fund	1
Warren Anderson Fund	4
External	**13**
Beckman Scholar Program	3
NASA Mars Data Analysis Program	1
National Institutes of Health (NIH) Area Grant	1
National Science Foundation Grant	8

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