

Colgate University Summer Undergraduate Research Directory



**Volume 27
2020**

Cover photo: Due to COVID-19, summer research 2020 took place remotely. This “Zoom” photo creation by Julie Dudrick, project director of the Upstate Institute, is a reminder of that experience. The students pictured are Upstate Institute Field School Fellows while the other diagrams are from faculty-initiated projects from across the disciplines.

- (1) Marisa Modugno '22, Upstate Fellow, see page 93
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2020**

**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: Yireh “Raina” Jung 2023 (Neuroscience)
Mentor: Carolyn Guile (Art and Art History; Russian and Eurasian Studies)
Title: *Architecture and Culture during the Venetian Plagues of 1576 and 1630*
Funding: Center for Freedom and Western Civilization

Name: Samuel “Sam” Stuttard 2020 (Art and Art History)
Mentor: Carolyn Guile (Art and Art History; Russian and Eurasian Studies)
Title: *Gothicists: Ruskin, Pugin, and Gothic Architecture in Upstate NY*
Funding: Center for Freedom and Western Civilization

Department of the Classics

Name: Hannah Kloster 2021 (Classics)
Mentor: Rebecca Ammerman (Classics)
Title: *The Sea as a Connecting Force: Greek Seafarers and Indigenous Women Negotiating a Colonial Middle Ground*
Funding: AHUM Division

Name: Han “Sherlock” Shi 2021 (Classics)
Mentor: Daniel Tober (Classics)
Title: *The Origin of Historiography: Herodotus and Sima Qian*
Funding: Center for Freedom and Western Civilization

Name: Cole Ventresca 2023 (Undeclared)
Mentor: Rebecca Ammerman (Classics)
Title: *North Urban Paestum Project 2020: Reconstructing the History of the Sanctuary of Athena*
Funding: AHUM Division

Department of East Asian Languages and Literatures

Name: Yuqi “Angela” Zheng 2023 (Educational Studies; Philosophy & Religion)
Mentor: Jing Wang (East Asian Languages and Literatures)
Title: *The Needham Question: Rethinking Methods*
Funding: AHUM Division

Department of English

Name: Carina Haden 2021 (English)
Mentor: Jennifer Brice (English)
Title: *Creative Writing Fellowships*
Funding: AHUM Division

Name: Sowon Kim 2022 (Arts & Humanities)
Mentor: Jennifer Brice (English)
Title: *On Leaving and Returning Home: Creative Writing Project*
Funding: J. Curtiss Taylor ’54 Endowed Student Research Fund

Name: Kathrine “Katie” Roell 2021 (English; French)
Mentor: Jennifer Brice (English)
Title: *Creative Writing Fellowships*
Funding: AHUM Division

Department of Philosophy

Name: Nicholas Blake 2021 (Biochemistry; Philosophy)
Mentor: David Dudrick (Philosophy)
Title: *Albert Camus’ Plague and the Existential and Religious Responses to Natural Disasters and Suffering*
Funding: Center for Freedom and Western Civilization

Name: Mengqun Sun 2021 (Philosophy)
Mentor: Laura Tomlinson (Philosophy)
Title: *Reasons for Action*
Funding: J. Curtiss Taylor ’54 Endowed Student Research Fund

DIVISION OF NATURAL SCIENCES AND MATHEMATICS (NASC)

Department of Biology

Name: Yejin Cha 2021 (Computer Science)
Mentor: Ahmet Ay (Biology; Mathematics)
Title: *Vertebrate Segmentation: From Gene Networks to Human Diseases*
Funding: Michael J. Wolk ’60 Heart Foundation

Name: Kaleigh Gale 2021 (Biology)
Mentor: Timothy “Tim” McCay (Biology; Environmental Studies)
Title: *Distribution and Public Perception of Invasive Pheretimid “Jumping Worms” in the Northeastern United States*
Funding: Michael J. Wolk ’60 Heart Foundation

Name: Aidan Harrington 2021 (Biology)
Mentor: James “Eddie” Watkins (Biology)
Title: *The Ecophysiology of Polyploidy in the Fern Genus Dryopteris*
Funding: Oberheim Memorial Fund

Name: Drew Johnson 2022 (Environmental Biology)
Mentor: Timothy “Tim” McCay (Biology; Environmental Studies)
Title: *Distribution and Public Perception of Invasive Pheretimid “Jumping Worms” in the Northeastern United States*
Funding: Michael J. Wolk ’60 Heart Foundation

Name: Vani Kanoria 2022 (Applied Math)
Mentor: Ahmet Ay (Biology; Mathematics)
Title: *Vertebrate Segmentation: From Gene Networks to Human Diseases*
Funding: Michael J. Wolk ’60 Heart Foundation

Name: Alben Leonard 2021 (Biology)
Mentor: Barbara Hoopes (Biology)
Title: *Characterization of mutations associated with body size differences in dogs*
Funding: Michael J. Wolk ’60 Heart Foundation

Name: Anne “Annie” Mollman 2021 (Biology)
Mentor: Timothy “Tim” McCay (Biology; Environmental Studies)
Title: *Recolonization of northern North America by native, wetland-dependent earthworms (Sparaganophilus eiseni and Eisenoides lonnbergi) following glacial retreat*
Funding: Michael J. Wolk '60 Heart Foundation

Name: Syed “Tazmilur” Saad 2022 (Computer Science)
Mentor: Ahmet Ay (Biology; Mathematics)
Title: *Deciphering Cancer with Biological Networks*
Funding: Oberheim Memorial Fund

Name: Van Tran 2021 (Computer Science)
Mentor: Ahmet Ay (Biology; Mathematics)
Title: *Deciphering Cancer with Biological Networks*
Funding: Michael J. Wolk '60 Heart Foundation

Name: Jacob Watts 2021 (Biology)
Mentor: James “Eddie” Watkins (Biology)
Title: *The Ecophysiology of Polyploidy in the Fern Genus Dryopteris*
Funding: Beckman Scholar Program

Name: Morgan Wynkoop 2021 (Spanish; Molecular Biology)
Mentor: Ana Jimenez (Biology)
Title: *Cellular determinants of aging in large and small breeds of dogs*
Funding: Beckman Scholar Program

Name: Aziz Zafar 2023 (Biology; Applied Math)
Mentor: James “Eddie” Watkins (Biology)
Title: *The Ecophysiology of Polyploidy in the Fern Genus Dryopteris*
Funding: Michael J. Wolk '60 Heart Foundation

Department of Chemistry

Name: Vincent “Vinny” Betti 2021 (Biochemistry; Spanish)
Mentor: Jacob Goldberg (Chemistry)
Title: *New Chemical Tools to Study Biological Systems*
Funding: Michael J. Wolk '60 Heart Foundation

Name: Harrison Blume 2022 (Biochemistry)
Mentor: Jacob Goldberg (Chemistry)
Title: *New Chemical Tools to Study Biological Systems*
Funding: Michael J. Wolk '60 Heart Foundation

Name: Jose “Fernando” Carbajal Perez 2021 (Chemistry)
Mentor: Anthony Chianese (Chemistry)
Title: *Mechanistic Studies of Ruthenium-Catalyzed Hydrogenation Reactions*
Funding: National Science Foundation

Name: Tarik Cigeroglu 2023 (Undeclared)
Mentor: Eric Muller (Chemistry)
Title: *Understanding intermolecular interactions and nanoscale morphology in molecular materials and biological structures*
Funding: Warren Anderson Fund

Name: Dechokyab “Dechok” De 2022 (Biochemistry)
Mentor: Anne Perring (Chemistry)
Title: *Aerosol Loadings and Cleaning Strategies in Denver Schools*
Funding: University of Colorado Foundation

Name: Ethan Grove 2021 (Biochemistry)
Mentor: Jacob Goldberg (Chemistry)
Title: *New Chemical Tools to Study Biological Systems*
Funding: Michael J. Wolk '60 Heart Foundation

Name: Cole Jarczyk 2021 (Chemistry; Economics)
Mentor: Anthony Chianese (Chemistry)
Title: *Mechanistic Studies of Ruthenium-Catalyzed Hydrogenation Reactions*
Funding: National Science Foundation

Name: Sophie Kelly 2021 (Biochemistry)
Mentor: Anthony Chianese (Chemistry)
Title: *Mechanistic Studies of Ruthenium-Catalyzed Hydrogenation Reactions*
Funding: National Science Foundation

Name: Thao Kim 2021 (Chemistry)
Mentor: Anthony Chianese (Chemistry)
Title: *Mechanistic Studies of Ruthenium-Catalyzed Hydrogenation Reactions*
Funding: National Science Foundation

Name: Colin Miller 2022 (Biochemistry)
Mentor: Ephraim Woods (Chemistry)
Title: *Heterogeneous Photochemistry of Tropospheric Aerosol Particles*
Funding: Beckman Scholar Program

Name: Sara Million-Perez 2022 (Neuroscience)
Mentor: Anne Perring (Chemistry)
Title: *Aerosol Loadings and Cleaning Strategies in Denver Schools*
Funding: University of Colorado Foundation

Name: John Pham 2020 (Chemistry; Applied Math)
Mentor: Anthony Chianese (Chemistry)
Title: *Mechanistic Studies of Ruthenium-Catalyzed Hydrogenation Reactions*
Funding: National Science Foundation

Name: Eamon Reynolds 2020 (Chemistry)
Mentor: Anthony Chianese (Chemistry)
Title: *Mechanistic Studies of Ruthenium-Catalyzed Hydrogenation Reactions*
Funding: National Science Foundation

Name: John “Jack” Underhill 2022 (Biology; Philosophy)
Mentor: Eric Muller (Chemistry)
Title: *Understanding intermolecular interactions and nanoscale morphology in molecular materials and biological structures*
Funding: Miller-Cochran Fund

Name: George “Dewey” Wilbanks 2021 (Religion; Biochemistry)
Mentor: Anne Perring (Chemistry)
Title: *Aerosol Loadings and Cleaning Strategies in Denver Schools*
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Name: Zachary “Zach” Williams 2023 (Undeclared)
Mentor: Eric Muller (Chemistry)
Title: *Understanding intermolecular interactions and nanoscale morphology in molecular materials and biological structures*
Funding: Michael J. Wolk ’60 Heart Foundation

Name: Ruojun “Esther” Wu 2023 (Biochemistry)
Mentor: Jacob Goldberg (Chemistry)
Title: *New Chemical Tools to Study Biological Systems*
Funding: Michael J. Wolk ’60 Heart Foundation

Name: Vicky Yang 2022 (Biochemistry)
Mentor: Jacob Goldberg (Chemistry)
Title: *New Chemical Tools to Study Biological Systems*
Funding: Michael J. Wolk ’60 Heart Foundation

Name: Weiyu “Jessica” Zhong 2022 (Chemistry)
Mentor: Ernie Nolen (Chemistry)
Title: *Organic Synthesis of a Tumor-Associated Carbohydrate Antigen Mimic for Immunological Studies*
Funding: National Institutes of Health (NIH)

Department of Computer Science

Name: Weijie “Richard” Cai 2021 (Physics)
Mentor: Hiva Samadian (Computer Science)
Title: *Course Registration Mobile Client Application Development*
Funding: NASC Division

Name: Jyotirmay Chauhan 2023 (Undeclared)
Mentor: Aaron Gember-Jacobson (Computer Science)
Title: *Practical bug detection in software implementations of routing protocols*
Funding: Holden Endowment Fund

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

Name: Xi “Chase” Jiang 2021 (Economics; Computer Science)
Mentor: Aaron Gember-Jacobson (Computer Science)
Title: *Practical bug detection in software implementations of routing protocols*
Funding: National Science Foundation

Name: Bao Nguyen 2022 (Computer Science)
Mentor: Hiva Samadian (Computer Science)
Title: *Structural Properties of Solvable Graphs for Multiple Robot Motion Planning*
Funding: Holden Endowment Fund

Name: Nam Nguyen 2021 (Mathematics; Philosophy)
Mentor: Hiva Samadian (Computer Science)
Title: *Structural Properties of Solvable Graphs for Multiple Robot Motion Planning*
Funding: Holden Endowment Fund

Name: Tyler Potter 2021 (Computer Science)
Mentor: Aaron Gember-Jacobson (Computer Science)
Title: *Practical bug detection in software implementations of routing protocols*
Funding: National Science Foundation

Name: Yaoqi Shou 2022 (Computer Science)
Mentor: Hiva Samadian (Computer Science)
Title: *Convergence of Jump Based Binarization Algorithms*
Funding: NASC Division

Department of Geology

Name: Giancarlo Arcese 2022 (Mathematics; Economics)
Mentor: Karen Harpp (Geology; Peace and Conflict Studies)
Title: *Virtual Galapagos: An Innovative, Interactive Science Outreach Project*
Funding: Norma Vergo Prize

Name: Ian Armstrong 2021 (Astrogeophysics)
Mentor: Joseph “Joe” Levy (Geology)
Title: *Boulder Distributions along Martian Surface Features*
Funding: Doug Rankin ’53 Endowment-Geology Research

Name: Divyansh “Div” Chamria 2023 (Undeclared)
Mentor: Karen Harpp (Geology; Peace and Conflict Studies)
Title: *Virtual Galapagos: An Innovative, Interactive Science Outreach Project*
Funding: National Science Foundation

Name: Bronson Cvijanovich 2022 (Astrogeophysics)
Mentor: Joseph “Joe” Levy (Geology)
Title: *Boulder Distributions along Martian Surface Features*
Funding: Norma Vergo Prize

Name: Fairuz Ishraque 2022 (Astrogeophysics; Natural Sciences)
Mentor: Joseph “Joe” Levy (Geology)
Title: *Boulder Distributions along Martian Surface Features*
Funding: NASA Mars Data Analysis Program

Name: Jessica Johnson 2022 (Astrogeophysics)
Mentor: Joseph “Joe” Levy (Geology)
Title: *Boulder Distributions along Martian Surface Features*
Funding: National Science Foundation

Name: Meaghan Kendall 2021 (Natural Sciences)
Mentor: Amy Leventer (Geology)
Title: *Antarctic Diatom Assemblages*
Funding: Doug Rankin ’53 Endowment-Geology Research

Name: Shane Knopp 2023 (Undeclared)
Mentor: Aubreya Adams (Geology)
Title: *Deep Earth Imaging of the Alaskan Subduction Zone*
Funding: Doug Rankin '53 Endowment-Appalachian Research

Name: Lily Kuentz 2021 (Environmental Geology)
Mentor: Joseph "Joe" Levy (Geology)
Title: *Boulder Distributions along Martian Surface Features*
Funding: National Science Foundation

Name: Rachel Meyne 2021 (Geology)
Mentor: Amy Leventer (Geology)
Title: *Characterizing the Biological Signature of Deglaciation*
Funding: Bob Linsley/James McLelland Fund

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

Name: Thomas "Tommy" Subak 2023 (Undeclared)
Mentor: Aubreya Adams (Geology)
Title: *Deep Earth Imaging of the Alaskan Subduction Zone*
Funding: Doug Rankin '53 Endowment-Appalachian Research

Name: Adam Zaharoni 2021 (Geology; Classical Studies)
Mentor: Aubreya Adams (Geology)
Title: *Deep Earth Imaging of the Alaskan Subduction Zone*
Funding: Doug Rankin '53 Endowment-Appalachian Research

Department of Mathematics

Name: Chau Pham 2022 (Computer Science)
Mentor(s): William "Will" Cipolli (Mathematics) and Joshua "Josh" Finnell (University Libraries)
Title: *Examining the Impacts of Public Libraries in Central New York*
Funding: Science and Math Initiative-SMI (NASC Division)

Neuroscience Program

Name: Johanne Castro 2021 (Neuroscience)
Mentor: Jason Meyers (Biology; Neuroscience)
Title: *Using Raspberry Pi for Automated Analysis of Startle Behavior in Zebrafish*
Funding: Michael J. Wolk '60 Heart Foundation

Name: Emily Cruz Gonzalez 2021 (Computer Science; English)
Mentor: Jason Meyers (Biology; Neuroscience)
Title: *Using Raspberry Pi for Automated Analysis of Startle Behavior in Zebrafish*
Funding: Science and Math Initiative-SMI (NASC Division)

Name: David Maynard 2021 (Molecular Biology; Spanish)
Mentor: Jason Meyers (Biology; Neuroscience)
Title: *The Wnt/B-catenin pathway and Notch Signaling are necessary for neuromast regeneration in zebrafish*
Funding: Michael J. Wolk '60 Heart Foundation

Department of Physics and Astronomy

Name: Samuel “Sam” Adler 2023 (Undeclared)
Mentor: Beth Parks (Physics and Astronomy)
Title: *Testing the Diffusion Demonstration*
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Name: Federico Aguilera Gonzalez 2022 (Physics)
Mentor: Cosmin Ilie (Physics and Astronomy)
Title: *Dark Matter and Stellar Evolution, Dark Kinetic Heating of Population III Stars*
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Name: Jeremy Baker 2022 (Astronomy/Physics)
Mentor: Jeffrey “Jeff” Bary (Physics and Astronomy)
Title: *A multi-epoch spectroscopic study of accretion and outflow signatures in binary T Tauri systems*
Funding: NASC Division; Volgenau Wiley Endowed Research Fellowship

Name: Muhammad Bin Awais 2021 (Physics)
Mentor: Beth Parks (Physics and Astronomy)
Title: *Application of and evaluation of Source Apportionment models to particulate pollution samples from Uganda*
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Name: Colin Dixon 2021 (Physics; Environmental Studies)
Mentor: Beth Parks (Physics and Astronomy)
Title: *Modeling heat transport in insulation measurements*
Funding: NASC Division; Volgenau Wiley Endowed Research Fellowship

Name: Daniel Dougherty 2021 (Philosophy; Astronomy/Physics)
Mentor: Jeffrey “Jeff” Bary (Physics and Astronomy)
Title: *A multi-epoch spectroscopic study of accretion and outflow signatures in binary T Tauri systems*
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Name: Daniel Espinosa 2023 (Undeclared)
Mentor: Kenneth “Ken” Segall (Physics and Astronomy)
Title: *Neuromorphic Reservoir Computing from Josephson Junctions*
Funding: Volgenau Wiley Endowed Research Fellowship

Name: Jacob “Jake” Freedman 2021 (Physics)
Mentor: Enrique “Kiko” Galvez (Physics and Astronomy)
Title: *Gravitational Lensing with an SLM*
Funding: NASC Division; Volgenau Wiley Endowed Research Fellowship

Name: William “Will” Friend 2022 (Astronomy/Physics)
Mentor: Kenneth “Ken” Segall (Physics and Astronomy)
Title: *Artificial Neurons Using Superconductors*
Funding: Volgenau Wiley Endowed Research Fellowship

Name: Amogh Gupta 2021 (Physics; Mathematics)
Mentor: Rebecca Metzler (Physics and Astronomy)
Title: *Biominerals: exploring composition, structure, and function*
Funding: National Science Foundation

Name: Caleb Levy 2023 (Undeclared)
 Mentor: Cosmin Ilie (Physics and Astronomy)
 Title: *Dark Matter and Stellar Evolution*
 Funding: Justus '43 and Jayne Schlichting Student Research Fund

Name: Rishi Lohar 2021 (Physics; Mathematics)
 Mentor: Beth Parks (Physics and Astronomy)
 Title: *Terahertz spectroscopy of carbon nanotubes*
 Funding: Justus '43 and Jayne Schlichting Student Research Fund

Name: Amanda Lue 2022 (Astronomy/Physics)
 Mentor: Jeffrey "Jeff" Bary (Physics and Astronomy)
 Title: *A multi-epoch spectroscopic study of accretion and outflow signatures in binary T Tauri systems*
 Funding: NASC Division; Volgenau Wiley Endowed Research Fellowship

Name: Brian Ma 2021 (Physics)
 Mentor: Kenneth "Ken" Segall (Physics and Astronomy)
 Title: *Artificial Neurons Using Superconductors*
 Funding: Volgenau Wiley Endowed Research Fellowship

Name: Chloe Malinowski 2022 (Astronomy/Physics; Applied Math)
 Mentor: Thomas Balonek (Physics and Astronomy)
 Title: *Optical Variability of Quasars and Stars at the Colgate Observatory*
 Funding: NASA New York Space Grant

Name: Phillip Matos 2021 (Physics; Mathematics)
 Mentor: Rebecca Metzler (Physics and Astronomy)
 Title: *Biominerals: exploring composition, structure, and function*
 Funding: NASC Division; Volgenau Wiley Endowed Research Fellowship

Name: Eric Matt 2022 (German; Physics)
 Mentor: Kenneth "Ken" Segall (Physics and Astronomy)
 Title: *Artificial Neurons Using Superconductors*
 Funding: Volgenau Wiley Endowed Research Fellowship

Name: Thao Nguyen 2022 (Physics)
 Mentor: Rebecca Metzler (Physics and Astronomy)
 Title: *Biominerals: exploring composition, structure, and function*
 Funding: Justus '43 and Jayne Schlichting Student Research Fund

Name: Leon Nichols 2023 (Undeclared)
 Mentor: Rebecca Metzler (Physics and Astronomy)
 Title: *Biominerals: exploring composition, structure, and function*
 Funding: Justus '43 and Jayne Schlichting Student Research Fund

Name: Jillian Paulin 2023 (Undeclared)
 Mentor: Cosmin Ilie (Physics and Astronomy)
 Title: *Dark Matter and Stellar Evolution*
 Funding: Justus '43 and Jayne Schlichting Student Research Fund

Name: Matthew “Matt” Sampson 2023 (Undeclared)
Mentor: Thomas Balonek (Physics and Astronomy)
Title: *Optical Variability of Quasars and Stars at the Colgate Observatory, Quasar 1308+326
Optical Fluctuations: 1989-2020*
Funding: Justus '43 and Jayne Schlichting Student Research Fund

Name: Baibhav Sharma 2021 (Physics)
Mentor: Enrique “Kiko” Galvez (Physics and Astronomy)
Title: *Diagnosis of Brain Disease via Quantum Entanglement*
Funding: NASC Division; Volgenau Wiley Endowed Research Fellowship

Name: John Slater 2022 (Astronomy/Physics)
Mentor: Thomas Balonek (Physics and Astronomy)
Title: *Optical Variability of Quasars and Stars at the Colgate Observatory*
Funding: NASA New York Space Grant

Name: Jack Tregidga 2021 (Physics; Middle Eastern and Islamic Studies)
Mentor: Kenneth “Ken” Segall (Physics and Astronomy)
Title: *Numerical Simulation of Artificial Neurons Using Superconductors*
Funding: Volgenau Wiley Endowed Research Fellowship

Name: Victor Unnone 2023 (Undeclared)
Mentor: Thomas Balonek (Physics and Astronomy)
Title: *Optical Variability of Quasars and Stars at the Colgate Observatory, Outbursts
of 1308+326 in 2003 and 2007*
Funding: Justus '43 and Jayne Schlichting Student Research Fund

Name: ChanJu “Zoe” You 2022 (Physics; Chinese)
Mentor: Abdel “Isak” Isakovic (Physics and Astronomy)
Title: *Quantum Effects and Noise in Low Dimensional Systems*
Funding: Science and Math Initiative-SMI (NASC Division)

Department of Psychological and Brain Sciences

Name: Quang-Anh “Alex” Tran 2022 (Educational Studies; Psychological Science)
Mentor: Rebecca Shiner (Psychological and Brain Sciences)
Title(s): *The Effects of Intolerance of Uncertainty on Self-Control;
Intolerance of Uncertainty Predicts Coping, Depression, and Anxiety During
the COVID-19 Pandemic*
Funding: NASC Division

Name: Shimiao Zuo 2021 (International Relations; Psychological Science)
Mentor: Rebecca Shiner (Psychological and Brain Sciences)
Title: *Intolerance of Uncertainty Predicts Coping, Depression, and Anxiety During
the COVID-19 Pandemic*
Funding: Science and Math Initiative-SMI (NASC Division)

Name: Jailekha Zutshi 2021 (Economics; Psychological Science)
Mentor: Rebecca Shiner (Psychological and Brain Sciences)
Title: *Intolerance of Uncertainty Predicts Coping, Depression, and Anxiety During
the COVID-19 Pandemic*
Funding: Science and Math Initiative-SMI (NASC Division)

DIVISION OF SOCIAL SCIENCES (SOSC)

Department of Anthropology

Name: Anna Brown 2021 (Spanish; Anthropology)
Mentor: Santiago Juarez (Anthropology)
Title: *Exploring new methods of archaeological recording: Implications of 3D scanning technology for archaeological research*
Funding: Lampert Institute for Civic and Global Affairs

Name: Savannah Milton 2021 (Anthropology)
Mentor: Jordan Kerber (Anthropology; Native American Studies)
Title: *The Afterlife of Graves: Visitor Motivations and the Ethics of Dark Tourism*
Funding: SOSC Division

Department of Economics

Name: Jonathan Aguilera 2021 (Economics)
Mentor: Dean Scrimgeour (Economics)
Title: *An Analysis of Attrition in the Consumer Expenditure Survey*
Funding: SOSC Division

Name: Dipesh Khatri 2022 (Economics)
Mentor: Rishi Sharma (Economics)
Title: *How do remittances relate to exchange rate policy: The case of Nepal*
Funding: Lampert Institute for Civic and Global Affairs

Name: Sahil Lalwani 2022 (Economics; Applied Math)
Mentor: Michael Connolly (Economics)
Title: *Regulation and Environmental Risks in Mortgage Lending: Exploring the interaction of unconventional monetary policy and natural disasters*
Funding: SOSC Division

Name: Ethan "Pete" Paasche 2021 (Mathematical Economics)
Mentor: Dean Scrimgeour (Economics)
Title: *Measuring the Increasing Duration of Presidential Appointment Nomination and Confirmation*
Funding: SOSC Division

Name: Ayush Sinha 2022 (Economics)
Mentor: Michael Connolly (Economics)
Title: *Regulation and Environmental Risks in Mortgage Lending*
Funding: SOSC Division

Name: Yuxuan Zhang 2021 (Economics; Mathematics)
Mentor: Takao Kato (Economics)
Title: *Factors influencing leadership effects on team performance: A case study on Chinese Manufacturing Plants*
Funding: Walter Broughton '63 Research Fund

Department of Educational Studies

Name: Erin Flannery 2023 (Undeclared)
Mentor: Mark Stern (Educational Studies)
Title: *Studying Abroad: Commodification or Cultivation?*
Funding: SOSOC Division

Name: Xiyu “Cici” Wu 2021 (Educational Studies; Mathematics)
Mentor: Brenda Sanya (Educational Studies)
Title: *Lessons in Being Yi: Student Experiences with the Trilingual Education Policies at Liangshan Yi Autonomous Prefecture*
Funding: Lampert Institute for Civic and Global Affairs

Department of Geography

Name: Elena Forbath 2021 (Geography; Biology)
Mentor: Michael “Mike” Loranty (Geography)
Title: *Assessing Relationships between Vegetation Indies and Plant Composition in Siberian Larch Forests via Remote Sensing*
Funding: National Science Foundation

Name: Dvorah Southland 2021 (Russian and Eurasian Studies; International Relations)
Mentor: Jessica Graybill (Geography; Russian and Eurasian Studies)
Title: *Power at the Pole: Who Studies the High North?*
Funding: SOSOC Division

Department of History

Name: Saumya Garg 2022 (History; Mathematical Economics)
Mentor: Graham Hodges (History; Africana and Latin American Studies)
Title: *Descendants of the Underground Railroad*
Funding: SOSOC Division

Name: Leila Ismaio 2021 (Middle Eastern and Islamic Studies; Peace and Conflict Studies)
Mentor: Alexander “Xan” Karn (History)
Title: *Education Endures: English Education for Refugees and Asylum Seekers in Louisiana during COVID-19*
Funding: Endowed Fund for Peace Research

Name: Caitlyn “Caity” Marentette 2022 (Anthropology; History)
Mentor: Noor-Aiman “Noor” Khan (History)
Title: *Analyzing Military Correspondence Between the Mughal and Ottoman Empires*
Funding: SOSOC Division

Name: Megan Nicholson 2021 (History; English)
Mentor: Graham Hodges (History; Africana and Latin American Studies)
Title: *Descendants of the Underground Railroad*
Funding: SOSOC Division

Name: Unal “Gunes” Tiryaki 2023 (History)
Mentor: Noor-Aiman “Noor” Khan (History)
Title: *Analyzing Military Correspondence Between the Mughal and Ottoman Empires*
Funding: SOSOC Division

Name: Melissa Verbeek 2021 (Middle Eastern and Islamic Studies)
Mentor: Alexander “Xan” Karn (History)
Title: *Education Endures: English Education for Refugees and Asylum Seekers in Louisiana during COVID-19*
Funding: Endowed Fund for Peace Research

Name: Lijun “Karen” Zhang 2021 (History; Philosophy)
Mentor: Andrew “Andy” Rotter (History)
Title: *Prostitution in Singapore, 1939-1963*
Funding: SOSC Division

Department of Political Science

Name: Vedika Almal 2021 (History; International Relations)
Mentor: Fred Chernoff (Political Science)
Title: *Nuclear Terrorism: Threat and Prevention*
Funding: SOSC Division

Name: Anjali Barrett 2022 (Middle Eastern and Islamic Studies; Political Science)
Mentor: Kevin Walker (Political Science)
Title: *Immigration and American Citizenship - The Founders View and Beyond*
Funding: Center for Freedom and Western Civilization

Name: Michael Caron 2021 (Philosophy)
Mentor: Robert Kraynak (Political Science)
Title: *Are There Two Edmund Burkes?*
Funding: Center for Freedom and Western Civilization

Name: William “Jackson” Coleman 2022 (Political Science)
Mentor: Navine Murshid (Political Science)
Title: *Bolivia as a Case Study for Trade Policy in Developing Nations*
Funding: SOSC Division

Name: Christopher “Chris” DePetro 2021 (Political Science)
Mentor: Barry Shain (Political Science)
Title: *“Revolutionary-era American Pamphlet Literature in Context: A Documentary History, 1764-1776,” and “Recent Scholarship Exploring the Federalist, 1787-1788”*
Funding: SOSC Division

Name: Isabelle Dunning 2021 (International Relations; Spanish)
Mentor: Valerie Morkevičius (Political Science)
Title: *Redefining Thucydides’ Trap as Hubris Summary*
Funding: Center for Freedom and Western Civilization

Name: William “Will” Nagle 2020 (International Relations)
Mentor: Robert Kraynak (Political Science)
Title: *Weber and Tocqueville on American Political Culture: The Protestant Ethic and Democratic Morality*
Funding: Center for Freedom and Western Civilization

Name: Fiona Saunders 2022 (Political Science)
Mentor: Barry Shain (Political Science)
Title: *“Revolutionary-era American Pamphlet Literature in Context: A Documentary History, 1764-1776,” and “Recent Scholarship Exploring the Federalist, 1787-1788”*
Funding: SOSC Division

Name: Connor Scannell 2021 (Political Science)
Mentor: Rachelle Walker (Political Science)
Title: *Democratic Development: DeTocqueville v. Acemoglu and Robinson*
Funding: Center for Freedom and Western Civilization

Name: Ryan Zoellner 2020 (Philosophy & Religion; Political Science)
Mentor: Valerie Morkevičius (Political Science)
Title: *Survey of Western Christian Just War Theory Compared to Islamic Notions of JWT and Governance*
Funding: Center for Freedom and Western Civilization

Department of Sociology

Name: Jack Jamieson 2021 (Sociology)
Mentor: Carolyn Hsu (Sociology)
Title: *An Analysis of COVID-19’s Impact on Higher Education According to Durkheim’s Theory of Social Cohesion*
Funding: SOSC Division

DIVISION OF UNIVERSITY STUDIES (UNST)

Environmental Studies Program

Name: Caylea Barone 2021 (Environmental Studies; Art and Art History)
Mentor: Christopher “Chris” Henke (Sociology; Environmental Studies)
Title: *Assessing la Certificación para la Sostenibilidad Turística (CST): A Study of Tourism Certification and Sustainability in Costa Rica*
Funding: Lampert Institute for Civic and Global Affairs

Name: Nicholas “Nick” Poon 2022 (Physics)
Mentor: Linda Tseng (Physics and Astronomy; Environmental Studies)
Title: *Quantitative microbial risk assessment along coastal Los Angeles*
Funding: UNST Division

Name: Miranda Smith 2021 (Environmental Studies; Biology)
Mentor: Linda Tseng (Physics and Astronomy; Environmental Studies)
Title: *A review of microplastics and their impact on biota*
Funding: UNST Division

Name: Cecilia Vu 2022 (Environmental Biology)
Mentor: Linda Tseng (Physics and Astronomy; Environmental Studies)
Title: *Microplastic chemical retention*
Funding: UNST Division

Name: Danielle Zarnick 2021 (Geography; Religion)
Mentor: Andrew “Andy” Pattison (Environmental Studies)
Title: *The Role of Land-Use Policy on Shaping Biodiversity in the Sierra San Pedro Mártir region of Baja California, Mexico*
Funding: UNST Division

Film and Media Studies Program

Name: Rebecca Sweigart 2023 (Art and Art History)
Mentor: Mary Simonson (Film and Media Studies; Women’s Studies)
Title: *Staging Cinema: Performance, Vocality, and Liveness in 1920s Cinema*
Funding: UNST Division

Name: Jenifer “Jen” Trujillo 2022 (Peace and Conflict Studies)
Mentor: Mary Simonson (Film and Media Studies; Women’s Studies)
Title: *Staging Cinema: Performance, Vocality, and Liveness in 1920s Cinema*
Funding: UNST Division

Name: Brian Weber 2022 (Computer Science; Film and Media Studies)
Mentor: Mary Simonson (Film and Media Studies; Women’s Studies)
Title: *Staging Cinema: Performance, Vocality, and Liveness in 1920s Cinema*
Funding: UNST Division

Russian and Eurasian Studies Program

Name: Tedi Totojani 2023 (Undeclared)
Mentor: Alice Nakhimovsky (Russian and Eurasian Studies; Jewish Studies)
Title: *Dostoevsky as a Religious and Political Thinker*
Funding: Center for Freedom and Western Civilization

Name: Yang Zhang 2021 (Russian and Eurasian Studies; Political Science)
Mentor: Alice Nakhimovsky (Russian and Eurasian Studies; Jewish Studies)
Title: *Political Systems and Pandemic Responses: A Comparative Study*
Funding: Center for Freedom and Western Civilization

University Studies

Name: Sophia Ferrero 2023 (Undeclared)
Mentor: Aleksandr Sklyar (University Studies)
Title: *Impact of Novel Viruses and Pandemics on Communities Dependent on Tourism Income*
Funding: UNST Division

CENTER FOR FREEDOM AND WESTERN CIVILIZATION

Name: Anjali Barrett 2022 (Middle Eastern and Islamic Studies; Political Science)
Mentor: Kevin Walker (Political Science)
Title: *Immigration and American Citizenship - The Founders View and Beyond*
Funding: Center for Freedom and Western Civilization

Name: Nicholas Blake 2021 (Biochemistry; Philosophy)
Mentor: David Dudrick (Philosophy)
Title: *Albert Camus' Plague and the Existential and Religious Responses to Natural Disasters and Suffering*
Funding: Center for Freedom and Western Civilization

Name: Michael Caron 2021 (Philosophy)
Mentor: Robert Kraynak (Political Science)
Title: *Are There Two Edmund Burkes?*
Funding: Center for Freedom and Western Civilization

Name: Isabelle Dunning 2021 (International Relations; Spanish)
Mentor: Valerie Morkevičius (Political Science)
Title: *Redefining Thucydides' Trap as Hubris Summary*
Funding: Center for Freedom and Western Civilization

Name: Yireh "Raina" Jung 2023 (Neuroscience)
Mentor: Carolyn Guile (Art and Art History; Russian and Eurasian Studies)
Title: *Architecture and Culture during the Venetian Plagues of 1576 and 1630*
Funding: Center for Freedom and Western Civilization

Name: William "Will" Nagle 2020 (International Relations)
Mentor: Robert Kraynak (Political Science)
Title: *Weber and Tocqueville on American Political Culture: The Protestant Ethic and Democratic Morality*
Funding: Center for Freedom and Western Civilization

Name: Connor Scannell 2021 (Political Science)
Mentor: Rachelle Walker (Political Science)
Title: *Democratic Development: DeTocqueville v. Acemoglu and Robinson*
Funding: Center for Freedom and Western Civilization

Name: Han "Sherlock" Shi 2021 (Classics)
Mentor: Daniel Tober (Classics)
Title: *The Origin of Historiography: Herodotus and Sima Qian*
Funding: Center for Freedom and Western Civilization

Name: Samuel "Sam" Stuttard 2020 (Art and Art History)
Mentor: Carolyn Guile (Art and Art History; Russian and Eurasian Studies)
Title: *Gothicists: Ruskin, Pugin, and Gothic Architecture in Upstate NY*
Funding: Center for Freedom and Western Civilization

Name: Tedi Totojani 2023 (Undeclared)
Mentor: Alice Nakhimovsky (Russian and Eurasian Studies; Jewish Studies)
Title: *Dostoevsky as a Religious and Political Thinker*
Funding: Center for Freedom and Western Civilization

Name: Yang Zhang 2021 (Russian and Eurasian Studies; Political Science)
Mentor: Alice Nakhimovsky (Russian and Eurasian Studies; Jewish Studies)
Title: *Political Systems and Pandemic Responses: A Comparative Study*
Funding: Center for Freedom and Western Civilization

Name: Ryan Zoellner 2020 (Philosophy & Religion; Political Science)
Mentor: Valerie Morkevičius (Political Science)
Title: *Survey of Western Christian Just War Theory Compared to Islamic Notions of JWT and Governance*
Funding: Center for Freedom and Western Civilization

LAMPERT INSTITUTE FOR CIVIC AND GLOBAL AFFAIRS

Name: Caylea Barone 2021 (Environmental Studies; Art and Art History)
Mentor: Christopher “Chris” Henke (Sociology; Environmental Studies)
Title: *Assessing la Certificación para la Sostenibilidad Turística (CST): A Study of Tourism Certification and Sustainability in Costa Rica*
Funding: Lampert Institute for Civic and Global Affairs

Name: Anna Brown 2021 (Spanish; Anthropology)
Mentor: Santiago Juarez (Anthropology)
Title: *Exploring new methods of archaeological recording: Implications of 3D scanning technology for archaeological research*
Funding: Lampert Institute for Civic and Global Affairs

Name: Dipesh Khati 2022 (Economics)
Mentor: Rishi Sharma (Economics)
Title: *How do remittances relate to exchange rate policy: The case of Nepal*
Funding: Lampert Institute for Civic and Global Affairs

Name: Xiyu “Cici” Wu 2021 (Educational Studies; Mathematics)
Mentor: Brenda Sanya (Educational Studies)
Title: *Lessons in Being Yi: Student Experiences with the Trilingual Education Policies at Liangshan Yi Autonomous Prefecture*
Funding: Lampert Institute for Civic and Global Affairs

OTHER

Name: Chau Pham 2022 (Computer Science)
Mentor(s): William “Will” Cipolli (Mathematics) and Joshua “Josh” Finnell (University Libraries)
Title: *Examining the Impacts of Public Libraries in Central New York*
Funding: Science and Math Initiative-SMI (NASC Division)

UPSTATE INSTITUTE

Name: Samuel “Sam” Adgie 2022 (Philosophy)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Innovating Youth Enrichment During the COVID Crisis: How Summer Camps and Mentorship Programs Can Adapt and Improve During the Coronavirus Pandemic*
Funding: Upstate Institute

Name: Mohammad Anas Asghar 2023 (Undeclared)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Hybrid Modeled Non-profits: the future?*
Funding: Upstate Institute

Name: Kelsey Bennett 2022 (Environmental Economics; Philosophy)
Mentor: Julie Dudrick (Upstate Institute)
Title: *AdkAction Road Salt Reduction Project*
Funding: Upstate Institute

Name: Jenna Borovinsky 2022 (Molecular Biology)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Pathfinder Village Mobile Market Program*
Funding: Upstate Institute

Name: Theodore “Teddy” Campbell 2020 (Geography)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Visitor Use Survey for the Paul Smith’s College VIC*
Funding: Upstate Institute

Name: Aliyah Kennise “Aliyah” De Jesus 2021 (Molecular Biology; Women’s Studies)
Mentor: Julie Dudrick (Upstate Institute)
Title: *In the Age of a Pandemic: Reimagining Traditional Modes of Non-Profit Fundraising*
Funding: Upstate Institute

Name: Rachel Diodati 2022 (Neuroscience)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Chenango United Way Finding Success in Modern United Way Model*
Funding: Upstate Institute

Name: Abigail “Abby” Douglas 2022 (Sociology)
Mentor: Julie Dudrick (Upstate Institute)
Title: *In the Age of a Pandemic: Reimagining Traditional Modes of Non-Profit Fundraising*
Funding: Upstate Institute

Name: Megan “Meg” D’Souza 2023 (Sociology)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Formalizing a Community for Young Scholars Alumni*
Funding: Upstate Institute

Name: Catria Gadwah-Meaden 2020 (Mathematical Economics)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Review of Hudson Headwaters Health Foundation’s Grant Work*
Funding: Upstate Institute

Name: Emma Gaylo 2021 (Educational Studies; Sociology)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Upstate Institute work with For the Good Inc.*
Funding: Upstate Institute

Name: Alexis Gian 2020 (Economics; Biology)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Alcohol Misuse in Madison County*
Funding: Upstate Institute

Name: Jamie Hogan 2021 (Environmental Studies)
Mentor: Julie Dudrick (Upstate Institute)
Title: *4-Corners Food Cooperative*
Funding: Upstate Institute

Name: Andrew Jaworski 2021 (Political Science)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Summer Field School Fellowship*
Funding: Upstate Institute

Name: Emma Kaminski 2022 (Environmental Geography; Russian and Eurasian Studies)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Summer Field School Fellowship*
Funding: Upstate Institute

Name: William “Will” Krohn 2023 (Biology; Environmental Studies)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Bird Conservation in New York State*
Funding: Upstate Institute

Name: Marisa Modugno 2022 (Peace and Conflict Studies)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Creating a Board Portal for the Oneida County History Center*
Funding: Upstate Institute

Name: Elizabeth “Lizzy” Moore 2021 (Peace and Conflict Studies; Geography)
Mentor: Julie Dudrick (Upstate Institute)
Title: *The Center: Serving Diverse Communities in a Virtual World*
Funding: Upstate Institute

Name: Antoni “Antek” Ryzak 2020 (International Relations)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Summer Field School Fellowship*
Funding: Upstate Institute

Name: Jaanvi Sachdeva 2021 (Environmental Studies; International Relations)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Summer Field School Fellowship*
Funding: Upstate Institute

Name: Emily Schwartz 2021 (Environmental Studies)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Mountain Lake PBS Membership*
Funding: Upstate Institute

Name: Abigail “Abby” Sotomayor 2020 (Environmental Studies; Biology)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Summer Field School Fellowship*
Funding: Upstate Institute

Name: Zhelun Zhou 2020 (History; Philosophy & Religion)
Mentor: Julie Dudrick (Upstate Institute)
Title: *Alice’s Wonderland: The Art of Alice Hudson*
Funding: Upstate Institute

Research Summaries

Research Fellow: Samuel “Sam” Adgie (2022)

Concentration: Philosophy

Faculty Mentor: Julie Dudrick

Department: Upstate Institute

Title of Project: Innovating Youth Enrichment During the COVID Crisis: How Summer Camps and Mentorship Programs Can Adapt and Improve During the Coronavirus Pandemic

Funding Source: Upstate Institute

Project Summary:

Fiver Children’s Foundation, or Fiver for short, is a New York based nonprofit that is dedicated to enabling positive youth development in underserved communities and guiding students as they transition into their careers or post-secondary education. While Fiver holds many events throughout the year, the most anticipated and celebrated is the annual Camp Fiver each summer. Unfortunately, due to New York state health guidelines regarding COVID-19 the traditional in-person form of camp was not possible this year. However, by bringing the spirit and identity of camp to a virtual platform, aptly named Camp WiFiver, Fiver was able to provide a uniquely beneficial experience to its participants in a safe way. As a community partner working heavily with the data that was collected during this period, I wanted to discover how students were reacting to a virtual camp, what the most effective aspects of an entirely online program were, and how the technology used and developed this summer can continue to be utilized by camps of all kinds post COVID-19.

In plain terms, Camp WiFiver’s participants responded exceptionally well to the online programming. At a time when most students were not able to frequently leave their homes, the opportunity to connect with their peers and engage in a variety of activities proved to be incredibly beneficial. 90% of responders from the first camp session said that Camp WiFiver helped them “have fun during quarantine” and 76% gave Fiver an eight or higher out of ten on supporting them socially and emotionally during the COVID-19 crisis, likely attributable to an emphasis on one on one communication with participants. The virtual classes involving physical activity (such as dancing or basketball) were another area shown to be effective, with 43% of participants in Session 2 saying camp helped them “stay physically active.” The overwhelmingly positive reaction to the online camp is also shown in the sustained participation throughout each session’s two-week period. Overall, internal data clearly shows that participants thoroughly enjoyed Camp WiFiver’s curriculum.

Although it was encouraging to see the efficacious results of Camp WiFiver, what piqued my interest even more in my research were the possibilities of how online programs could be utilized and optimized in the future. This was initially seen in how participants wanted some of the aspects of WiFiver to carry on even after it became safe to gather in-person. 82% of responders from Session 2 said they wanted “virtual cabin meetings throughout the year” and 57% said that they wanted “virtual adventure learning classes...throughout the year.” By applying the technological infrastructure that was already developed for this summer, Fiver and similar youth enrichment programs can grow from the difficulties of today and become stronger for tomorrow. Offering online programs presents the ability to hold virtual camps at nontraditional times of the year (winter, spring break, long weekends, single day camps), bring in participants from a wider geographical range than usual, and provide year-round activities that can be completed online. Times are changing, and my project aims to show that it is best to move with the current while maintaining the unique identities that make each summer camp and youth development program so special.

Research Fellow: Samuel “Sam” Adler (2023)

Concentration: Undeclared

Faculty Mentor: Beth Parks

Department: Physics and Astronomy

Title of Project: Testing the Diffusion Demonstration

Funding Source: Justus '43 and Jayne Schlichting Student Research Fund

Project Summary:

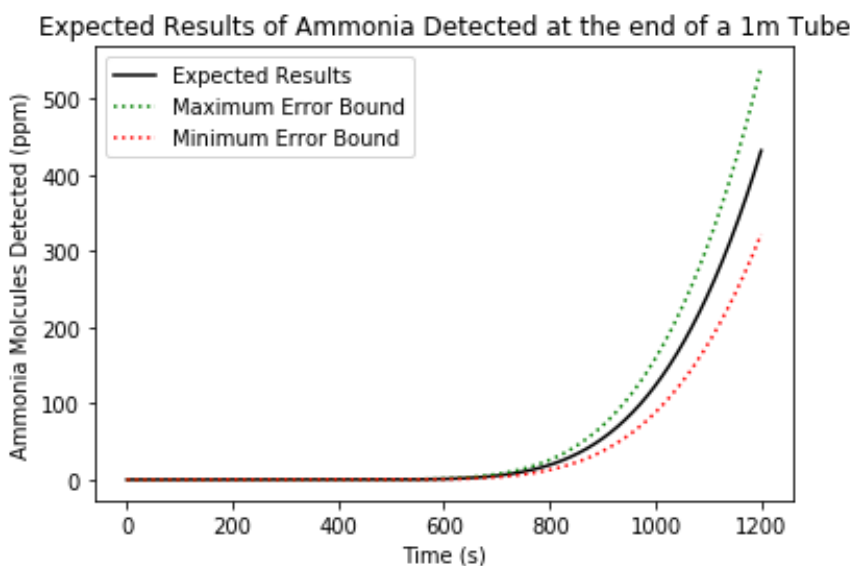
Diffusion is the net movement of anything from a higher concentration to a lower concentration. In a physics context, where the laws of diffusion have been derived, diffusion relates to the spread of atoms or molecules. An example of diffusion is oxygen molecules moving from a high concentration in the lungs to the blood stream which has a lower concentration of oxygen. Understanding this process is not only useful in the field of physics as diffusion theory spans many fields of academia. Whether it involves studying the rate a new idea or product travels through a market or the spread of a culture through society, diffusion theory helps model and explain our observations.

Students are usually introduced to diffusion through a classroom experiment involving the reaction between ammonia and hydrochloric acid inside a long glass tube. Cotton balls are placed at opposite ends of the tube after being soaked in aqueous ammonium hydroxide and hydrochloric acid, allowing the gaseous vapors to travel down the tube towards each other. Once the gases meet they form a white ring of ammonium chloride on the walls of the tube. This is a classic demonstration of an extremely fundamental phenomenon, but it turns out that it is a much more complicated process than one would commonly believe. I spent the summer working to understand the theory of this experiment in preparation for returning to campus to test it.

The process of diffusion in physical systems is governed by Fick's Law, which states that the flux (movement) of a system is directly proportional to the negative gradient of its concentration. Basically, this says that molecules will move from a region of higher density to one of lower density, and that the bigger the difference in density, the faster the movement. This property stems from the random motion of gas molecules. With this basic understanding we would expect Fick's Law to predict that ammonium chloride would form along the length of the tube as the gases diffuse randomly into each other. Instead, we observe the formation of a fairly well-defined ring which is referred to as a Liesegang ring. A complex theory about Liesegang rings predicts that more of these rings will form as the experiment is left for longer, but since our system is not sealed, and therefore has minor turbulence, we are unable to observe the formation of any successive rings.

When I return to campus we will design our experiment to measure the rate at which ammonia diffuses down a very long tube. This experiment will be set up by placing a cotton ball soaked in ammonia hydroxide at one end of the tube and placing a gas sensor which counts the ammonia particles at the other end. Shown here is a graph of the results we would expect to observe.

Our experiment is designed only to prove the applicability of Fick's Law to this common classroom experiment. While our experiment will not be able to test the Liesegang phenomena it should be able to prove that the observation of these fast forming rings is not in contradiction with Fick's Law.



Research Fellow: Jonathan Aguilera (2021)

Concentration: Economics

Faculty Mentor: Dean Scrimgeour

Department: Economics

Title of Project: An Analysis of Attrition in the Consumer Expenditure Survey

Funding Source: SOSOC Division

Project Summary:

The Consumer Expenditure Survey (CE) is a federal household survey that provides detailed information on the complete range of consumer expenditures, income, and demographic characters in the United States. CE data are collected by the Census Bureau for the U.S. Bureau of Labor Statistics where respondents are interviewed every three months over ten months. A rotating panel structure is used where in each month, households may be reporting for the first time, second time, and so on which we refer to as rounds. One notable issue of this panel data format is the existence of attrition which is when a respondent does not respond in any of the future rounds. Attrition affects the precision of regression estimates due to the smaller sample but more importantly may create a biased sample if it is nonrandom. This in turn can create biased inferences. Previous research on the topic shows that attrition bias is usually small and would not significantly affect model estimates. This phenomenon was tested by examining both the presence and effect of attrition on expenditure spending from survey participants in April 2010 to September 2018.

We study the effect of attrition on observable factors in the Consumer Expenditure Survey. Attrition on unobservable factors was not used as it requires an instrument for nonresponse that is credibly exogenous to behavior in general. Previous studies have used variables that characterize the interview process such as surveys on the quality of the interview or through a separate validation dataset. Despite this, the attrition testing process is the same as a pooling test and a regression using inverse probability weights were used. Inverse probability weights are used in a weighted least squares estimation where the new regression gives more weight to households who have similar initial characteristics to households that subsequently leave the panel. The pooling test is used to see whether the non-attriting sample significantly differs from both the full sample and attrition sample in its model parameters. Formally, attrition bias exists when the error term in the equation of interest is correlated with the error term in the attrition equation. Thus, attrition bias is model-specific and high attrition rates do not indicate high biases.

When determining whether attrition in the data model is random, a probit model is used where the attrition status of the household is the dependent variable and the explanatory variables are baseline values for all variables that are believed to affect the outcome variable of interest. Based on previous models for attrition, our explanatory variables are of race, education, home ownership, locality, and expenditures.

Initial summary statistics across both male and female heads of households found that attritors were less likely to own their own residence. Results from the attrition probit model show that there is a significant negative correlation of attrition and age, not completing high school compared to having a bachelor's degree, having young adults in the household, number of bedrooms, owning the residence, identifying as Asian compared to identifying as White, and being from the Western region of the United States compared to the Northeast. Conversely, there is a significant correlation between attrition and being a high school graduate or having some college compared to having a bachelor's degree, family size, total expenditures in the first round of results, identifying as Black compared to white, and identifying as female. The most prominent effect seen was thus one of home ownership. Participants who are more likely to move homes (e.g. Young people who start off their career renting an apartment) are harder to track down and may be too preoccupied from the moving process to continue the survey.

Overall, the significance in the probit coefficients and the results from the pooling test indicate that attrition is non-random which prompted further investigation. This was done through the inverse probability test. It was seen that there was no significant change in the coefficients on the linear regression of expenditure. Since attrition bias is model-specific, the effect attrition has on other variables may differ. What can be said is that although attrition is nonrandom, it does not have a significant effect on predictions made on the total expenditures of participants in the Consumer Expenditure Survey.

Research Fellow: Federico Aguilera Gonzalez (2022)

Concentration: Physics

Faculty Mentor: Cosmin Ilie

Department: Physics and Astronomy

Title of Project: Dark Matter and Stellar Evolution, Dark Kinetic Heating of Population III Stars

Funding Source: Justus '43 and Jayne Schlichting Student Research Fund

Project Summary:

Dark Matter is a topic of great interest for physicist around the world, because there is still plenty to be discovered about it and its very elusive nature of not interacting with common matter in many ways. Dark Matter constitutes the majority of matter in our universe, and yet, physicists are currently not able to directly detect it. However, its effects can be detected indirectly, which is the reason we know of its existence.

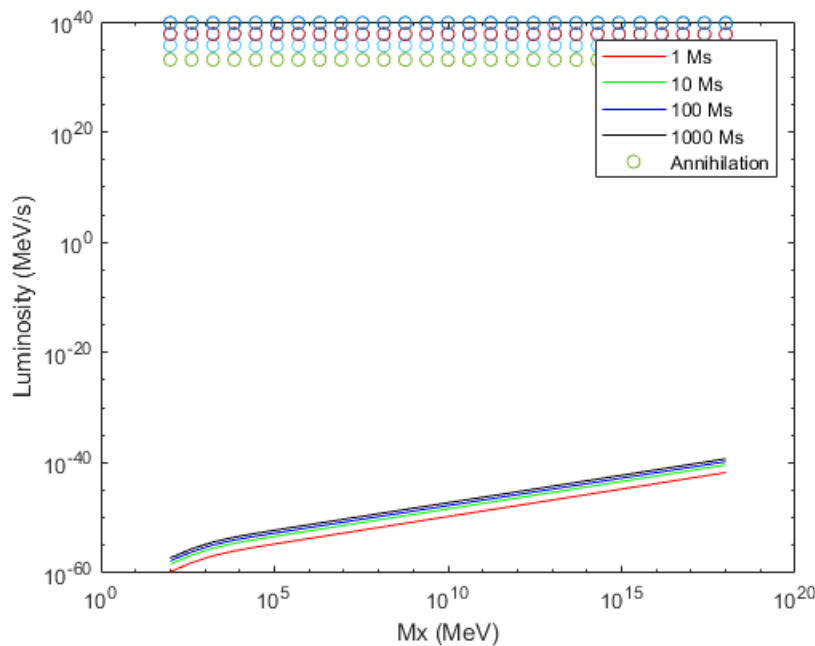
The known properties of Dark Matter to this day are few, and several research projects aim to find ways to detect Dark Matter with current (or near future) technology that would give us more information about its properties. One of these projects, worked on by Baryakhtar, Bramante, and others, looks at the heating of neutron stars due to the transfer of kinetic energy from Dark Matter particles. Incoming Dark Matter particles transfer their energy to the neutrons inside the stars, which is converted to the star's thermal energy, rising its temperature and luminosity. This phenomenon is known as Dark Kinetic Heating.

In a similar fashion, the aim of this project was to study the Dark Kinetic Heating of not neutron stars, but Population III stars. Population III stars are believed to be the first stars that were formed after the Big Bang. They are thought to be mainly composed of Hydrogen with minimal contents of higher order atoms. Their nature is extremely different from that of neutron stars, so the study of the same phenomenon for these two different types of star are vastly different.

At the same early age of the Universe in which Population III stars are thought to be present in, Dark Matter could have clumped near these stars, which would make interactions between them possible. The main objective of this project was to compare the effects of Dark Kinetic Heating on Population III stars compared to the effects of a different phenomenon known as Dark Matter Annihilation.

Results showed that Dark Matter Annihilation effects overwhelm those of Dark Kinetic Heating by several orders of magnitude, to the point that Dark Kinetic Heating can be safely disregarded as negligible, as seen in the graphs below.

Dark Matter Annihilation Luminosity vs. Dark Kinetic Heating Luminosity



The effects of annihilation are about 100 orders of magnitude greater than those of Dark Kinetic Heating.

Research Fellow: Vedika Almal (2021)

Concentration(s): History; IREL

Faculty Mentor: Fred Chernoff

Department: Political Science

Title of Project: Nuclear Terrorism: Threat and Prevention

Funding Source: SOSOC Division

Project Summary:

This summer, I received a research grant to study the nuances of nuclear terrorism. In particular, my research focused on the consideration of states that should take into account while developing a strategy to effectively deal with and prevent nuclear terrorism. I started my research by asking very broad questions. My goal was to read up on what scholars from different schools of thought in the field of International Relations have had to say about nuclear terrorism and highlight the differences and similarities in their arguments. By exploring their opinions on how terrorist organizations might acquire nuclear weapons, how they might use it, the limitations they face and the liberties they enjoy in comparison to states, I aimed to arrive at a conclusion that sheds light on different methods states could use to prevent a nuclear terrorist attack, highlighting the necessary elements of a successful strategy.

My interest in this topic was sparked by two classes that I took at Colgate: Fundamentals of International Relations and National Security. While discussing nuclear weapons, both classes presented nuclear weapons as a revolution in national security and strategic studies. They almost have more non-military uses than military ones, most importantly the nuclear deterrence, where the fear of escalation and annihilation keeps nuclear powers from going to war. I started wondering if the same rationales would apply to terrorist organizations -- they don't have the same fears and limitations as states, so what happens if they acquire these weapons? While reading up on the Iranian nuclear program as a research assistant in the spring, I realized the relevance of this topic once again: it wasn't just the idea of Iran possessing a nuclear weapon that was worrying, but the potential of those weapons falling into the hands of terrorists that makes the idea of a nuclear Middle East so much more dangerous.

During my literature review, I noticed a number of recurring themes across the works of different scholars: the possible avenues of acquisition of nuclear material, a comparison between states and terrorist organizations, and the rationality behind a nuclear terrorist attack. My research suggests that because of the differences between states and terrorist organizations -- the lack of a "return address", the absence of the fear of reprisal, the disparity in incentive structures -- nuclear deterrence is not an effective way to prevent nuclear terrorism. One way that most scholars touch upon is to prevent the acquisition of nuclear weapons; given the financial, logistical, and technological constraints on terrorist organizations, they are likely to acquire either knowledge or material or both from an existing or proliferating nuclear state. Securing current nuclear weapons and material and preventing proliferation in new states is a potential strategy to prevent nuclear terrorism. That being said, many scholars also highlight that terrorist organizations are rational actors with interests and ideologies. Their willingness to conduct a nuclear attack depends on the opportunity costs of doing so; by identifying the motivations and thought processes of terrorist organizations, states could aim to increase the opportunity cost of a nuclear attack by so much that it ends up counteracting the goals or threatening the survival of the group.

The unique nature of nuclear terrorism, where the weapons themselves are revolutionary and the nature of terrorist organizations is so inherently different from states, made my research challenging and interesting. Given that nuclear terrorism is one of states' biggest national security worries -- one without a universally accepted strategy to combat it -- I found it meaningful and necessary to study this topic in its own right.

Research Fellow(s): Giancarlo Arcese (2022)
Divyansh “Div” Chamria (2023)
Tam Nguyen (2022)

Concentration(s): Mathematics; Economics
Concentration: Undeclared
Concentration: Computer Science

Faculty Mentor: Karen Harpp

Department(s): Geology; PCON

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

Funding Source: Norma Vergo Prize; National Science Foundation; Hackett-Rathmell 1968 Memorial Fund

Project Summary:

Colgate Virtual Galapagos is an interactive digital learning module in development by students and faculty from Colgate University. The goal of the project is to teach children science in an innovative way through the lens of the Galapagos Islands. A team of six people worked on the project over the summer: two Colgate Faculty members, three Colgate students, and one Colgate graduate. My primary role in the project was to take ideas, information, and media from the content-section of our team and use it to create the design and layout of the digital learning module.

One of our main objectives for the summer was to design a user-interface (U.I.) that was both straightforward and child-friendly. We worked towards this objective by video-conferencing frequently and sharing updates we had made to the U.I. to the team for feedback. We would then incorporate this feedback into the U.I. and share it in our next meeting. Another method we used to build our U.I. was to assemble a group of people to test the prototype of the first scientific mystery. After we completed coding the first section of our module, we sent the link for our website to a group of testers to solicit their thoughts on the project. This allowed us to collect and incorporate even more feedback.

Another objective of our work during the summer was to write the source code for our project in a coherent, systematic, and easily understood manner. Because Giancarlo was the sole programmer for the majority of the summer research period, this objective mostly related to just him, which made it a difficult task to approach. Because other students will collaboratively write code for Colgate Virtual Galapagos in the future, it was important that Giancarlo writes his code in such a way where another student could easily pick up on something where he left off. Giancarlo helped solve this problem by making sure he was writing his code in a standard and organized manner. He would also frequently meet with other students who were helping write the code to get their feedback on his writing conventions and to keep them updated on what he was doing.

This summer, we also worked on adding some more content to the site. Div was brought on for this purpose. He went through the work that was done earlier and did research to expand upon the topics at hand, by looking at them from a more scientifically accurate lens. He wrote two scripts, and recorded and edited two videos based on those scripts. He also worked on the code alongside Giancarlo, making U.I. changes where required.

Colgate Virtual Galapagos is an on-going project; you can access the project by contacting Karen Harpp (kharpp@colgate.edu) for further information.



Research Fellow(s): Ian Armstrong (2021)
Bronson Cvijanovich (2022)
Fairuz Ishraque (2022)
Jessica Johnson (2022)
Lily Kuentz (2021)

Concentration: Astrogeophysics
Concentration: Astrogeophysics
Concentration(s): Astrogeophysics; NASC
Concentration: Astrogeophysics
Concentration: Environmental Geology

Faculty Mentor: Joseph “Joe” Levy

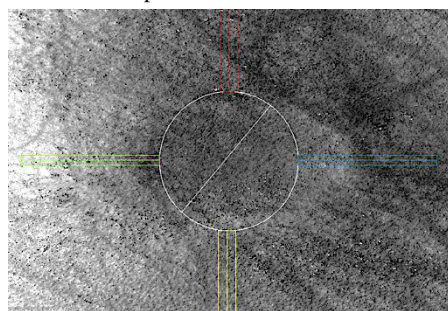
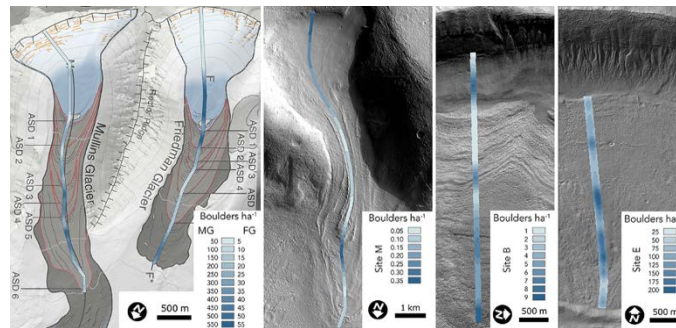
Department: Geology

Title of Project: Boulder Distributions along Martian Surface Features

Funding Source: Doug Rankin '53 Endowment-Geology Research; Norma Vergo Prize;
NASA Mars Data Analysis Program; National Science Foundation

Project Summary:

Large regions of the modern Martian surface are covered with glacial features called lobate debris aprons (LDAs). A majority of Mars is also covered by a mixture of compacted snow and ice-coated dust called latitude dependent mantle (LDM). Meteorite impacts on these surfaces leave behind craters that radially excavate subsurface debris, ranging in size from fine clays to large boulders. Lunar studies show that the grain size distribution of these ejecta follow a power law relation with the average grain size decreasing from the crater center. One eventual result of such cratering on Mars are features called boulder halos, which can be described as remnants of impacts where only boulders remain after the steep crater walls have disappeared via erosion and infilling. Boulder halos are ubiquitous across the surface of Mars and appear to lie atop the LDM; however, the size distribution of debris in both boulder halos and LDAs is not well known. In our research, we mapped the boulder distributions at both LDA and halo sites to better understand the formation processes.



Each project began with a collection of randomly selected HiRISE images filtered by their surface features (either LDAs or boulder halos). Study sites were chosen based on latitude, longitude, resolution (25 cm/pixel), and quality of the observable features. For LDAs, transects were drawn in ArcMap by first creating a topographic layer to indicate direction. These transects began at the top of each LDA (observable by elevation and surface features) and were drawn perpendicular to the topographic lines until the end of the LDA. For the boulder halos, four transects the length of the halo's diameter were drawn in approximately each cardinal direction. After establishing the length and width of each transect, boulders were mapped according to their size and position.

Boulders appear as several pixel-wide features that are distinguishable from their surroundings by surface contrast indicating the rock face reflecting sunlight and the face in shadow. Boulders within the boulder halo transects were mapped according to width in order to observe the relationship between boulder and halo size as well as distance from the halo. Boulder widths were originally measured at the LDA sites, though once enough data was collected to conclude relationships between boulder size and distance down the LDA, data collection focused on boulder position (XY coordinates).

Regarding LDAs, we found that boulder distributions are non-random and spatially clustered with relation to aspects such as latitude, LDA azimuth, LDA length, etc., showing similarities to their terrestrial counterparts (Mullins and Friedman Valleys in Antarctica). By conducting Martian and terrestrial analysis of surface features, we were able to better conclude possible origins and flow patterns of the LDA. Our boulder halo results show that, across 20 sites in both the northern and southern hemispheres, there is no correlation between halo size and average boulder size, suggesting that there is a thick protective layer of dust. This indicates that impacts merely excavate boulders suspended in this dust layer instead of creating new boulders by fragmenting the underlying bedrock. Furthermore, boulder sizes are larger in the northern hemisphere than in the southern. This suggests that the southern hemisphere boulders and, therefore, underlying bedrock are composed of brittle material that is more prone to crumbling. Our research has shown not only that LDAs and boulder halos exhibit patterns such as their clustering and distribution, but these also may serve as historic, regional climatic records. The boulder clusters and distributions identified on the LDAs and halos can lead to further insight regarding age, deposition and erosion processes, global climatic and orbital conditions. Further analysis of Martian surface features in reference to terrestrial analogs will aid the reconstruction of the Martian climate history as well as the current geologic processes.

Research Fellow: Mohammad Anas Asghar (2023)

Concentration: Undeclared

Faculty Mentor: Julie Dudrick

Department: Upstate Institute

Title of Project: Hybrid Modeled Non-profits: the future?

Funding Source: Upstate Institute

Project Summary:

This summer, I worked with Yleana Leadership Foundation, which is a nonprofit operating in NYC, aiming to reduce the achievement gap by serving underserved and underrepresented communities. Non-profits are often viewed as organizations that rely solely on grants and donations. Although this might have been true in the past, in the present day an increasing number of organizations have shifted to the hybrid model whereby a nonprofit organization runs a for-profit arm as well. Yleana is one such organization, and over the summer I researched different issues that hybrid modeled nonprofits face, how Yleana deals with these issues and recommendations in general for hybrid modeled nonprofits.

Through my research, which included reading existing research papers on the topic and having several discussions with the Chief Growth Officer at Yleana, I was able to narrow my focus to four major issues that hybrid modeled nonprofits face. The number one issue is whether to register as a nonprofit or for-profit entity initially. Registering as a for-profit opens the financial markets to an organization. However, that means that the organization cannot give tax credit to donors and cannot have volunteers helping them with certain activities. Yleana holds yearly summer camps where students from different colleges and universities volunteer to teach SAT to students from underserved communities. Yleana registered initially as a nonprofit because the nonprofit target audience of Yleana was bigger than its for-profit audience. The general recommendation for hybrid modeled organizations is to perform an analysis of their target market and initially register as for-profit or non-profit based on which has the bigger target audience.

The second issue faced by hybrid modeled nonprofits is the lack of clearly established funding pathways. For-profits tap into financial markets while nonprofits rely on donations and grants. However, because hybrid modeled nonprofits are relatively new to the market, they do not have a clear pathway for funding. Yleana leadership foundation is in a fortunate position in that it is angel funded by one of the donors, so it does not have to worry too much about funds. However, Yleana leadership earns enough from SSA (Socratic Summer Academy), the for-profit arm of Yleana, to cover the operational costs of both Yleana and SSA. The general advice for hybrid modeled nonprofits is to use a combination of grants, donations and profits generated from the for-profit arm to fund the non-profit organization.

The third issue an organization using the hybrid model might face is the distinction between their customers and beneficiaries, or, in simpler terms, profit making activities vs social good activities. Many times, an organization is providing similar services for its customers and its beneficiaries. However, the organization might have a hard time distinguishing between the two. Moreover, if the distinction is too visible, it might create two disproportionate groups. A lack of distinction also makes it hard to separate the profit-making initiatives from social good initiatives. Often, different strategies are used for a business based on whether the activity is driven by profit or social good. Yleana dealt with the issue of the rift between the mission goal and profit activities by making the two products like each other. This meant that even when SSA, the for-profit arm, is growing, it indirectly has a positive impact on Yleana, as the teachers are getting trained and Yleana is discovering new strategies for SAT prep which it will eventually use at Yleana. For example, because of the pandemic, Yleana's summer program had to shift online, and Yleana tested their virtual program on SSA students. The general advice for hybrids is to maintain a connection between the for-profit product and non-profit activities. This would allow the organization to pursue growth and mission at the same time. By doing this, the organization can use the existing employees and leverage their skills for both products.

The final problem faced by hybrids is the development of an organizational culture. There are very few employees in the job market who have worked at a hybrid modeled non-profit, so often hybrids employ people from for-profits and non-profits. This can lead to a conflict between employees as they come from different backgrounds and their actions in the past were guided by different principles and objectives. To solve this issue, Yleana has an intern program, where they train college student to work in a hybrid modeled nonprofit. The general advice for hybrids is to invest in an intern program so they have a pipeline of students to hire from or hire fresh college graduates who don't have much experience and train them on the job.

Research Fellow(s): Jeremy Baker (2022)
Daniel Dougherty (2021)
Amanda Lue (2022)

Concentration: Astronomy/Physics
Concentration(s): Astronomy/Physics; PHIL
Concentration: Astronomy/Physics

Faculty Mentor: Jeffrey “Jeff” Bary

Department: Physics and Astronomy

Title of Project: A multi-epoch spectroscopic study of accretion and outflow signatures in binary T Tauri systems

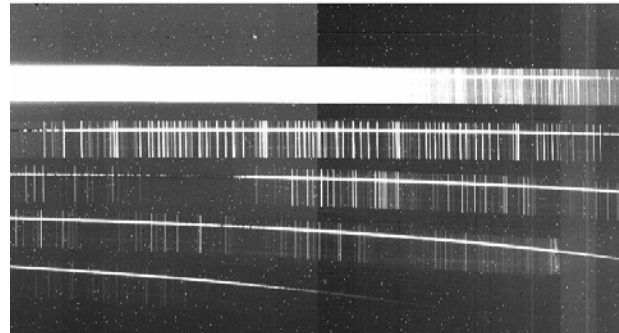
Funding Source: NASC Division; Justus ’43 and Jayne Schlichting Student Research Fund; Volgenau Wiley Endowed Research Fellowship

Project Summary:

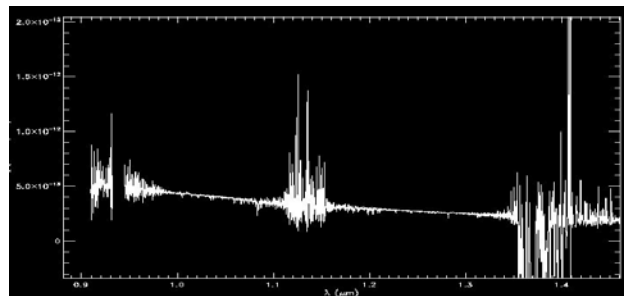
Our research group worked under Jeff Bary to observe the spectra of protoplanetary circumstellar disks. Around young stars and brown dwarfs are disks made of gas and dust. Planets can form in these disks. One of the mechanisms of protoplanetary disks is magnetospheric accretion: columns of dust and gas follow magnetic field lines and fall to the star’s surface at free-fall speeds. One can characterize this accretion through spectroscopy. Spectroscopy is the study of how the light from an astronomical object is constituted with respect to wavelength, or color. Features in how light is distributed with respect to wavelength, such as sudden rises or dips in brightness called emission and absorption lines, can be peculiar to mechanisms in the protoplanetary disk. Our group wants to look through the observed spectra of known and possible accretors and, through the depth of emission or absorption of these features, calculate accretion rates.

The summer was mostly spent making a list of possible targets for our observing run. After reviewing literature about protoplanetary disks to acquaint ourselves with the material, we started building a list of known and possible accretors. We filtered the list initially by finding out which targets were even observable, checking the air mass of objects at the observatory during the nights of observation and their magnitudes in relevant filters (J, H, and K). We catalogued possible targets by their brightness, celestial coordinates, and spectral type, among other information. We then searched for literature on the list of possible targets to further refine the list and figure out any established accretion rates, which targets were interesting, etc. In the final stages of building a target list, we acquired finder’s charts and proximal A0V type stars for telluric-correction during data reduction.

Our observation run took place June 27th, 28th, and 29th, at the Apache Point Observatory (APO) in New Mexico. Spectra were taken with APO’s spectrograph, TripleSpec. It has a wavelength range of 0.95-2.46 μ m and a 1.1 arcsecond slit with 2.1 pixels per slit. It is a CCD camera fitted with a slit viewer--a source is centered on the slit and the light from it is dispersed onto the detector. Pictured to the right is the raw spectra of one of our targets, RZ Psc. The telescope and spectrograph were operated by the research group remotely with a program called TUI and by an operator at APO. We also observed some transiting exoplanets and A0V stars and made frames for data reduction--flat and dark frames.



After observing the targets, we began performing data reduction on an IDL package called APOTripleSpecTool. This allowed us to apply flat frames to our spectra, get spectral plots, combine spectra to increase SNR, correct for telluric lines, and merge the orders to make a continuous spectral plot across TSpec’s wavelength sensitivity range. We will begin searching these data reduced spectra for emission and absorption features corresponding to accretion activity in protoplanetary disks. The data reduced spectral plot for RZ Psc is shown to the right.



Research Fellow: Caylea Barone (2021)

Concentration(s): Environmental Studies; ARTS

Faculty Mentor: Christopher “Chris” Henke

Department(s): Sociology; Environmental Studies

Title of Project: Assessing la Certificación para la Sostenibilidad Turística (CST): A Study of Tourism Certification and Sustainability in Costa Rica

Funding Source: Lampert Institute for Civic and Global Affairs

Project Summary:

Tourism is the largest industry in the world, with over 32 million flights carrying 1.2 billion people annually. As a result of its global impact in light of anthropogenic climate change, the tourism industry must strive for sustainability. My research explored ecotourism, an alternative to mass tourism, which attempts to minimize negative ecological, social, and economic impacts and provide opportunities for sustainable development.

Supported by the Lampert Institute, I assessed the parameters and implementation of the *Certificación para la Sostenibilidad Turística* (Certificate for Sustainable Tourism, (CST)) in Costa Rica. While their Tourism Institute (ICT) pioneered the CST program more than twenty years ago, little scholarly research exists on the program. I hoped to observe the CST first-hand in tandem with evaluating the complex factors influencing sustainable tourism, however, the central goals of my project had to remain flexible throughout the summer due to the uncertain and evolving conditions of the Coronavirus pandemic.

Despite this, I collaborated with David Chamberlain, Programs Associate from the Institute of Central American Development Studies (ICADS), to develop a convenience sample and interview industry stakeholders remotely. My research questions were assessed through a mixed-methods approach, generating qualitative and quantitative data. The interviews were rewarding, speaking with employees at a rural, ecotourism company; an ecotourism transport provider; an ecotour guide at a family-owned, organic, agroforestry farm; and program auditors for the CST with the ICT. To complement my interviews, I developed and conducted a robust survey through Qualtrics, though, did not receive a response rate adequate for statistical analysis in this study. Challenges brought by the halt of tourism, closed borders, and office shutdowns in Costa Rica made it difficult for many to remain employed, let alone access their administrative emails to complete my survey. Nonetheless, the way data is analyzed is a subjective and iterative process, and I aimed to use the information from local interviewees to form the basis of my conclusions. Analysis was completed using theoretical frameworks from sustainability and certification studies and I found that from the perspectives of CST auditors, certification functions as a benchmark of the country’s path and progress for sustainable development. However, ecotourism operators expressed mixed results on the effectiveness, attainment, and benefits of the CST, confirming findings from my literature review regarding common barriers to certification. The themes that emerged in the process of interviewing participants, speaking with experts, reading official ICT documents, and analyzing these data revealed a complex set of decision-making processes and sustainability philosophies that underlie the development of ecotourism and tourism policy in Costa Rica.

Ultimately, the CST helps expand our understanding of how tourism regulations can develop responsibility and accountability through certification systems while implementing principles of sustainable development. The ICT is working to grow its model for certifying sustainable ecotourism on an international scale, addressing the need to reduce environmental degradation while increasing wealth in developing countries.

I thank the Lampert Institute and the Institutional Review Board for this opportunity. A special thanks to my research advisor, Professor Christopher Henke, for his encouragement, friendship, and advice and Professor Illan Nam, the Director of the Lampert Institute, for her continual support with my project. I approached this research with a fascination to understand the people and organizations involved with changing the tourism industry for the better, and I look forward to travelling to Costa Rica, continuing this research, and observing first-hand the *Pura Vida* lifestyle in their unique culture of sustainability.

Research Fellow: Anjali Barrett (2022)

Concentration(s): MIST; Political Science

Faculty Mentor: Kevin Walker

Department: Political Science

Title of Project: Immigration and American Citizenship - The Founders View and Beyond

Funding Source: Center for Freedom and Western Civilization

Project Summary:

With the founding of a new country based on the ideals of self-governance, democracy, equality, and freedom, questions of who belongs and why they may be entitled to this belonging while others are not became pressing considerations at the Founding and continue to demand attention even today. The literature on this subject mostly falls into three schools: those who believe that American identity is unequal and ascriptive, those who see immigration as primarily relevant to the economy, and those who subscribe to the writings of Toqueville and his school of thought. First, inegalitarian thinkers believe that inclusion is not inherently built into the systems that govern the United States though disagree on whether this is an inherently “good” or “bad” thing. Second, fiscal scholars see immigration only in terms of its value to the economy and, from there, draw conclusions as to the worth of immigration based on its economic utility. Lastly, Toquevillian scholars stress the liberal and democratic features of early America and argue that inequalities and ascriptive identities were not prevalent or verifiable. With these modern schools of thought in mind, the Founders and their writings lend to a more nuanced view and provide context while examining the most defining question of this debate – what makes a citizen: character or industry? This question reveals an important distinction between the views of the Founders as Washington and his classic republican followers believe citizens should be admitted to the polity based on the content of their character and sees the very participation of citizenship as a vehicle with which to inculcate virtue whereas Hamilton and his followers saw immigration as a way with which to add value to the commercial republic and economic industry. The inclusion/exclusion of Native Americans, Catholics, and African Americans highlights the Founders’ visions of these 5th column groups as it pertains to their citizenship and demonstrates that, at the time, exclusion was based less on race than it was on religion and other differences.

These debates of the late 1700’s and early 1800’s were not only region-based but culture-based as well. Diverse opinions regarding immigration and the question of who could become a citizen were extremely prevalent in shaping the constitution and came up multiple times at the Constitutional Convention. While specific legislative outcomes of these discussions did not make their way into the Articles of Confederation, the spirit of debate in and of itself at the Constitutional Convention is what ultimately informed perhaps the most prominent piece of early immigration legislation, the Naturalization Acts of 1790 and 1795 and accounted for the Constitution’s intentional vagueness on the issue of citizenship and naturalization. It was this vagueness that allowed for flexibility, compromise, and balance to take place. Ultimately, the political process and the activity of debate in and of itself is what led to a comprehensive and adaptable view. The Naturalization Acts of the late 1700’s did not completely change or modify individual views on citizenship but proved to be good inroads for future pieces of legislation.

In most recent times, this political process is not nearly as effective. Instead of looking to the nature of politics to resolve highly contested political issues and relying on the spirit of deliberative democracy, modern times depend considerably on the administration to decide on issues. The political dynamic on immigration reform more recently revolves around gridlock rather than the spirit of debate and compromise. Instead of resolving important and controversial issues of immigration as the Founders did with healthy debate and balancing interests, in 2014, John Boehner simply refused to act on immigration reform instead of dealing with this extremely important and difficult issue. In response, Barack Obama also unilaterally ruled for DACA which, while it was a crucial piece of legislation, it required little to no bipartisan agreement or compromise.

In this way, the history of immigration legislation and policy serves as a good model as to what the political process looks like when it is working because the natural debate over who should be allowed to be a citizen resulted in a political process that channels interests into a compromise.

Research Fellow: Kelsey Bennett (2022)

Concentration(s): Environmental Economics; PHIL

Faculty Mentor: Julie Dudrick

Department: Upstate Institute

Title of Project: AdkAction Road Salt Reduction Project

Funding Source: Upstate Institute

Project Summary:

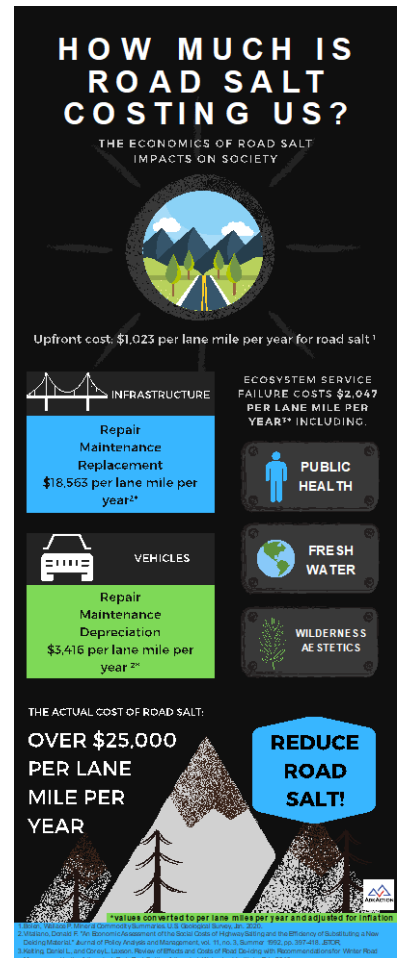
The Adirondack park is located in the northern section of New York. Each winter the park is blanketed with, on average, 90 inches of snow. This makes the park a popular winter tourist destination for skiing, snowmobiling, and other winter sports. In order to keep up with the visitors and encourage the winter tourism economy, road salt has been heavily poured onto the winter roads to keep roadways passible. However, after years of heavy salt use, the park is suffering from problems to the environment, homeowners, and government.

AdkAction is a small nonprofit based in Saranac Lake in the Adirondacks. AdkAction has been working to reduce road salt use since 2010 and is starting to see the state take significant steps to improve the negative impacts from road salt use. For example, this summer, New York state passed a bill to launch a road salt reduction project which passed in both houses in late July. This bill means that the Adirondacks are one step closer to being required to use less road salt and consider alternative practices that clear roads in an equally or more effective way.

I spent the summer focusing on two projects: an economic analysis of road salt use and a series of interviews with concerned Adirondack residents. The excessive salting of Adirondack roadways is costing municipalities and individuals thousands of dollars for each lane mile of roadway. When sodium chloride comes in contact with metal, it causes rust and the resulting corrosion is a costly issue. Municipalities are being forced to repair rapidly degrading infrastructure such as bridges, while homeowners face rusted-out vehicles and even plumbing failures. The hidden costs are important to bring to light because one main reason for choosing road salt over alternative deicers is its low cost. In other words, road salt is more expensive than it initially appears, and municipalities should invest time and resources converting their winter road management to a more sustainable and cheaper solution.

The other project I focused on designing and conducting interviews of Adirondack homeowners about how road salt use has impacted them. These interviews are called "Salt Stories" and will be used in the AdkAction partnership working on the "Hold the Salt Campaign" website. Several common themes showed up throughout these interviews. Of the Adirondack residents I spoke with, all of them were concerned about corrosion and had been able to see damage of some form resulting from salt. The most common visible damage is corrosion of vehicles causing rust and frequent repairs. Similarly, everyone was concerned about the freshwater in the park. Many wells have been impacted and even lakes known for being pristine and free from invasive species are seeing damage due to elevated salt and chloride levels. Joe Thill, a homeowner, explained, "There are people losing vehicles. There are people concerned about salt increasing in the lakes. It's not just homeowners with plumbing issues. It's affecting more people than that. I think it really does make a difference when they use less salt on our roads." Mr. Thill has faced significant impacts resulting from road salt use and has actively tried to speak out against the current salting practices. Even with these concerns, everyone interviewed is hopeful for positive change in the future.

The issue of reducing road salt use is complicated because road salt is both harmful to the environment but also necessary to keep winter drivers safe. AdkAction and other organizations looking into alternative practices have determined that the best solution is to reduce road salt use rather than look for an alternative deicer. This is because all effective deicers are in some way flawed and cause different environmental harm. Instead of searching for a replacement, AdkAction recommends focusing on reducing road salt use, improving equipment to remove more snow manually, and when applicable using abrasives, such as sand, in place of deicers.



Research Fellow(s): Vincent “Vinny” Betti (2021)
 Harrison Blume (2022)
 Ethan Grove (2021)
 Ruojun “Esther” Wu (2023)
 Vicky Yang (2022)

Concentration(s): Biochemistry; Spanish
Concentration: Biochemistry
Concentration: Biochemistry
Concentration: Biochemistry
Concentration: Biochemistry

Faculty Mentor: Jacob Goldberg

Department: Chemistry

Title of Project: New Chemical Tools to Study Biological Systems

Funding Source: Michael J. Wolk '60 Heart Foundation

Project Summary:

Over the course of this unusual summer, the Goldberg group met remotely to design experiments and analyze data, as well as to discuss, critique, and reflect on primary literature that relates to several ongoing, although interrupted, projects in the laboratory. Current projects vary in duration and scope, but the main goal of all of our projects is to create probes and tools to better understand biochemical processes. Many of the discussions involved extensively planning for projects that will resume in-person during the upcoming fall semester and in the long term. One project currently in progress is a study of the physiological consequences of zinc release in the brain. Our primary interest in this area is the synthesis and application of fluorescent probes to image zinc in the synapses of the dorsal cochlear nucleus, which is a region of the brain that is extensively involved in sound discrimination and auditory processing. Developing methods to ascertain the concentration and possible roles of zinc ions in this and other areas of the brain is a rapidly expanding area of inquiry, and we are excited to be a part of it. Tools to study the biochemistry of metals in the nervous systems, particularly those that can report quantitative data, will be of significant importance to a wider understanding of many physiological and pathological states, including stroke, ischemia, schizophrenia, and age-related neurodegenerative disorders.

Among the zinc sensors that we were able to synthesize this summer is carboxy-ZP1, which can be prepared as one of two different regioisomers, as depicted in Figure 1, using relatively straightforward chemistry. This fall, we intend to conjugate ZP1 to different targeting systems to selectively deliver the probe to synaptic targets. We have chosen several candidate peptides and small molecules to investigate.

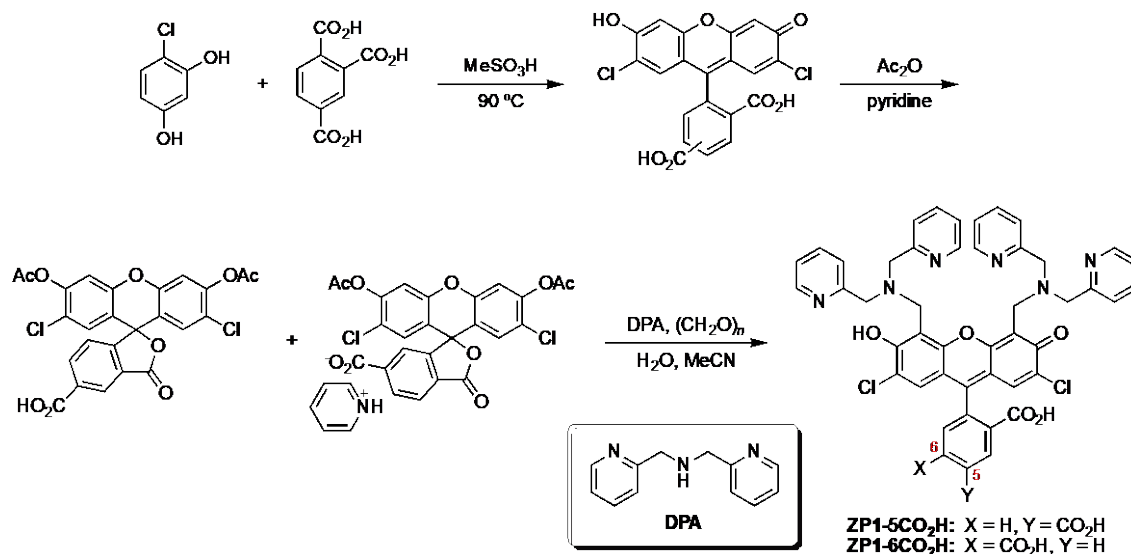


Figure 1. A convenient synthetic route for preparing carboxy-ZP1 zinc sensors that can be attached to a variety of small molecule, peptide, and protein cargo delivery systems. The sensors can be derivatized at either the 5- or 6-position of the bottom ring, as shown, using routine amide bond forming reactions. The route is based on one proposed by Woodrooffe *et al.* (*Chem. Biol.* **2004**, *11*, 1659-1666).

Research Fellow: Muhammad Bin Awais (2021)

Concentration: Physics

Faculty Mentor: Beth Parks

Department: Physics and Astronomy

Title of Project: Application of and evaluation of Source Apportionment models to particulate pollution samples from Uganda

Funding Source: Justus '43 and Jayne Schlichting Student Research Fund

Project Summary:

The state of the ambient air in Uganda is particularly dismal. Prof. Beth Parks during her Fulbright experience in 2016 collected samples of particulate pollution (immobilized in filters) from Uganda and brought them back to Colgate. The pollution levels in these samples were discovered to be alarmingly high. We can obtain some idea of this from the figure below. The WHO's guideline for the limit of 24-hour exposure to PM_{10} (Particulate Matter with an aerodynamic diameter of less than 10 microns) is $50 \mu\text{g m}^{-3}$. This figure was exceeded 83% of the time in Mbarara, 100% of the time in Kyebando and 86% of the time in Rubindi. This project aimed to synthesize, polish and analyze all those data and readings to provide greater and deeper analysis into the situation. The project mainly looked to perform source apportionment of the data i.e. to predict an appropriate number of sources that could lead to the data/readings we were seeing. Furthermore, the study into PM_{10} holds significance because particles of this size are particularly notorious for being deposited deeper in the lungs and causing health problems, are retained in the atmosphere longer, interfere with the nutrient cycle of the ecosystem and are transported over larger distances.



Figure 1: The figure compares the state of two filters with the one on the left being clean and the one on the right after collection of pollution particles.

The main aim of the project was to utilize mathematical and computational techniques to sift through and manipulate the data. The first stage included the evaluation of various mathematical techniques and models to determine their suitability to the task at hand. Eventually, we decided to perform Positive Matrix Factorization (PMF) on the data. This model works by transforming the elemental concentration or organic species concentration data into a time-series and basically, factorizes the data into a linear combination of smaller matrices. By doing so, it effectively determines the optimal number of smaller matrices that can form a linear combination and return the concentration data matrix to us. In essence, each of those smaller matrices could potentially represent a source. After understanding the mathematics and logic behind the model, we used PMF software that was made by the United States Environmental Protection Agency (EPA) to perform the analysis. The bulk of the project time was spent on this since the software has many quirks and sensitivities and because we had to perform our own error analysis. It was a very fulfilling experience surely.

Research Fellow: Nicholas Blake (2021)

Concentration(s): Biochemistry; Philosophy

Faculty Mentor: David Dudrick

Department: Philosophy

Title of Project: Albert Camus' Plague and the Existential and Religious Responses to Natural Disasters and Suffering

Funding Source: Center for Freedom and Western Civilization

Project Summary:

Albert Camus' *the Plague*, behind *The Stranger*, is one of his most well-known works. As the name suggests, *The Plague* is a fictional account by a doctor concerning the pandemic of bubonic plague that hits the moderately sized coastal town of Oran, Algeria, which was then a French colony. Considering the current situation with COVID-19, a book about a pandemic seemed appropriate.

Existentialism is not only a method of philosophy that emphasizes the human condition as a whole but also a literary movement. Camus is considered by many to be an existentialist writer, though he himself rejected the term. Regardless of whether he is a "true" existentialist, existentialist philosophers Martin Heidegger and Jean-Paul Sartre provide very thorough investigations of human existence in their books *Being and Time* and *Being and Nothingness* respectively. Using Heidegger and Sartre, my summer project was analyzing how the citizens in the town react to the plague and what this reaction can in turn tell us about Heidegger's notion of being inauthentic.

What strikes the doctor and the other citizens the most about the plague, is not the death and disease but the exile. Being away from loved ones or being unable to conduct their own business, brings the citizens face to face with their own unique values and the understanding that their whole world is centered around these values. This brings them closer to what Heidegger calls authenticity. However, because these values are impeded by the exile, being aware of them authentically brings torment.

There are a variety of ways the citizens react to this torment, and Sartre and Heidegger both provide useful analytical tools to study these ways of adapting. There is escaping the world of torment by fleeing into a world of memory or imagination. However, these imaginary worlds, while providing a temporary escape, also reflect the desire for normalcy and so further aggravate those who imagine or remember.

There is also the escape via moods. Passionate yearning, resentment, hope and confidence are all moods where the citizens turn away from their situation through a variety of methods each unique to the particular mood. However, these moods require energy, and require that the citizens still be in some way aware of their situation, even if the awareness is one that covers up the "true" situation.

There is one last mood that provides the best escape, indifference. In indifference they no longer flee their situation but give up the adoption of their own unique values. They do this by falling into the inauthentic world of the They, where the values and the corresponding world is a world not of their own, but of "any man", the They.

From this we can better illuminate Heidegger's analysis of the inauthentic manner of human existence. Though he says he does not mean inauthentic in a negative way, his mere choice of terminology indicates some preference to authenticity. And even if he doesn't think inauthenticity is worse, he does not give any guidance to when one should be authentic or inauthentic. However, the citizens of the town show that, at least in times of great disaster like pandemics, inauthenticity is a necessary and practical response that alleviates the burdens that nature and society sometimes throw on us.

Research Fellow: Jenna Borovinsky (2022)

Concentration: Molecular Biology

Faculty Mentor: Julie Dudrick

Department: Upstate Institute

Title of Project: Pathfinder Village Mobile Market Program

Funding Source: Upstate Institute

Project Summary:

This summer I had the incredible opportunity to remotely intern at Pathfinder Village. Pathfinder Village is a community in Edmeston, NY in which people with Down syndrome and other developmental disabilities are able to thrive and find their talents and values. Beginning in 2018, staff at Pathfinder Village began a Pathfinder Produce Mobile Market accommodating those who struggle with a medical condition and food insecurity in its surrounding Otsego County community. The program's staff includes members of Pathfinder Village with developmental disabilities making it a very meaningful work opportunity. The program, approved by grants from the LCHP (Leatherstocking Collaborative Health Partners), entails delivering fresh produce along with recipes to those that qualify for the program; in total 50 Medicaid recipients were approved to receive vouchers. In 2019, a proposal was accepted to expand the program with another 50 vouchers to Lantern Hill Mobile Home Park in Oneonta, NY, with the goal of expanding the program to neighboring counties. However, because there are individuals in Otsego County itself who qualify and are on the waitlist, the original program is clearly popular and needs more funding.

Through my research I have made several observations about the Otsego County and Lantern Hill communities such as the extreme food insecurity, lack of transportation, and other social determinants, that have led to many health issues in these two communities. My goal is to help improve these issues and help gain the attention of insurance companies to gain more funding for this mobile market program which has shown to be super impactful on the community in improving some of these barriers.

My specific duties during this internship included researching food deserts and food insecurity in general, as well as specifically to rural regions. I also researched social determinants of health in Otsego County and went through Community Needs Assessment Surveys for Otsego County. Additionally, I looked at the benefits of eating fruits and vegetables and how that affects health. Furthermore, I researched incentivized Medicaid programs and food prescription programs and was able to get in touch with the CEO of a major food prescription program called Farmbox RX, which is incentivized by an insurance company. In order to see the effects, the two Pathfinder programs have had thus far, each voucher recipient was given a survey prior to receiving produce, and then another survey six months after the produce delivery program began. A great portion of my research involved going through the 200 surveys and then analyzing and comparing them. The surveys show very promising results. I also participated in a couple of weekly University of Buffalo Zoom calls, as they just recently received a federal grant from the National Cancer Institute to study the impact of mobile markets on the health of rural communities in NYS, showing the impact similar markets are making. The Zoom calls were very beneficial in hearing tips on how similar mobile markets were running, especially during the COVID-19 pandemic. I also had the great opportunity to have a conversation with a voucher recipient at the Lantern Hill Mobile Market, which was very beneficial as I was able to hear how impactful the program has been on their community in both health and morale.

Overall, Pathfinder Village's Mobile Market Program, and the Lantern Hill Mobile Market Program is improving residents' access to fruits and vegetables. This increased consumption statistically leads to a healthier lifestyle which can aid ongoing medical conditions. These two markets need to continue sharing data that shows the benefits of these programs to gain attention by insurance companies. This will provide enough financial assistance for the program to keep running without relying on grant funding.

Research Fellow: Anna Brown (2021)

Concentration(s): Spanish; Anthropology

Faculty Mentor: Santiago Juarez

Department: Anthropology

Title of Project: Exploring new methods of archaeological recording: Implications of 3D scanning technology for archaeological research

Funding Source: Lampert Institute for Civic and Global Affairs

Project Summary:

This summer, I was granted the opportunity of working as a research fellow for the Lampert Institute of Civic and Global Affairs. Before the pandemic, I had been working closely with Professors Santiago Juarez and Dr. Kristen De Lucia in order to develop an independent research plan for this summer that would integrate my work with 3D scanning. This work involved an extensive amount of training in the use of 3D scanning technology so that I could produce and archive 3D models of artifacts from the Longyear Museum of Anthropology. My original proposal involved travelling to Xaltocan, Mexico so I could study how 3D archaeological recording impacts the preservation, restoration, and sharing of museum artifacts and other archaeological data. After the pandemic disrupted my travel plans, I decided to expand upon my interests of studying the Aztec people archaeologically by studying remains of spindle whorls from Late Post-Classic Mexico while working from home.

The production and consumption of Aztec cloth in Late Post-Classic Mexico (1200 AD- 1521 AD) and within the early colonial period (16th century) were integral to the cultural, economic, and political spheres of Aztec daily life. The two most spun fibers during the Late Post-Classic Period, cotton and maguey, were utilized for completely different purposes. While maguey was a commoner good grown, cultivated, and spun locally to later be worn as clothing by commoners, cotton was an elite commodity whose production and consumption were driven by the tribute system. The tribute system was an extensive network in which commoners throughout the Aztec empire produced various goods to be collected, sold, and/or consumed by elites. Cotton cloth was the most desirable and valuable commodity within this system. My research highlights how the cultural significance of these two fibers varies by location. What I found is that changes in economic and political demands for cotton growth and production throughout the late post-classic period up until today have altered the cultural significance of cotton production and weaving over time.

I started by looking at various archaeological projects in the Valley of Mexico in which spindle whorls were collected and their properties were recorded. I utilized online databases such as TDAR, Anthrosource, and JSTOR in order to gather this information. I focused on archaeological data collected in Otumba, Xaltocan, and Rio Viejo, Oaxaca and compared the number of whorls found, whorl type, decoration, unique designs or shapes, whether spinning was specialized or unspecialized craft, whether it was a household, intensive, or a gendered activity as these properties were recorded at each site. This revealed compelling information about the unique cultural and economic value of cotton at each site.

I then looked at ethnographic sources from Jamiltepec and Chiapas in order to gain a better understanding of how cloth production in Mexico functions today. While I mention contemporary gender roles within these communities, this information was not used as evidence for how gender roles functioned in Late Post-Classic Mexico, as this would be highly problematic considering that these roles shift over time. What I found from these sources is that changes in the economic demands for cloth have altered the people's relationships with the materials themselves.

If there is anything that conducting research this summer has taught me, it is that having an open mind and being flexible to what is happening around you are integral for success, especially in times of crisis. The Lampert Institute for Civic and Global Affairs allowed me the flexibility to alter my original proposal so that I could pursue my interests in Mesoamerican archaeology despite working from home. Looking forward, I hope to integrate my work with 3D scanning into this project upon my return to campus. I have installed and experimented with new 3D imaging software entitled Autodesk Maya on my personal laptop so that I can explore its abilities before arriving to campus. Upon my arrival, I will use this software to incorporate images of spindle whorls into my project.

Research Fellow: Weijie “Richard” Cai (2021)

Concentration: Physics

Faculty Mentor: Hiva Samadian

Department: Computer Science

Title of Project: Course Registration Mobile Client Application Development

Funding Source: NASC Division

Project Summary:

As a Colgate student, I have noticed some inconvenience from our current course selection website and registration system by myself and my friends in Colgate. For example, the current system does not provide mobility as a mobile application does, and students cannot favor some courses that they are planning to select for future references. Since mobile clients have been widely used now by most people, including Colgate students, the mobile client application can make the course registration more convenient and transparent and on demand updated information more accessible and personalized for both incoming and enrolled Colgate students. So, the study of other Colgate students’ opinions on the issue and the feasibility of utilizing a mobile client system as a solution is one of the objectives of this research. In order to achieve this objective, I need to show respondent students a demo application by developing a mobile course registration system. In this project I developed a mobile client application which provides solutions for a number of identified problems, such as favoring courses, getting notification due to the change of favored courses, and so forth. In also made a demo video for representing the application, and a questionnaire to use it for the survey study.

In order to accomplish the goal of the main research topic, a Colgate course registration mobile application needs to be implemented first. Before I started to work on this application development, I researched on which UI framework I should use in order to accomplish all functionalities of this application. Finally, I decided to use Apache Cordova for the UI design and front-end framework by building Ionic 5, primarily through Ionic Command Line Utility (CLI), and ant design of angular upon Apache Cordova. The reason I chose Apache Cordova is that only one version of code is needed for both IOS and Android system. It increments the efficiency and consistency of the mobile application development. The basic UI design of the home page, which displays all majors, is the accordion panel component from ant design of angular for mobile devices. The design of accordion panel differs from normal card component of the short course description and diversifies the application. I collected all data from Colgate course offering website by simply sending API request to the specific URL and fetching JSON file, then decoding into custom class object. I didn’t use database for the original version of the application because I could directly use data from the web and the data would update based on the web status. More work could be done if the application is put in use and combines with Colgate database in the future.

This mobile application required functions of viewing the latest Colgate courses categorized by majors and searching courses by department, course number, and instructor last name, which match the functions that the current web client has already contained. Moreover, it involves a Wishlist System. Students can save their favored courses to Wishlist for easy reference during registration ahead of time and get notified when courses are added or removed from Wishlist. Meanwhile, while the courses are added, the popup notification shows if there are still available seats or not.

This Application will contain more functionalities in the future work. First, there would be a timetable UI design that whenever students add one course, it would show up on the timetable. It is very convenient for students to check the time availability and hypothetical scheduling while selecting a couple of courses whose schedule may overlap. Second, As the seat availability of courses in the Wishlist changes, the user gets notified.

Originally, Professor Samadian and I proposed a survey and made a demo video after I implemented the application. The survey contains some general and specific questions about the application shown in the demo video. General questions, such as gender, age, class, and so forth, aim to analyze the data from various respondents. Specific questions are related to opinions about the functionalities of this application and different user experiences between mobile and web course selection and registration system. However, we were not given permission to conduct the proposed survey. The application, demo video for presenting it, and the survey questionnaire are ready to be used whenever the permission is given.

My experience in this project of implementing an application and studying the self-built application enhanced my abilities of UI design, survey design, self-learning, formal writing, presentation, collaboration and communication. I understood the combination between software engineering and computer science study. By successfully building this application and survey study, I would be more prepared for my future study and career as a computer science student. Meanwhile, this application can also benefit current Colgate students. This study shows the connection between computer science study and real-life issues.

Research Fellow: Theodore “Teddy” Campbell (2020)

Concentration: Geography

Faculty Mentor: Julie Dudrick

Department: Upstate Institute

Title of Project: Visitor Use Survey for the Paul Smith’s College VIC

Funding Source: Upstate Institute

Project Summary:

This summer, I worked remotely as an Upstate Institute Summer Field School Fellow with the Paul Smith’s College Visitor Interpretive Center (VIC) in New York State’s Adirondack Park. My work consisted of designing, distributing, and analyzing a visitor use survey for the VIC. There had never been a survey of the visitors to the VIC before. The results of the survey are to be used both for improving the VIC based on the advice of respondents, and to be used for future grant writing efforts.

The survey was designed in Qualtrics with these goals in mind, and consisted of three sections. In order to improve the VIC, the first two sections of the survey asked for visitor’s opinions about the VIC in general, and about the programs at the VIC. Programs at the VIC are regularly scheduled educational events where experts teach visitors about aspects of the unique Adirondack environment. The final section of the survey consisted of demographic questions, including age, race, gender, and income bracket. These questions give valuable data to the VIC that can be used in future grant writing efforts. For example, the VIC has a very high percentage (90+%) of white visitors, so there is now evidence that they need to work on reaching a more diverse segment of the population. To further refine the wording of the questions, a pretest version of the survey was distributed to around 30 VIC staff and volunteers to make sure the questions were clear, and that the data received from each question was valuable. When the pretest was returned, the creation of the survey was finalized.

The survey was distributed in two different versions to different audiences, as well as in two different ways. First, there was an online survey sent through the VIC’s weekly emailed newsletter. This same survey was also mailed to a smaller group. A version of the survey was emailed to Paul Smith’s College students and staff. As the VIC is located right next to the college, and students make up a very different demographic, their experiences would likely differ from those of local or regional adults who visit the VIC. Distributing the survey both electronically and through the mail also helped to survey a wider section of VIC visitors. These three methods yielded 286 total survey responses. 668 people opened the newsletter email, and 193 filled out a survey, for a 28.9% response rate. 140 surveys were mailed to former VIC visitors, and we received 39 responses, for a similar 27.9% response rate. The students and staff survey was sent to 1,100 members of Paul Smith’s College, and 54 people responded, for a 4.9% response rate. While the survey data cannot be used as a definitive way to represent all VIC visitors, 286 responses yields some useful information.

Survey results from Qualtrics and from mailed surveys were combined into a spreadsheet to create a full picture of VIC visitors’ demographic information and opinions about various aspects of the VIC and VIC programs. This spreadsheet will remain available to the VIC. Quantitative questions were combined into bar or pie charts, and the two qualitative questions were coded into various sections of similar responses. The survey had a series of useful results, a sample of which have been included below:



Research Fellow: Michael Caron (2021)

Concentration: Philosophy

Faculty Mentor: Robert Kraynak

Department: Political Science

Title of Project: Are There Two Edmund Burkes?

Funding Source: Center for Freedom and Western Civilization

Project Summary:

My summer research project with Professor Kraynak is an in-depth analysis of political theorist Edmund Burke, studying specifically his alleged participation in both liberalism and conservatism during the mid to late 1700s. I have narrowed my lens on this topic to focus specifically on Charles James Fox's charge of inconsistency against Edmund Burke, ultimately demonstrating that such a charge was both unwarranted and inaccurate. Through an examination of Edmund Burke's own works along with critiques by secondary sources studying the political theorist's ideologies, I have demonstrated that Burke functions as a consistent conservative-minded political theorist whose work emphasizes the importance of ordered liberty in civil society. This argument supports the notion that there exists only one Edmund Burke, refuting the argument presented by individuals such as Charles James Fox that claims that there exists both a liberal-minded Burke as well as a conservative-minded Burke. Through an examination of both liberal and conservative ideals found in his literary works, I hope to have demonstrated that Edmund Burke has taken traditionalism and placed the developed theory within the political philosophy of conservatism.

In order to present the strongest argument demonstrating Burke's consistency as a conservative-minded political theorist, I have focused my research on Edmund Burke's speeches and writings on the American colonies, the Irish Catholics, the East India Company's injustices in India, commerce and economic reform in Britain, as well as his ideologies regarding natural law. Specific names of these speeches and writings that I have studied carefully in this work include but are not limited to *Reflections on the Revolution in France*, *Speech on Conciliation with the Colonies*, *Speech on Mr. Fox's East India Bill*, and *A Letter to a Peer of Ireland on the Penal Laws Against Irish Catholics*. In addition to the primary source documents that I have drawn upon in my research, I have also looked to secondary source literature written by scholars including Conor O'Brien, Peter Berkowitz, Russell Kirk, Peter Stanlis, Greg Collins, and Paul Cliteur to further strengthen my thesis. Works by these authors include Kirk's *Edmund Burke: A Genius Reconsidered*, O'Brien's *The Great Melody: The Thematic Biography of Edmund Burke*, Stanlis's *Edmund Burke and the Natural Law*, Collins's *Commerce and Manners*, and Cliteur's *The American Conservatives, Edmund Burke and Natural Law*.

Research Fellow(s): Johanne Castro (2021)
Emily Cruz Gonzalez (2021)

Concentration: Neuroscience
Concentration(s): Computer Science; English

Faculty Mentor: Jason Meyers

Department(s): Biology; Neuroscience

Title of Project: Using Raspberry Pi for Automated Analysis of Startle Behavior in Zebrafish

Funding Source: Michael J. Wolk '60 Heart Foundation; Science and Math Initiative-SMI (NASC Division)

Project Summary:

Zebrafish (*Danio rerio*) has been widely used in behavioral neuroscience because of its comparable genetic structure to humans (Pelkowski et al., 2011). Larval zebrafish are more likely used in a laboratory setting than their adult counterparts because they are easier to maintain and be part of large-scale behavioral analyses and can display adult behaviors, such as escape responses (Colwill and Creton, 2011). A common zebrafish behavior is the startle response when introduced to a tactile, visual, or acoustic stimulus, characterized by an initial escape response displaying a C-shaped body bend facing away from the stimulus (Colwill and Creton, 2011). Accurate analysis of this behavior could be time-consuming and requires great attention to detail. Several studies have set up and utilized automated systems to quantify startle responses and other types of zebrafish behavior. Based on previous studies, we have aimed to develop a prototype of an automated stimulator, data collector, and, eventually, an efficient data analyzer of zebrafish behavior using Raspberry Pi.

To design a system that would increase the efficiency of data collection and analysis in the laboratory setting, we chose to utilize the Raspberry Pi, Pi camera, and its compatible software as they are cost-effective. Despite Raspberry Pi's limited processing, widely available programs such as Python and OpenCV could be used to develop a program that would enable the effective recording and analysis of zebrafish startle responses. Preliminary tests of the system allowed us to identify the movement of the zebrafish through the course of the various stimuli. The stimuli were generated through haptic feedback motors controlled by connections to the Raspberry Pi by a breadboard. The data collected by the system is in the form of high speed, 90 frames /second, videos. The videos are then automatically analyzed with each frame through setting the threshold and finding the center of mass for each fish to determine how much the center of mass has moved, evaluating the intensity of their responses. The current program allowed us to optimize the data collected by manipulating camera settings to set the image exposure, threshold, adjust stimulus intensity, timing, and recording speed. The preliminary tests showed that the zebrafish respond more to stimuli of higher intensities. As a flexible system, this could be subjected to further development such as improved centroid tracking, and it can also be altered depending on the way data collection is intended. Other types of stimuli, such as acoustic and visual, can also be generated to analyze other behaviors, such as social and reward-related behaviors.



Figure 1. The Raspberry Pi camera is set up to allow recording of zebrafish's startle response during their stimulation. The stimulator is attached to the petri dish wherein a beaker is placed. Larval zebrafish are placed in the beaker directly under the camera. The Pi camera is positioned so that it captures the movement of zebrafish upon the stimulation and save the collected data on Raspberry Pi as a video file. In the second image, the zebrafish are shown mid-response to stimulus.

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- Pelkowski, S. D., Kapoor, M., Richendrfer, H. A., Wang, X., Colwill, R. M., & Creton, R. (2011). A novel high-throughput imaging system for automated analyses of avoidance behavior in zebrafish larvae. *Behavioural brain research*, 223(1), 135-144.

Research Fellow: Yejin Cha (2021)

Concentration: Computer Science

Faculty Mentor: Ahmet Ay

Department(s): Biology; Mathematics

Title of Project: Vertebrate Segmentation: From Gene Networks to Human Diseases

Funding Source: Michael J. Wolk '60 Heart Foundation

Project Summary:

The zebrafish segmentation clock network controls the rhythmic somite (vertebra precursor) segmentation during embryonic development. In this system, positional information for segmentation is encoded solely by spatial fold change (SFC) in the fibroblast growth factor FGF signal output (Simsek and Özbudak, 2018). Neighboring cells in the zebrafish embryo measure SFC to determine somite segment sizes accurately. This summer, my goal was to use mathematical modeling to discover the biological regulatory networks that can reproduce the effects of different ppERK concentration conditions on the SFC curve (Figure 1).

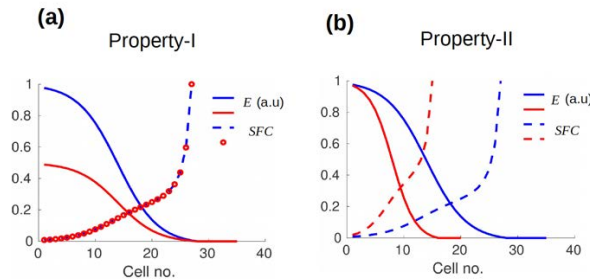


Figure 1. (a) Wildtype ppERK(M0) concentration is represented with a solid blue line. The blue dotted line represents the corresponding SFC graph with the wildtype ppERK concentration. The solid red line and the red dotted line represent the case when the ppERK concentration is reduced by half(M1) and its corresponding SFC curve. (b) The solid red line shows the case where the ppERK concentration is shifted to the left(M2). The red dotted line shows that in this case, the SFC curve shifts to the left also.

Using MATLAB, we simulated all possible non-isomorphic topologies of three gene network in a one-dimensional 32 cell tissue with a dynamic ppERK concentration gradient across the field (Cotterell and Sharpe, 2010). The gene dynamics depend on the following model parameters: the strength and sign of the interactions between genes, and degradation rates. Our current model contains 12 parameters; the first nine are the strengths of gene-gene regulatory interactions, and the last three are the degradation rates for each gene's products. We have developed two differential equation models: one with and another one without cell-to-cell communication. The cell-to-cell communication in our model is implemented by substituting a gene's value in a cell with that gene's average level in the adjacent cells. We used Euler's method to solve each model.

We tested 2,000 possible regulatory network topologies(digraphs) with 30,000 biologically feasible parameter sets on Colgate's high-performance computing cluster Turing. Our simulations suggest that we can reproduce the three experimental observations without a neighbor communication case with some network topologies (Figure 2a). For the cell-to-cell communication case, we can also achieve reasonably good fits with a few network topologies (Figure 2b).

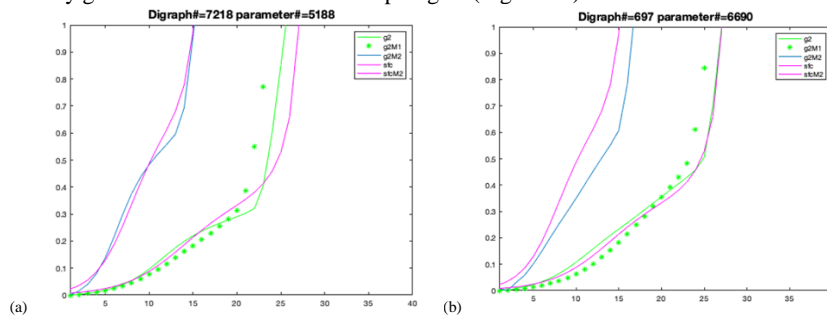


Figure 2. (a) SFC curve plotted using digraph #7218 and parameter set #5188 for the no-neighbor case. Pink curves represent our desired outcome. A perfect fit (18/18) is achieved. (b) SFC curve plotted using digraph #697 and parameter set #6690 for the neighbor case. A score of 16 out of 18 is achieved.

In summary, we were able to attain high scores for both models using unequal step sizes for three experiments. We hope to find perfect scoring networks for both no-neighbor and neighbor cases using equal step sizes in the next step. One possible direction we will take is to incorporate gene-specific ppERK interaction weight parameters.

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Research Fellow(s): Jyotirmay Chauhan (2023)
Xi “Chase” Jiang (2021)
Tyler Potter (2021)

Concentration: Undeclared
Concentration(s): Economics; COSC
Concentration: Computer Science

Faculty Mentor: Aaron Gember-Jacobson

Department: Computer Science

Title of Project: Practical bug detection in software implementations of routing protocols

Funding Source: Holden Endowment Fund; National Science Foundation

Project Summary:

Motivation:

Computer networks use devices known as routers to connect computers and allow them to share information with one another. If you think of the information being sent over a network as a car, these routers act as a GPS guiding the information on a network from their source, to their destination. Prior studies have shown that a significant portion of network outages are caused by bugs within the implementation of routing protocols, which are used by routers to discern how information should be forwarded through the network(1). Moreover, a significant portion of these bugs can be found by adding simple checks to the routing software which implements these protocols(2). For these reasons, we researched ways to automatically verify the implementation of routing protocols, as a means to detect these bugs without the need for human intervention.

Challenges:

To achieve our end goal of finding ways to verify the implementations of routing protocols such as OSPF and BGP we had to take several steps. First, we wanted to understand previous bugs that had been discovered within the protocol implementations in the routing software we were using(3), so we attempted to look at previous bug reports of the software. We surmised that this would allow us to recreate the bugs and therefore be able to gain a closer understanding of what was wrong with the implementation of the routing protocol and what policies led to the bug. However, many of the bugs reported had already been fixed within their respective, archived version of the software, so tracing bugs with this strategy didn’t yield many results.

We then shifted to a new strategy in which we would read the standards document of a routing protocol(4), transcribe the “rules” of said standard, and then use both packet traces and router logs to check for policy violations. While more achievable than our previous strategy, this implementation also produced some of its own challenges. Namely, attempting to write the sometimes dynamic rules set forth by a routing protocol standard, which is usually written in a “human” digestible format, into something quantifiable by a program and being able to get several packages and software libraries to work together as a means to dissect the information from router logs and packets.

Outcomes:

We have created a tool which can look at both information logged by routers and the control packets exchanged by routers with respect to the 51 rules we compiled from the standards document of OSPF to verify that most observable rules in terms of packet verification and event verification are being followed. Future work for this project could consist of adding more rules for verification from the OSPF standard, adding the ability to verify other routing protocols such as BGP, and introducing unexpected behaviors into a network to evaluate artificially introduced bugs with our tool.

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Research Fellow(s): Tarik Cigeroglu (2023)
John “Jack” Underhill (2022)
Zachary “Zach” Williams (2023)

Concentration: Undeclared
Concentration(s): Biology; Philosophy
Concentration: Undeclared

Faculty Mentor: Eric Muller

Department: Chemistry

Title of Project: Understanding intermolecular interactions and nanoscale morphology in molecular materials and biological structures

Funding Source: Warren Anderson Fund; Miller-Cochran Fund; Michael J. Wolk '60 Heart Foundation

Project Summary:

Vibrational spectroscopy offers insight into chemical identity, molecular scale, and nanoscale structure by using infrared light. Conventional optical methods are limited by the wave nature of light in both sensitivity and imaging spatial resolution. By using near-field enhancement of a nanoscale metallic tip probe, infrared scattering-scanning near-field optical microscopy (IR s-SNOM) overcomes the classical diffraction limit, achieving a typical spatial resolution smaller than 20 nm and sensitivity to even a single protein complex. In order to study proteins and molecules in a chemically relevant environment, we extend the IR s-SNOM to an *in-liquid* environment with an attenuated total reflection geometry. This new optical geometry is significantly different from earlier implementations, and preliminary measurements of sensitivity are not fully replicated by existing simplified physical models. Here we develop a new approach to modeling in order to understand the fundamental optical and physical phenomena. We develop models based upon numerical two- and three-dimensional finite-element modeling. We aim to answer questions about what signal enhancements may be possible, achievable spatial resolution, and sensitivity to both protein samples and the liquid environment.

We develop a new approach to modeling in-liquid IR s-SNOM signal using a finite-element-method (FEM) solver, which explicitly calculates optical fields as solutions to Maxwell's equations. Previous approaches to modeling near-field spectroscopy have been built using analytic models and a highly simplified picture of the optical interactions in the region around the tip and sample. Necessary simplifications have included, for example, approximating the tip as a sphere above an infinitely thin planar sample. In contrast, our numerical model is based on FEM, which is a general approach to solving partial differential equations that obtains solutions for the field at a set of discretely spaced points. Numerical calculations using the FEM solver, Comsol Multiphysics, offers many advantages, including enabling us to build a more realistic picture of the sample with arbitrary geometry in two- or three-dimensions that can incorporate the total internal reflection geometry, account for the presence of the liquid, and explicitly calculate signal from samples of varying thickness or with non-planar features.

We began our modeling with the simplest picture, approximating the tip as a point source above a ZnSe substrate. This allowed us to model distance dependence of the tip as well as the angular distribution of emitted light through the ZnSe prism, into air, and into liquid above the tip, which already revealed that directionality of scattering may be very important to the detected signal. Through the course of the summer, we built up our model to include an increasingly sophisticated picture of optical interactions around the tip and sample. We developed models in first in 2D and then 3D that incorporate plane wave illumination of a metallic s-SNOM tip, attenuated total reflection geometry, variable-tip sample distance and tip motion, and the liquid environment around the tip. We find the optical field enhancement can be as high or higher for in liquid s-SNOM compared to earlier approaches, with surprisingly greater near-field localization.

Our new approach yields new insight into optical enhancement and nanoscale confinement in liquid and for geometries inaccessible to existing models. Towards the end of summer, we implemented additional calculations using Matlab that distinguish the near-field light interacting with the sample from the far-field detected light. We are working to implement this as a method to calculate detected s-SNOM spectra and simulate imaging. Our approach is generalizable and can provide greater detail than established methods even for s-SNOM in a conventional geometry. We expect our approach will be broadly used in development of s-SNOM as well as serving as an important tool for interpreting near-field spectra and understanding nanoscale phenomena.

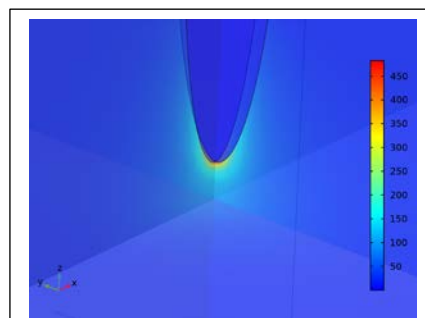


Figure 1: A metallic tip enhances and localizes light within a few nm region of its apex (red region). Optical field enhancement for a gold tip above a ZnSe substrate is calculated in a model that explicitly includes both the ATR geometry and liquid environment.

Research Fellow: William “Jackson” Coleman (2022)

Concentration: Political Science

Faculty Mentor: Navine Murshid

Department: Political Science

Title of Project: Bolivia as a Case Study for Trade Policy in Developing Nations

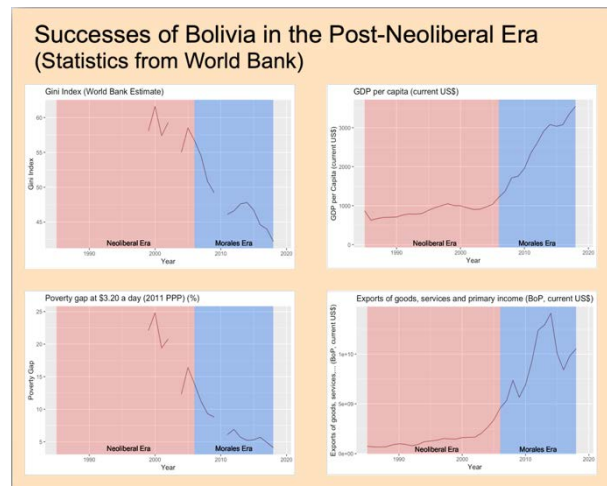
Funding Source: SOSOC Division

Project Summary:

In Spring 2020, I took Professor Murshid’s International Political Economy course, a large focus of which was on neoliberalism, the economic philosophy defined by free trade, fiscal austerity, and privatization that has been dominant since the 1970s and 1980s. Just months before I began that class, Bolivia’s longtime president, Evo Morales, had been forced out of power by the military and by protests from conservative sectors of society. Morales had achieved power by capitalizing on popular resistance to neoliberalism in Bolivian society, particularly among the country’s indigenous population. In Professor Murshid’s class, I decided to explore Bolivia’s trade policy during Morales’ tenure for my final project. This past summer I expanded on that project, doing further research into Bolivia’s experiment of resisting neoliberalism.

In the 1970s and 1980s, nearly every Latin American country embarked on a path of neoliberal economic policies, as traditional economic strategies were failing to provide growth and often leading to massive debt and economies in crisis. The solution offered by everyone from local technocrats to professors at the University of Chicago was privatization, trade liberalization, and deregulation, with the state transforming into an apparatus to serve the market. Bolivia’s neoliberal turn began in 1985 under the presidency of Victor Paz Estenssoro with the New Economic Policy, an economic plan crafted with help from Harvard economist Jeffrey Sachs. The failure of these policies culminated in the Cochabamba Water War, El Alto Gas War, and ultimately with the election of Evo Morales, the first indigenous leader of a country with one of the largest indigenous populations in the Americas. Over the summer, I sought to understand what key steps Morales took to follow up on his promise to chart a new economic path forward for Bolivia, and whether those steps were successful and could be a potential model for other developing nations. I found that Morales set out to resist the neoliberal “Washington Consensus” by nationalizing key resources, most notably the hydrocarbon industry, ignoring the advice of the IMF, and forging regional alliances with leaders who shared his economic philosophy, best realized in the ALBA-TCP, a group of Latin American nations with left-leaning governments which was created on the principles of solidarity and cooperation. Bolivia under Morales saw a large decrease in extreme poverty and inequality, while at the same time posting economic growth numbers that many neoliberal nations would envy.

The Bolivian model included a unique combination of heterodox trade policy, traditional leftist ideas, and regional cooperation— ideas that developing countries could look to as an antidote to the many failures of neoliberalism. Yet, this model was also contingent on environmental and geopolitical realities. While many aspects of Bolivia’s model could be replicated in any developing nation, few countries are blessed with the natural resources that Bolivia has at its disposal, especially in the hydrocarbon sector. The success of a multi-national organization like the ALBA-TCP is also very dependent on the political and ideological stability of the member nations, and that while it is a promising avenue of international cooperation and ethical trade, it is difficult to envision it being successful when its member states are constantly changing. Yet, the Bolivian experiment shows that a country can both create strong economic growth and reduce inequality without subscribing to neoliberal doctrine.



Research Fellow(s): Dechokyab “Dechok” De (2022)
Sara Million-Perez (2022)
George “Dewey” Wilbanks (2021)

Concentration: Biochemistry
Concentration: Neuroscience
Concentration(s): Religion; Biochemistry

Faculty Mentor: Anne Perring

Department: Chemistry

Title of Project: Aerosol Loadings and Cleaning Strategies in Denver Schools

Funding Source: University of Colorado Foundation; Justus '43 and Jayne Schlichting Student Research Fund

Project Summary:

Due to COVID-19, our research focus shifted from biological aerosols and ice nucleating particles to analysis of aerosol loadings in indoor environments. The primary goal was to look at aerosols in Denver-area schools, investigating how ventilation and additional filtration could be used to reduce aerosol exposure as classrooms are repopulated this fall. Data was collected by a group of collaborators at CU Boulder and we analyzed it using IgorPro, a scientific data analysis software. The research group in Colorado used an Instascope, which measures the size and fluorescent response of individual aerosol particles between 0.5 and 10 μm in such a way that it can reasonably distinguish broad categories of bioaerosol (bacteria, fungi and pollen). Each instrument is unique and may have day-to-day variability in background signal so analyzing the data required us to use a combination of manual manipulation and custom functions written with help from Professor Perring. We discussed key outputs for each set of observations and stored the condensed results in shared spreadsheets.

The project is ongoing; this summer we processed data from the first two phases of the experiment. First, we analyzed data from 24 classrooms in 4 different schools during the process of airwashing (a mechanical method to drive deposited material off of surfaces). We tracked concentrations of total, fluorescent, and bacteria-like particles before, during and after airwashing to look at the resuspendable material present, the duration of elevated concentrations, and to estimate air turnover rates. Results were reported by school, by flooring, and comparing rooms that had or had not been cleaned. We find large differences between schools (mainly due to differences in ventilation rate), moderate differences between flooring types and minimal differences between clean and dirty rooms.

Second we analyzed data from 30 classrooms in 5 schools (most overlapping from phase 1) under conditions that mimicked occupation by students with and without a High Efficiency Particulate Air (HEPA) filter. In this phase, the total, fluorescent, and bacteria-like concentrations were measured before, during and after resuspension without a HEPA operating and then, lastly, with the HEPA operating. The initial decay after resuspension was used to estimate rates of ventilation and gravitational settling and the decay with the HEPA allowed us to estimate the HEPA removal rate. The ventilation rate was also subsequently monitored using CO_2 . We used ratios of final (with HEPA) to initial (no HEPA) concentrations to track the “efficiency” of the HEPA.

We again find high school-to-school variability and we see that the HEPAs are more effective at reducing total aerosol concentrations than at reducing concentrations of bacteria-like particles (Figure 1), likely due to the smaller size of bacteria. Some aspects of this phase were inconsistent, indicating a need for further experimental refinements; first, while it was expected that the HEPA filters would have the most impact (highest efficiency) in rooms with high initial particle loads and/or low ventilation rates, this was not consistently observed; and second, there was frequent disagreement between the ventilation rates estimated from aerosol measurements and from subsequent CO_2 measurements. The former may be due to variability in the brand of HEPA used and the latter to temporal variability in ventilation rate. Denver students will now be remote until October so additional, more systematic, data will be collected in the coming weeks. The ultimate goal is to determine how to most effectively deploy HEPA filters to minimize student aerosol exposure, especially in the most problematic rooms and/or schools.

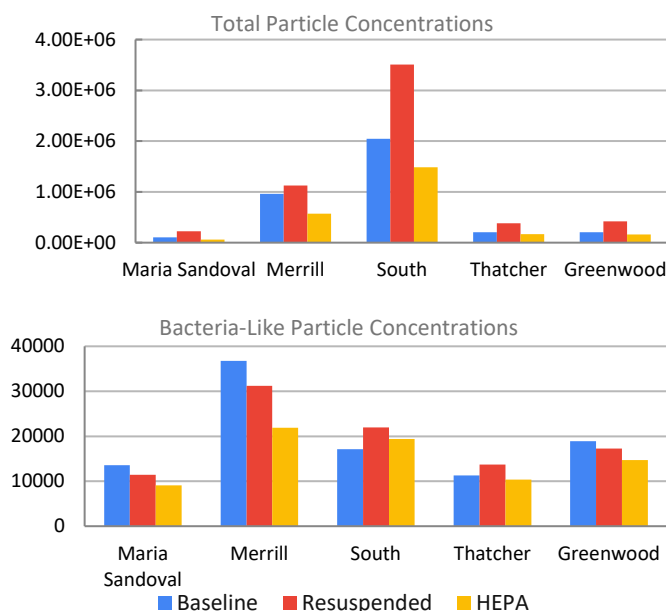


Figure 1: Total particle average concentrations (top) and bacteria-like average concentrations (bottom) by school

Research Fellow(s): Aliyah Kennise De Jesus (2021)
Abigail “Abby” Douglas (2022)

Concentration(s): Molecular Biology; WMST
Concentration: Sociology

Faculty Mentor: Julie Dudrick

Department: Upstate Institute

Title of Project: In the Age of a Pandemic: Reimagining Traditional Modes of Non-Profit Fundraising

Funding Source: Upstate Institute

Project Summary:

This past summer, we had the opportunity to work with the Madison County Council on Alcoholism and Substance Abuse, known informally as BRiDGES. Founded in 1987, BRiDGES is a non-profit providing advocacy, leadership, and services to local families, individuals, and workplaces affected by addiction and substance abuse within the Madison County community. In keeping with the changing times over the past decade, it has expanded its scope to include suicide prevention, tobacco addiction services, problem gambling prevention, and LGBTQIA services. However, differing from other organizations addressing problems through downstream interventions focused on the aftershocks, BRiDGES’s strategies are designed to create lasting, sustainable environmental- and community -level change. In light of this, our project focused on the reimagination of traditional nonprofit fundraising amidst the realities of a global pandemic through the design, development, and launch of “STEPtember for Suicide Prevention.”

Working directly with BRiDGES’s Suicide Prevention Coalition, we created “STEPtember for Suicide Prevention” - a month-long virtual walk fundraiser that will directly support local suicide prevention, postvention, education, and reduction initiatives. Though BRiDGES has hosted several suicide prevention walks in the past, this is the first time that all planning and programming was done solely by BRiDGES and all money raised will support local initiatives. Each step of the process was completed with the intention of addressing Madison County’s alarming suicide rate of 14.1 per 100,000 deaths. Specifically, we constructed the event’s branding (name, logo, and color scheme), created visually pleasing promotional materials and social media posts, established a strong media presence through the creation of an official website and Facebook page, and developed the necessary logistical infrastructure for the “behind-the-scenes” work. With a limited budget, this was done through the implementation of free or cost-effective alternatives, a consideration proving significant for the maximization of profits and activity/operation of a rural nonprofit.

In addition to the challenge of creating a virtual walk experience with nominal funding, we also endured the added difficulty of completing such a project off-site. This remote work brought with it not only the barriers of virtual Zoom meetings and countless email threads, but also the excitement of programming innovation and event design. Regardless, it was a challenging, yet creative and fulfilling mutual collaboration benefitting BRiDGES, Madison County, and us in numerous ways. Additionally, we were also tasked with the challenge of making the walk virtual given the COVID-19 pandemic, something that BRiDGES was unprepared for and unfamiliar with. We were able to create a walk, from scratch, by researching the methods used by other popular walks and organizations, enabling BRiDGES to host a virtual walk throughout the entire month of September. Without ties to a particular event site, the walk’s virtual nature will allow participation from anywhere.

In conclusion, “STEPtember for Suicide Prevention” presents an exciting reimagination of traditional nonprofit fundraising and programming as well as the culmination of our remote summer work. We are incredibly grateful for this opportunity not only to develop our intellectual and professional interests, but also to leave behind a meaningful contribution to a place we call our second home.

Research Fellow(s): Christopher “Chris” DePetro (2021)
Fiona Saunders (2022)

Concentration: Political Science
Concentration: Political Science

Faculty Mentor: Barry Shain

Department: Political Science

Title of Project: “Revolutionary-era American Pamphlet Literature in Context: A Documentary History, 1764-1776,” and “Recent Scholarship Exploring the Federalist, 1787-1788”

Funding Source: SOSC Division

Project Summary:

This past summer, we worked under the supervision of Professor Shain in the Political Science department to assist him on his current research projects. Professor Shain’s primary focus this summer was on completing the second of two books in a series on the Declaration of Independence and the surrounding context from both the British and colonists’ perspectives. His first book, published in 2014, titled *The Declaration of Independence in Historical Context* focused primarily on American colonial documents ranging from petitions to documents from the first national congresses. The second book, on which we both worked this summer, is concerned with colonial and some British pamphlets, including published articles to secret exchanged letters. While we did not fully complete this second project, we made progress towards the publication of this book.

We mostly assisted Professor Shain and his project through editing and writing introductory headings for each of the primary documents we included in the book. This meant reading and going through primary documents from the 1700s, understanding them, and then proceeding to summarize the content of the documents, provide information on the context for the document and the author (if known), and give an analysis of the importance of the document.

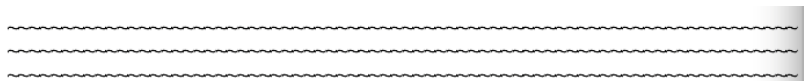
While understanding more of the context of the movement towards American independence was certainly beneficial, one of the biggest challenges, and ultimately, learning experiences of this summer research was having to deal with quite old, primary colonial and British documents. One aspect of the summer project included formatting the documents into readable, current English, and presenting them in a way suitable to be published. The images below illustrate an example of an original British document, titled “An Essay on the Constitutional Power of Great-Britain Over the Colonies in America; with the Resolves of the Committee for the Province of Pennsylvania, and their Instructions to their Representatives in Assembly” by John Dickinson. The image on the left depicts the document untouched, and the image on the right shows the typing and formatting of the document, including switching the “f” likenesses into the current English writing of the letter “s”.

Working with Professor Shain was a rewarding experience and we look forward to seeing the completed work published in the near future.

P R E F A C E.

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SUCH an attempt, tho’ very rude, might be improved by better hands; and it seemed absolutely necessary, no longer to confine ourselves to occasional complaints and partial remedies, but, if possible, to attain some degree of certainty concerning our lives, liberties and properties.



P R E F A C E

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Research Fellow: Rachel Diodati (2022)

Concentration: Neuroscience

Faculty Mentor: Julie Dudrick

Department: Upstate Institute

Title of Project: Chenango United Way Finding Success in Modern United Way Model

Funding Source: Upstate Institute

Project Summary:

This past summer I had the pleasure to complete a Fellowship with the staff of Chenango United Way. CUW is a non-profit organization that has a membership to the larger United Way Worldwide organization. The goal of the United Way is to embrace the power of local giving within a community and use it to help fund positive change. Each United Way launches a yearly fundraising campaign that implores the community to give back to help facilitate projects that will bring relief to local people. Projects sponsored by the United Way are uniquely targeted towards the needs of the community and as a result offer a more intimate level of connection between the non-profit and the people they serve. CUW has worked diligently to create an immense amount of trust between themselves and the community, which stems from their ability to understand and address local issues.

As a Fellow this summer I was responsible for understanding the new proposal for a, “Modern United Way” which was set forth by United Way Worldwide. As CUW is an extremely small United Way with only two staff members they were looking for some assistance to understand how this new blueprint would work and where in terms of compliance they were within this model. In order to retain their membership to United Way Worldwide they need to implement the new guidelines set forth by this model by December of 2022.



The Modern United Way blueprint model that highlights the cornerstones of what it means to be a Modern United Way¹.

My project called for two parts. The first required an immersion into the Modern United Way model, how it worked, what was necessary to be compliant, and the next steps for Chenango United Way. The second was an exposure to how CUW operated as a non-profit and a United Way. Through these two avenues I was able to answer the proposed research questions which were: what steps can a small United Way take to be successful under the new Modern United Way business model? And, what best practices exist within the United Way system to ensure the long-term viability of small United Ways?

After familiarizing myself with the immense amount of resources that United Way Worldwide had offered, we found that the best course of action would be to have CUW staff, board members, and volunteers participate in the Modern

United Way self-assessment. This would offer a gage not only for places of growth but also areas of strength. The results of this assessment would show that CUW was significantly further along in their journey to compliance than they had originally anticipated. It also pointed out areas of growth that could be easily addressed while also signaling ones that may take more time. The plan that came as a result to this assessment was to pick three items that could be addressed relatively quickly and begin integrating them into the operations of CUW. Also, CUW staff plans to retake the self-assessment in subsequent summers until the deadline of December 2022. Finally, CUW staff can now differentiate items that are not entirely applicable to small United Way and do not need to be addressed in this first wave of change. This plan allows CUW to begin to enter the Modern United Way model at a reasonable pace while still giving the time and energy to focus on their everyday obligations.

It has been an amazing experience to be able to work with the incredible staff members of Chenango United Way. While I had never had any previous exposure to non-profit work I was extremely interested in the operations and community relations that an opportunity like this has to offer. I learned an incredible amount about the intricacy of knowing one’s community and how that can intensify the impact that one is able to have. I feel extremely grateful to have had the chance to work with this community partner and learn a little more about the area where I am so lucky to go to school. I look forward to staying up to date with the work of Chenango United Way as they continue to do amazing things for the people of the region!

Research Fellow: Colin Dixon (2021)

Concentration(s): Physics; ENST

Faculty Mentor: Beth Parks

Department: Physics and Astronomy

Title of Project: Modeling heat transport in insulation measurements

Funding Source: NASC Division; Volgenau Wiley Endowed Research Fellowship

Project Summary:

In the US, 21% of all energy consumption¹ is for residential uses, and around 51% of residential energy consumption goes towards heating and cooling². Therefore, increasing heating and cooling efficiency is an important step for reducing carbon emissions, and it has important benefits for people's quality of life. One keyway to increase efficiency is improving insulation/weatherization, which reduces energy-use by about 20%³. In addition to reducing energy it keeps the temperature more consistent throughout the house, reduces chilly drafts, and muffles exterior sound. This makes the house more comfortable, which helps with stress and sleep, and it reduces damp and chilly conditions which contribute to respiratory illnesses⁴.

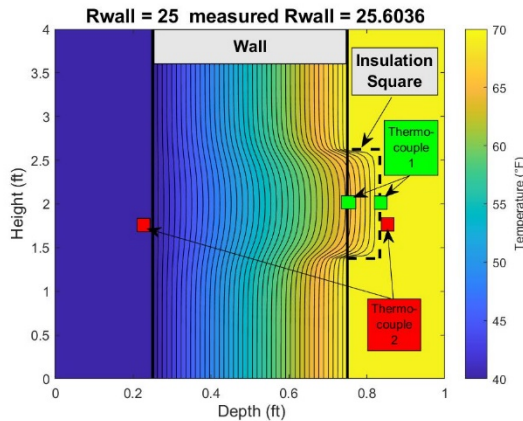


Figure 1: MATLAB simulation showing a vertical cross section of our R-Value measurement method using two thermocouples and a square of insulation.

Many older houses are good candidates for improved insulation and weatherization, but most homeowners have no idea how well insulated their homes are. Currently a professional energy auditor needs to assess a house before improvements can be made. For some this first step can be too expensive or seem too time consuming. The goal of this research project is to create a tool that is simpler and faster at measuring the R-Value of a wall, so that homeowners can do it themselves. The R-Value is a measurement of how well a wall, roof, door, etc. resists heat loss. When two materials are touching their R-Values add together for a combined R-Value (eq.1), and the ratio of the R-Values equals the ratio of the temperature difference through each material (eq.2).

Eq. 1: $R_{combined} = R_{wall} + R_{square}$

Eq. 2: $\frac{R_{square}}{R_{combined}} = \frac{\Delta T_{square}}{\Delta T_{combined}}$

Our method of measuring the wall's R-Value uses thermocouples to measure temperature and a square of foam insulation to provide a known R-Value of 5. The thermocouples work because the electrical properties of the metal in the detectors change with the temperature. We put the two detectors of thermocouple 1 on either side of the insulation square to measure the temperature change through the insulation square. Then we put one detector of thermocouple 2 on the inside of the insulation square and the other on the outside of the wall, which tells us the temperature change through the combined square and wall (Figure 1). Using eq. 2, we can calculate the combined R-Value, and then eq. 1 to calculate the R-Value of the wall.

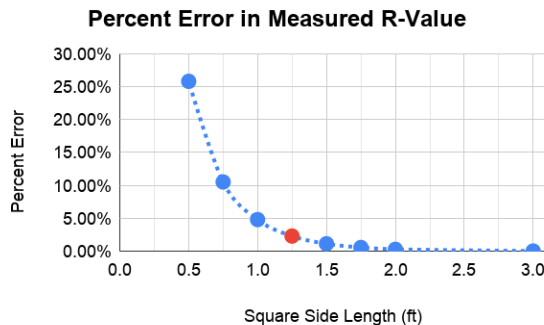


Figure 2: This graph shows the percent error in the R-Values of the wall when measured with different sized insulation squares.

Ideally the insulation square would be as large as the wall, because, as can be seen at the edges of our insulation square (Figure 1), the temperature gradient in the wall has to change at the edge of the insulation square. This creates an error in our measured R-Value, and to ensure the error isn't too large I created a MATLAB simulation of the heat flow through the insulation square and the wall. The simulation uses a model of heat flux which describes how much heat will be flowing in and out at every point of the wall. If at any point the heat going in is greater than the heat going out than the temperature will rise, and vice versa. I found our insulation square, which has sides 1.25 feet wide, to have a very small error when used on 6-inch walls that have an R-Value of 25. This is a good approximation for an older house, but in reality, walls have wooden joist, air ducts, and other materials which will vary the R-Value throughout the wall. For future research I hope to put these variations into the simulation and to see if our method is still effective.

¹U.S. Energy Information Administration - EIA - Independent Statistics and Analysis." Use of Energy in Explained - U.S. Energy Information Administration (EIA), US Energy Information Administration, Apr. 2020, www.eia.gov/energyexplained/use-of-energy/.

²U.S. Energy Information Administration - EIA - Independent Statistics and Analysis." Use of Energy in Homes - U.S. Energy Information Administration (EIA), U.S. Energy Information Administration, 4 Aug. 2020, www.eia.gov/energyexplained/use-of-energy/homes.php

³Energy Data Facts." Energy Data Facts | Residential Program Solution Center, US Department of Energy, 2016, rpsc.energy.gov/energy-data-facts.

⁴Energy Efficiency Improves Your Quality of Life: Learn How to Insulate." EnergySage, 2018, www.energysage.com/energy-efficiency/why-conserve-energy/benefits-of-home-insulation/.

Research Fellow: Megan “Meg” D’Souza (2023)

Concentration: Sociology

Faculty Mentor: Julie Dudrick

Department: Upstate Institute

Title of Project: Formalizing a Community for Young Scholars Alumni

Funding Source: Upstate Institute

Project Summary:

This summer, I had the privilege of working with the Young Scholars Liberty Partnerships Program (YSLPP): a multi-year program created by Utica College of Syracuse University and the Utica City School district to ensure academic excellence and teach career readiness to six cohorts of students. Each year, in a selective process, Young Scholars inducts rising-seventh grade students who will attend James H. Donovan Middle School and John F. Kennedy Middle School. Young Scholars will continue to work with these students until they complete their education at T.R. Proctor High School. The program creates a support system for students who have the potential to academically succeed but may be prevented from doing so for a variety of reasons. To combat these barriers, Young Scholars provides comprehensive academic, social, and cultural enrichment programming that paves the way towards graduating high school, earning a New York State Regents Diploma with Advanced Designation, and enrolling in a post-secondary education institution. Such activities include academic tutoring and review sessions, exam prep, counseling, community service opportunities, field trips, mentorships, and multiple summer programs.

Young Scholars is dedicated to being a force for long-term, positive change in the lives of its students, and is always looking for ways to expand its impact. The program has been incredibly effective when it comes to increasing and maintaining strong high school graduation rates. However, many of the generational socio-economic difficulties experienced by students that Young Scholars seeks to mitigate cannot be solved by with a high school diploma alone. Recently, Young Scholars received a generous offer from the UpMobility Foundation to create a custom Young Scholars alumni platform. Young Scholars has decided to take this opportunity to formally tap into the underutilized power of its alumni. Alumni, with their breadth of professional knowledge, can serve as new mentors for other alumni and current Young Scholars as they navigate professional decisions and post-secondary education challenges during life after high school. This summer, I worked to create avenues in which this alumni expertise could be shared by fostering a greater sense of community among the 22 class years of Young Scholars alumni and increasing alumni engagement with the program itself.

My primary task this summer was to gather data on alumni via an outreach questionnaire I designed, to collect sufficient information to begin building an alumni database for the future platform. The survey asks for preferred methods of contact, paths alumni have taken since graduating from the program, needs alumni would like addressed, and individual levels of interest in becoming involved with programming. The process of sharing this questionnaire with alumni went hand in hand with the launch of the Young Scholars Alumni Society (YSAS)—the new name for the alumni community that became tied to all the subsequent alumni programming. I raised awareness about the existence of YSAS through direct and indirect means. Planning, coordinating, and moderating biweekly virtual alumni panels on a spread of professional development topics and posting spotlights on the alumni panelists provided opportunities for those in the Young Scholars community to personally connect with alumni role models. Emails targeted towards different subsets of alumni, designing and posting flyers on multiple social media platforms, and private messaging alumni via Facebook all helped share the alumni outreach survey, information on events, and any updates to the community. Lastly, I also created a new private Facebook group, with membership restricted to alumni alone. This serves as a specific online space for alumni to network with one another and stay informed as well as a complement to the upcoming dedicated alumni platform.

In addition to developing the Young Scholars Alumni Society, I had the chance to work as a seventh-grade teacher’s assistant during a one-week virtual summer program. All of these experiences with Young Scholars gave me insight into the crucial role community plays in life-long success. I am incredibly grateful to have had this opportunity to become better connected to my Upstate New York Community and contribute to the meaningful network of support that is Young Scholars.

Research Fellow: Isabelle Dunning (2021)

Concentration(s): International Relations; SPAN

Faculty Mentor: Valerie Morkevičius

Department: Political Science

Title of Project: Redefining Thucydides' Trap as Hubris Summary

Funding Source: Center for Freedom and Western Civilization

Project Summary:

This paper seeks to evaluate a modern interpretation of Thucydides, an ancient Athenian general and historian who, from 431 B.C.E. to 410 B.C. E, chronicled the Peloponnesian War between Athens and Sparta. His *History of the Peloponnesian War* was extraordinary for its time because of the rigorous standards of objectivity and accuracy with which he claimed to write. In this paper, I compare my reading of Thucydides to Graham Allison's, an international relations professor at Harvard University of fifty years and an advisor to multiple secretaries of defense. In his recent book, *Destined for War: Can America and China Escape Thucydides's Trap?* Allison draws a parallel between the contemporary Sino-American rivalry and the ancient conflict between Sparta, an established power, and Athens, a rising power. He claims that China is already surpassing the US economically and will also do so militarily in the near future. Allison defines Thucydides' Trap as the "inevitability" of war caused by the structural stress of a rising power overtaking an established power and warns that, if the US does not follow his recommendations, that the two nations could succumb to it, as Athens and Sparta did.

My paper begins by defining the international relations theory of realism and how Allison and Thucydides both subscribe to its assumptions. Realism is one of the original and most influential theories in the discipline of international relations. It emphasizes the conflictual and competitive tendencies of states, and its roots originate in the ideas presented by Thucydides, Hobbes, and Machiavelli. Realists assume that states are the primary actors in international relations, who struggle for power and act in their national-interest to ensure their own security. There are two distinct branches of realism: classical realism and structural realism. Classical realism is the original international relations paradigm. This theory explains state behavior with human nature, which it is very pessimistic about. Structural realism abandons all considerations of human nature as an explanation for the conflictual nature of states and instead blames the anarchic international system. It uses macroeconomic theory to analyze international relations by considering states to be identical units, varying only in their relative capabilities. Thucydides is a classical realist, and Allison a structural realist.

In this paper, I criticize Allison's purely structural interpretation of Thucydides' Trap, the concept on which his book is based, because he oversimplifies Thucydides' multifaceted analysis of the Peloponnesian War. I argue that a closer reading of Thucydides' *History of the Peloponnesian War* reveals that the trap he considered most dangerous for a state to fall into is the hubris of its leaders. In order to demonstrate this to be true, I analyze the factors that Thucydides believed motivated state behavior: fear, honor, and self-interest, all of which are forces of human nature. I define hubris as an excess of these compulsions. Thucydides thought that the best quality a leader could have is moderation because it allows leaders to restrain these compulsions and use them to make rational decisions. He also thought it was imperative for state survival that leaders act according to the fears, honor, and interest of the state, instead of their own. Allison reduces Thucydides' complex explanation of the leadership errors that led to the Peloponnesian War to a singular sentence he writes about the structural circumstances. I conclude by discussing Allison's possible motivations for oversimplifying and overlooking his warnings about the perils of human nature unrestrained by rationality.

Research Fellow: Daniel Espinosa (2023)

Concentration: Undeclared

Faculty Mentor: Kenneth “Ken” Segall

Department: Physics and Astronomy

Title of Project: Neuromorphic Reservoir Computing from Josephson Junctions

Funding Source: Volgenau Wiley Endowed Research Fellowship

Project Summary:

Introduction

Most computer systems today work based on the von Neumann architecture dating back to 1950’s vacuum tube computers. They separate arithmetic logic from memory and the data streams which travel along their circuitry. Neuromorphic computing is inspired by the mechanisms of the brain, and thus hopes to interconnect these different elements unto a single unit: the neuron.

Research in neuromorphic computing allows us to learn more about how the brain functions, and to create computer architectures which could potentially be several orders of magnitude more efficient than what we currently use. The field of neuromorphic computing has resurged with renewed interest from firms like Intel, with their proprietary Loihi chips, to novel quantum computing analogues implemented by Google, etc. This project explores the intersection between neuromorphic computing and reservoir computing, the latter which for our system consists of neurons connected in a recurrent fashion.

In this project we aim to create a superconducting neuromorphic reservoir computer out of Josephson Junctions. These exhibit many interesting properties, as displayed in numerous other projects from the department such as memory cells, learning gates and, of course, neurons—which we will exploit to perform computation. Thus, I will not dwell on their particularities in this summary.

Design and Simulation

We made use of WRSpice software to dynamically test our reservoir computer model using different methods of transient analysis. This software also permits us to design and modify the superconducting chips on the fly, which allowed us to rapidly iterate through different models until we found one that showcased the properties which define reservoirs.

After a thorough analysis of the literature and rigorous testing of our current reservoir design, affectionately named “NEO” (Neural reservoir Early Outline), we have designed a system which allows us to send a number of action potentials whose encoding is determined by the time at which they are sent, and thus introduce nonlinear dynamics and noise as we please from a single input source. This also has allowed us to store action potentials in our system as well as generate additional action potentials inside of the reservoir as a function of the weights of the hidden layers in the recurrent neural network, essentially merging memory, transmission and processing in a single neuromorphic package.

Conclusion

Our current results all seem to be pointing in the direction that neuromorphic reservoir computing with these junctions is possible, however further testing in signal and data processing, as well as creating an additional readout neural network, are still steps we must take to turn this system into a powerful computational tool. From there it would be a matter of scalability to further reap the benefits of designing and operating in a superconducting framework, namely the environmental, speed and efficiency benefits this system provides us, which are more robust than other current solutions we have explored.

Research Fellow: Sophia Ferrero (2023)

Concentration: Undeclared

Faculty Mentor: Aleksandr Sklyar

Department: University Studies

Title of Project: Impact of Novel Viruses and Pandemics on Communities Dependent on Tourism Income

Funding Source: UNST Division

Project Summary:

This summer, I conducted research into one central question: What is the impact of novel viruses and pandemics on communities dependent on tourism income? One would expect that “impacts” in this research would be synonymous with “negative economic effects.” There is no denying the loss of revenue for those communities as a whole and the rippling consequences of these economic effects is devastating. However, I quickly realized that it is also crucially important to question the historical and conceptual basis of each of the concepts in the research question itself. As a result, instead of looking at specific short-term, emergent economic impacts, I looked more closely at the histories and stories told through image (spectacle) construction in the global tourism industry. I traced and defined the relationships between capitalist structures and tourism, and I questioned how these images and relationships are impacted by viruses and pandemics. Such a conceptual and historical analysis of the imaginations of complex histories and definitions helps us to understand that even as pandemics and crises have unequal impacts across spaces and communities, the conceptual, historical, and social contours of those effects can hardly be considered novel.

The majority of this study consisted of a critical analysis of how capitalist structures developed in the era of the Anthropocene allow for the commodification and subsequent cheapening of spaces, communities, and relationships. The tourism industry relies on and manifests those processes of cheapening places, people, and things in the spectacles and narratives it uses to increase visitation in the pursuit of a prevailing infinite growth model. I traced the roles, processes, and repercussions of profit-driven colonial image construction in the tourism industry. By choosing what to show consumers and separating other aspects from tourists’ imaginations, tourism campaigns erase and unimagine multiple histories, spaces, and times from realities. This concept applies to both the realms of tourism through colonial practices, image alterations, and corporate and governmental risk management. Even as there are uncertainties about the future of both the pandemic and its impacts on the tourism industry, what remains are the capitalist structures that both run on and produce that uncertainty, cheapening, and prevailing spectacles. It also prevails that certain capitalist structures and entities can collapse during a crisis, while also being “business as usual.” Within these conclusions, the Anthropocene/ Capitalocene argument is rather definitive, however, in terms of what that leads us to do, the possibilities remain open.

Next, after researching these interwoven theories and practices surrounding the Anthropocene, in an effort to draw connections that might allow us to better understand what the future may hold, I also examined the impacts of past and current epidemics on stigma manifestation and the tourism industry. Deeply intertwined with the histories of numerous communities, epidemics have followed the colonization of the Americas, Australia, Asia, and the Pacific where millions of indigenous people were killed by the diseases carried by colonizers. These legacies of colonialism, xenophobia, and capitalism carry throughout history and continue to re-emerge, as seen with violent physical attacks on Asians and individuals who are perceived to possess stereotypical Asian physical traits during COVID-19. COVID-19 has brought upon a new set of standards of lifestyles and hygiene in varying ways across communities, standards that the tourism industry must adapt to. However, there is still ambiguity surrounding how the pandemic will continue to impact communities and industries. What is certain is that societies and environments have and will continue to greatly influence the impact and movement of pandemics.

Despite efforts to analyze past and current cases of the impacts of pandemics and novel viruses on spectacle construction and subsequently tourism-dependent communities, the only thing that seems to be certain is uncertainty.

Considering the weight of the current pandemic and the inevitability of future crises that will, through the pervasive structures of capitalism, impact communities unequally, it seems inappropriate to end with abstractions. How can one seek to live ethically within structures, logics, and practices that cheapen the value of humans and other ecologies? To stand up to these logics of cheapening, on-going anti-capitalist activism can be applied, but to cater to the needs of a tourism-dependent community, I would like to recommend moving away from models of accumulation and towards varied distribution. We should move away from expanding growth and the infinite growth model, and more towards redistributive, more localized community-based models.

Research Fellow: Erin Flannery (2023)

Concentration: Undeclared

Faculty Mentor: Mark Stern

Department: Educational Studies

Title of Project: Studying Abroad: Commodification or Cultivation?

Funding Source: SOSC Division

Project Summary:

Studying abroad has become a staple institution within higher education as a response to an increasingly global society. Studying abroad is said to foster cross-cultural education, interconnectedness, and critical thinking about global issues; however, there is a competing discourse that combats the so-called notion of global citizenship due to its exclusionary nature and legacy of colonialism.¹ In dialogue with postcolonial education scholars, this project examined the history and contemporary manifestations of study abroad programs by critically exploring the remnants of colonialism within study abroad programs at elite liberal arts colleges and universities and how the term “global citizenship” signifies at these institutions. Through conducting 15 semi-structured interviews with students who have studied abroad (see list of questions at the end of this document), I analyzed student experiences abroad with an eye toward the language they used to talk about their experiences and by coding and organizing the data for common themes structured around inflections of ideas around race, geography, and global geopolitics. More specifically, the interview questions focused on how students experience topics such as acquisition of knowledge, their experiences of “safety,” negotiation of identity, and how they have experienced change during and after study abroad. Findings from this project resonate with contemporary critical scholarship and suggest that, without formative intervention, study abroad programs can unintentionally reproduce the colonial legacies from which they were born. Specifically, in this study, I focused on how, at elite liberal arts colleges that are usually predominantly white institutions, student’s experiences are marked by consumer culture, exclusion, and a promotion of soft power through cultural immersion and volunteer opportunities. The implications for pedagogy and study abroad office might include: critical global citizenship education training before going abroad, mandatory reform of study abroad curricula to include diverse narratives, along with a reform of itineraries to actively combat colonial actions abroad.

¹While my work discusses relations between colonialism and study abroad programs, many scholars use the terms imperialism and colonialism interchangeably due to the similar histories of political and economic control within these systems (Loomba, 2015, p. 6-11).

Research Fellow: Elena Forbath (2021)

Concentration(s): Geography; Biology

Faculty Mentor: Michael “Mike” Loranty

Department: Geography

Title of Project: Assessing Relationships between Vegetation Indices and Plant Composition in Siberian Larch Forests via Remote Sensing

Funding Source: National Science Foundation

Project Summary:

Vegetation indices are a useful and widely used measure of plant health and changes in community composition. They can be easily obtained through remote sensing, which utilizes camera-like devices equipped mounted on aircrafts or satellites to measure properties of Earths’ surface. It is a more effective alternative to field measurements. A rapidly developing method of remote sensing is the use of Uncrewed Aerial Vehicles (UAV), or drones. With UAVs, scientists can take numerous images of field sites that measure reflected electromagnetic (EM) radiation within and outside of the visible light spectrum. These images are processed to generate maps that can be used to investigate vegetation characteristics. This summer, Professor Mike Loranty and I investigated vegetation at fields sites in Cherskiy, Siberia by analyzing drone imagery we collected during the 2019 field season. We studied the effects of plant community composition as well as removing certain types of vegetation on Normalized Difference Vegetation Index (NDVI). NDVI is a widely used vegetation index and can help classify ground vegetation and show vegetation health. It is calculated by dividing the difference between Near Infrared and Red reflectance by the sum of Near Infrared and Red and Near Infrared reflectance. Areas with healthier and more abundant green plants reflect more NIR light, resulting in a higher NDVI. The equation for NDVI is below:

$$\text{NDVI} = (\text{NIR} - \text{Red}) / (\text{NIR} + \text{Red})$$

I collaborated with Dr. Jennie DeMarco of Western Colorado University who we worked with in Siberia last summer. Dr. DeMarco created an experiment to investigate the effect of removing either grass, shrubs, or both vegetation types on larch recruitment. She created forty plots in one field site, each plot assigned a different treatment. We used a DJI Phantom 4 Advanced drone, attached with a multispectral camera, to take RGB and multispectral photos of the entire field site. RGB photos collect reflectance of three visible wavelengths of light: red, green and blue. Multispectral photos capture the reflectance of the Near Infrared wavelengths, which are invisible to the naked eye. We processed the RGB and multispectral photos separately to create maps of the field site using Pix4D mapper and Agisoft Metashape. In addition to drone photos, we obtained GPS locations of each plot center using a Real Time Kinematic (RTK) GPS. We then used R programming language to extract the NDVI values from each plot from the field site map. Dr. DeMarco also recorded the percent cover of various plant types within each plot. These plant types include grasses, evergreen shrubs, deciduous shrubs, lichen, and conifers.

We found that there was no change in NDVI before and after vegetation removal in all of the plots regardless of treatment. This could be a result of the photos being taken at different times of day, affecting illumination of light onto the plants and changing the measured NDVI value. In addition, we found that there was no significant relationship between percent cover, for any of the functional groups, and pre-vegetation removal NDVI. However, there is a slight correlation between NDVI of plots and the percent cover of conifers and deciduous shrubs, which could be explained by a stronger Near Infrared reflectance than other vegetation types or canopy architecture of these functional groups. Inaccurate georeferencing of the maps with the plot coordinates could have caused NDVI values that are not within the actual plot to be extracted, affecting final analyses. Moreover, moss present underneath the removed vegetation could cause post-removal NDVI to be higher than expected, since NDVI of moss would not have been accounted for before. While remote sensing is an extremely effective means to collect data over large areas, more work is necessary to determine how measurements of ground vegetation cover and precise georeferencing influence temporal differences in reflectance.

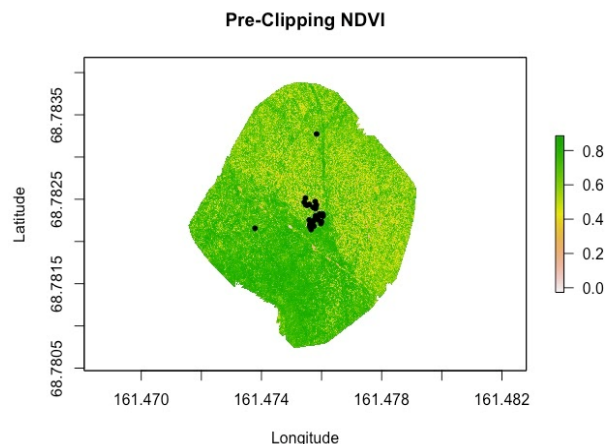


Figure 1: NDVI map of field site in Cherskiy, Siberia with black dots showing plot locations.

Research Fellow: Jacob “Jake” Freedman (2021)

Concentration: Physics

Faculty Mentor: Enrique “Kiko” Galvez

Department: Physics and Astronomy

Title of Project: Gravitational Lensing with an SLM

Funding Source: NASC Division; Volgenau Wiley Endowed Research Fellowship

Project Summary:

The possibility of the deflection of light due to a gravitating body (gravitational lensing) was first considered (at least publicly) by the German polymath Johann Soldner in an article published in 1804 in which he predicted that a light ray passing near the Sun should be deflected by an angle of 0.84 arcsec [5]. It was then more than a hundred years before Albert Einstein updated this prediction to 1.74 arcsec, a value derived from his theory of general relativity [3]. After the infamous failed attempt to confirm Einstein’s results of 1914¹, Arthur Eddington was at last was able to make use of a solar eclipse to verify the 1.74 arcsec prediction [5]. Now a bona fide theory, many others in the scientific community became inclined to study the effects, including those of the optical variety, of general relativity. One of these new recruits was Orest Chwolson who, in 1924, studied systems in which an observer [2] was situated along a line containing two stars. He predicted that such a configuration would yield a circular ring as seen by the observer. Incidentally this effect was later mentioned by Einstein in 1936, and the rings are now called “Einstein rings” [5]. One could debate which of the two deserves to have their name in the term, but these Einstein rings are nonetheless the subject of this paper.

We plan to, using a spatial light modulator as a lens, simulate the optical effects of gravitational lensing. A Spatial Light Modulator (SLM) is a computer-controlled device that has the ability to impart a desired phase on pixels of an incident beam of light [1]. The properties of a lens derive from the fact that it applies a spatially dependent phase to an incident beam [4], thus the SLM can be programmed to behave like a lens.

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- [2] O. Chwolson. Über eine mögliche form fiktiver doppelsterne. *Astronomische Nachrichten*, 221(20), 1924.
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- [5] J. Wambsganss. Gravitational lensing in astronomy. *Living Reviews in Relativity*, 1(1), nov 1998.

¹The astronomers were captured by Russian soldiers

Research Fellow: William “Will” Friend (2022)

Concentration: Astronomy/Physics

Faculty Mentor: Kenneth “Ken” Segall

Department: Physics and Astronomy

Title of Project: Artificial Neurons Using Superconductors

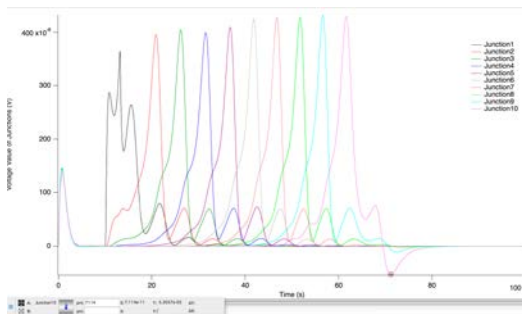
Funding Source: Volgenau Wiley Endowed Research Fellowship

Project Summary:

Moore’s law, which states that the number of transistors in a microchip doubles every two years, has been the driving force behind the development of computers since their creation. However, as the number of transistors on these microchips have increased over the years, it is becoming increasingly difficult to scale down their size to accommodate the growing number. This has resulted in the prediction of 2025 as the termination of Moore’s law where it will no longer be financially or physically possible to keep scaling down and adding transistors. This has led to a significant amount of research in alternative computing methods that veer away from the use of transistors in favor of more efficient in terms of speed and power usage. One of the leading candidates in this research is the use of a superconducting element known as the Josephson Junction (JJ). In a collaboration among three Colgate professors, it was discovered that this circuit element can be used to create a biologically accurate artificial neuron, which opens the door to a model of neuromorphic computing.

The ultimate goal of this summer project was to take these previously modeled synapse components, and connect them all to create a fully functional artificial learning synapse. My work focused on modelling the axon – the transmission line of one neuron’s action potential to another neuron – through a *Josephson Transmission line* (JTL). I specifically dealt with issues in preserving the action potential’s pulse shape when terminating the JTL, and analyzed different methods through simulations and data analysis. After finding an optimal termination circuit, I designed an experiment that measured the flux through a memory gate, being fed a range of action potential pulses transmitted to the gate through the optimized JTL.

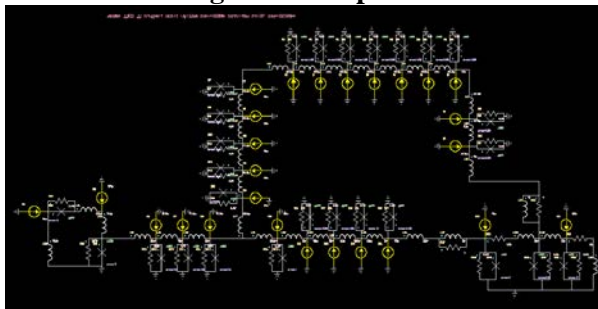
Propagation of an Artificial Pulse



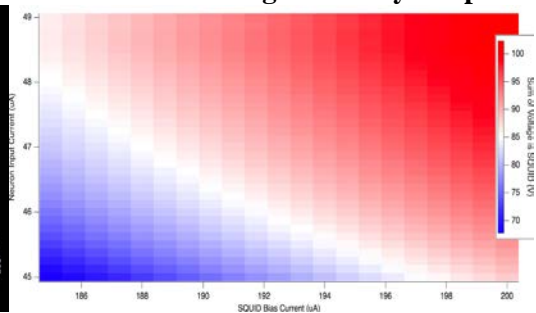
JTL



Circuit Designed for Experiment



Plot of Flux through Memory Loop



Research Fellow: Catria Gadwah-Meaden (2020)

Concentration: Mathematical Economics

Faculty Mentor: Julie Dudrick

Department: Upstate Institute

Title of Project: Review of Hudson Headwaters Health Foundation's Grant Work

Funding Source: Upstate Institute

Project Summary:

This summer, I worked with Hudson Headwaters Health Foundation in support of Hudson Headwaters Health Network, a nonprofit system of 19 community health centers which provides primary care to a largely rural, underserved patient population in the Adirondack region. The Foundation helps Hudson Headwaters better achieve its mission to “provide the best health care, and access to that care,” for everyone in their communities, regardless of their ability to pay or insurance coverage. My project focused on the grant work that the Foundation has done to support the Network in recent years, particularly their Innovation Grant and Upstream Fund Grant programs. The former provides small grants, up to \$2500, for pilot projects and trainings proposed by Network staff, increasing engagement and allowing employees a greater degree of agency in addressing the problems they see within the communities they work. The latter provides larger grants to programs in the Adirondack community through various community partnerships, and is aimed specifically at addressing social determinants of health. Both grant programs are hugely beneficial to a population that is often burdened by poverty, food insecurity, and insufficient public and community resources. My primary task was to assess the impact of the grant work done thus far. I then used that information to help Hudson Headwaters build a framework for granting moving forward that is focused on furthering its mission and meeting the needs of its patient population.

The nature of my research consisted of reviewing all grant applications, reports, and related materials, as well as interviewing all Innovation Grant recipients to date and several Foundation board members. As the Upstream Fund Grant program is only in its first year, most of my work focused on the Innovation Grant program. Through reviewing Innovation Grant applications and reports, I was able to identify various measures and collect data that would help me assess the program's impact. I identified both high and low impact centers, the spread of funded project results, and the distributions of program type, degree of novelty, primary beneficiaries, and targeted values within the Network's strategic plan, among other things. This analysis revealed a well-balanced granting program which targets patient and employee needs relatively equally, a program that has been integral in improving quality of care, professional development, access, and population health, and one that has room to grow and impressive potential. My interviews allowed me to put this impact in context and informed the bulk of my recommendations for future granting. Upon the completion of my fellowship, I reported my findings and recommendations in a white paper which was distributed to Foundation employees and board members, and will present my recommendations to the board at their next meeting.

These recommendations touched on five specific areas: The Innovation Grant application, the Innovation Grant reporting process, the Foundation's visibility and communication, granting for impact, and promoting a data driven approach to grant work. Through my interviews, I was able to identify opportunities to promote visibility within the Network, general Network engagement, and Foundation board and Granting Committee involvement – all of which were motivated by significant discrepancies in awareness on both the Network side and the Foundation side. I was also able to compile a list of projects and work that both employees and board members would like to see more of. Due to the high level of need in the area, it was concluded that the Foundation should focus on the approach with which programs tackle problems, rather than expend resources on determining the “most important” problems to target. This area is where the most stands to be gained from a data driven approach—something the Foundation is actively trying to implement. That said, interviews revealed Network-wide difficulties in both identifying and tracking objective measures of success, whether due to the nature of a given program, limitations in background or training, or both. In light of this, various alternative modes of implementing a “data driven” approach were recommended, as well as the provision of additional support to applicants and recipients in order to aid in the transition to more objective grant making.

The work I completed this summer was the first time any overarching, all-inclusive review was done of the Foundation's grant work. The data, analysis, interview notes, and recommendations I provided will empower the Foundation to more meaningfully develop and evolve their grant work, allowing for even stronger programs and wider impact in the years to come.

Research Fellow(s): Kaleigh Gale (2021)
Drew Johnson (2022)

Concentration: Biology
Concentration: Environmental Biology

Faculty Mentor: Timothy “Tim” McCay

Department(s): Biology; ENST

Title of Project: Distribution and Public Perception of Invasive Pheretimid “Jumping Worms” in the Northeastern United States

Funding Source: Michael J. Wolk ’60 Heart Foundation

Project Summary:

Pheretimid earthworms (“Jumping Worms”) are an exotic species with characteristics that make them effective invaders in the Northeast. Because Jumping Worms thrive in wood mulches, gardening practices may play a large role in distributing them. Additionally, there exist many anecdotal accounts of negative effects in gardens. Despite much cause for alarm, a central reporting system for early detection and monitoring is lacking. To illustrate the spread of Jumping Worms throughout the Northeast we compiled observations from experts and amateurs from many different data sources. Additionally, we conducted a survey of Extension Master Gardener Volunteers and other members of the gardening community to better understand the current Northeastern distribution of Jumping Worms, perception of these species within the gardening community, and attempts at control.

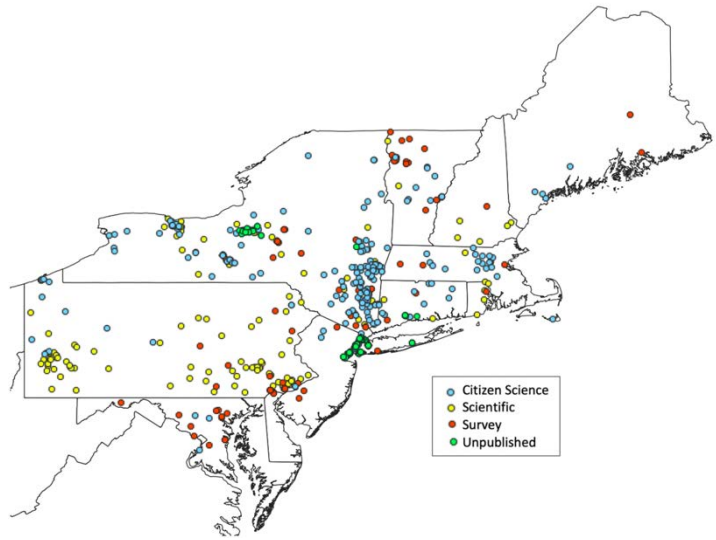


Table 1: Breakdown of all Jumping Worm Data. In addition to all collected citizen science data (CS) and all data collected from scientific sources (Sci), all data points from the survey that either had a longitude and latitude listed or a location with a latitude and longitude that could be pinpointed on Google Maps were totaled and broken down into their respective categories. Worms per 100,000 hectares was calculated by dividing the total number of worm data points in a state by its size in hectares divided by 100,000. Worms/100,000 was calculated by dividing the added citizen science and survey data by the population of the state divided by 100,000.

		DE	NH	MA	VT	MD	RI	NY	CT	ME	NJ	PA	
C S	imapiynyas. ives.	0	0	0	0	0	0	13 8	2	2	0	1	14 2
	GLWW	0	0	11	0	0	0	4	3	2	0	2	22
	inaturalist	0	0	5	7	3	0	25	5	0	2	3	60
	Social Media												
	Naturalist	0	0	1	17	2	9	0	3	0	0	1	23 6
Sci	3	2	9	20	7	1	30	2	2	3	13	92	
Unpublished	0	0	0	0	0	0	129	0	0	0	0	129	
Survey	0	5	5	1	0	3	61	3	0	0	86	164	
#	3	8	31	30	10	4	388	15	6	5	115	615	
Worms/100,000 Hectares (w/o survey)			0.124	0.950	1.164		0.318	2.314	0.836			0.243	
Worms/100,000 Hectares (w/ survey)	0.465	0.330	1.133	1.204	0.311	1.274	2.746	1.045	0.065	0.221	0.964		
Worms/100,000 Individuals (w/o survey)			0.074	0.247	1.442		0	0.864	0.281			0.125	
Worms/100,000 Individuals (w/ survey)	0	0.441	0.319	1.603	0.050	0.283	1.177	0.365	0.372	0.023	0.797		

The distribution of Jumping Worms in the northeastern United States is more extensive than previously believed, with a significant expansion due to amateur reporting. A significant portion of this new knowledge is thanks to a compilation of citizen science data. The perception of Jumping Worms within the gardening community is less favorable than the perception of other exotic earthworms, largely owing to their perceived negative effects in gardens and natural ecosystems. This data underscores the large and expanding ranges of these invasive species and emphasize the role of gardeners and citizen scientists in identifying their spread.

Research Fellow: Emma Gaylo (2021)

Concentration(s): Educational Studies; SOCI

Faculty Mentor: Julie Dudrick

Department: Upstate Institute

Title of Project: Upstate Institute work with For the Good Inc.

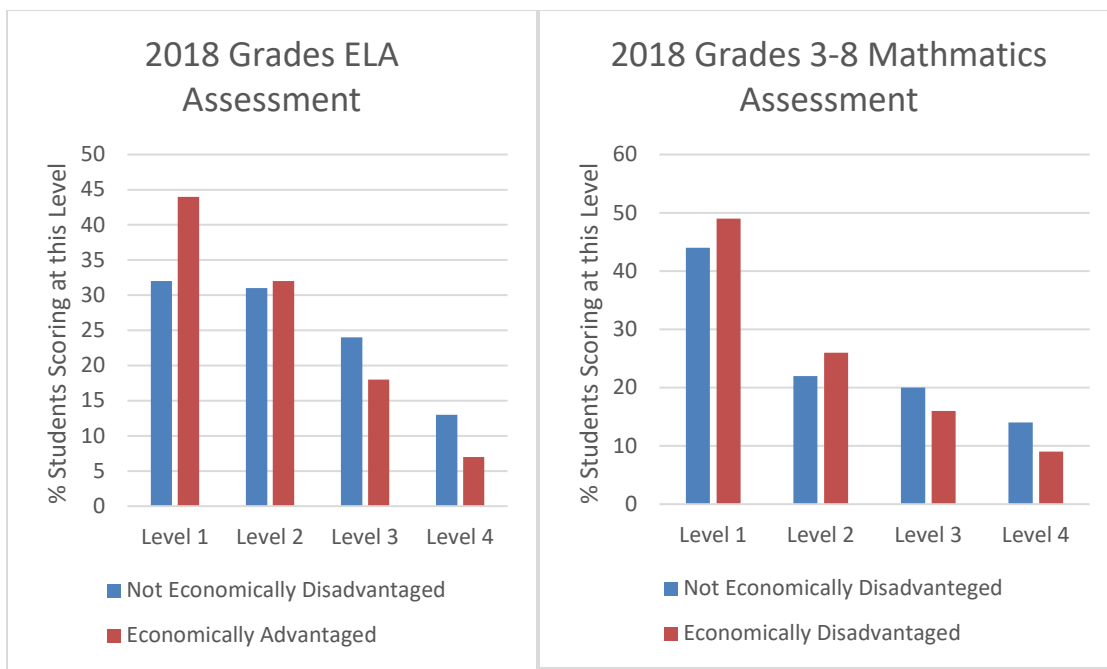
Funding Source: Upstate Institute

Project Summary:

For the Good Inc. is a nonprofit based in Utica, New York. One of the programs that they administer is the Study Buddy Club. This tutoring program connects low income students with college students to provide those involved both with free tutoring as well as to encourage them to attend college after they graduate high school, through activities such as college visits to allow them to experience a college environment. My work this summer focused on working to overcome the issues that have been created by the COVID-19 pandemic. One such issue is the need to move the Study Buddy Club from an in-person experience to an online platform. This move required not only research into effective online platforms for tutoring, but also the creation of a funding proposal that would be sent to Cree Inc., a company moving into the Utica area. The population that the Study Buddy Club serves often does not have access to consistent internet access or a device that could be used to access the materials of the Club. To provide these things for its students, the Study Buddy Club needs outside funding, as they do not currently have the resources to provide these things.

My research was split into two parts. The first involved looking through documents released by Cree Inc. as well as news articles written about the company to create a profile on the areas that their philanthropy focused on as well as to understand how they are involved with the non-profits and other charities they currently work with. Through this research, I was able to create a profile on Cree Inc that For the Good can use to tailor a funding proposal to them that might be more likely to be accepted because it focused on areas in which Cree has an interest.

The second part of the research involved creating a research document that focused both on the state of education in Utica and the literature on the effectiveness of tutoring programs such as the Study Buddy Club in promoting high school achievement as well as college attendance for the students who are involved in them. The research on Utica itself is shown below and demonstrates a marked difference in the achievement of students based on their economic status as well as the commonality of economic issues for the students who attend Utica Public Schools. This document not only helps in writing a funding proposal for Cree itself, but also can be used in the future when contacting other companies for funding.



Research Fellow: Alexis Gian (2020)

Concentration(s): Economics; Biology

Faculty Mentor: Julie Dudrick

Department: Upstate Institute

Title of Project: Alcohol Misuse in Madison County

Funding Source: Upstate Institute

Project Summary:

In the most recent Community Health Assessment conducted by the Madison County Department of Health (MCDOH) in partnership with local hospitals, alcohol misuse was identified as a priority area for Madison County. In response, the MCDOH is developing a health issue profile to conduct a comprehensive assessment of alcohol misuse within the county. My project is to assist in the creation of this profile, which will eventually be shared with community stakeholders and the general public. The findings will be used to address the issue and to inform current and future alcohol-related initiatives in the county. In this summary, I share a few highlights from the profile.

Overview

Alcohol use contributes significantly to the disease burden in the United States and worldwide.¹ Excessive alcohol use, which includes behaviors such as binge drinking, heavy drinking, and any alcohol use by anyone under 21 or by pregnant women, is responsible for an estimated 93,000 deaths annually in the United States,² with binge drinking accounting for half of these deaths.³ In addition to an association with health risks, excessive alcohol use also leads to large economic and social costs.³

County Trends

Madison County is a primarily rural area and, as of the most recent data, adults in the county report higher rates of binge drinking (25%)⁴ compared to the NYS average (18.3%).⁵ The hospitalization rate associated with alcohol abuse has increased over time, whereas the ER rate has declined slightly over time. Both rates in Madison County are lower than the NYS average.

	Madison County	New York State	National
Percentage of Adults Binge Drinking	25%	18.3%	16.7%
Age-Adjusted ER Rate due to Alcohol Abuse	25.0 per 10,000	82.7 per 10,000	-
Age-Adjusted Hospitalization Rate due to Alcohol Abuse	15 per 10,000	28.1 per 10,000	-
Financial Cost	-	\$16.3B	> \$200B per year

Table 1. Alcohol statistics at the county, state and national levels.

	Madison County	New York State	National
Youths who report alcohol use in the past 30 days	20%	-	18.8%
High school students who report alcohol use in the past 30 days	25.3%	27%	30%
Youths who report binge drinking in the past 30 days	9.7%	-	4.8%
High school students who report binge drinking in the past 30 days	12.5%	10%	13.5%

Table 2. Underage drinking behavior at the county, state and national level. Youths refers to those aged 12 to 20.

Underage Drinking

As of 2018, alcohol continues to be the most frequently used drug among youth in Madison County.⁶ (see Table 2).

Alcohol-Related Motor Vehicle Accidents

The rate of alcohol-related motor vehicle injuries and death is higher in Madison County than the NYS average.

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Research Fellow: Amogh Gupta (2021)

Concentration(s): Physics; Mathematics

Faculty Mentor: Rebecca Metzler

Department: Physics and Astronomy

Title of Project: Biominerals: exploring composition, structure, and function

Funding Source: National Science Foundation

Project Summary:

We focused our study this summer on learning more about how the barnacle exoskeleton forms by exploring the structure, composition, and material properties of the exoskeleton. The majority of my research was focused on studying the chemical composition of the exoskeleton and base plate of the barnacles under different pH and temperature values as well as understanding the growth of the barnacle over time and how its chemical composition relates to other barnacles. The goal of the project is to further understand how the shells of barnacles form and what environmental differences might vary the hardness of their shells, especially given continuing ocean acidification. 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, while also providing an understanding how ocean acidification will affect a key species in the marine ecosystem.

My major focus at the beginning of the research was to analyze data from FTIR (Fourier Transform Infrared) Spectroscopy using a program called OMNIC. This data is collected by grinding the part of the barnacle that you want studied, here, the exoskeleton (parietal plates) and base plate were used. In OMNIC, I took various measurements of the grind data, then by analyzing those measurements in Excel and Matlab (Figure 1), we are able to make conclusions not only about the chemical composition of the barnacle's components under the pH levels tested but also about the level of atomic disorder. We do this by using pure calcite grind data as a base for comparison to the barnacle data and using this, we can see how the barnacle with its mix of organic and inorganic materials compares to something like calcite that is inorganic. All of the FTIR data showed the exoskeleton and base plate, independent of temperature and pH, to be calcite with varying amounts of organic. Understanding how this mix makes materials stronger can not only help us build stronger and more flexible materials but also more reusable materials.

Other aspects of my research involved analyzing the growth of the barnacle using Confocal data (Image 2). By analyzing the area growth of the barnacle in the images we can see where and how quickly it grows over time. We do this by using an image analysis software called ImageJ which allows us to make area measurements on the images taken. By then plotting the area measurements vs. time, we can very easily visualize the growth over time.

Another part that I worked on was analyzing EDS (Energy dispersive x-ray spectroscopy) data which is another method for getting the chemical composition of the barnacle's surface. Here we focused on the operculum and the parietal plate. Once this data was analyzed, we can see not only the different elements that the operculum and the parietal plate are made of, but also what percent each element takes in composing the whole. By then running T-Tests on the data, we can see if the data collected on the operculum and parietal plate are related to each other in a statistically significant manner. This tells us which parts of the barnacle are composed in a related manner and if it happened by chance or if it can be repeated.

With further research, we would collect more data on the barnacles to further quantify their chemical compositions and narrow down the timescales in which certain growth happens. We would like to be able to pinpoint when a barnacle starts forming the exoskeleton, how long it takes, and what processes affect its formation. With more data, we can also see how a particular barnacle's components compositions relate to each other.

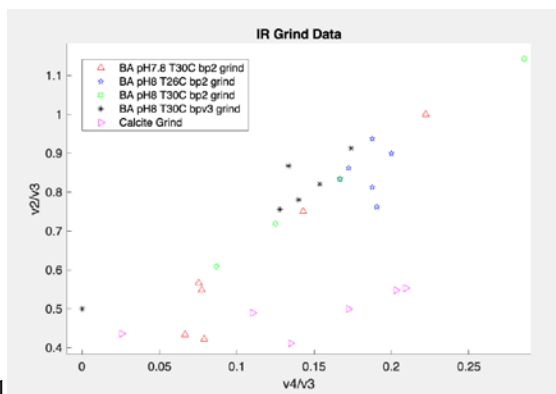


Figure 1

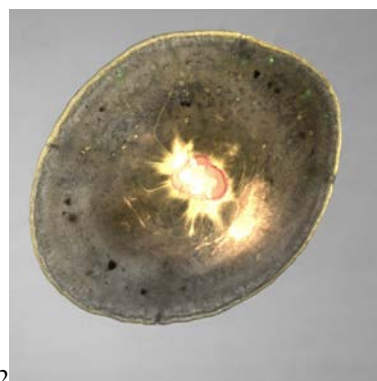


Figure 2

**Research Fellow(s): Carina Haden (2021)
Kathrine “Katie” Roell (2021)**

**Concentration: English
Concentration(s): English; French**

Faculty Mentor: Jennifer Brice

Department: English

Title of Project: Creative Writing Fellowships

Funding Source: AHUM Division

Project Summary:

The Living Writers Fellowship is a project led each year by Professor Jennifer Brice, and this year assisted by students Kathrine (Katie) Roell and Carina Haden. Each fall, Professor Brice selects several books, with the aim to encompass several different genres and include a diverse group of authors. After each book is assigned, the author of that book comes to campus to present to and interact with the students. The Living Writers Fellowship lays down the groundwork for the success of this course each fall.

This year, Professor Brice chose nine different books to be a part of the Living Writers Course. Haden and Roell read each of those books, meeting remotely via Zoom with Professor Brice after each one was complete. During each meeting, the books were found in conjunction with resources collected by Haden and Roell. These resources included interviews with the authors, reviews of the books, and other relevant supplementary material. In addition to collecting these resources, Haden and Roell were also responsible for annotating each resource, to make them more accessible and engaging. Roell and Haden also crafted biographies for each author, as well as a description of each book. All of these resources are to be added to the Living Writers Moodle page for the students of the course this coming fall.

This summer, COVID-19 inspired the creation of a new aspect to the Living Writers Fellowship, the Summer Reads Program. The Summer Reads Program was designed to be an interactive book club, with discussions held via twitter on the first two books of the Living Writer’s Program, *Year of Wonders* by Geraldine Brooks, and Emily Bernard’s *Black is the Body*. For Summer Reads, Haden and Roell not only completed the typical research for the chosen books, but helped to interact with the participants via the Living Writers Twitter. Additionally, Haden and Roell were involved with the creation of the podcasts and transcripts that were produced as part of the program as additional resources for participants. The two not only edited several of the transcripts, but also participated in two podcasts, one on *Year of Wonders* by Geraldine Brooks, and another about Emily Bernard’s *Black is the Body*.

**Research Fellow(s): Aidan Harrington (2021)
Jacob Watts (2021)**

**Concentration: Biology
Concentration: Biology**

Faculty Mentor: James “Eddie” Watkins

Department: Biology

Title of Project: The Ecophysiology of Polyploidy in the Fern Genus *Dryopteris*

Funding Source: Oberheim Memorial Fund; Beckman Scholar Program

Project Summary:

This summer we set out to do an ecophysiological survey of the fern genus *Equisetum* (Equisetaceae). A unique plant long thought to be a ‘fern-ally’, instead of a proper fern, *Equisetum* is an ancient lineage with only a few representatives of what was once a diverse group. The plant has no stems, very small leaves, and grows in a telescopic cylindrical arrangement (similar to a fishing pole) with lateral branches emerging in whorls around each node of the plant. Another interesting feature is that *Equisetum* incorporates silica crystals into the structure of the plant itself, providing structural support to a plant that has no wood, stems, or other anatomical features that provide rigidity. The diversity of environments in which *Equisetum* grows despite its highly conserved morphological characteristics also make it an excellent plant to study niche theories and model how plants diverge physiologically. Studying functional traits such as photosynthetic rates will allow us to connect its physiology specifically to the habitats it grows in and will provide a more complete assessment of the major ecological controls governing its diversity and distribution.

In Central New York we were able to locate *E. variegatum*, *E. hymaeae*, *E. arvense*, *E. sylvaticum*, and *E. fluviatile*. We then made predictions about physiological traits such as max photosynthetic rates, light compensation points, and saturation points based on the light and water environments in which they grow, hypothesizing these would be the highest in high light environments. The habitats range from rich and dark forests with moist soil, bright and gravelly roadside ditches, drainage outflows, and dry fields. Using a LiCor 6400, we measured light response curves on each species, where we gave each individual plant more light than it would ever experience, and slowly reduced the light to absolute darkness, measuring photosynthesis at each point. Our data shows that different species in the genus have wildly different physiological parameters, despite the fact they are often found growing together.

Results: *Equisetum fluviatile* had the highest photosynthetic rates (Fig. 1). This matches our predictions because the plant is typically found in high light areas, often growing partially submerged in water. Conversely, *Equisetum sylvaticum* had the lowest max rates (Fig. 1), which also aligns with the dark interior forest habitat in which it grows exclusively. The other two species are far more generalist, often found in a variety of light and water environments and both had more moderate physiological parameters compared to the latter. We also found that the species with the most branches (*E. sylvaticum*, *E. arvense*) had the lowest photosynthetic rates. This might indicate that these two species are adapted for highly efficient light capture, rather than an ability to photosynthesize at higher rates but with less light use efficiency. While *E. sylvaticum* does not occupy a range of light environments, *E. arvense* does, and a future research should aim to address if branching amounts vary between light environments within the same species.

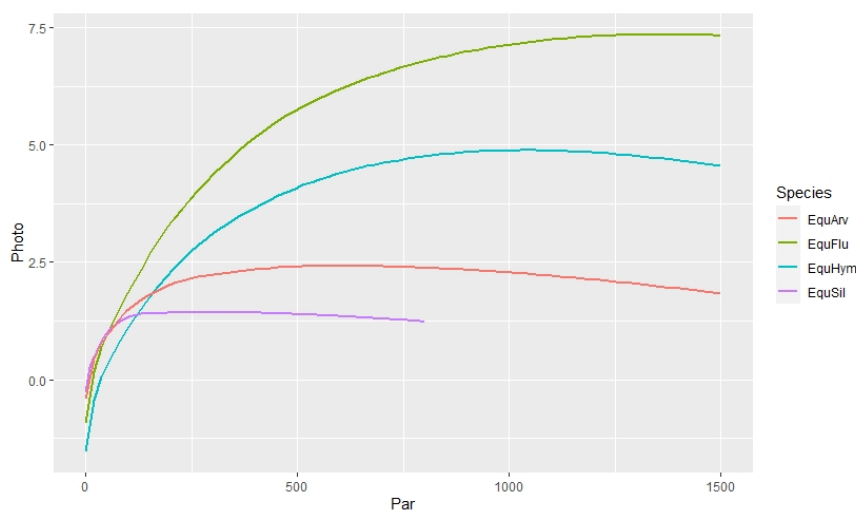


Figure 1: Light response curves for four common *Equisetum* species. Photosynthesis is $\mu\text{mol CO}_2 \text{ m}^{-2}\text{s}^{-1}$ assimilated and Par is photosynthetic active radiation (light) in $\mu\text{mol photons m}^{-2}\text{s}^{-1}$.

Research Fellow: Jamie Hogan (2021)

Concentration: Environmental Studies

Faculty Mentor: Julie Dudrick

Department: Upstate Institute

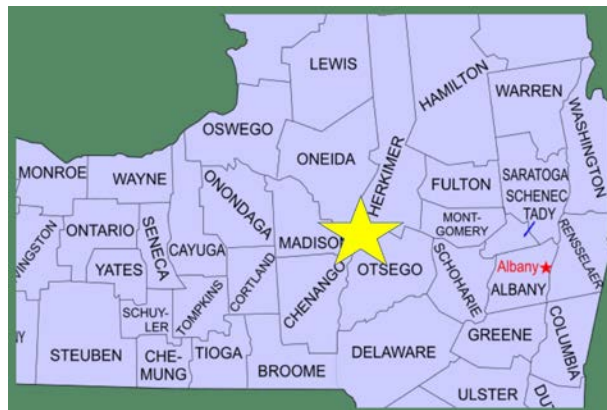
Title of Project: 4-Corners Food Cooperative

Funding Source: Upstate Institute

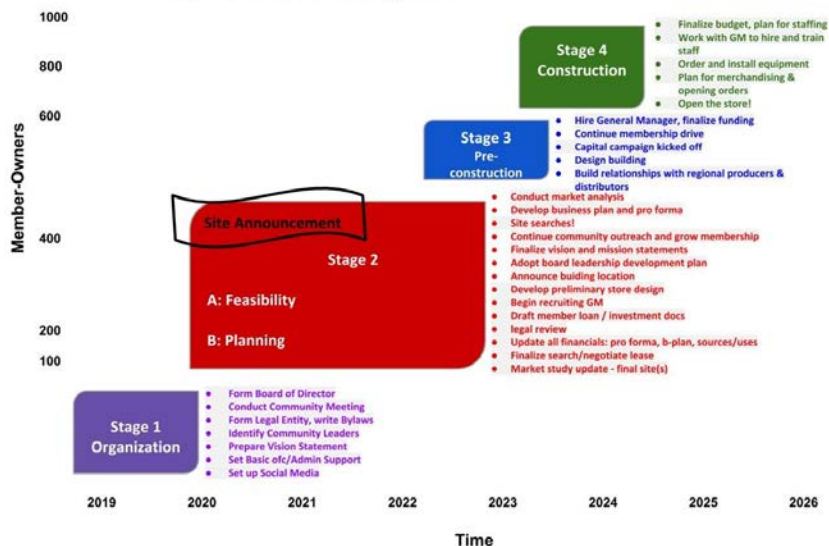
Project Summary:

This summer I assisted the developing 4-Corners Food Cooperative with general research on the best practices of cooperatives, as well as outreach efforts with community members. A food cooperative is a grocery store owned by the people who shop there, and often serves to fill an existing “food desert,” an area that severely lacks access to fresh produce and groceries via local stores. With the goal to mitigate the food desert along the Route 20 corridor and surrounding counties, 4-Corners Food Co-op is in its first few years of development (many successful food cooperatives take approximately seven years to fully launch). The timeline below outlines the major milestones of opening the food co-op for business.

Local outreach is extremely important for food cooperatives, as they are owned and operated by community members. This summer I made significant updates to 4-Corner’s website and social media accounts, as well as designed templates for future communications. Further research efforts included outreach to potential vendors and farmers, who will reach a larger market without the hassle of farmer’s markets. Communications included e-mail templates, social media posts, as well as informational postcards that can be distributed throughout public spaces. Recommendations moving forward include appointing a social media manager to maintain a consistent online presence, as well as intentionally diversifying and amplifying their volunteer workforce to prevent burnout.



4-Corners Food Co-op, LLC



Research Fellow(s): Leila Ismaio (2021)
Melissa Verbeek (2021)

Concentration(s): MIST; PCON
Concentration: Middle Eastern and Islamic Studies

Faculty Mentor: Xan Karn

Department: History

Title of Project: Education Endures: English Education for Refugees and Asylum Seekers in Louisiana during COVID-19

Funding Source: Endowed Fund for Peace Research

Project Summary:



Our names are Melissa Verbeek and Leila Ismaio, and we are both part of the class of 2021. During the Spring of 2020, we were fortunate to have received the Kathryn W. Davis *Projects for Peace* fellowship, which presented us with the opportunity to implement a program within the Jordanian school system to address tensions between Syrian refugees and Jordanian students using art programming. Then came COVID-19; despite all the planning, coordination, and hope for a successful program, the pandemic halted all our plans and froze the intended Davis grant. From there, we began to seek out alternate funding and were able to receive a Colgate research grant. Using this research grant we were determined to do research *and* include an action component that reflected some

of our original ideals of community cohesion and education.

Our research, which comprises an exhibit of publications on Medium, investigates the education gap and socioeconomic challenges faced by vulnerable youth, specifically refugees, asylum seekers, and human trafficking survivors, in Louisiana that only became exacerbated by COVID-19. We chose Louisiana due to our connections in the area, as well as Louisiana's standing as one of the worst education systems in the nation. In a state of about 720,000 students, roughly **⅓ of all students live in low-income households** (1). Louisiana, like other low-income areas, has not been able to provide virtually any form of “virtual education” where significant challenges leave already vulnerable communities susceptible to even further exploitation. This is particularly detrimental to refugee communities who are among the most “at risk” here in the United States (2). These vulnerable communities suffer sub-standard and overcrowded homes, limited access to information or services, and lack the financial means to “ride out” isolation (2). *With that being said, a majority of our research and publication remains guided by our action component that provided us with an opportunity to conduct an ethnographic study that enabled us to learn from the lived experiences of the refugee youth.*

This “action component” quickly turned into an established initiative, *Education Endures*. Through this project, we hoped to address the education gap in Louisiana, which has only been exacerbated by the negative effects of COVID-19. Through developing a supplemental ESL curriculum, providing recurring class sessions for a wide range of ages and abilities, and planning community events throughout the 2020 Summer, the initiative targets refugee, asylee, and other vulnerable youth in the state of Louisiana; this population is considered some of the most “at-need” and isolated youth in the country in regards to both COVID-19 and the current states’ educational infrastructure. We were able to provide two families with tablets from our research funding, while our partner organization, Catholic Charities, was able to step in and contribute the third. We also created and distributed “Education Bundles” to over twenty families across Louisiana. Within each bundle, students were provided with basic school supplies, including pencils, pens, sharpeners, colored pencils, notebooks, and whiteboards, as well as other fun additions (like bubbles, fun erasers, and flashcards, depending on the age of each participant). We wanted students to not only be able to fully be able to engage in classes effortlessly, but hoped it would excite students to actively participate and continue with the program consistently.



The Educational Bundles before delivery

Currently, we are working on sustainable efforts to work with local student groups to expand accessible tutoring opportunities into the school year.

Research Fellow: Joakim Jakovleski (2022)

Concentration: Computer Science

Faculty Mentor: Joel Sommers

Department: Computer Science

Title of Project: Automating Active Measurement Metadata Collection and Analysis

Funding Source: National Science Foundation

Project Summary:

Latency is a critical factor in internet application performance and user quality of experience. On the web, increases in latency are associated with user abandonment and lower ad conversions, and a number of services exist to monitor and diagnose latency. Understanding the *stability* or *constancy* of latency over time is important, since transport protocol performance typically depends on estimates of round-trip time (RTT) and throughput can suffer in the face of dramatic shifts or variation in RTT. We aim to measure the most common durations of these constant periods in order to establish the current condition and stability of the Internet.

To measure these durations we used three methods, two defined in *Zhang et.al. (2001)*, and a newer Hidden Markov Model (HMM) method outlined in *Mouchet et.al. (2020)*. The last method had the advantage of being built into the RIPE Atlas API, where we also obtained the data we worked on – latency measurements in a two-week period of paths between data collection devices called **anchors**. Anchors collect ping measurement RTTs, and we use the methods to divvy up those RTTs into “constant” sectors, where the RTT stays relatively the same. Initial measurements, carried out on few such devices, revealed that the two methods taken from *Zhang et.al.* performed poorly in both speed and precision, while the HMM method sometimes overperformed, finding multiple regions of different round-trip times in a statistically constant region. We were able to process this output further to get more satisfying results, and therefore limited our larger studies to the HMM method exclusively.

For our analyses, we tried to find sufficiently large sets of anchors that shared a common characteristic, thus allowing us to measure different parts of the Internet. The sets included paths between academic institutions, internet exchange points (IXPs), anchors on one continent (Asia), two continents (North and South America), as well as the set of all existing anchors. Together with these location-based analyses, we also conduct a longitudinal analysis, which explores one set (three anchors from each continent) in different time periods – namely the first two weeks of every three-month period since January 2016. All analyses were conducted on both IPv4 and IPv6 address families.

We used cumulative distribution function (CDF) plots with a logarithmic time scale to analyze the data from the HMM method and see the nature of constancy periods within different datasets (figure 1). We found that the general trend indicated a majority of shorter constant periods overall: some sets have as many as half of their constancy periods be under an hour, and no set has a significant number of constant periods above 70 hours – 3 days of the surveyed 2 weeks. The longitudinal analysis gives a possible direction in which to further investigate – while the constant regions are more diverse in duration earlier on, they begin to trend towards the shorter end of the spectrum pretty quickly.

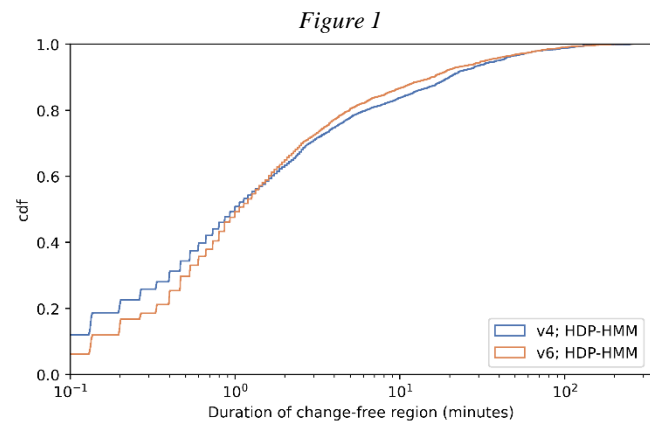
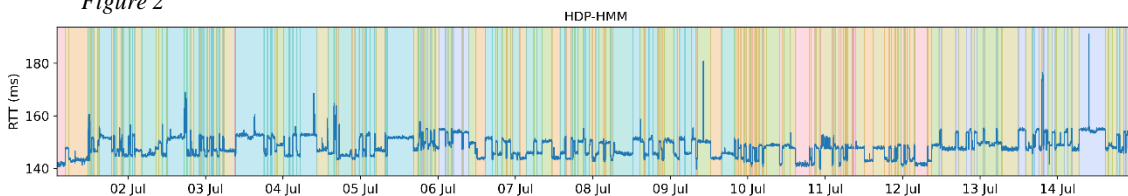


Figure 2



Time series plots of a lot of paths show a common characteristic that might explain such behavior: quick changes in RTTs, contributing in many short constancy regions (figure 2). Sometimes all these regions differ from one another in terms of RTT, but they also often oscillate between only a few different RTTs: such phenomena are definitely to be considered by future work.

Sources:

Zhang Y., Duffield N., Paxson V., and Shenker S. On the constancy of Internet Path Properties. Proceedings of IMW, 2001; Mouchet M., Vaton S., Chonavel T., Aben E., and Den Hertog J. Large scale characterization and segmentation of Internet Path Delays with Infinite HMMs. IEEE Access, 2020.

Research Fellow: Jack Jamieson (2021)

Concentration: Sociology

Faculty Mentor: Carolyn Hsu

Department: Sociology

Title of Project: An Analysis of COVID-19's Impact on Higher Education According to Durkheim's Theory of Social Cohesion

Funding Source: SOSC Division

Project Summary:

COVID-19, the world's most recent pandemic, has disrupted most all aspects of society, and the education sector is certainly not immune. In March of 2020, after COVID-19 cases first surfaced and then rapidly grew in number in the United States, nearly all universities closed campuses. Students, except for international students and those with special circumstances, returned home to their primary residences and completed their coursework remotely. Professors were forced to rely on new online platforms such as Zoom and Google Classroom to distribute course material and continue teaching. As cases persisted and COVID-19 spread throughout the summer months, schools had to decide whether it was safe to re-open to students for the fall semester. Substantial debate regarding the safety of re-opening schools surfaced, along with a diversity of institutional re-opening plans. Through detailed and thorough interviews with administration members at two universities involved with the decision to re-open their campuses for the fall, my project sought to uncover and compare the factors taken into consideration by schools regarding their COVID-19 plans.

The theoretical framework of my project revolved around Emilé Durkheim's discussion of Social Cohesion. Social Cohesion is rooted in the idea that "people must be integrated into groups in order to feel fulfilled" and that "man feel that he is not a whole, but part of a whole" (Durkheim 1972a: 92). Durkheim argued that society is healthier and functions better in a more cohesive environment because people are happier when their society helps them feel connected to others. He also recognizes the converse, known as Egoism, where individuals are selfish and close themselves off to the rest of society (Durkheim 1972b: 114). Social Cohesion is relevant for the context of my project as it would take a communal effort from everyone at a university for their plan to limit COVID-19 transmission to be successful. People would have to unite, understand the implications of their actions for the greater community, and embody Social Cohesion ideals.

I conducted in-depth interviews at two prominent universities that explored the institutional components and considerations for controlling COVID-19 on campus. My interview subjects were from the campus security and communications departments. These individuals hold valuable stories to tell about how their university would operate in response to COVID-19 and the messages about COVID-19 mitigation sent out to the greater university community. After transcribing and coding each interview with a specific scheme, it became apparent that Social Cohesion was a fundamental element within the plans for limiting the spread of COVID-19. Understanding how to create unity in a time where social interaction is discouraged was at the forefront of the discussions. One interview subject stated, "shared suffering is a great bonding experience, and over the course of the semester, the students will bond with each other over the fact that they did this together". This quotation is just one of many, which depicts how the theory of Social Cohesion and togetherness manifests itself into COVID-19 mitigation plans.

This project served as the foundation for my senior year thesis. I hope to further this research and understand how the institutional response impacts students' behavior regarding COVID-19 mitigation measures during the 2020-2021 school year.

References

- Durkheim, Emile. 1972a "La Science Positive de la Morale en Allemagne." P. 90-94, 115 in *Emile Durkheim: Selected Writings*, edited by Anthony Giddens. Cambridge: Cambridge University Press.
- Durkheim, Emile. 1972b "L'education Morale." P. 111-115 in *Emile Durkheim: Selected Writings*, edited by Anthony Giddens. Cambridge: Cambridge University Press.

Research Fellow(s): Cole Jarczyk (2021)
Sophie Kelly (2021)
Thao Kim (2021)
John Pham (2020)
Eamon Reynolds (2020)

Concentration(s): Chemistry; Economics
Concentration: Biochemistry
Concentration: Chemistry
Concentration(s): Chemistry; APMA
Concentration: Chemistry

Faculty Mentor: Anthony Chianese

Department: Chemistry

Title of Project: Mechanistic Studies of Ruthenium-Catalyzed Hydrogenation Reactions

Funding Source: National Science Foundation

Project Summary:

The primary objective of the Chianese Group this summer is to better understand the mechanistic pathway for the hydrogenation of ethyl acetate by Milstein's PNN catalyst using density functional theory (DFT), a computational mechanical modeling method. We focused on finding a pathway from structure b to v (Figure 1), proposing potential mechanisms involving a proton from C-H linkers rather than the N-H linker through the computer modeling software Gaussian, and modeling the kinetics of the reaction through the Copasi program. We also compared three different functionals in Gaussian to see if different functionals would alter the predicted energies of the pathways.

Although there are an abundance of DFT papers in the community, many papers do not have corresponding kinetic studies to accompany their reaction mechanisms. By using our pre-existing kinetics data as well as performing new kinetics tests at varying concentrations of catalyst and substrate, we are attempting to find a correlation between the kinetics data and a working mechanism of the minimum energy pathway. Currently, the kinetic data does not perfectly match the DFT computations.

There were many new DFT findings from the summer research. In particular, the identification of a new turnover determining intermediate (TDI) as well as modifications to the previously expected turnover determining transition states (TDTS). The presence of the product, ethanol, during DFT analysis has been observed to alter the stability of the compounds in the catalytic sequence.

Comparison of functionals B3LYP, M06 and MN15 in calculating energies of the TDIs and TDTSs in the overall pathway was done before the new TDI was found. The data showed some discrepancies, but none gave a statistically significant difference within Gaussian's calculation error. In the future once the new pathway is more complete we plan to investigate the new TDIs and TDTSs using these three functionals again to ensure the data are consistent with each functional.

Regarding the mechanisms involving a proton from C-H linkers instead of the N-H linker, we found that involving a proton from the C-H linker was not energetically favorable. We modeled the transfer of C-H linker protons on both the tertbutyl-phosphine side and the nitrogen side in three ways: The C-H linker proton on its own, with an ethanol stabilizing the proton, and with both a stabilizing ethanol and a proton shuttle (Figure 2). All three sequences yielded energies significantly higher than the current pathway, therefore we concluded that that the proton from the C-H linker was most likely not involved in the overall mechanism. To explore another possibility and make sure that the ethanol stabilization is not a bad tradeoff, we also investigated the mechanism involving only a proton shuttle and without the ethanol stabilization, but so far, the results are not very promising.

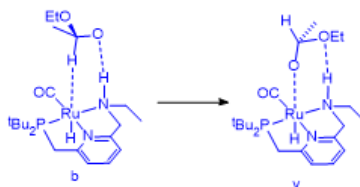


Figure 1: The turnover determining transition state is suspected to exist between structures b and v. Finding the minimum energy pathway from b to v, which is part of the ester reduction of the catalytic cycle, is essential.

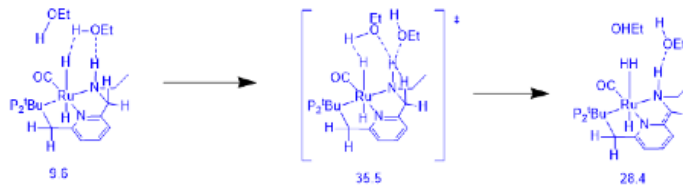


Figure 2: Proton transfer of the nitrogen side C-H linker with an ethanol stabilizer and a proton shuttle. The energies are in kcal/mol.

Research Fellow: Yireh “Raina” Jung (2023)

Concentration: Neuroscience

Faculty Mentor: Carolyn Guile

Department(s): Art and Art History; REST

Title of Project: Architecture and Culture during the Venetian Plagues of 1576 and 1630

Funding Source: Center for Freedom and Western Civilization

Project Summary:

The bubonic plague, commonly known as the Black Death, arrived in the city of Venice in the mid-fourteenth century. Venice had experienced twenty-two plague outbreaks in different parts of the city by 1528. The way that the Venetian community responded to plague outbreaks reflect its geographic situation and cultural composition. With its position on the shores of the Adriatic Sea, Venice soon became the center of with the East and the Byzantine Empire. These geographic characteristics of Venice attracted diverse groups of people from surrounding regions. In this way, Venice would come to be known as the city of immigrants. Predominantly a Christian state, Venice also was home to diverse populations. In the central area of Rialto, for example, one also found Persians, Greeks, Jews, and Turks.

The plagues of 1576 and 1630 in Venice that each lasted for about a year led to the construction of two churches: Andrea Palladio’s church of the Redeemer (Il Redentore) and Baldassare Longhena’s church of Santa Maria della Salute respectively. Both churches were constructed to give thanks to God for deliverance from the pandemic. It is said that the plague ceased when the Doge and Patriarch vowed to build a church dedicated to Christ the Redeemer for the plague of 1576, and to the Virgin Mary, for the plague of 1630.

Andrea Palladio’s structure invoked natural and classical themes in its construction; the paper discusses its formal features in relation to function. Baldassare Longhena’s design shares similar features as that of Palladio’s, predominantly for providing a space for ducal ceremony. Similarity between the two churches as well as the influences of geographical features on the structure of Santa Maria della Salute is discussed in the paper.

Public events were also created to celebrate the end of these plagues: the paper discusses these as well. Andrea Palladio’s church of the Redeemer provides a place for the Feast of the Redeemer, an annual celebration taking place every July 1 to commemorate the end of the 1576 plague. Baldassare Longhena’s church of Santa Maria della Salute provides a place for the Feast of the Presentation of the Virgin, a celebration of the end of the plague of 1630. These architectures are representations of religious and social history from the time of plagues.

Besides the construction of votive churches, Venice responded to plague by taking public health measures such as quarantine, *Lazaretto*, an institution used during the plague outbreak to prevent the spread of the disease by quarantining travelers, and public health officials. Generally, the lazaretto was built on islands outside of the city and used for quarantine. Here, officials stopped incoming ships at outer islands and evaluated the health of the crew. Many sources recognize Venice’s response to plague outbreaks as the origins of public health policy. This paper examines how the combination of diverse communities and the rich history of Christianity in Venice, in its geographical situation, gave a rise to distinctive measures taken by the Venetian community.

Abstract: The purpose of this study is to research how the Venetian community, in its geographic situation and cultural composition, responded to the plagues of 1576 and 1630. This study looked at architectural-religious-social history of the Venetian response to the plagues both individually and intersectionally. Evidence gathered suggests that it is the cultural and geographical features of Venice that differentiated its response from that of neighboring countries. With its status as a Christian state, an excellent trading center that attracted diverse people, and a geographic composition that made Venice reachable only by water, the Venetian response to these plagues gave rise to innovations in public health policies.

Research Fellow: Emma Kaminski (2022)

Concentration(s): Environmental GEOG; REST

Faculty Mentor: Julie Dudrick

Department: Upstate Institute

Title of Project: Summer Field School Fellowship

Funding Source: Upstate Institute

Project Summary:

The Village of Earlville, located in rural Central New York, is a small town, with a population of just over 800. This already small population has been in decline for years, and is on course to only get smaller. The village's population decline goes hand in hand with its economic decline; Earlville's infrastructure and local businesses are in dire straits as a lack of money, people, and support cause problems with staying relevant and successful. Specifically, small local businesses in Earlville are finding it difficult to stay afloat, as there are not enough paying customers to sustain them, and nearby large commercial businesses, such as the recently established Dollar General in town, undercut prices, appealing to the many low-income residents. The failure of small businesses in staying in business has led to a decaying downtown, which appears mostly empty, with boarded up storefronts, and dilapidated buildings. The appearance of the town, as well as its sometimes lacking capabilities in transportation, internet connection, and access to essential products like fresh produce, make the village an uninviting place for potential residents and customers.



In stark contrast to its various problems, Earlville remains a warm and unique place to live. It prides itself on its immense historical past, beautiful scenery, and a close-knit community, qualities which are incredibly desirable, and rare to find, in a place to live. Earlville's downfall in being so scarcely populated and remote is also one of its greatest advantages. Recognizing the way that Earlville's best qualities have become disadvantages in modern times, myself and Professor Graybill worked under the Earlville for Earlville project, with assistance from the Partnership for Community Development to assess the town of Earlville's wants and needs, so they could be taken into account to apply for future grants, and proposed development of the town.

To assess what needs Earlville had, we first reviewed the Comprehensive plans for the town of Hamilton (1999 + 2017) and the Village of Earlville (2001) to find what efforts had already been made or proposed according to these most recent official reports. After assessing these, we determined which of the issues facing Earlville residents were most pressing or needed the most work. From there I created a survey under the direction of Professor Graybill to be distributed among Earlville residents, both online and on paper. The survey's goal was not only to find what serious issues residents needed addressed, but to find what things they wanted out of Earlville, such as parks and community events. The survey covered the topics of transportation, recreation, access to food, community, and local business. The results of this survey will be used as guidelines for Earlville for Earlville and the Partnership for Community development as they create grant proposals and their own future development projects in the area.



Research Fellow: Vani Kanoria (2022)

Concentration: Applied Math

Faculty Mentor: Ahmet Ay

Department(s): Biology; Mathematics

Title of Project: Vertebrate Segmentation: From Gene Networks to Human Diseases

Funding Source: Michael J. Wolk '60 Heart Foundation

Project Summary:

The precursors of spatially repetitive vertebrae segments are periodically generated by a biological regulatory network (a set of genes or proteins that interact with each other to control a specific cell function). This biological network (segmentation clock network) controls the vertebrate segmentation during embryonic development.

Here, we developed a stochastic multicellular computational model to elucidate how the dynamics, i.e., period, amplitude, and synchronization, of the zebrafish segmentation clock, are regulated. We expect the model we developed will lead to significant advances in our understanding of the dynamics of the vertebrate segmentation and related human diseases such as scoliosis. This knowledge may also shed light on other biological networks such as the human circadian clock.

Our mathematical model is based on mass-action kinetics and describes the concentration changes of mRNA, protein, and dimer species. We simulated this model using three different approaches; deterministic, fully stochastic, and hybrid version of the two. The deterministic approach uses ordinary differential equations to simulate the two-cell biological system and solves them using Euler's method. We used this approach to demonstrate that our model can reproduce the average dynamics of the segmentation oscillator in wild-type and different mutant conditions. The deterministic approaches are often inaccurate for biological systems with small molecular abundances. Since our oscillatory system shows small molecule numbers, we developed a stochastic approach also. We performed the stochastic simulations for our model using the Next Reaction Method with delays (Anderson 2007). In this approach, we probabilistically determine which reaction fires at each iteration, and when it fires. Although the stochastic methods provide an accurate description of a biological system, they are often not practical due to their high computational time. As a third approach, we developed a hybrid approach that simulates fast biological reactions (e.g., dimer formation) deterministically and slow reactions (e.g., transcription) stochastically (Alfonsi *et al.*, 2005). In this approach, we solve the deterministic part using ode45 (a built-in MATLAB differential equation solver) with the 'events' function. We stop the deterministic simulation when an 'event' occurs and perform a stochastic reaction.

We have implemented one cell and two cell versions of these three approaches. Our deterministic approach can reproduce the average dynamics of the segmentation oscillator in wild-type and mutant conditions. However, it cannot explain the biological heterogeneity observed in this system. Our stochastic and hybrid approaches can create the dynamics of this biological system in wild-type zebrafish embryos. In the next step, we will test this code to study how gene expression variation is controlled in this essential biological system in various genetic mutant backgrounds.

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Research Fellow: Meaghan Kendall (2021)

Concentration: Natural Sciences

Faculty Mentor: Amy Leventer

Department: Geology

Title of Project: Antarctic Diatom Assemblages

Funding Source: Doug Rankin '53 Endowment-Geology Research

Project Summary:

This summer I conducted research with Professor Amy Leventer on diatoms, single-celled algae with siliceous shells from East Antarctica. Diatoms can be used to study past and present ice sheet behavior and oceanic conditions. This paleo perspective is key to understanding the susceptibility of the East Antarctic ice sheet to modern warming. The diatom valves studied are from sediment cores collected during a 2017 research cruise aboard the Australian research vessel *Investigator*. Core IN2017-C022-PC07, from the Sabrina Coast continental slope, recovered a sequence of sediments deposited during alternating glacial and interglacial cycles, five of each, reaching back in time approximately 350,000 years. One of the goals of this work is to compare interglacial intervals to each other, as not all warm periods are alike, and similarly, to compare the glacial intervals. This research evaluates oceanic conditions that drove the scale of retreat and advance of both sea ice and glacial ice, as climate warmed and cooled. This work is complementary to data collected from a suite of six piston cores collected during the *Investigator* cruise. Compilation of the entire data set will provide a larger scale view of changing oceanic and climatic conditions across a part of the East Antarctic margin that is currently losing ice mass, and that could potentially contribute to several meters of sea level rise.

Diatom abundance and assemblage data are used to document this alternation of ice retreat and advance. Interglacial periods are characterized by relatively high abundances of diatom valves, reflecting high primary productivity of the overlying open marine system, where diatoms flourished. The data indicate that productivity is not uniformly high either within an individual interglacial interval, or between different interglacial periods. In most cases, the initial phase of an interglacial period is the warmest and most productive, followed by decreasing diatom abundance. This peak in abundance is comprised of species that today are common components of spring time algal blooms. The remainder of the diatom assemblage generally is characterized by open water species that today live in the permanently open ocean zone, however the present interglacial has a distinctive peak in sea ice associated species.

In contrast, diatom abundance is low during glacial intervals, the result of increased temporal and spatial extent of sea ice, blocking the light needed for photosynthesis. Glacial sediments also have a much higher relative proportion of reworked specimens than interglacial sediments. These reworked diatoms result from the expansion of the East Antarctic ice sheet during glacial periods, across the continental shelf, with the grounding zone closer to or coincident with edge of the shelf. As the ice moved across the shelf, at its base it eroded previously deposited older sediments, and transported them to the shelf edge, where they cascaded downslope, and eventually settled at the sea floor.

Research Fellow: Dipesh Khati (2022)

Concentration: Economics

Faculty Mentor: Rishi Sharma

Department: Economics

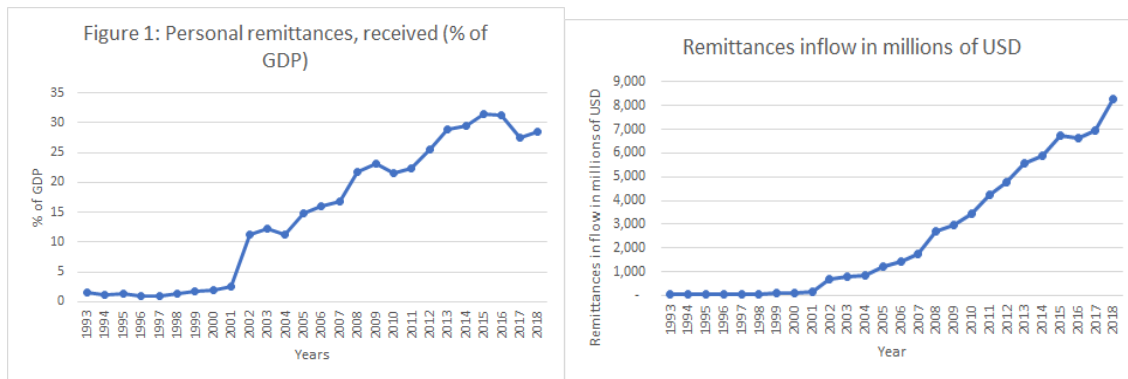
Title of Project: How do remittances relate to exchange rate policy: The case of Nepal

Funding Source: Lampert Institute for Civic and Global Affairs

Project Summary:

Nepal formally introduced the current exchange rate policy on February 12, 1993. Based on this policy, the Nepalese Rupee was pegged vis-a-vis the Indian Rupee while effectively floating against other convertible currencies. The peg was set at 1.6 Nepalese Rupee vis-a-vis 1 Indian Rupee. The same exchange rate policy has been in place over 27 years now. Despite the large magnitude of changes in the Nepalese economy, the exchange rate policy has never been revised.

One of the major changes that has taken place in the structure of Nepalese economy is the relative importance of remittances in the GDP of Nepal. In 1993 when the current exchange rate policy was first instituted, remittance inflow to Nepal was \$55 million which was approximately 1.5% of the GDP (World Bank). Since then remittances have grown at an incredible pace. In 2018, remittances have grown to be worth around 8.3 billion which is approximately 28.5% of the GDP (World Bank).



With this paper, I have tried to take a look at the exchange rate policy of Nepal from the stand point of remittances. I had done a survey of literature that have tried to discuss the issues related to remittances and exchange rate policy in Nepal. Using, those findings I have used AA-DD framework to understand the impact of remittances on exchange rate and exchange rate policy.

Based on my findings, remittances have contributed to create a wedge in between policy interest rate and the bank's lending rate which has compromised the possibility of flexible exchange rate policy in Nepal. Similarly, the remittances have contributed in increasing imports and reliance on India. Thus, remittances have nudged the Nepalese exchange rate policy towards the Indian Rupee as an anchor currency. Similarly, the inflow of remittances has contributed towards depreciation of real exchange rate of Nepal vis-a-vis the Indian Rupee by increasing the supply of money in the economy (can be understood as decreasing banks' interest rates). With this finding, I recommend that Nepal should revise its peg rate (depreciate it to a new level) in order to protect the Nepalese exports market from export competitive trap.

Research Fellow: Sowon Kim (2022)

Concentration: Arts & Humanities

Faculty Mentor: Jennifer Brice

Department: English

Title of Project: On Leaving and Returning Home: Creative Writing Project

Funding Source: J. Curtiss Taylor '54 Endowed Student Research Fund

Project Summary:

Migration has been a huge part of my education, since I have constantly moved away from my home in South Korea since high school. Such journey is not my story only. As Angelica Bammer states, “the separation of people from their native culture either through physical dislocation (as refugees, immigrants, migrants, exiles, or expatriates)” became “one of the most formative experiences of our century”. Over the summer, I read novels, narrative-nonfictions, and critical essays which engage with the topic of ‘home’, including Park Wan-suh’s *Tofu*, a collection of poems written by Kim Soo-young, Lu Xun’s *Hometown*, Ha Jin’s *The Writer as Migrant*, Kahled Hosseini’s *The Kite Runner*, and an anthology collection of essays called *A Map is Only One Story: Twenty Writers on Immigration, Family, and the Meaning of Home*. Then I wrote a series of narrative nonfiction reflecting on my own experience of leaving and returning home, under the guidance of professor Crespi and professor Brice. To give proper context to the writing project, I went back and spent time in my hometown, Changwon, South Korea.

The project culminated in three essays, each focusing on a specific aspect of home. The first essay ponders upon the mother tongue as home, and what it means to find (and lose) a home in books, in language. The second essay thinks about how food from home brings the family together and creates a community across time and place. The third and last essay, which is on living again with parents, discusses the shifting dynamics in the relationship between my parents and I upon my return this summer. The essay also gives a brief account of how my return, the initial quarantine and stay at South Korea looked like in times of pandemic.

Research Fellow: Hannah Kloster (2021)

Concentration: Classics

Faculty Mentor: Rebecca Ammerman

Department: Classics

**Title of Project: The Sea as a Connecting Force: Greek Seafarers and Indigenous Women
Negotiating a Colonial Middle Ground**

Funding Source: AHUM Division

Project Summary:

The Mediterranean Sea, rather than separating those living on its shores, served to link its different peoples and societies together. Seafaring was responsible for much of long-distance transportation, trade, and exchange in antiquity. Not only did trade play a large role in cultural connections, but the founding of permanent settlements served to facilitate the spread of ideas, culture, and a mixing of societies from the Levant to Gibraltar. The Greeks were a prominent cultural force in antiquity. First contacts with the “Other” would have occurred at trade emporia. Here various groups met, often on the coasts, to exchange goods. Valuable objects were also exchanged among the elites through the mode of the gift exchange. These gifts served to increase prestige and to cement alliances. In addition to these gifts, women were often objects of exchange as well in order to cement alliances. A foreign woman who married a Greek man brought with her the wealth, customs, and culture of her native land. Thus, the sea helped to forge “hybrid” societies, in which many groups lived together and learned from one another.

The idea of sea faring stretches back in the Greek imagination to its earliest myths. The tale of the Argonauts, the forefathers of those heroes who fought at Troy, concerns the journey of the first ship, the Argo, around the Mediterranean, and the “abduction” of Medea from her home kingdom of Colchis. Medea is the foreigner in every sense of the word. She is a woman, she is a princess of Colchis on the Black Sea, she may even be “dark-visaged,” and she is a descendent of the Sun, making her something other than mortal. Medea makes an excellent character for the study of Greek attitudes towards the “Other,” as she is the multifaceted “Other.” Medea, enraged that her husband Jason has left her for another wife after she has moved to Greece with him, kills not only Jason’s new wife and father-in-law, but also her own children. She comes to exemplify the attitude of Greek men towards foreign women. They are a “dangerous import,” and have control over the line of succession, as a woman knows the parentage of her child. In the extreme case of Medea, she ends Jason’s line of succession by killing their sons. Women, and particularly foreign women, were met with wariness from Greek men.

In addition to mythic sources, the archaeological record of Southern Italy reflects the trade patterns of the Mediterranean as well as the interactions between Greek seafarers and the indigenous populations. Due to COVID-19, I was unable to work with the physical artifacts in Italy as I had originally planned, but I was able to study a number of publications of these collections and plan to pursue this research in another context with a specific eye towards gender identities and the role of women in the interactions between different groups in Southern Italy.

In sum, this summer I was able to research the primary ancient sources on the mythological characters of Medea, Circe, and Calypso, each of them dangerously powerful women who interacted with Greek seafarers, as well as Medea’s husband Jason, the famous wanderer Odysseus, and finally Diomedes, a Greek hero who after leaving Troy intermarried with a Daunian princess in Southern Italy. My summer was profitably spent becoming thoroughly familiar with the primary sources on these mythological characters, as well as secondary literature on the context and interpretation of these myths. In addition to the primary and secondary mythological sources, I was able to study much of the archaeological publications of settlements where there is evidence for Greek and indigenous interactions.

Research Fellow(s): Shane Knopp (2023)
Thomas “Tommy” Subak (2023)
Adam Zaharoni (2021)

Concentration: Undeclared
Concentration: Undeclared
Concentration(s): Geology; CLST

Faculty Mentor: Aubreya Adams

Department: Geology

Title of Project: Deep Earth Imaging of the Alaskan Subduction Zone

Funding Source: Doug Rankin '53 Endowment-Appalachian Research

Project Summary:

The original plans of this summer research experience evolved due to the COVID-19 pandemic. The project was supposed to last eight weeks with in-person supervision on campus in which the researchers would build a deep earth model of the Alaskan subduction zone. However, such seismic research requires significant in-person training. Instead, the remote and abbreviated project focused on introductory and background work. In three weeks, the researchers learned the process of submitting scientific proposals, developed skills with Matrix Laboratory (MatLab), and analyzed seismic research papers.

We learned the general details about how to plan research and read several scientific proposals for various projects. Timetables for the proposal of a project, organization of the research, and the research process itself are all key elements that we discussed as background information. It also involved looking at the organizations that fund research and how that process works. The scientific proposals are formatted with several sections, such as a review of the project, the intellectual merit of the project, and the broader impacts involved.

We began to get familiar with the MatLab language by first completing an introductory course that explained the basic background mechanics such as commands, variables, functions, plotting data, etc. After, we ran and analyzed a pre-written script line by line that mapped earthquake monitoring stations in New York. Eventually, we had to modify this script to map locations of stations at the Alaskan subduction system. Some requirements to complete this part of the project were importing data through the use of an ordinary text file and not a Matlab one. We did this by using the `dlmread` command built into Matlab. Finally, we used an Automated Tilt and Compliance removal script to learn how Matlab can process earthquake data such as filtering out transients.

We also read and discussed several published papers on various topics such as megathrust earthquakes, the Alaskan subduction zone, and the Cascadian subduction zone. The first paper we looked at was in regards to great earthquakes, defined in the report as those with a magnitude greater than 8.0. This paper showed the diversity of subduction zone behaviors that elicit these great earthquakes and advocated for increased research in the area in the form of technology to develop a better catalog and thus understanding how and what causes these quakes. We then examined a paper on the Alaskan subduction zone, which primarily focuses on the differences between the Shumagin Gap and the Semidi Segment. The former has no recorded great earthquakes while the latter has several. This difference is hypothesized to be a result of different fault behaviors: creep and locked, respectively. The creeping faults might be a result of the hydration of the crust, as shown in the paper. The final report we looked at was a seismic velocity model of the Cascadia subduction zone using both land and ocean bottom seismometers.

Research Fellow: William “Will” Krohn (2023)

Concentration(s): Biology; ENST

Faculty Mentor: Julie Dudrick

Department: Upstate Institute

Title of Project: Bird Conservation in New York State

Funding Source: Upstate Institute

Project Summary:

This summer I worked remotely for the Upstate Institute at Colgate University as a Fellow for two environmental organizations in New York focused on bird conservation. First was the Adirondack Center for Loon Conservation, located in Saranac Lake, which focuses solely on protecting the Common Loon (*Gavia immer*), a species of special concern in New York State. Their efforts also go toward educating the residents and visitors of the Adirondacks on environmental issues that affect loons. My second project was at the New York State Breeding Bird Atlas III, a citizen science project that is documenting all breeding birds within the state between 2020 and 2025. While the methods and practices of these organizations are different, they share the same goals, and the work I did for each project had many similarities.

Biomagnification of mercury in aquatic ecosystems has become a huge issue for loons, among many other species, in the last 50 years. The Adirondack Center for Loon Conservation evolved out of a partnership with the Biodiversity Research Institute aiming to study the effects of mercury bioaccumulation in these ecosystems. Now they still continue their work monitoring concentrations of methylmercury in the blood and feathers of loons, but they also band loons and observe nesting sites to study the reproductive success of loons. A loon pair only lays 1-2 eggs per year and nests have become more fragile in recent years due to increased human disturbance, higher rates of water level fluctuation, and other environmental threats being accelerated by climate change. It is obviously paramount for loons to reproduce successfully and bear healthy offspring if they are to exist as a species. Many species go extinct not because every organism is hunted/killed, but because conditions arise in which the organism can no longer reproduce. By being focused on loons, the Adirondack Center for Loon Conservation can effectively educate its members on larger environmental issues through outreach programs establishing community-based environmental stewardship, which I worked on.

The Adirondack Loon-Friendly Lake Certification Program was started last year and I worked on surveying residents as they became interested in the program. Interest at first was slow due to the pandemic, but it is gradually increasing. While waiting for data, I wrote lay articles on the issues that loons in the Adirondacks face, to be read by members wanting to learn more.

Much like loons, the survival of other birds in New York is dependent on reproductive success. The New York Breeding Bird Atlas III is the third installment of the project of monitoring biodiversity through bird species breeding in New York. The Atlas happens every 20 years, and it provides the most comprehensive data set in the state via eBird. Data from the project has been cited in six peer reviewed publications to date. Most of these papers have focused on landscape and climactic changes causing shifts in bird populations and ranges. In this sense, my two projects have a very similar goal, but at different scales.

At the New York Breeding Bird Atlas, my work was specifically in outreach. Being a citizen science project means that people must be “recruited” to submit data to the Atlas. Luckily, the data here is collected through birding, a pastime and hobby of many. I used social media and the Atlas’ website to educate and motivate birders and provide the resources they needed. One of the ways in which I did this was by interviewing atlasers, recording their stories, and writing about them as well as what birding during a pandemic is like. All of my articles are published on ebird.org.

There is still much work to be done in studying the effects of climate change, and this issue is so large that it cannot be addressed unless everyone is on board. The good news is that every day more and more people are getting educated through efforts like mine this summer.

Research Fellow: Sahil Lalwani (2022)

Concentration(s): Economics; Applied Math

Faculty Mentor: Michael Connolly

Department: Economics

Title of Project: Regulation and Environmental Risks in Mortgage Lending: Exploring the interaction of unconventional monetary policy and natural disasters

Funding Source: SOSC Division

Project Summary:

Freddie Mac and Fannie Mae are Government Supported Enterprises (GSEs) that deal in the Secondary Mortgage Market for both multifamily and single-family homes. All mortgage loans that meet the underwriting standards of Freddie and Fannie may be purchased, packaged and insured against loss of principal and interest in the resulting mortgage backed securities in return for a guarantee fee charged by these GSEs. However, the pricing strategy of GSEs does not vary spatially with the differential ex-ante risk faced by a property by virtue of its geographical location and position. This project aims to explore the intersection of unconventional monetary policy and natural disasters by considering and analyzing QE3 and Hurricane Sandy as a natural experiment for our study. A major objective of this project is assessing the impact of unconventional monetary policy tools in fostering economic growth and stability in areas directly impacted by natural disasters in the U.S. through the bank lending channel.

Our literature review explored the growing body of research on the direct impact of different rounds of quantitative easing on the mortgage lending channels in the US as well as the indirect impact of different rounds of quantitative easing on securitization volumes for MBS as well as effects of income and employment. We also explored research estimating the impact of large (often billion-dollar) natural disaster events on securitization and mortgage credit volumes. Current research suggests that MBS purchases in different rounds of QE caused unintended real effects, in terms of large positive stimulus to the economy and increased employment, through the bank lending channel. In fact, Luck and Zimmermann (2020) find evidence that banks with higher mortgage-backed securities holdings refinanced relatively more mortgages after the first round of QE, which increased local consumption in the nontradable goods sector. In contrast, banks increased lending to firms and home purchase mortgage origination after the third round of QE, which led to a sizable increase in overall employment. In addition, Kahn and Ouazad (2019) suggest that there is a statistically and economically significant increase in securitization volumes at the conforming limit in years following a billion dollar natural disaster event.

We use data from the Home Mortgage Disclosure Act (HMDA) and HUD USPS Zip code Crosswalk files to compile the amount of mortgage lending in each postal zip code annually. In addition, FFIEC call report data reports the total assets and total mortgage securities in a balance sheet format at the bank level on a quarterly basis. Using these publicly available datasets, we constructed an ex-ante exposure measure of each postal zip code to a round of quantitative easing for all Atlantic states in the US: we treat postal zip codes that have historical activities from banks with more MBS holdings as exposed areas and those with less holdings as non-exposed areas. Using Single Family, Fixed rate mortgage level dataset for Freddie Mac that contains the amount of lending at the three-digit postal zip code level, we find that exposed areas had a persistent higher level of lending compared to non-exposed areas following QE3 (Figure 1).

Next, we use data on hurricane wind speed radii, digital elevation and proximity to wetland or coastal areas to identify and visualize all three-digit postal zip codes affected by Hurricane Sandy. Figure 2 visualizes all postal zip code areas (shaded) affected by Hurricane Sandy, assessed on the basis of data on wind speed radii publicly available on NOAA's Atlantic Hurricane database. As a next step, we aim to understand whether there exists a difference between mortgage lending behavior and patterns in areas affected by Hurricane Sandy and those not affected, further differentiated by their level of exposure to a round of QE, before and after the announcement of QE3 on 13 September 2012.

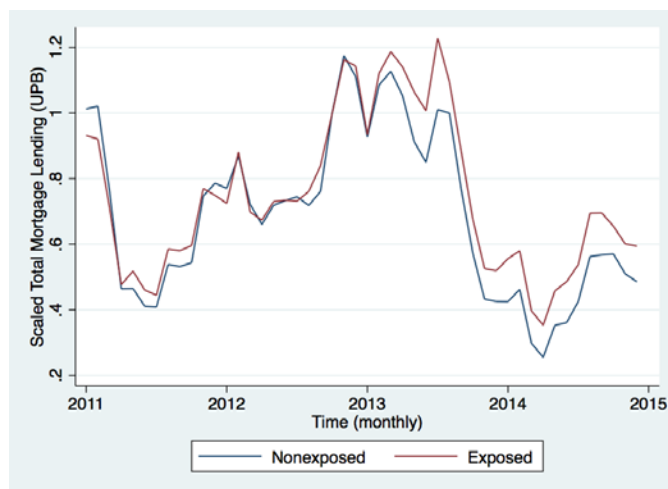


Figure 1: Mortgage lending in exposed vs nonexposed areas (2011-2015) securitized by Freddie Mac



Figure 2: Postal zip code areas affected by Hurricane Sandy

Research Fellow: Alben Leonard (2021)

Concentration: Biology

Faculty Mentor: Barbara Hoopes

Department: Biology

Title of Project: Characterization of mutations associated with body size differences in dogs

Funding Source: Michael J. Wolk '60 Heart Foundation

Project Summary:

Previous work has shown that over 90% of body size differences in dogs are a function of 16 phenotypes, including variance in birth weight.¹ The main objective of this project is to more narrowly study factors which influence birth weight variation in dogs, and construct a mixed model to predict the birth weight of pups. Genomic and anatomical data were collected from toy poodles. Emphasis was placed on genetic factors previously implicated as sources of birth weight variation, such as IGF1R and GHR2. Additionally, associations with anatomical correlates of birth weight in dogs, such as adult height (for both the dogs themselves and their mothers), brachycephaly (short-headedness relative to the average dog in the population being considered) and brachymorphy (short-leggedness relative to the average dog in the population being considered), were also considered.

My principal contributions to the project were gathering relevant literature, and constructing figures to represent data. Because our work was conceived as a follow-up to that of Plassais 2019 and Sampson 2019, I was mostly concerned with discovering relevant literature not cited in either of these two articles, in addition to filtering the works cited in these two publications for relevance to our immediate concerns. I scoured several databases for work on the influence of factors such as brachycephaly, brachymorphy, the age of sire at conception, the age of the dam at birth, and litter size, in addition to genetic factors. I was able to find some relevant work in dogs concerning the 'non-genetic'² factors, although much of the available literature on these questions did not analyze data from dogs, and instead analyzed data from various agricultural mammals. Moreover, using data collected by the Hoopes laboratory, I found that birth weight is a merely weak predictor of adult height (Figure 1). This implies that different factors influence birth weight and adult height. Ultimately, analyses of variance using our data set reinforced the previous finding that the IGF1R gene contributes significantly to variance in birth weight. Our data also implied that the SMAD and STC2 genes do not significantly contribute to birth weight variation.

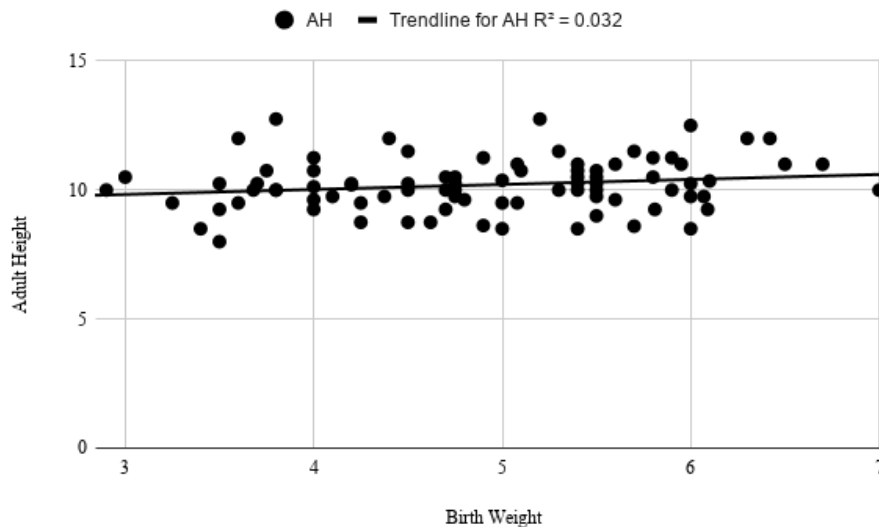


Figure 1. Representation of adult height as a function of birth weight.

¹Plassais, J., et al. (2019). Whole genome sequencing of canids reveals genomic regions under selection and variants influencing morphology. *Nature Communications*.

²'Non-genetic' is in caution quotes, in order to avoid misunderstanding. 'Non-genetic' as used here simply means that the factor was not an explicitly labeled gene, and does not necessarily imply that I take the factor in question (such as litter size) to be non-heritable. More generally, this disclaimer should not be taken to imply that I maintain a specific view on the heritability, or lack thereof, of factors labeled 'non-genetic.'

Research Fellow: Caleb Levy (2023)

Concentration: Undeclared

Faculty Mentor: Cosmin Ilie

Department: Physics and Astronomy

Title of Project: Dark Matter and Stellar Evolution

Funding Source: Justus '43 and Jayne Schlichting Student Research Fund

Project Summary:

Dark matter (DM) is one of the most perplexing puzzles facing physics today. Its presence in the universe is evidenced through the gravitational effect it has on sub-galactic up to cosmological scales. However, the question of what DM is made off is still up in the air. Experiments on Earth (Such as the XENON experiments) hope to observe DM directly by measuring the interactions DM particles may have with baryonic matter. However, there have yet to be any confirmed detections of DM and so the best these experiments can do is place upper bounds on key DM properties. My research this summer focused on another method of constraining DM properties through the observation of the first generation of stars in the universe as well as placing limits on the maximum mass the first stars may have.

The first generation of stars (Pop III stars) is believed to have formed in DM mini-halos at redshifts of $z \sim 10 - 50$ out of pristine gas from big bang nucleosynthesis, though they have not yet been observed. Once these stars have entered their main sequence, DM particles that transit the star may scatter off the stellar hydrogen and helium, losing sufficient energy to become trapped in the star's gravitational well. This process is known as **capture**. DM particles requiring one scatter to be captured are said to be in the single-scatter regime while those requiring more than one scatter are in the multi-scatter regime. Once a sufficiently high number of DM particles have been captured by the star, assuming DM particles are their own anti-partners, the DM particles may self-annihilate, providing an additional energy source for the star. The research we conducted over the summer built upon previous work by considering the effects of helium on the capture and annihilation process. Helium makes up approximately 25% of a Pop III star's mass when it has just entered its main sequence phase. The high mass of helium particles relative to that of hydrogen means that the scattering cross-section for helium particles is significantly greater than that of hydrogen. This means that DM interactions with helium particles is much greater than that of hydrogen, so much so that above $\sim 2\%$ helium, the capture process is dominated by helium interactions.

The additional power source provided by DM capture and annihilation limits the mass of a pop III star by way of the Eddington luminosity. Essentially, once the star's luminosity is at the Eddington limit, further mass accretion is prevented. Hence, by making assumptions on DM properties, we can place upper bounds on Pop III masses due to the additional DM luminosity. Conversely, if we were to observe Pop III stars and learn of their properties, we can place upper bounds on the DM-nucleon scattering cross-section, a very important DM parameter.

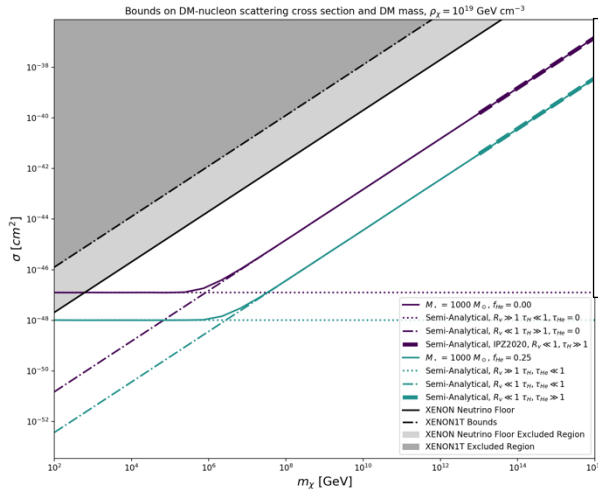


Fig. 1: Upper bounds on the DM-nucleon scattering cross section as a function of DM mass. For the most massive stars considered (1000 solar masses) and the highest DM densities (10^{19} GeV/cm^3), detection of Eddington-limited pop III stars could bound DM properties below the maximum sensitivity achieved by direct detection. The presence of helium allows us to place tighter bounds due to its enhancement of the DM luminosity.

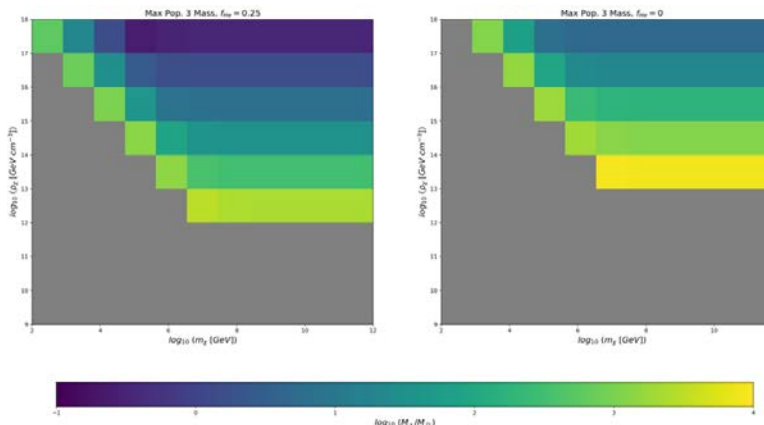


Fig. 2: Maximum mass a pop III star can have for a given set of DM parameters, assuming a self-annihilating model of DM. Modeling helium allows for tighter bounds on pop III masses for all DM parameters due to the increase in DM luminosity from the helium's presence in the star. The grey region corresponds to maximum masses greater than 10^4 solar masses which likely would not occur due to disruption from processes outside of the Eddington limit

Research Fellow: Brian Ma (2021)

Concentration: Physics

Faculty Mentor: Kenneth “Ken” Segall

Department: Physics and Astronomy

Title of Project: Artificial Neurons Using Superconductors

Funding Source: Volgenau Wiley Endowed Research Fellowship

Project Summary:

Superconducting circuits containing Josephson Junctions (JJ) can be used to model biological neurons. These JJ neurons can become excited when an input signal exceeds its threshold value, and output oscillatory signals of its own. Using this property, these neurons can be linked together to conduct logical operations. In modern computers, transistors are used to carry out these operations. However, JJ neurons are around 100 times faster and use 300 times less power. Further, the nature of how JJ neurons can be connected allows the number of components for larger logical operations to grow linearly, rather than exponentially, which is the case for transistors.

In this project, we constructed a JJ neuron based binary half-adder, which is one of the fundamental logical operations computers are built upon [Figure 1]. One of the problems of JJ neurons was the phase differences in output oscillations. Thus, when two signals are “added together” they are often out of sync and do not bring the signal past the activation threshold value of the next JJ neuron. This was solved by utilizing a RC high pass filter to integrate the output signal over time, thus allowing for a more constant current output for each JJ neuron [Figure 2]. Using mutual inductance to couple neurons together, and a high pass filter, we were successful in creating a half adder based on JJ neurons.

Figure 1: Truth table of a binary half-adder.

Input 1	Input 2	Sum bit	Carry bit
0	0	0	0
1	0	1	0
0	1	1	0
1	1	0	1

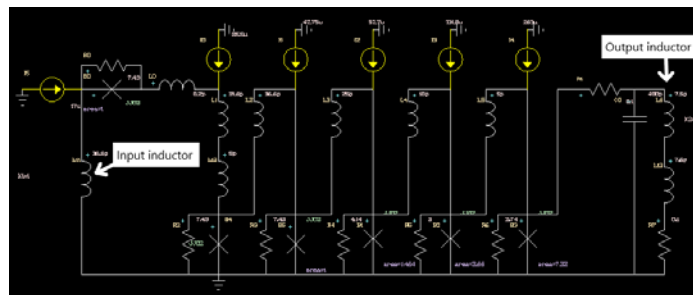


Figure 2: Circuit diagram of a JJ neuron with a high pass filter before the output inductor.

The half adder was created by combining an AND gate and a XOR gate for the carry bit and the sum bit respectively. To create the AND gate, the outputs of two JJ neurons were coupled to a single loop via mutual inductance, thus adding the currents together. The next JJ neuron is set up such that its critical current is only exceeded when both previous JJ neurons are activated. To create the XOR gate, a similar set-up is employed. However, due to the nature of Josephson junctions, the activation range is periodic [Figure 3]. Using this property, current addition can be performed to bring the input current into the range that no longer activates the neuron, thus allowing the neuron to fire only when a single previous neuron is activated. Figure 4 shows a JJ-neuron based half-adder performing the desired logical operations.

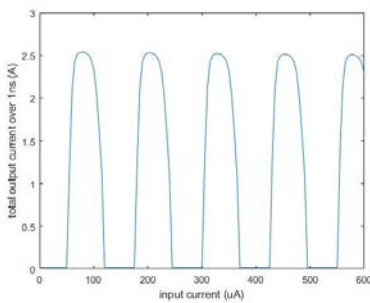


Figure 3: Activation ranges of a JJ neuron.

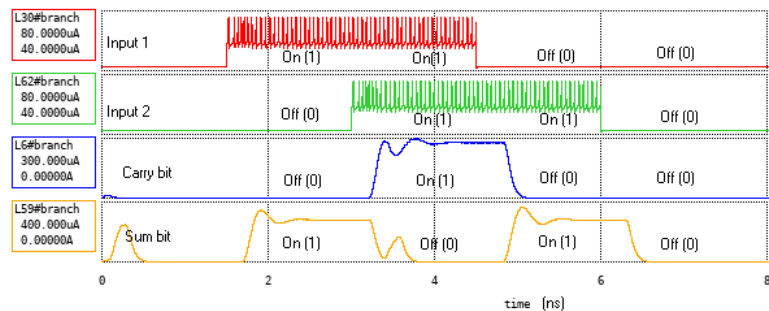


Figure 4: Input and output currents of a JJ half-adder.

Research Fellow: Chloe Malinowski (2022)

Concentration(s): Astronomy/Physics; APMA

Faculty Mentor: Thomas Balonek

Department: Physics and Astronomy

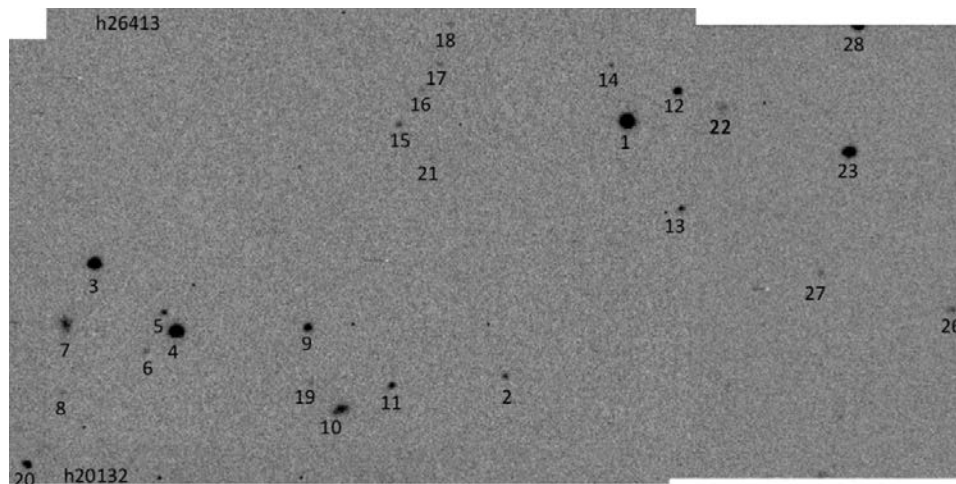
Title of Project: Optical Variability of Quasars and Stars at the Colgate Observatory

Funding Source: NASA New York Space Grant

Project Summary:

Before the process of analyzing the optical variability of any quasar could begin, we first had to understand the efforts of image processing. To create a properly organized and efficient procedure for determining the magnitude of Quasar 1308+326, J. Slater, M. Sampson, V. Unnone and I had to learn how to use Image Reduction and Analysis Facility (IRAF) and manually examine the potential flaws of images taken at Foggy Bottom Observatory (FBO). Within IRAF, we were able to use three programs coded by previous research students called Superproc, Superphot, and Superflux to analyze over 1,000 images of Quasar 1308+326.

When dealing with raw images, there are two main things to consider: noise from the sky and noise from the CCD camera itself that cloud the data that we actually wish to obtain. In order to rid ourselves of this noise, images taken from FBO must be flat field corrected; in doing this, a dark, or an image containing the camera's own noise, and a skyflat, an image containing the sky's own noise, are subtracted from the raw image of the quasar, eliminating as much noise as possible. Fortunately, the program Superproc did this all for us at our command. Since we expect Quasar 1308+326 (labeled as "2" on the image below) to be variable, it must then follow that we compare its magnitude, or brightness, to another object in the image, one remaining at a constant magnitude. Fortunately, a star we refer to as Comp. Star 1 (labeled as "1" on the image below) is accepted to be constant in magnitude, although it should be made clear that this remains unknown. By running Superproc, we were able to manually view each image, look for variations of trailing objects, and determine if images were worth using at all. The four of us broke into two pairs of two and attacked the task of analyzing every image of Quasar 1308+326 taken by this CCD camera. In the end, Superproc produced a .cmag file that was intended to be read by the program Superflux. This last program was able to use this file to produce the magnitude of every object within an image; I say this because no image was able to contain all 28 objects in it at once. It is from this data that we are able to begin graphing the magnitude of Quasar 1308+326 over extensive periods of time.



A template created by J. Slater to identify the locations of objects in each image.

Research Fellow: Caitlyn “Caity” Marentette (2022)

Concentration(s): Anthropology; History

Faculty Mentor: Noor-Aiman “Noor” Khan

Department: History

Title of Project: Analyzing Military Correspondence Between the Mughal and Ottoman Empires

Funding Source: SOSC Division

Project Summary:

Recent decades have demonstrated the birth and growth of social history, a subtopic of historical discipline that represents individuals of a society from a bottom-up perspective. With this intellectual movement, several others simultaneously took place, critiquing the centuries-old practice of Western historical pedagogy, which comprised itself of the stories of rulers, majors’ wars and military leaders, the rich, the socially-advantaged, and a comparative (and problematic) East-West dichotomy. In my research, I have attempted to exercise two intellectual ideas: one, I attempted to utilize an aspect of popular historical study, the Mughal Empire military, in a context that prioritizes the cultural identity production of a common unit—the cavalry. This requires being aware of how history was recorded, from where I received my sources, and an intellectual focus on the common military units, not governing bodies or wealthy foreigners, to consider this a work of social history. Secondly, in order to carefully and thoughtfully study the Mughal Empire military, it is important to be aware of preconceived notions regarding how people perceived the world around them, and how prior Orientalist discourse has affected study of the region. In a premodern South Asian society, the concept of “nation” and “state” was not applied to governing regions. Furthermore, while India had one absolute governing figure, the geographical stretch of premodern India, the multiplicity of religions, the differing governing structures across the subcontinent, the linguistic variations and sociocultural discrepancies fostered a highly regionalized and heterogeneous unity.

My research project, “Considering the Social Classification of Early 17th Century Mughal Military Subjects,” focuses on the role of cavalry units—specifically the importance of man-horse pairings, the social significance of the horse in South Asia, and the social classification of military figures through their documentation in *’arz-o-chehrah*, or “muster master” scrolls. This project touches upon the similarities in social structure and etiquette across the Gunpowder Empires, which comprised of the Ottoman, Safavid, and Mughal Empires, through their mutual interest in specific horse breeds. It also questions and highlights the importance of horses through history, considering them not as commodities, but as cultural relics, entities of worship, social status markers, and effective military bodies. Focusing on classification systems, I have investigated how a military unit is classified, including but not limited to one’s lineage, one’s military rank, one’s geographical origin, and more. Through this study, it becomes evident that horses reveal much about a person’s ranking—sometimes even revealing other identifying information about the soldier, such as geographic origin or ancestral lineage. Lastly, this research provides insight to classification systems within the Mughal Empire, oftentimes highlighting the fact that classification did not subscribe to modern Westernized categorizations, such as race and ethnicity. While methods of classification saw some similarities, such as linguistic homogeneity, their contents reflected the differences posed by each region within the Empire. This in turn created a complex system of categorization that considered several components to the cavalry unit identity.

Research Fellow: Philip Matos (2021)

Concentration(s): Physics; Mathematics

Faculty Mentor: Rebecca Metzler

Department: Physics and Astronomy

Title of Project: Biominerals: exploring composition, structure, and function

Funding Source: NASC Division; Volgenau Wiley Endowed Research Fellowship

Project Summary:

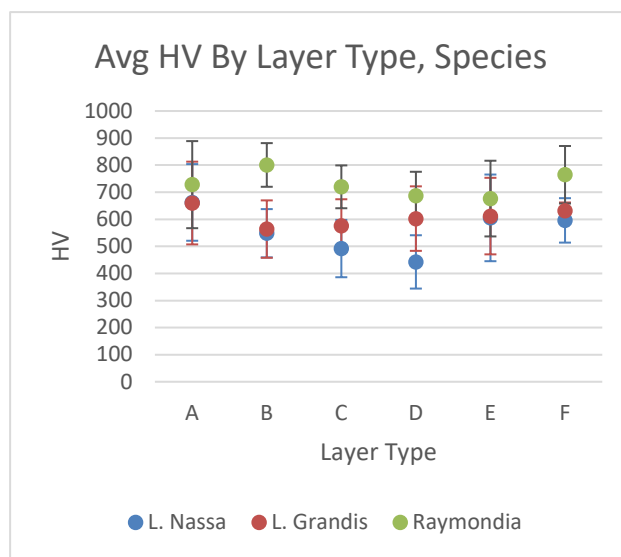
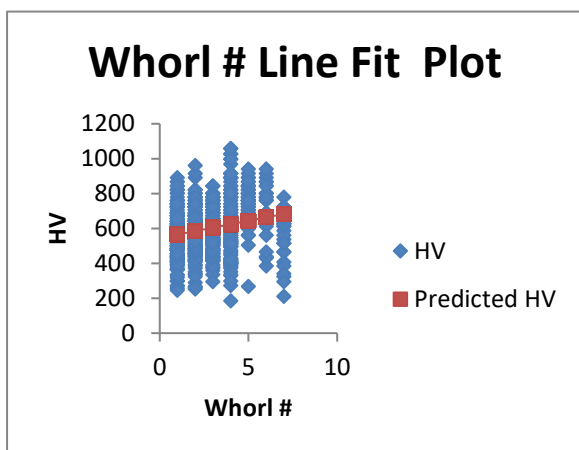
Lake Tanganyika, the second largest and oldest lake in the world, hosts a vast diversity of marine life. An especially fascinating element of its ecosystem is the co-evolution between some of the snails and crabs. The snails, aiming to avoid being eaten by the crabs, developed harder shells. In turn, the crabs developed stronger claws to open up the shells. This led to even stronger shells, and the cycle continues. We focused in on these notably stronger-than-average shells of some these snail species (specifically, *Lavigeria Grandis*, *Lavigeria Nassa*, and *Reymondia*) to try to pin down traits that correlated to stronger shells.

This was done using data collected over previous summers on the structures of the shells. The shells are composed of crossed-lamellar crystal structures forming primary layers, which are placed over each other to form laths, which in turn are stacked to form sheets. Certain shells are oriented so that some of the sheets have their layers oriented with an offset between 70° to 90° against the sheets above or below, which we believed might have been correlated with a high shell strength. The prior collected data had recorded the hardness of each layer along with the “whorl number” of that layer (where in the whorl it shows up, understanding that layers further out in the shell were made by the snail later in its life) and classified each layer with a type under the following options:

Layer Type	Description
A	Pattern perpendicular to whorl
B	Pattern moves clockwise
C	Pattern moves counterclockwise
D	Pattern parallel to whorl
E	Disorganized pattern
F	Grey pattern

This summer, the data was taken from tables of individual organisms and compiled into larger ones grouped by species to do further data analysis. These tables were organized by whorl number and layer type in order to look for any statistically significant difference in average hardness between categories. Single factor ANOVA tests were run. If the p-value was lower than 0.05 (which was more often the case than not), then the values were further explored to see *which* specific categories were notable against each other. This was done so using a Tukey-Kramer test on every single possible pair, utilizing the information generated by the ANOVA test. In addition, linear regressions were run on average hardness vs whorl number to see if there was any progression in the hardness.

We found that the most successes occurred for *L. Nassa* and the combined *Lavigeria* genus (*L. Grandis* put together with *L. Nassa*). With this, we were able to find that the perpendicular layers we were looking for (layer type A) had on average a greater hardness and that this hardness was statistically significant compared against all other layer types. In addition, we found a positive correlation between hardness and whorl number.



Research Fellow: Eric Matt (2022)

Concentration(s): German; Physics

Faculty Mentor: Kenneth “Ken” Segall

Department: Physics and Astronomy

Title of Project: Artificial Neurons Using Superconductors

Funding Source: Volgenau Wiley Endowed Research Fellowship

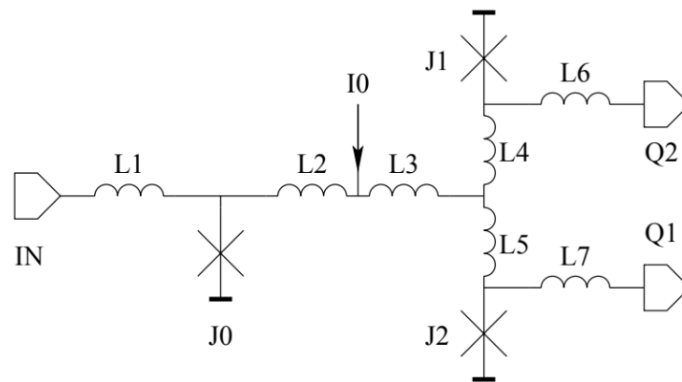
Project Summary:

Moore’s law, which states that the number of transistors in a microchip doubles every two years, has been the driving force behind the development of computers since their creation. However, as the number of transistors on these microchips have increased over the years, it is becoming increasingly difficult to scale down their size to accommodate the growing number. This has resulted in the prediction of 2025 as the termination of Moore’s law where it will no longer be financially or physically possible to keep scaling down and adding transistors. This has led to a significant amount of research in alternative computing methods that veer away from the use of transistors in favor of more efficient options in terms of speed and power usage. One of the leading candidates in this research is the use of a superconducting element known as the Josephson Junction (JJ). In a collaboration among three Colgate professors, it was discovered that this circuit element can be used to create a biologically accurate artificial neuron, which opens the door to a model of neuromorphic computing.

The ultimate goal of this summer project was to take these previously modeled synapse components, and connect them all together in such a way as to create a fully functional artificial learning synapse. In support of this goal, I spent the majority of my time designing a splitter circuit element, which takes an incoming action potential pulse and splits it into two identical pulses. In this process it is important to maintain the shape, velocity, and amplitude of the pulse, while also minimizing any deformities and propagation time. To do this, I used

a circuit simulation and analysis software known as WRspice. To the right is a diagram of a splitter where an input signal comes in on the left branch and is split into two separate signals on the right branches. The input signal originates from a Josephson Junction Neuron, which is connected to this splitter circuit via another superconducting circuit known as a Josephson Transmission Line. This transmission line is used to transport a SFQ pulse across some physical distance and can also be

used to gradually transform inherent properties of the pulse if needed. Once the splitter circuit is optimized according to the properties of the incoming pulse, the outgoing pulses can be manipulated or split again according to how they are being used. My work culminated in a splitter circuit that was designed specifically to interact well with other circuits designed by students for use in the overall learning synapse.



Research Fellow: David Maynard (2021)

Concentration(s): Molecular Biology; Spanish

Faculty Mentor: Jason Meyers

Department(s): Biology; Neuroscience

Title of Project: The Wnt/B-catenin pathway and Notch Signaling are necessary for neuromast regeneration in zebrafish

Funding Source: Michael J. Wolk '60 Heart Foundation

Project Summary:

Zebrafish (*Danio rerio*) are a useful model organism as they exhibit physiological, developmental, and genetic similarities with humans (Meyers, 2018). They are of particular interest for regeneration studies as they successfully regenerate the limbs, heart, brain, eyes, and other neural stem cells upon injury (Gemberling et al., 2013). This regenerative capability is applicable to the mechanosensory lateral line system, which the fish use to detect water movement patterns along the side of their bodies (Chitnis et al., 2011). The lateral line consists of a series of organs called neuromasts that contain mechanosensory hair cells that are surrounded by support cells (Head et al., 2013). These hair and support cells are then encompassed by mantle cells to complete the neuromast (Seleit et al., 2017). Understanding how the neuromast regenerates could potentially have human applications as its hair cells are similar to the hair cells found within the human ear. It is known that support cells give rise to hair cells (Pinto-Teixeira et al., 2015), and our lab has provided evidence that mantle cells give rise to support cells (Figure 1), but the signaling pathways that dictate neuromast regeneration are not fully understood.

It has been proposed that the Wnt/B-catenin pathway and Notch signaling are involved in the regeneration of hair cells. (Kniss et al., 2016). The Wnt/B-catenin pathway induces proliferation in neuromasts (Head et al., 2013) while Notch signaling is involved in hair cell and support cell differentiation (Haddon et al., 1998). We investigated how these two pathways may be involved in neuromast regeneration with mantle cells serving as the lone progenitors. Our lab has previously developed an effective method to eliminate hair and support cells. Zebrafish are exposed to Hoechst nuclear dye which binds to DNA and stains nuclei blue. Using a confocal microscope, hair and support cells can be selectively exposed to a UV light laser (Figure 1a). UV light exposure leads to free radicals within the nuclear dye that causes damage and induces cell death (Figure 1b). Within 24 hours mantle cells collapse together (Figure 1c) and after seven days the neuromast is found to be fully regenerated (Figure 1d).

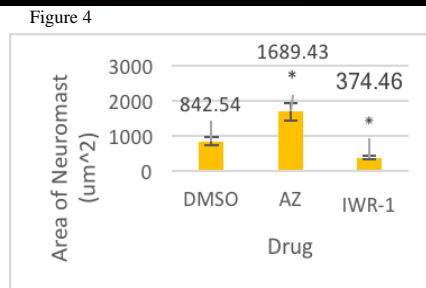
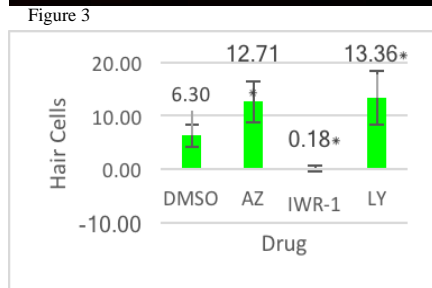
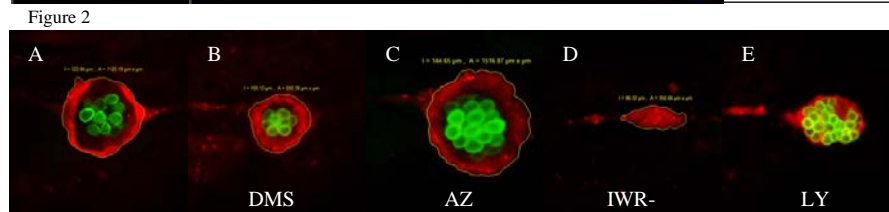
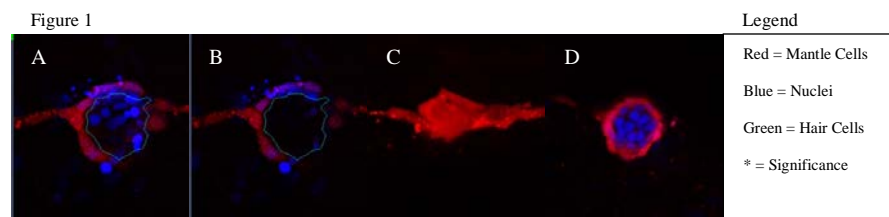


Figure 1: Mantle cells serve as progenitors in neuromast regeneration. A) Neuromast before injury. B) Neuromast after injury. C) Neuromast 24 hours post injury. D) Neuromast seven days post injury.

Figure 2: Wnt/B-catenin and Notch signaling pathways play a role in neuromast regeneration. A) Healthy neuromast before injury. B) Neuromast with DMSO treatment three days post injury. C) Neuromast with 1-azakenpaulone (AZ) treatment three days post injury. D) Neuromast with IWR-1 treatment three days post injury. E) Neuromast with LY411 (LY) treatment three days post injury.

Figure 3: Alterations in Wnt/B-catenin pathway and Notch signaling significantly affect hair cell regeneration. An upregulation of the Wnt pathway (AZ treatment) significantly increases hair cell regeneration compared to the control (DMSO) ($p=4.32 \times 10^{-8}$). A downregulation of the Wnt pathway (IWR-1 treatment) significantly decreases hair cell regeneration ($p=4.10 \times 10^{-11}$). An inhibition of Notch signaling (LY treatment) significantly increases hair cell regeneration ($p=3.05 \times 10^{-7}$).

Figure 4: Alterations in the Wnt/B-catenin pathway significantly alter neuromast size upon regeneration. An upregulation of the Wnt pathway (AZ treatment) significantly increases the size of the regenerating neuromast compared to the control (DMSO) ($p=3.72 \times 10^{-10}$). A downregulation of the Wnt pathway (IWR-1 treatment) significantly decreases the size of the regenerating neuromast ($p=1.07 \times 10^{-10}$).

Using this laser ablation method, hair and support cells were removed, and then fish were treated with drugs to manipulate signaling pathways. Thus, signaling pathways were only affected during neuromast regeneration. In order to observe the effects of the Wnt/B-catenin pathway on neuromast regeneration, a group of fish were treated with 1-azakenpaulone, a reagent that upregulates the pathway. Another group was treated with IWR-1, a reagent that downregulates the Wnt/B-catenin pathway. To observe the effects of Notch signaling on neuromast regeneration, a separate group of fish were treated with LY411 (LY), a reagent that inhibits Notch signaling. As a control, some fish were treated with dimethyl sulfoxide (DMSO), the solvent used for all the drugs. DMSO has no effect on signaling pathways as this group of fish shows signs of normal neuromast regeneration three days post injury (Figure 2b). They are progressing towards a fully healthy, uninjured neuromast (Figure 2a). However, compared to DMSO treated fish, fish treated with AZ were found to have larger neuromasts with more hair cells just three days post injury (Figure 2c). Inversely, fish treated with IWR-1 were found to have smaller neuromasts with little to no hair cells three days post injury (Figure 2d). Thus, upregulating the Wnt/B-catenin pathway increases the rate of neuromast regeneration while downregulating said pathway halts neuromast regeneration. Furthermore, fish treated with LY were found to have neuromasts with an abundance, if not an entirety, of hair cells three days post injury (Figure 2e). Thus, Notch signaling is necessary in neuromast regeneration for cell differentiation.

From these different fish groups, it was found that AZ treatment significantly increases hair cell count during regeneration ($p=4.32 \times 10^{-8}$), IWR-1 significantly decreases hair cell count (4.10×10^{-11}), and LY significantly increases hair cell count ($p=3.05 \times 10^{-7}$) (Figure 3). Furthermore, AZ treatment significantly increases the size of the neuromast during regeneration ($p=3.72 \times 10^{-10}$), and IWR-1 significantly decreases the size of the neuromast ($p=1.07 \times 10^{-10}$) (Figure 4).

In conclusion, it has been found that the Wnt/B-catenin pathway affects neuromast size and hair cell count during regeneration. Notch signaling also affects hair cell count during neuromast regeneration. These two pathways are necessary for the regeneration of neuromasts when mantle cells serve as progenitors. Future experiments may include further drug testing to explore other signaling pathways that may be used in neuromast regeneration. BrdU labeling to identify proliferating cells may also give greater insight into the regeneration of neuromasts.

References
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Research Fellow: Rachel Meyne (2021)

Concentration: Geology

Faculty Mentor: Amy Leventer

Department: Geology

Title of Project: Characterizing the Biological Signature of Deglaciation

Funding Source: Bob Linsley/James McLelland Fund

Project Summary:

The primary objective of this project was to characterize the biological signature of deglaciation as recorded in continental shelf sediments from East 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. This project focused on a core that preserved shelf sediments deposited since the Last Glacial Maximum and covering the time period over which glacial ice streams rapidly retreated. This sediment core was 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 over deepened 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 analysis focuses 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.

This summer I analyzed absolute diatom abundances and assemblage composition of jumbo piston core (JPC) 43. I will use this data to infer paleoceanographic conditions related to glacial retreat during the Holocene. Comparing the record from JPC 43 to records from other cores recovered from the Sabrina Coast will allow us to investigate how deglacial processes can vary both spatially and temporally. 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.

Research Fellow: Colin Miller (2022)

Concentration: Biochemistry

Faculty Mentor: Ephraim Woods

Department: Chemistry

Title of Project: Heterogeneous Photochemistry of Tropospheric Aerosol Particles

Funding Source: Beckman Scholar Program

Project Summary:

The project is focused on atmospheric chemistry, or the interactions of different molecules and particles that are present in the atmosphere. More specifically, we are looking into the effects of iodine on the destruction of ozone as well as how it helps to create aerosol particles. Iodine is known to act as a reactant with ozone, a prevalent molecule in both the troposphere and stratosphere to create a multitude of interesting molecular species, most notably iodate (IO_3^-). Iodine also acts as a precursor to the formation of cloud condensation nuclei (CCN) which are molecules that attract water droplets as well as other molecules to create larger particles. The creation of clouds is known to have a direct effect on the heating of the Earth's surface. Cloud coverage has a cooling effect to combat the heating effect caused by greenhouse gases like carbon dioxide and methane. One of the key aspects of atmospheric chemistry that has not been thoroughly studied is the kinetics, or the speed of the reaction and the stages the reactants progress through to form the final products. Though we were unable to work with our experimental apparatus, which would allow us to gather kinetic data while imitating the actual environment where these reactions would take place, we were able to gather some interesting information utilizing Gaussian and GaussView.

This summer was spent utilizing the capabilities of GaussView to obtain thermodynamic data while becoming more familiar with GaussView and the options it has to offer. I was able to learn a lot more about things like basis sets and solvent models and how they are used by GaussView to calculate optimal geometries as well as gathering vibrational data of certain molecules. These calculations were done in order to make some comparisons with our novel method of data collection with currently accepted, but non-ideal methods. I also reviewed some recent literature about the creation of intermediates with iodine and ozone. This summer has been a good experience for becoming acquainted with the science behind iodine due to this summer being the first part of a 15-month-long research period before becoming more involved with the experimental apparatus. I was able to calculate some adiabatic and vertical binding energies for different molecular species using the aforementioned basis sets and GaussView. While a portion of the summer was spent verifying results with previously published literature, these values have not been reported and will help to provide insight into the kinetics and molecular pathways of the reactions of iodine and ozone.

Species	Eo (none)	Eo (default)	Eo (IEFPCM)	Eo (SMD)	Eo (CPCM)	EBE (none)	EBE (default)	EBE (IEFPCM)	EBE (SMD)	EBE (CPCM)
IO3	-521.3101032	-521.3222211	-521.3222211	-521.3453912	-521.3223087	0.1674278	0.2523511	0.2523511	0.2507376	0.2523802
IO3-	-521.477531	-521.5745722	-521.5745722	-521.5961288	-521.5746889	4.555944837	6.866826723	6.866826723	6.822921129	6.867618574
IO2	-446.1529409	-446.1668831	-446.1668831	-446.1874485	-446.1669731	0.09385	0.1788208	0.1788208	0.1755739	0.178819
IO2-	-446.2467909	-446.3457039	-446.3457039	-446.3630224	-446.3457921	2.55378989	4.865964317	4.865964317	4.777611622	4.865915337
IO	-370.9687574	-370.9736685	-370.9736685	-370.981917	-370.9736988	0.0884725	0.181407	0.181407	0.1826835	0.1814217
IO-	-371.0572299	-371.1550755	-371.1550755	-371.1646005	-371.1551205	2.407460586	4.93633844	4.93633844	4.971073792	4.936738447
I3	-887.4328498	-887.4343265	-887.4343265	-887.4395921	-887.4343386	0.1539667	0.2185705	0.2185705	0.2062301	0.2185749
I3-	-887.5868165	-887.652897	-887.652897	-887.6458222	-887.6529135	4.18964946	5.947609304	5.947609304	5.611809743	5.947729034
I2	-591.6320124	-591.633744	-591.633744	-591.637794	-591.6337595	0.1014449	0.1762208	0.1762208	0.1661518	0.1762277
I2-	-591.7334573	-591.8099648	-591.8099648	-591.8039458	-591.8099872	2.760457752	4.795214677	4.795214677	4.521223091	4.795402436
I	-295.781703	-295.7830076	-295.7830076	-295.7856229	-295.7830191	0.1213589	0.2140907	0.2140907	0.209833	0.2140792
I-	-295.9030619	-295.9970983	-295.9970983	-295.9954559	-295.9970983	3.302345571	5.825707674	5.825707674	5.709849696	5.825394743
I2O-	-666.9079256	-666.982895	-666.982895	-666.9831967	-666.9829096					
I2O2-										
I2OH	-667.4350094	-667.4398663	-667.4398663	-667.4474065	-667.4399022	0.1390036	0.2117408	0.2117408	0.2034106	0.2117478
I2OH-	-667.574013	-667.6516071	-667.6516071	-667.6508171	-667.65165	3.782482561	5.761763605	5.761763605	5.535087201	5.761954085
HOI+	-371.2715024	-371.3739415	-371.3739415	-371.4093965	-371.373973	0.3604738	0.2629545	0.2629545	0.2340252	0.2629613
HOI	-371.6319762	-371.636896	-371.636896	-371.6434217	-371.6369343	9.808996761	7.155360081	7.155360081	6.368153327	7.155545119
IOO0		-521.3583984	-521.3583984			0.1422864	0.1422864			
IOO0-	-521.4125635	-521.5006848	-521.5006848	-521.5090388	-521.5007431	3.871812145	3.871812145	3.871812145		

Fig. 1: A table of calculated values for the various molecular species associated with reactions between iodine and ozone. This table was created by calculating the energy level of both the ionized and unionized form of the species and then subtracting them and converting Hartree's to electron volts to obtain the theoretical values for ionizing the respective species.

Research Fellow: Savannah Milton (2021)

Concentration: Anthropology

Faculty Mentor: Jordan Kerber

Department(s): Anthropology; NAST

Title of Project: The Afterlife of Graves: Visitor Motivations and the Ethics of Dark Tourism

Funding Source: SOS Division

Project Summary:

The focus of this summer research project was the effect of Covid-19 on local museums in Florida and New York state, and how quarantine has affected the digital programming and outreach of these museums. Though digital technologies and outreach are rapidly becoming an essential part of public education, anthropology, art, and historical museums are often seen frozen in time, and as temples and storehouses of learning. The introduction of digital programming to museums, though it has made significant strides in recent years, was still an underutilized resource before quarantine. This is in part because museums rely heavily on visual learning anchored in a physical space, and due to a lack of budget or expertise required to create and maintain digital programming in addition to regular programming. Quarantine and the shut-down of physical museums therefore provided an unprecedented window into the digital future of museums, and insight into some of the challenges and rewards museums encounter when digitizing. This project primarily focused on a number of small museums, however some larger museums such as the MET and the New York State Museum were included as a basis for comparison. These small museums often do not have the funding to experiment with as many forms of audience engagement as larger museums and rely on and engage with a much smaller audience base. With over 11,000 American museums and 13% of museums worldwide predicted to permanently close, I sought to understand how this difference in size and structure affected their approach to outreach programming. I also decided to look at the reactions of museum patrons to the influx of content online, and their usage before and after digital resources provided by museums.

Because the academic literature primarily focuses on digital programming from a museum staff standpoint, I felt it was critical to gather information on the visitor's perspective to fill this gap in the literature. A total of 81 participants responded to an online survey with ages ranging from 18 to 88 years of age. Some questions were optional, and therefore have fewer responses than the total number of survey participants. When asked, museum patrons named distance, crowds, time, and cost as the primary obstacles that discouraged them from visiting museums. Of the 43 responses to the question "Have the digital resources provided by museums provided a way to navigate any barriers you may have mentioned in the previous section?", 55.8% said digital programming had helped them overcome previously mentioned barriers, with an additional 18.6% saying that though they were useful, they did not frequently use digital resources or that, while helpful, they could not compare to an in-person experience. Of the 81 respondents, 29.8% reported that they used museum resources more frequently during/after quarantine, while 35.8% responded they used them the same amount before and during quarantine. 34.6% said they did not use digital museum resources more following quarantine. Suggestions by visitors regarding programs they would like to see more of included: virtual reality simulations and 3D models, guided and 3D tours, virtual seminars and talks, and more resources for different learning levels and curricula.

While interviewing staff at both small and large museums in New York state and Florida and examining social media pages and other digital resources, three main challenges included budgeting, balancing digital marketing with a museum's education mission, and concerns about intellectual property rights and accessibility. Though compared to large museums, small museums tended to have a limited number of websites and social media accounts as well as a smaller number of followers, there is a higher degree of collaboration and communication both within the museum structure, and with museum patrons. Small museums rely more heavily on their ability to be flexible, and directors and staff take on multiple roles. Therefore, while their overall spread across the internet may be more limited, small museums are in a position where a personal level of engagement is already highly prioritized. Though this is partially out of necessity, as small museums do not have the fame to attract large numbers of visitors, it also reflects the trend of museums moving towards a multivocal system that emphasizes the social role of museums in the community. This development was also emphasized throughout the summer, as museums across the nation provided relief for homeless populations, collected community stories regarding life during quarantine, highlighted voices from marginalized communities, and partnered with students to provide safe spaces to make signs for peaceful protests and to facilitate dialogue about the colonial history of museum. I aim to analyze and interpret further the results of this study as part of my capstone thesis in the anthropology senior seminar this fall.

Research Fellow: Marisa Modugno (2022)

Concentration: Peace and Conflict Studies

Faculty Mentor: Julie Dudrick

Department: Upstate Institute

Title of Project: Creating a Board Portal for the Oneida County History Center

Funding Source: Upstate Institute

Project Summary:

Since 1876, the Oneida County History Center (OCHC) has been dedicated to preserving and promoting the history of the region. Located in Utica, New York, the OCHC hosts exhibits, a research library, and a variety of weekly programs. This summer, I worked with the OCHC in a variety of capacities.

My main project was the creating a board portal. A board portal is a secure platform for nonprofit boards to coordinate schedules, upload organizational documents, record meetings, and more. Initially, I sat down with the Director for Education and Outreach and the Interim Executive Director. Together, we identified the needs and requirements of the organization; they needed a platform that was secure, easy to use, and within budget. I researched platforms that met these requirements and we ultimately decided to use Google Sites through G-Suite for Nonprofits. Next, we developed a system of organizing their documents into categories. Finally, I created a tutorial for uploading documents and maintaining the system to ensure ease of access.

Besides my main project, I updated their online bookstore. I added descriptions and cataloged books that required more information. I also researched and recommended titles to be added to the bookstore, including local history books and books by local authors. Finally, I also learned a lot about local history through writing articles on historical events that impacted Utica as well as editing and compiling biographies for Living Legends and Hall of Fame nominees.

Because of the pandemic, I worked remotely from my home in Canada. From March to June, the OCHC hosted online events, including virtual lectures, and the staff worked remotely. The Center itself began preparing for reopening in June when a few staff members were able to return to the office. They developed cleaning protocols, curbside-pickup for bookstore purchases, and procedures for volunteers and visitors. Both directors said that this experience has been extremely exciting and challenging. The directors were happy to welcome back their regular volunteers and fully reopen on July 13th.

Research Fellow: Anne “Annie” Mollman (2021)

Concentration: Biology

Faculty Mentor: Timothy “Tim” McCay

Department(s): Biology; ENST

Title of Project: Recolonization of northern North America by native, wetland-dependent earthworms (*Sparganophilus eiseni* and *Eisenoides lonnbergi*) following glacial retreat

Funding Source: Michael J. Wolk '60 Heart Foundation

Project Summary:

Although earthworms are important bioindicators of soil quality, many species are vastly understudied. This is especially true for native earthworms in the Northeast. Two such species of native earthworms, *Eisenoides lonnbergi* and *Sparganophilus eiseni* have distributions that are relatively unknown. Both are obligate wetland species, meaning they occur in saturated soils or standing water. While *E. lonnbergi* is typically found in wetlands with stagnant water, *S. eiseni* is more commonly found along stream banks.

The Post-Quaternary Introduction Hypothesis posits that native earthworms were eliminated from northern latitudes by glaciation and that most, if not all, earthworms above the lower limit of glaciation are introduced exotic species. Recent evidence, though, suggests a relatively wide northern distribution for these two semi-aquatic native species. Thus, it is of interest to better understand the ways in which those species have recolonized northern latitudes more extensively than many other North American native species.

We aimed to create a model to explain the pattern of post-glacial recolonization for these species. This model was based on the assumption that these species disperse only through suitable habitats (wetland areas). Because cocoons (cases with eggs) are known to move in streams, we further assume that cocoons drifting in streams can be a method of dispersal, and that rapid streams (flowing down a steep gradient) can move cocoons more quickly than slow streams.

Using QGIS software, a model was constructed that focused on New York due to the ease with which sampling could be done. The model was used to predict areas of low, medium, or high likelihood of colonization based on distance from glacial refuge, slope, water features, and landform.



We sampled a number of locations in Madison county and the surrounding counties to confirm the presence of *Sparganophilus eiseni* at locations with a high likelihood of recolonization. Sampling occurred until sufficient individuals were collected to confirm their presence at each location, and attributes of the location were recorded.



Pictured above is *Sparganophilus eiseni*, as found in Payne Creek, in Hamilton, NY. *S. eiseni* is notable for its collar which exists in close proximity to the mouth of the organism. The way in which the individual curls up is distinct. This specimen was found in saturated rocky soil on the bank of the creek, as seen in pictures two and three. Preliminary sampling has both supported the basic premises of our model and has suggested areas for further refinement. This work will continue in the fall semester.

Research Fellow: Elizabeth “Lizzy” Moore (2021)

Concentration(s): PCON; Geography

Faculty Mentor: Julie Dudrick

Department: Upstate Institute

Title of Project: The Center: Serving Diverse Communities in a Virtual World

Funding Source: Upstate Institute

Project Summary:

The Center in Utica, formerly known as the Mohawk Valley Resource Center for Refugees, assists refugees, immigrants, and those with limited English language proficiency through a variety of services aimed to help these populations achieve independence and self-sufficiency. These include interpretation and translation services; assistance in accessing healthcare, employment, and immigration services; educational programming such as English language classes and cultural competency training; and much more. My research is focused on outreach strategies in diverse communities like Utica and how these strategies have changed due to the pandemic. I examined the literature available on challenges faced by organizations like The Center and suggestions for improved community outreach methods. Using this information, I conducted interviews with representatives from peer organizations around the country and I was able to learn about the diverse ways that the changes caused by COVID-19 are being addressed.

Although social service organizations provide vital assistance to vulnerable members of our communities, they face a host of challenges in carrying out their mission. A lack of a clear outreach message can create a disconnect between the organization and their clients, partners, and community members. Clients may feel insecure in their communities, especially due to socioeconomic or immigration status. This can hinder their ability to feel a sense of belonging or to enjoy public spaces. Decreased funding due to changing government policies and conditions attached to available funding can hinder organizations from being able to plan and implement programs that better respond to the needs of their clients. These challenges have, in many ways, been exacerbated by the COVID-19 pandemic. Due to the varied levels of technology literacy and limited internet availability in the communities served by these organizations, ESL classes and employment services can see decreased participation when only offered via the internet. Funding limitations can prevent these organizations from connecting clients with the technology needed to conduct vital services via the internet. This is particularly an issue in 2020 because, as the economy lags, funding from private donors decreases while major fundraising events are now canceled. Furthermore, the pandemic has led to decreased staffing as workers care for themselves and their families.

Interviews with social service organizations across the country revealed a variety of methods for addressing these challenges. Refugee Services of Texas was able to provide their clients with tablets and Chromebooks through donations, allowing a greater portion of the community to access virtual services from the organization. The Refugee Development Center in Lansing is conducting ESL classes over the phone for households that do not have access to a computer or internet. Interfaith Ministries of Greater Houston hosted their fundraising gala online and delivered meals to the homes of attendees to give them a better experience. These are just some examples of these organizations adapting to the virtual world that has developed in response to COVID-19. The Center may be able to adapt some of these ideas to better serve the diverse needs of the Utica community.

Research Fellow: William “Will” Nagle (2020)

Concentration: International Relations

Faculty Mentor: Robert Kraynak

Department: Political Science

Title of Project: Weber and Tocqueville on American Political Culture: The Protestant Ethic and Democratic Morality

Funding Source: Center for Freedom and Western Civilization

Project Summary:

In times of increasing political and social turmoil in America, it can sometimes feel as if the fervor that animates the people that partake in civic life has accelerated beyond even the most pressing of issues. To gain a sense of perspective, it can be useful to not just draw inspiration from past Americans, but also to ‘see ourselves as others see us’ by considering the thinking of foreigners examining our country. Two such writers in particular have substantially contributed to the creation of a distinctly American narrative, and have also shared the experience of visiting the United States. The first, Alexis De Tocqueville, travelled to America at the behest of the government of France in 1830. The resulting two-volume work, *Democracy in America*, stands as the culmination of his studies and remains immensely popular among a diverse set to this day. The second, Max Weber, began writing a series of sociological essays in 1904 and 1905 that later became *the Protestant Ethic and the Spirit of Capitalism*, centered to a large extent on America. These two writers might seem too different to compare at first glance. Tocqueville lived at a time when the forces of modernity and democracy had just begun to permeate the West, and the old religion and politics retained some moral force while the afterglow of High Enlightenment thinkers like Montesquieu, Descartes and Rousseau still shined brightly. Weber, on the other hand, wrote in the wake of the industrial revolution’s dramatic reshaping of society, compounded by German thinkers like Marx, Nietzsche, and even Kant’s critiques of established orders. The perhaps overwhelming differences in the two men’s outlooks can at first glance be seen in their divergent theses. Tocqueville emphasizes that America is a place where the “equality of social conditions” reigns and will fundamentally reshape society, with the question ahead being only how to channel this democratic instinct. Weber, for his part, seeks an explanation for the monumental rise of capitalism in Protestant Christianity itself, with the American founding father Benjamin Franklin embodying this phenomenon and by proxy the American national character. In the figure of Benjamin Franklin, we can roughly trace an outline of each author’s two theses: Is Franklin the prototypical democratic man, ascended from poverty to become a national icon? Or might he best be described as a secularized Puritan, combining remnants of his father’s Calvinism with capitalism and industry? In this paper, I test each writer’s thesis in turn on both the man himself through various secondary sources and biographies, as well as his self-presentation in his renowned *Autobiography of Benjamin Franklin*. Through this examination, I find that Weber and Tocqueville might indeed prove complementary in understanding the real Benjamin Franklin: A thoroughly democratic “new man” to be sure, yet undoubtedly driven by a secular “calling” that was to a degree rooted in his Protestant heritage. By avoiding a reductive view of Franklin and instead seeing him as a man of many masks, we can reconcile the perspectives of two Enlightenment thinkers towards a more robust understanding of the American national character.

Research Fellow: Bao Nguyen (2022)

Concentration: Computer Science

Faculty Mentor: Hiva Samadian

Department: Computer Science

Title of Project: Structural Properties of Solvable Graphs for Multiple Robot Motion Planning

Funding Source: Holden Endowment Fund

Project Summary:

In multiple robot motion planning (MRMP), a Solvable or Reachable Graph for m robots (SG^m) is a graph that any arrangement of a specified number of mobile agents located on the graph's vertices can be reached from any initial arrangement through agents' moves along the graph's edges. In this research, the topological properties of SG^m were investigated to answer the problem of deciding whether a graph is Solvable for m robots, without explicitly solving it. We proved several necessary and sufficient conditions for several basic topologies. Results of this research, when is completed, can be used in designing transportation networks (e.g. railways, traffic roads, AGV routes, robotic workspaces, etc.) for multiple moving agents such as trains, vehicles, and robots.

Our approach to the problem, which is called the Multi Robot Motion Planning (MRMP) problem, starts with constructing a graph from a given workspace and scenario (set-up of robots). This graph is one whose vertices include each robot's initial position, destination, and all locations where the robots are allowed to temporarily stop at. The motion of these robots is along the graph's edges, which must pass through free spaces to ensure there is no collision with obstacles in the workspace. We are then concerned with the relationship between the topological characteristics of these graphs and the solvability of the MRMP problem. This required several definitions and results to be established.

We defined a graph to be *Solvable* for m robots if any *Mission* of m robots on such graph is possible where a *Mission* is a set of robots' moves along edges of the graph to reach their destination from their initial position. We then investigated characteristics a graph must have to be solvable. Our approach was to work with elementary and foundational shapes of graphs and figure out their conditions for solvability to then work our way up to graphs of any shape by piecing these basic ones together. We defined and worked with Basic Unicycles, Extended Unicycles, Stars, and Extended Stars. After having gained a grasp on these basic shapes' condition for solvability, we worked with graphs that have a single Influence Zone, which are subgraphs based around a cycle or a non-cycle vertex of degree greater than or equal to 3. Then, solvability of a general graph is studied. Since these graphs generally have multiple Influence Zones, we partitioned them into a number of subgraphs which have a single Influence Zone. Definitions of adjacency and interconnectedness between Influence Zones of a graph was introduced and used to determine the condition for a general graph to be solvable. At the start of the work, we projected to also investigate *Minimal Solvable Graphs* (SG^m with minimum number of nodes). However, due to lack of time, we were not able to reach a conclusion on this matter.

My contribution to this project is I reviewed the paper, reorganized parts of the paper that wasn't in alignment with the flow. I worked on improving the lemmas and proofs and added definitions and clarifications to unclear parts. I wrote a program first in HTML/CSS/JavaScript to help visualize different type of graphs. I wrote a second program in Java to test the second lemma. User can specify the type of graph they want to generate, the number of vertices they want in the graph and a number of robots to be distributed in the graph. The program will run the algorithms described in Lemma 2 to deliver the robots to its final configuration. As this is my first time working on a research project, I learn a lot about how to go about reading and dissecting the research paper, how to ask questions to clarify and enhance the organization of the paper, how to formulate proofs and test their accuracy. I also learn how to use programming and visualizing tools to test proofs and visualize algorithms.

Research Fellow: Nam Nguyen (2021)

Concentration(s): Mathematics; Philosophy

Faculty Mentor: Hiva Samadian

Department: Computer Science

Title of Project: Structural Properties of Solvable Graphs for Multiple Robot Motion Planning

Funding Source: Holden Endowment Fund

Project Summary:

In multiple robot motion planning (MRMP), a Solvable or Reachable Graph for m robots (SG^m) is a graph that any arrangement of a specified number of mobile agents located on the graph's vertices can be reached from any initial arrangement through agents' moves along the graph's edges. In this research, the topological properties of SG^m were investigated to answer the problem of deciding whether a graph is Solvable for m robots, without explicitly solving it. We proved several necessary and sufficient conditions for several basic topologies. Results of this research, when is completed, can be used in designing transportation networks (e.g. railways, traffic roads, AGV routes, robotic workspaces, etc.) for multiple moving agents such as trains, vehicles, and robots.

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My work on this research project has been on a paper that was previously drafted and worked on by a number of authors including Professor Samadian. I started out writing a critique for the paper. Then, I focused on completing the proofs of some Theorems, Lemmas, and Corollaries as well as fixing formatting or logical issues and inconsistencies in collaboration with another summer research fellow and Professor Samadian. This provided me with a chance to utilize my mathematical toolset in an environment that was very foreign to me in the sense that I had to make sure everything went together with each proof supporting others and contributing to the whole paper. Applying my mathematical knowledge through teamworking on the real world problem of Multiple Robot Motion Planning proved to be a valuable learning experience.

Research Fellow: Leon Nichols (2023)

Concentration: Undeclared

Faculty Mentor: Rebecca Metzler

Department: Physics and Astronomy

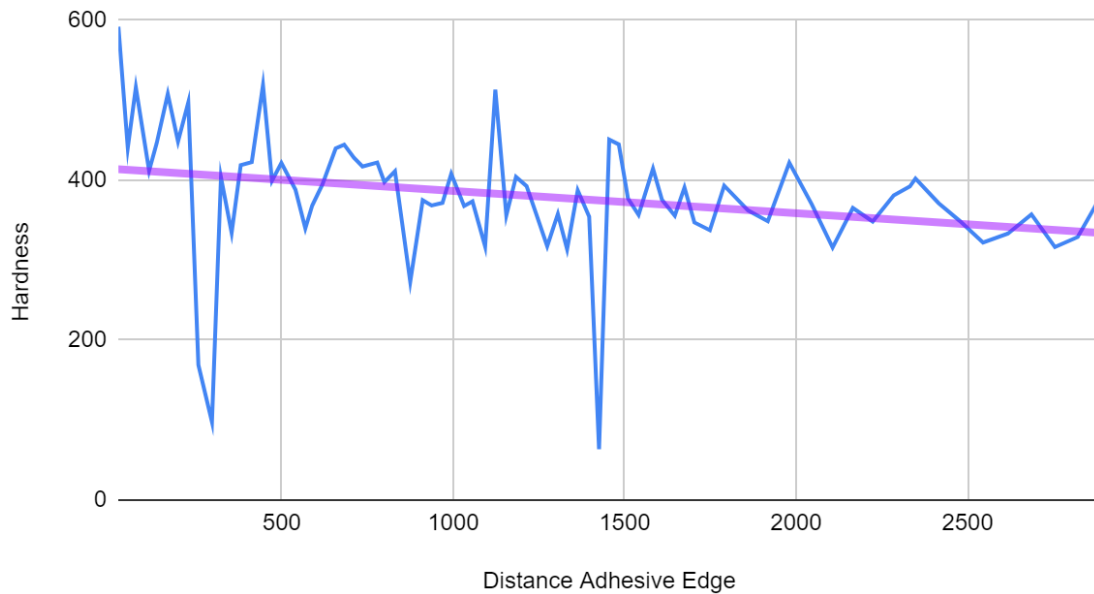
Title of Project: Biominerals: exploring composition, structure, and function

Funding Source: Justus '43 and Jayne Schlichting Student Research Fund

Project Summary:

This research project investigated *Etheria Elliptica*, a species of bivalve mollusks that can be found throughout Africa and Madagascar. Mollusks are regarded as masters of biomineralization for the fact that they can take relatively weak substances (primarily calcite / CaCO_3) and arrange them into durable shells. *Etheria Elliptica* is one of the few mollusks that uses aragonite in place of calcite. As part of studying this phenomenon of biomineralization, it is important to see how the hardness of these shells vary as you move from the outer adhesive layer towards the inner nacre. This project used micro-indentation – a technique for measuring hardness – as well as SEM imaging and ImageJ to analyze and record data regarding these shifts in durability. This data was put into spreadsheets and used to make figures displaying hardness and fracture radii vs. the distance from the adhesive edge. From these figures, sensible conclusions were drawn. Included is a wonderful group showing how the hardness of the shell decreased as the indentations moved away from the outer adhesive towards the inside of the shell:

Hardness vs. Distance Adhesive Edge (um)



Some important things to note about this figure are as follows: First, the huge dips in which the hardness suddenly drops. These areas of the shell were identified as having growth fractures that greatly diminished the integrity of the shell. It should also be noted that this figure was selected for inclusion because it has a great number of data points that do a wonderful job at capturing the general trend that was discovered. Other sets of data followed either the same trend or no trend at all.

Research Fellow: Megan Nicholson (2021)

Concentration(s): History; English

Faculty Mentor: Graham Hodges

Department(s): History; ALST

Title of Project: Descendants of the Underground Railroad

Funding Source: SOSC Division

Project Summary:

Our research project, *Descendants of the Underground Railroad*, used narratives of enslaved people from the United States and other world regions to trace descendants of autobiographical or biographical slave narratives. Using the University of North Carolina's database of North American Slave Narratives compiled in their "Documenting the American South" collection, we worked to collect basic biographic and publishing details of each history into a larger matrix. These details were used to search ancestry.com and newspapers.com to recreate individual family trees of descendants, while focusing on signs of an increasing middle-class lifestyle.

The summary of each narrative began with narratives organized alphabetically by the author's last name, with publication details of the narrative; detailing the author, title, publisher, date and place of publication, and year of escape. Although there were a variety of publishing locations, most narratives were published in the same area where the formerly enslaved person chose to settle after obtaining freedom.

After compiling publishing details, the main elements of each narrative were recorded. We began by focusing on the subject's life in slavery, noting their work as a slave and mention of Confederate troops. The next section focused on the subject's escape from slavery, detailing their number of escape attempts, length of time between escape and freedom, length of time between reaching freedom and settlement, method of escape, point of freedom and lists of any people who may have assisted the subject in their flight from slavery. Next, the subject's life after slavery were recorded, listing their points of settlement, their work as a free citizen, religious beliefs, marital status, number of children and relationship with family post-slavery. Finally, the subject's involvement or mention of the Civil War and the Underground Railroad were documented.

After detailing the subject's life and experiences, the writing style of each narrative was documented. We searched for the use of additional narratives within the main narrative, reliance on religion, focus on education, incorporation of poetry, philosophy, literature or history, and if any images were used. Among all of these elements, religion was used most often.

From this point, the descendants were traced on ancestry.com using the subject's name, birth year, and places of settlement to research census records, social security indexes and death certificates. Newspapers.com was also used by searching the subject's name, areas of settlement and a range of years to scour historical newspapers. These details were recorded on a spreadsheet, listing the descendant's name, relation to the subject, the descendant's parents, birth and death dates, settlement, marital status and occupation. For some subjects, a mention of children served as the only marker of a family tree, but for others, descendants could be traced to present day sixth-great-grandchildren.

Although the full list of subjects in the UNC database have not been fully researched, a large number of descendants have been traced. Although immediate success and fortune were not found typically found by the children of the subjects, there is clearly a marked upward trend in middle class lifestyles descending down the lineage. More than half of the immediate descendants found occupations in labor and agriculture, but for many, martial statuses of descendants were difficult to trace and find further descendants. For those whose enslaved ancestor turned to religion after their settlements, not only were descendant records easier to find, but more than half of their immediate descendants were educated in a form of organized education, allowing most of their second-or-third-great-grandchildren to attend college, obtain a degree ranging from an Associate's to a Ph.D., and eventually obtain work that allowed them to own their own homes.

Research Fellow: Ethan “Pete” Paasche (2021)

Concentration: Mathematical Economics

Faculty Mentor: Dean Scrimgeour

Department: Economics

Title of Project: Measuring the Increasing Duration of Presidential Appointment Nomination and Confirmation

Funding Source: SOSC Division

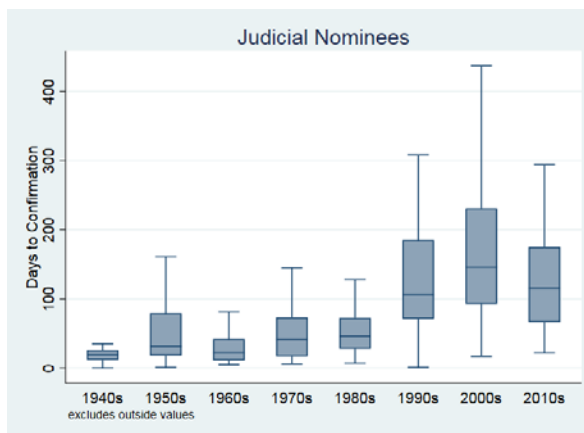
Project Summary:

We compiled and analyzed data regarding Presidential appointments to high level, long term governmental positions. Over time, the Senate has taken longer to confirm presidential nominees to the judiciary and to the Federal Reserve Board of Governors (“Board”). The average days to confirmation increased from eighteen before 1980 to 92 after for nominees to the Board. For the Supreme Court and Circuit Courts the increase was from 45 days to 123. This suggests that the longer confirmation process for judicial nominees is not simply about the courts, but reflects a larger issue with relations between the Senate and the Executive Branch.

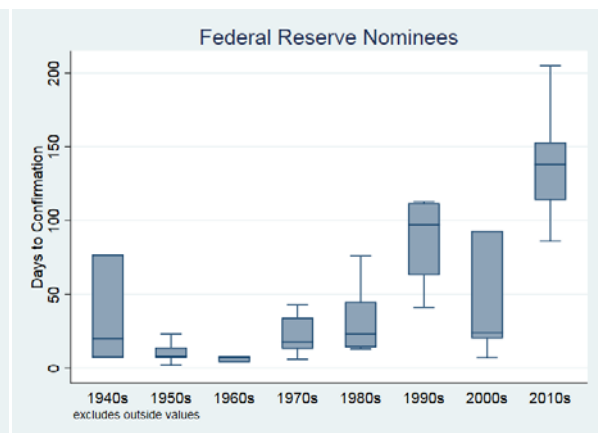
Presidential appointments needing Senate confirmation have been a crucial aspect of leadership within the United States for the country’s entire history. Positions on the Board, the Supreme Court of the United States, and the United States Circuit Courts are characterized by deliberately long terms -- fourteen years for the Board and life for the Supreme and Circuit Courts -- in order to remove political influences from the positions. Existing literature demonstrates that confirmation for Presidential judicial appointments over the course of the Reagan through Obama administrations has become increasingly prolonged.¹ We aimed to develop an enhanced understanding of the trends in Senate confirmation times and what may influence these trends, including demographic information on the nominees.

In order to establish a detailed, reliable dataset on historical nominations, much of the research process involved searching congressional records for the dates that the Senate received nominations from the President, dates of Congressional hearings in respective subcommittees, the reports given by that subcommittee, and ultimately the Senate vote on each nominee. Further data of interest included how long confirmed nominees ended up serving, previous federal positions held by the nominee, education of the nominee, age of the nominee, and sex of the nominee which was sourced primarily from the Federal Judicial Center, and the Saint Louis Federal Reserve’s database of Federal Reserve History.

Preliminary analysis of this data confirms a trend of increasing times spent on Senate confirmation. (In response, Congress passed the bipartisan Presidential Appointment and Streamlining Act of 2011, which aimed to reduce the number of Presidential appointment needing Senate confirmation positions.) The increasing time to confirmation of judicial nominees is shared by nominees to the Board and illustrated in the box plots below, which cover the period from 1940 to 2019. (Membership of the Federal Reserve Board was reorganized in the late 1930s.) Further analysis will examine changes in the length of time these judges and central bankers serve, whether nominations are likely to fail, and how long vacancies take to be filled.



Days to confirmation for Judicial Nominees 1940-2019



Days to confirmation for Federal Reserve Nominees 1940-2019

¹Binder, S. A., & Maltzman, F. (2002). Senatorial delay in confirming federal judges, 1947-1998. *American Journal of Political Science*, 190-199. McMillion, Barry J. (2012). *Length of Time from Nomination to Confirmation for “Uncontroversial” U.S. Circuit and District Court Nominees: Detailed Analysis* (CRS Report No. R42732) Retrieved from Congressional Research Service website: <https://fas.org/sgp/crs/misc/R42732.pdf>

Research Fellow: Jillian Paulin (2023)

Concentration: Undeclared

Faculty Mentor: Cosmin Ilie

Department: Physics and Astronomy

Title of Project: Dark Matter and Stellar Evolution

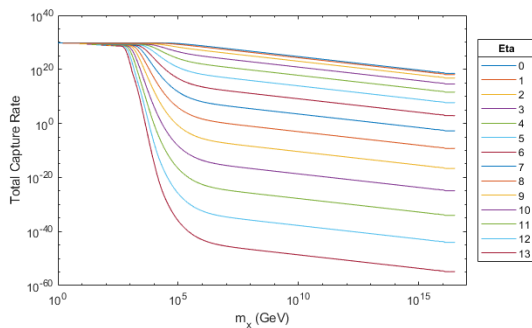
Funding Source: Justus '43 and Jayne Schlichting Student Research Fund

Project Summary:

Perhaps one of the most mysterious problems in physics today is that of dark matter. It makes up approximately 25% of the composition of the universe, but we still do not know what it is. We do, however, know that it has affected the evolution of the universe and of stars. There are several candidates, most notably Weakly Interacting Massive Particles (WIMPs) and axions, and several experiments are running and have been proposed to attempt to detect dark matter. These include XENON1T and DAMA. Dark matter may also be indirectly detected through its effect on celestial bodies.

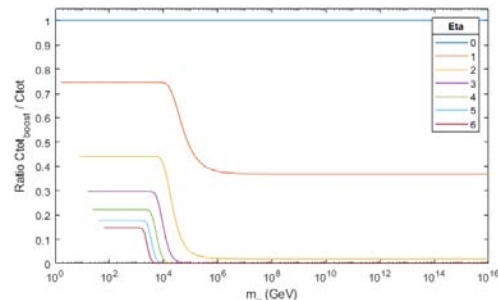
Population III stars have been predicted to exist by theorists, and may have been the very first stars to form in the universe. At this point in time, dark matter clumped to form numerous mini-halos in the universe. The matter in Population III stars was gravitationally attracted to these dark matter halos and condensed to form a star. However, these stars were not necessarily only powered by fusion, as our Sun is today. They may have been powered by a process called dark matter annihilation. This would have allowed them to increase their brightness to the Eddington limit—which is, essentially, the brightest a star can shine and still maintain hydrostatic equilibrium. Dark matter was obtained by these stars through, at first, adiabatic contraction, but later, through dark matter capture. A particle of dark matter may be captured after one or more collisions with baryonic matter, and is considered to be captured when its velocity falls below the escape velocity of the star. Each collision results in a loss of energy, so higher masses of dark matter particles moving at the same speed as dark matter particles with a smaller mass would require more collisions before capture. A Population III star may move with respect to the dark matter halo if it forms off-center from the halo. In this project, we examine the effect of a relative velocity between a Population III star and its dark matter halo on the rate at which it captures dark matter.

To calculate dark matter capture rates, a Maxwell-Boltzmann distribution of matter is often used to describe the velocities of dark matter particles. Stellar motion means we must account for a boosted Maxwell-Boltzmann distribution, instead, which is related to a value called η . The star's velocity is related to this value such that an increase in stellar velocity effects an increase in η . The faster the star moves with respect to the dark matter halo, the smaller the dark matter capture rate becomes. Remarkably, for a given value of η , the amount of suppression of a star's total capture rate is a constant value for a variety of different possible masses of dark matter. Note that the constant is different in the single-scatter regime and multi-scatter regime (in other words, low- and high-masses of dark matter).



To the right is a figure showing the ratio between the total capture rate of this same star for values of η ranging from 0 to 6. Even when $\eta = 1$, the star's velocity causes a reduction in capture rate of $\sim 60\%$ in the high-mass regime. Note that for each regime, the capture rate is reduced by a constant factor.

To the left is a figure representing the total dark matter capture rate of a 12 solar mass Population III star for various dark matter masses. η has been varied from 0 to 13 to show the extreme suppression in capture rate with increasing velocity, especially for higher dark matter masses (in other words, the multi-scatter regime).



Research Fellow: Chau Pham (2022)

Concentration: Computer Science

**Faculty Mentor(s): William “Will” Cipolli
Joshua “Josh” Finnell**

**Department: Mathematics
Department: University Libraries**

Title of Project: Examining the Impacts of Public Libraries in Central New York

Funding Source: Science and Math Initiative-SMI (NASC Division)

Project Summary:

Public libraries are both a source of entertainment and an integral factor in improving community literacy. They enrich people’s lives with book collections, unlimited Internet access, support for research, and programming. Understanding the utilization of these services can guide the growth of our community in Central New York. In this study, we utilize data analysis and visualization to demonstrate the impact of public libraries, highlighting their economic and educational values. We use the BiblioConnect dataset, which features 49 public libraries in 5 Central New York counties: Cayuga, Cortland, Madison, Onondaga, Oswego. Metrics in this dataset span over three main categories, as listed in the following table.

Borrower/Circulation	Program Statistics	Funding/Generated Value
Children’s Program Session Attendance	Total Circulation	Total Federal Aid
Young Adult’s Program Session Attendance	Children’s Circulation	Total Capital Income
Number of Program Sessions	Children’s Books Circulation	Operating Fund Balance
Number of Registered Borrowers	Adults’ Books Circulation	Total Local Public Sources

Because many individuals view funding public libraries through taxes as an expense rather than an investment, their funding remains a challenge. Therefore, libraries have felt the need to demonstrate their contribution to social and economic prosperity. We use return-on-investment (ROI) to examine the dollar value estimates of library services. ROI is calculated based on two metrics: circulation and programming, which best represent a library’s human and social capital values. We then compare a library’s generated values (ROI, capital income) with its investment values (federal aid, public sources). We found that for every county in Central New York, the generated value is significantly higher than the funding. For some counties, the value-investment ratio can be as high as 7 to 1. For example, in 2014, Cortland county’s public library value (\$707,303) was almost seven times higher than its funding (\$97,406). This means that for every dollar of taxpayer money, these libraries offer services that are worth as high as \$7. We can thus conclude that libraries offer services at a much higher value than their budget, and they are a sound community investment instead of a burden on government budgets.

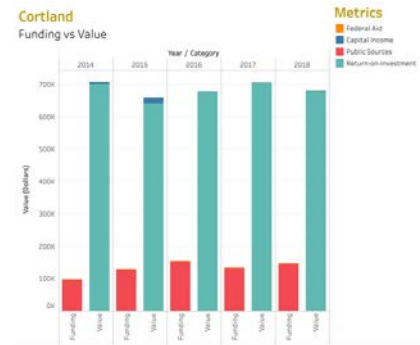


Figure 1: Libraries Funding versus Generated Values in Cortland

Public libraries are an integral part of educational growth. They offer children’s programs and book lending services, which promote reading skills and school readiness. In a child’s educational matriculation, 3rd grade ELA scores and high school graduation are the two most critical milestones. For this topic, we explore the impacts of library children’s services (programming and circulation) on ELA exam passing (above level 2) rate and high school graduation percentage. Correlation values are demonstrated with Kendall’s tau-b values, which vary from -1 to 1 and weaken as they come closer to 0. From 2014 to 2018, while the program attendance rate stayed within the 80-85% range, ELA passing rate experienced some fluctuations in the 50-80% range: it peaked in 2017 and then decreased. ELA passing rate and program attendance rate shared a moderate positive correlation, with tau values averaging at about 0.5. When it comes to graduation rate, its correlation with program attendance was also moderate positive, except for Madison and Onondaga (no correlation). We may thus conclude that libraries’ program attendance rates can be associated with a relatively higher graduation rate and ELA passing rate.

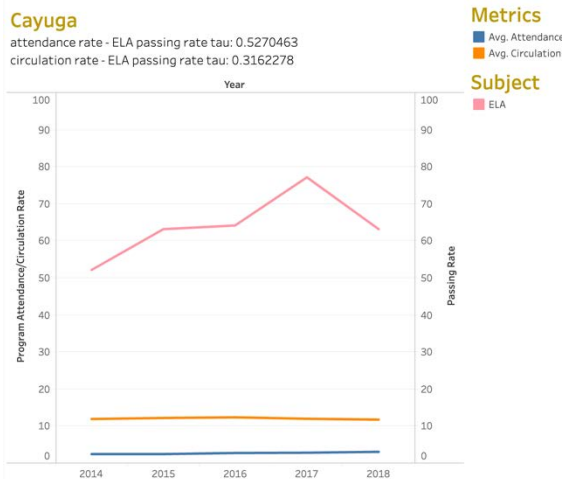


Figure 2: ELA passing Rate versus Library Usage in Cayuga

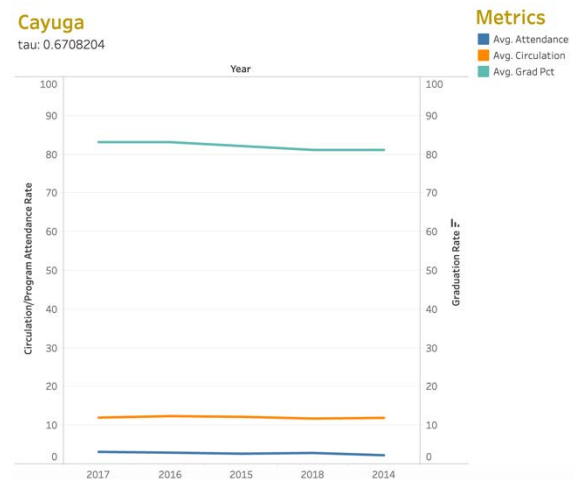


Figure 3: High School Graduation Rate versus Library Usage in Cayuga

Research Fellow: Nicholas “Nick” Poon (2022)

Concentration: Physics

Faculty Mentor: Linda Tseng

Department(s): PHYS; Environmental Studies

Title of Project: Quantitative microbial risk assessment along coastal Los Angeles

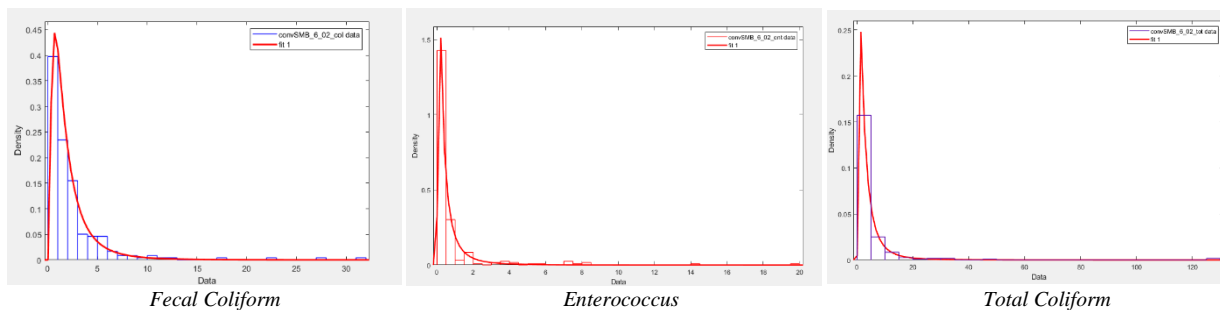
Funding Source: UNST Division

Project Summary:

Fecal indicator bacteria (FIB) are used to measure the water quality at beaches. The three main indicators that are widely used are: enterococcus, total coliform, and fecal coliform. These indicators are used to track the presence of harmful pathogens that (in our case) would cause gastrointestinal illness (GI). FIB’s are not inherently harmful themselves, but they are used as strong indicators for total GI symptoms.

The goal of this research was to determine whether there is a correlation between human Bacteroides levels (specific to human waste), measured by Professor Tseng’s collaborators in Los Angeles between 2009 and 2010, and the risk of GI (measured by the concentration of FIB). There are multiple sampling stations in Los Angeles that collect FIB concentrations at least once a week. Stations located within Manhattan County Beach, Hermosa Beach, and Redondo County Beach were all used in this research since all human Bacteroides data collected have storm drains leading to these beaches.

To calculate the risk of GI, we chose a model distribution that best fits each of the publicly available dry weather FIB data from the years 2009 and 2010. This was done by fitting each distribution available on MATLAB to the data of each indicator at each station. Then the distributions were narrowed down by comparing the data histograms to the distribution shape, and then finally by comparing their geometric mean. After plotting all the results into tables, it was determined the best fit for all FIB indicators is a lognormal distribution (plotted below for all indicators at station SMB 6-02).



With the FIB concentration model, we calculated the ingestion dose model using the following equation:

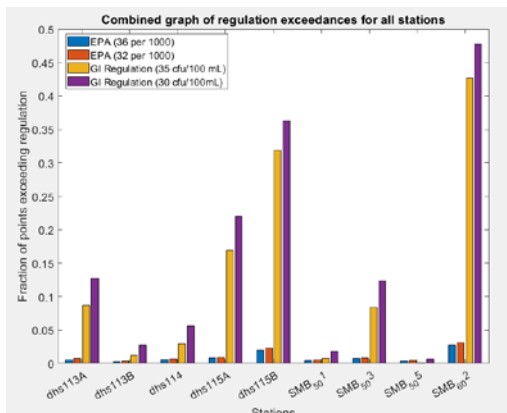
$$D_{Oral} = I_{Oral} * C$$

This was done by randomly sampling 10,000 points from the lognormal distribution curve of each FIB and multiplying each point to a point from 10,000 randomly sampled points from the ingestion volume curve. The ingestion volume was sampled from a lognormal distribution with parameters: mean = 3.54 ml d⁻¹ (Note: d = day) and standard deviation = 1.80 ml d⁻¹. Lastly, we calculated the risk of GI (the dose-response models) using the following equations:

$$p(ill)_{ENT,day} = [1 - \exp(-D_{ENT,Oral} / k)] * \Psi$$

$$p(ill)_{FC,day} = 1 - [1 + (D_{FC,Oral} / N_{50}) * (2^{1/\alpha} - 1)]^{-\alpha}$$

Just like the ingestion dose model, the enterococcus dose-response model required randomly sampling 10,000 points for two variables (k and Ψ). The dose-response model for fecal coliform and total coliform, on the other hand, only used constants and thus had a final dose-response model that did not deviate at all.



With the dose response models, we calculated the fraction of points (of the randomly sampled data) that exceeded EPA or GI regulation, based on probability of illness and FIB concentration respectively. Using the probability of illness appeared to be more protective. With these results, we referenced human Bacteroides data, which was collected in person in 2009-2019, and found that stations with high exceedance rates (figure to the right) correlated with high levels of human Bacteroides at storm drains that led to these stations. This suggests recreational water activities near the storm drain would have higher GI risks.

Research Fellow: Antoni “Antek” Ryzak (2020)

Concentration: International Relations

Faculty Mentor: Julie Dudrick

Department: Upstate Institute

Title of Project: Summer Field School Fellowship

Funding Source: Upstate Institute

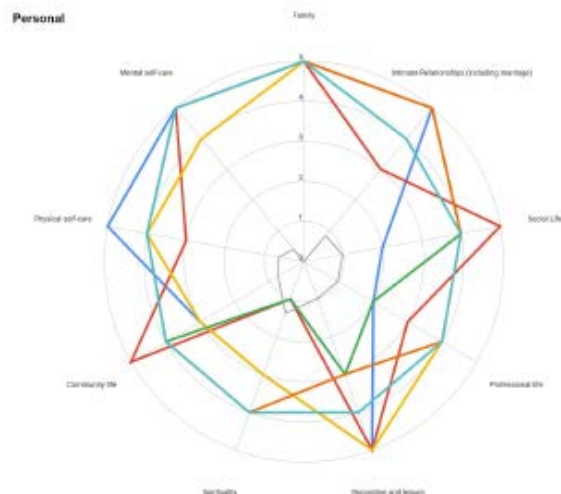
Project Summary:

In partnership with the nonprofit organization Midtown Utica Community Center, I conducted research through the Upstate Institute Summer Field School about the diversity among boards of nonprofits located in the Upstate region of New York state.

Nonprofits exist to serve their communities. They offer one of the most impactful and meaningful ways in which the lives of the members of their communities can be improved. As thought and action leaders, they often play a pivotal role in the evolution of those communities. As social environments and local communities evolve, so do their needs and problems. A successful non-profit organization should be a reflection of the community it aims to serve. Therefore, it should also mirror those changes.

For the purposes of my research, diversity was defined and understood as the diversity of individual perspectives. Three main ways into which I categorized my research are "Experience," "Demographic" and "Personal." First, the diversity of experience is the combination of a person's education, work, and positional experience. Second, demographic diversity refers to metrics such as, but not limited to, a person's gender, age, ethnicity, place of birth, spoken languages, and income. Finally, the third section attempts to capture a glimpse of a person's character and personal values by asking them to rank the importance of such aspects of life as family, social life, spirituality, or self-care.

Though the degree of diversity among different boards of nonprofits varies, this research has shown that it is hard to achieve diversity in all of its aspects (as understood by the study). For example, one of the researched boards is diverse in one category. However, not every demographic that the study took into account is represented on that board. Fewer than 25% of surveyed boards have shown to be diverse on all of the metrics, meaning that no question was answered in the exact same way by all respondents. Though the “Personal” category was harder to quantify, it could offer one more insight. The figure below shows an example of how the answers to this section were evaluated. Each color represents the answers of each respondent (here, total of 6). The smaller, grey line represents the standard deviation among answers to each question, measuring the difference between given answers, where the score of 0 means that all answers given were the same. By comparing the answers to this section against previous questions, I found a weak positive correlation ($r=0.22$) between increasing demographic diversity and increasing diversity of personal values.



Research Fellow: Syed “Tazmilur” Saad (2022)

Concentration: Computer Science

Faculty Mentor: Ahmet Ay

Department(s): Biology; Mathematics

Title of Project: Deciphering Cancer with Biological Networks

Funding Source: Oberheim Memorial Fund

Project Summary:

A significant portion of the population today are affected by mood disorders such as anxiety and depression. Multiple studies have found association between these mood disorders and misalignments in human circadian rhythms caused by variations in circadian clock genes. A single nucleotide polymorphism, or SNP for short, are single nucleotide substitutions that occur at a specific position in the genome in a significant portion of the human gene pool. They have been known to influence the genetic predisposition towards these mood disorders; however, the interactions between multiple genes are difficult to model. In this study, we attempt to use feature selection and statistical analysis to find links between specific SNPs and the disorder they may be associated with.

We collected genetic data for eight different SNPs from 933 individuals from the Colgate population. These SNPs include: PER2, PER3A, PER3B, PER3C, CLOCK3111, CRY1, CRY2 and VNTR. We also measured specific clinical features — their age, gender and socioeconomic status — and their responses to three different surveys: Beck Depression Inventory (BDI), the State-Trait Anxiety Inventory (STAI) and the Horne-Ostberg Morningness-Eveningness Questionnaire (MEQ) which were used to measure levels of depression, anxiety and diurnal preference, respectively.

We cleaned and preprocessed the dataset by removing incomplete samples, and then augmented it by adding up to 8-way interactions between the genes. Since each person could either be homozygous recessive, homozygous dominant or heterozygous for each gene we can encode this information in a matrix by recording which of these three options are true for each gene for each person. For example, we can create the following 1x3 matrices that represent each of the previous examples: (100) for homozygous recessive, (010) for homozygous dominant and (001) for heterozygous, respectively. Hence, there were $\frac{8}{n} \cdot 3^n$ possibilities for each n-way interaction, where n ranges from 1 to 8. For up to 8-way interactions plus three clinical features, we had a total of $\left(\sum_{n=1}^8 \frac{8}{n} \cdot 3^n\right) + 3 = 65538$ possible features in our expanded dataset. However less than 20000 of these features are non-empty. This size is still intractable, hence we used feature selection to reduce the dimensionality of our dataset.

We used four different feature selection methods to find epistatic combinations that might turn out to be effective, robust predictors of the mood disorders with 10-fold stratified cross validation: Fast Correlation Based Filter (FCBF), Minimum Redundancy feature selection (MRMR), Double Input Symmetrical Relevance (DISR) and Joint Mutual Information (JMI). We then observed the aggregated features and found which lower order interactions formed the largest proportion of the selected features. For example, variants of PER2 and CLOCK, PER2_{AG} and CLOCK_{TT}, each form 13% of the features that were selected by at least 3 of the feature selection methods. We also used the features to train different classifiers to see if we could accurately predict the patient's disorders. Unfortunately, our classifiers did not achieve satisfactory performance; however, the bulk of our results come from the statistical analysis we carried out on these datasets.

The methods of statistical analysis we carried out include: univariate logistic regression, multivariate logistic regression, Fisher's exact tests, linear regression with Bayesian Information Criterion to find the best subset of features, LASSO regression with cross-validation, ANOVA and Kruskal-Wallis tests with Tukey and Dunn post-hoc tests, respectively, ANCOVA and association analysis. We carried out all of these tests to notice patterns in the features that appear to be consistently significant across most of them. Some of the results we have seen point towards clinical features being particularly important: for example — age appears to be the only significant predictor for diurnal preference (MEQ), whereas separating the datasets by gender reveals different sets of genes that appear to influence each gender separately. Socioeconomic conditions also seem to be a good predictor of depression levels. We also find SNPs that appear to have an overarching effect across all of these disorders: particularly, CRY2_{AA} appears in almost all of the features that show up as significant. We plan on continuing to run these statistical tests on different encodings of our datasets to extract more information and obtain a more precise model.

Research Fellow: Matthew “Matt” Sampson (2023)

Concentration: Undeclared

Faculty Mentor: Thomas Balonek

Department: Physics and Astronomy

Title of Project: Optical Variability of Quasars and Stars at the Colgate Observatory, Quasar 1308+326 Optical Fluctuations: 1989-2020

Funding Source: Justus '43 and Jayne Schlichting Student Research Fund

Project Summary:

During the summer I reduced archival images taken at the Foggy Bottom Observatory by previous students. Our goal was to create a comprehensive light curve for the quasar 1308+326. A quasar appears similar to a star in the night sky; however, it is actually a swirling jet of gas around a black hole that gives off electromagnetic radiation.

The light curve below for quasar 1308+326 (Fig. 1) shows the activity of the quasar, including a few flare-ups. For instance, you can see some flare-ups (or bright spots) around 2003, 2007, and 2019. V. Unnone’s summary focuses on the 2003 and 2007 flare-ups, and J. Slater’s summary focuses on the 2019 flare-up. Interestingly, our data supports evidence of a 16.9 year structural period for the quasar 1308+326, as suggested by Britzen et al. (2017). It is apparent on the light curve that 1308+326 flared up around 2003 and again (around 16.9 years later) in 2019/2020. It is fascinating to see the history of this quasar, since Foggy Bottom Observatory was the only (recorded) place studying this quasar for a long period of time. Much of this data has only been seen by a handful of people. This summer we were able to fill in some of the gaps of the light curve, allowing us to rediscover some interesting data points. The short outburst in 2007, for example, was unanalyzed before this summer. We were able to use past observations that hadn’t been analyzed previously to produce this “full” light curve that spans from the late 80’s to the present. Overall, it was an amazing experience, and my co-researchers and I were able to learn a lot about researching in general, astronomy, analyzing images, and quasars.

For additional details on the research project, see the summaries by V. Unnone, C. Malinowski, and J. Slater.

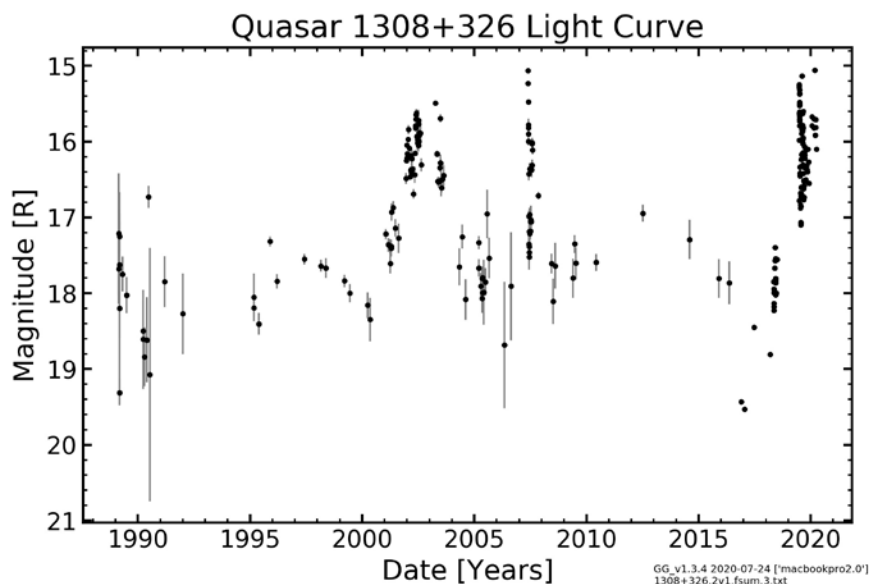


Figure 1

Research Fellow: Connor Scannell (2021)

Concentration: Political Science

Faculty Mentor: Rachelle Walker

Department: Political Science

Title of Project: Democratic Development: DeTocqueville v. Acemoglu and Robinson

Funding Source: Center for Freedom and Western Civilization

Project Summary:

In 1831, Alexis de Tocqueville, a French diplomat and political scientist, journeyed to America to study the nature of democracy and its potential utility to France. In 1835, he uttered the prophetic statement that democracy would produce the most happiness for the most people -- not just because of political liberty, but also because of the prosperity that was sure to follow. He was correct, and the American model of democratic development and prosperity has since had a profound influence on the rest of the world. In some ways, the lessons Tocqueville taught us in *Democracy in America* have become part of the canon of free-market economics, but in other ways, international relations and development economics have moved on -- rarely stopping to listen to the early American experience. Economic models are seen as more reliable guides than history or philosophy.

Today, there exists a tremendous disparity in wealth between nations around the globe. Countries across Africa, Central and South America, and parts of the Middle East have failed to develop at the pace of stable western democracies like the United States, the United Kingdom, or Japan. What are the causes of this disparity? How can developing countries be steered onto a path towards prosperity? Daron Acemoglu and James A. Robinson, prominent modern economists and authors of the book *Why Nations Fail*, would argue that many nations' failure to achieve stability and success is directly correlated with their government's ability to establish inclusive political and economic institutions. Inclusive institutions incorporate many principles synonymous with a modern understanding of democracy, such as representative government, protected property rights, a free market, and a fair judicial system. Acemoglu and Robinson equate the relative success or failure of a nation to adopting this set of policies. On the other hand, Alexis de Tocqueville would argue democracy is far more nuanced than the way in which it is portrayed by modern economists. Tocqueville credits what he defines as the social state of Americans as being the determinant of democratic prosperity in the United States, arguing that political and economic institutions are a product of the laws that govern society outside of formal institutions.

This paper will seek to bridge the gap between these two fundamentally different approaches to understanding democratic governance and the conditions that enable prosperity more generally. The comparison of these two philosophies will establish a more complete understanding of the nature of democracy and the means by which it can create prosperity.

Research Fellow: Emily Schwartz (2021)

Concentration: Environmental Studies

Faculty Mentor: Julie Dudrick

Department: Upstate Institute

Title of Project: Mountain Lake PBS Membership

Funding Source: Upstate Institute

Project Summary:

The Public Broadcasting Station (PBS) is a trusted broadcasting institution with over 330 membership stations across the United States. Nicknamed “America’s largest classroom”, the network strives to supply its viewers with the most up to date information, while simultaneously providing public engagement and educational opportunities to all age groups. Additionally, their service is free to any citizen who has internet service, cable, or an antenna, making them an important asset to each community. However, as a non-profit, PBS depends on donations and fundraising to reach budget goals and continue their operations from year to year. Thus, recent membership declines pose a serious threat to the status of PBS and their ability to run at full capacity. Impacts will threaten each station’s ability to provide communities with the engagement they have grown accustomed to for so long. That is why some PBS member stations, such as Mountain Lake PBS (MLPBS), have decided to conduct independent research on their domestic and international audiences, in order to understand how to better combat these membership issues.

Located in Plattsburgh, New York, MLPBS broadcasts to audiences in New York, Vermont, Quebec and Ontario. With a large portion of their audience abroad, they have been designated as a “PBS border station”. This membership compilation is similar to a handful of other membership stations scattered across the US, such as Prairie Public and Maine PBN. Together, each station faces similar membership restraints that can be better managed through collaboration. For instance, station’s working with Canada must either ship or drive donations, newsletters, and gifts across the border, making operations more intricate in regard to border laws and international fees. Thus, creative and unique new methods will be the answer to stabilizing border station’s membership bases in these uncertain times.

MLPBS has faced declines specifically in their Canadian membership and the development team is looking to implement innovative membership strategies as they enter a new media landscape and try to anticipate future fundraising needs. This summer, I am assessing how each US-Canadian border station currently operates in regard to Canadian viewership and donations. After initial research and discussion, a survey was created and sent to ten border stations that accurately addressed MLPBS’ largest Canadian membership concerns. These questions included how dependent each station is on Canadian viewers, whether a decline is noticeable, what efforts are in place to improve Canadian membership, and the effect of COVID-19 on each station’s operations. Of the ten stations I contacted, only four responded. Despite this, the data obtained provided MLPBS’ development department with invaluable information to use in the upcoming year.

The overall reception from the survey was positive and the border stations that did reply looked forward to conversations in the future. I compiled all the results into a final report and distributed it to each participant, which was overwhelmingly appreciated. Thus, this project not only effectively built upon the capacity of MLPBS, but also helped foster greater relationships with their partners across the US. As membership continues to be a vital part of this non-profit institution, the station’s that choose to band together in solidarity will hopefully be better equipped to meet their goals and membership needs.

Research Fellow: Han “Sherlock” Shi (2021)

Concentration: Classics

Faculty Mentor: Daniel Tober

Department: Classics

Title of Project: The Origin of Historiography: Herodotus and Sima Qian

Funding Source: Center for Freedom and Western Civilization

Project Summary:



Figure 2 Herodotus and Sima Qian

Herodotus and Sima Qian are known as the fathers of Greek and Chinese historiography respectively. Herodotus' *Histories* is the first (surviving) prose work of history from classical antiquity. Although there were historical writings in China before Sima Qian, his *Shiji* was the first comprehensive history of the Chinese kingdoms, and he invented the structure of *Jizhuanti*, namely the combination of annals for kings and biographies for other important figures, which greatly influenced later Chinese historians. Herodotus and Sima Qian wrote in different times and under different political circumstances: Herodotus, originally from a Greek city (Halicarnassus) under Persian control, wrote in the 5th-century BCE about the Greco-Persian wars; Sima Qian, on the other hand, completed the *Shiji* in the 1st-century BCE on the history of China from the legendary kings to his contemporary Han emperors. Despite the differences, however, both historians approached the writing of history in similar ways. They both included extensive ethnographies in their works, using descriptions of “the other” to think about what it meant to be Greek and Chinese, respectively; they both inserted themselves into their narratives, basing their authority as historians on their ability to conduct research firsthand and to collect and evaluate sources of information; and they both structured their narratives around the idea of empire.

Herodotus was born in Halicarnassus, a Greek polis in Asia Minor under Persian rule, and traveled to various places that were either part of the Persian empire or threatened by a Persian invasion. He also witnessed the rise of the Athenian naval empire in the middle of the fifth century BCE and the first stages of the Peloponnesian War, which was considered a response by the Spartans to the growth of the Athenian empire. Sima Qian, on the other hand, served a powerful emperor who desired to increase the centralization of power in his kingdom and waged many wars to conquer the barbarians around China. The building of an empire inevitably entails challenges within the country and conflict with other peoples, necessitating a reevaluation of the identity of their own people as opposed to others and on the differences in political organizations. Despite some negative judgments towards other cultures, they devoted great effort to investigating the foreign cultures in relation to their own rather than simply categorizing them as uncivilized enemies with exotic lifestyles. Culture and national identity have always been mediated by “the other”: the Greeks and the Persians or the Scythians, the Romans and the Carthaginians, Han Chinese and the Xiongnu (nomadic tribes living north of China). Moreover, Herodotus' and Sima Qian's discourses on “barbarians” incorporate reflections and critiques about their own culture and about the morality of empire. Both historians also frequently intrude into their texts to judge their sources, comment on certain events, and relate various personal experiences. These authorial interventions demonstrate the historians' understandings of historiography: they regard the writing of history as bearing moral messages rather than a mere collection of past events. Therefore, instead of recounting all the events one after another chronologically, they organize the narrative skillfully to emphasize certain themes and patterns. Through the organization of narrative and their first-person comments in the text, they deliver moral messages to their contemporaries and future generations. Their use of authorial intervention and ethnography both contribute to their purpose of using history as a critique of empire.

While research on Herodotus or on Sima Qian is plentiful, comparative studies of both historians are relatively rare. Reading their works against each other provides valuable insights into the development of historiography in the West and in the East as well as the relationship between historiography and empire. At the same time, one has to be cautious not to generalize about ancient China and ancient Greece, let alone the West and the East. Herodotus and Sima Qian were undoubtedly influenced by their own intellectual milieux, yet they also demonstrate unique characteristics that distinguish them from other Greek and Chinese historians, of their own times and after.

Research Fellow: Yaoqi Shou (2022)

Concentration: Computer Science

Faculty Mentor: Hiva Samadian

Department: Computer Science

Title of Project: Convergence of Jump Based Binarization Algorithms

Funding Source: NASC Division

Project Summary:

Binarization is a base for developing the Boolean model of gene regulatory networks that represent the regulatory mechanisms underneath the development of normal or abnormal functional phenotypes. These regulatory mechanisms are the focus of modern biomedical research on the molecular level. Specifically, by using a jump-based binarization algorithm it produces a threshold that separate the expressed genes from the unexpressed genes. One drawback of using this approach is that there aren't enough observation points to obtain an accurate threshold. Therefore, researchers interpolate the data to create more data points, and subsequently resulting a problem that this research is centered on—convergence of threshold. The threshold used for monitor genes would move its position after interpolation, which raises the questions whether it would converge to a certain point or not. Finding the convergence would help us locate the threshold.

A large part of the research is using an existing framework developed in a dissertation. It has provided definitions, models and theorems that serve as the foundation for this research. There are four types of algorithms addressed in this work: Sorted-Jumped non-Time Sizing, Sorted-Jumped Time Sizing, Original-Jump non-Time Sizing, and Original-Jump Time Sizing. This research focuses the Sorted-Jumped non-Time Sizing algorithm (SJnTS). The data that is given to the binarization algorithm was categorized into Group A and Group B. More specifically, this research studies the convergence of threshold of the Group B, because the previous work that this research is based on did not fully address the convergence of threshold of Group B. A total of three theorems are proven in this research that characterize the convergence of threshold of SJnTS on Group B.

I first came with three unproved conjectures, one of which is concerned with SJnTS threshold in general, and the other two concerning the convergence of threshold of individual cases. The reason for coming up the former is that I hope it would tackle the problem in general for any type of data. The latter are just extensions of the work from the previous dissertation. A great amount of time was dedicated to understanding a previous work as I believed proofs can be done in a similar fashion as some of the ones from the original work. Alternative approach was also given a shot, but there was no success.

The first conjecture states that the threshold is starting to converge within an interval if and only if all preceding intervals are in border condition. My approach of proving it mainly relies on the fact that threshold would only shift to the left because it is only concerned with the first interval that has length larger than the average. And this conjecture eventually is proven to be true. It explains why threshold would shift its position and tells us when exactly the threshold would start to converge.

Conjecture 2 states that If the first big initial interval $[sI_k, sI_{k+1}]$ is not a threshold jump right before it enters border condition, the threshold converges to P_{max} . (applies to Group B Type 3 data). Here, P_{max} is a point in the first big initial interval that the threshold will converge to under the condition that the first big initial interval is not a threshold jump before it enters border condition. We attempted to find the convergence of threshold of Group B Type 3 data of SJnTS but unfortunately failed. However, some advancement was made. This theorem relies on some powerful lemmas from the previous work, one of which says that after interpolating data each time the average length of these intervals is halved. It points out the fact that after interpolations sub-intervals remain proportional to the average. It helps with examining whether one interval contains the threshold in the proof. The basic proof is similar to that of the previous work where the convergence of threshold of Group A Type 1 and Type 2 data is proved.

Conjecture 3 states that there are three possible locations for convergence of threshold of Group B Type 4 Data sI_k , $[P_{min}, P_{max})$, and P_{max} . It was difficult to find a general answer for the location of convergence, so we decided to talk about it in terms of different cases.

1. If $[sI_k, sI_{k+1}] > Avg^i$, threshold converge to sI_k
2. $[P_{min}, P_{max})$ If $[sI_k, P_{min}] < Avg^i$, and $[P_{min}, P_{max}]$ contains a jump $> Avg^i$. (Note: there could be other points within $[P_{min}, P_{max}]$, that's why I say "contains a jump")
3. P_{max} . If $[sI_k, P_{min}] < Avg^i$, $[P_{min}, P_{max}]$ contains no jump larger than Avg^i

The proofs of these three conjectures have gone under multiple revisions done by Professor Samadians and I. And there have been a couple major mistakes in the proof. Only conjecture 1 is proved. The other two conjectures require further examination and work. This research has been very suitable for students to participate because it is challenging enough for students like me to immerse myself two months trying to solve problems. It is also not too difficult to the point that it exceeds my ability to understand the topic. I was able to utilize mathematics and things learned from discrete structure to write proofs of my conjectures. This research enhanced my ability of writing mathematical proofs and ability to conduct a formal research.

Research Fellow: Ayush Sinha (2022)

Concentration: Economics

Faculty Mentor: Michael Connolly

Department: Economics

Title of Project: Regulation and Environmental Risks in Mortgage Lending

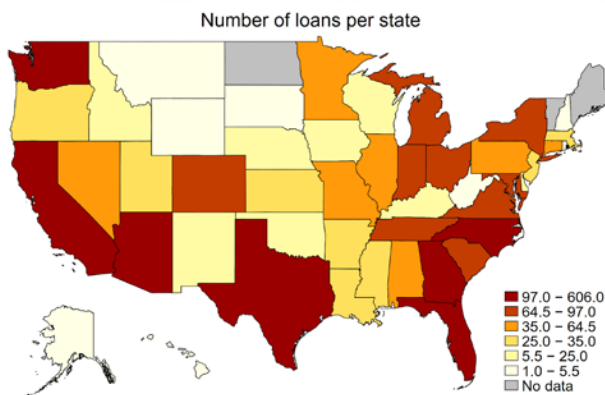
Funding Source: SOS Division

Project Summary:

Fannie Mae is one of the largest suppliers of both green and non-green multifamily housing bonds. A bond is considered green if it is securitized on loans which have been used to make green energy and water investments, green building certification, and provide green energy to multifamily apartment buildings. We study whether there is a "green premium" on green loans in the dollar amount of these loans and their note rate. We also try to find whether "greenness" within green loans also yields a premium, where greenness refers to higher Energy Star scores and lower Energy Use Intensity.

There is a growing body of research regarding the emerging market of green bonds where Fannie Mae is the leader in total dollar amount issued in the world. A literature review conducted finds that Green buildings are associated with higher property values and rents which is referred to as a green premium. An and Pivo (2018) examine multifamily properties in the CMBS market to examine whether there is a green premium to the debt side of the multifamily market in regards to default risk. One particular area that needs to be studied is about how these green loans are priced and whether these prices create incentives towards building more green properties over non-green ones.

Green	Average UPB (in millions)	Average Note Rate	Average Property Value (in millions)	LTV	Average Property Total Units
N	13.95	4.28	29.52	65.56	174.48
Y	21.95	4.20	33.32	68.83	219.83



We used data on DUS (Delegated Underwriting and Servicing) which is a type of MBS (Mortgage Backed Security) based on a single asset from the Fannie Mae DUS disclose website. This gives us a large amount of loan characteristics as well the green characteristics data for the loans on these properties. We focused on green loans issued from 2016 to July 2020 since Fannie Mae did not issue a substantial amount of green loans before that time. The map provides us a heatmap of green loans issued for properties in the given time period with large loan concentration in the

Southwest and Southeast. The table provides summary statistics of green loans versus non-green loans during that same time. Green loans are on average having a higher unpaid balance issued, have a lower interest rate, higher property value, higher LTV, and more property units (measures size of property).

We used multivariate regressions to determine correlations of note rate and unpaid Balance at issuance to green indicators and also control for other variables. A green loan is approximately 0.25% larger in terms of dollar amount lent and the note rate is 0.22% lower compared to a non-green loan.

There is an insignificant coefficient for the dollar amount lent and the note rate for loans lent for properties that are above the median in Energy Use Intensity and with high Energy Star scores. We do not yet find a green premium due to these characteristics, but this warrants further investigation.

Research Fellow: John Slater (2022)

Concentration: Astronomy/Physics

Faculty Mentor: Thomas Balonek

Department: Physics and Astronomy

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

Funding Source: NASA New York Space Grant

Project Summary:

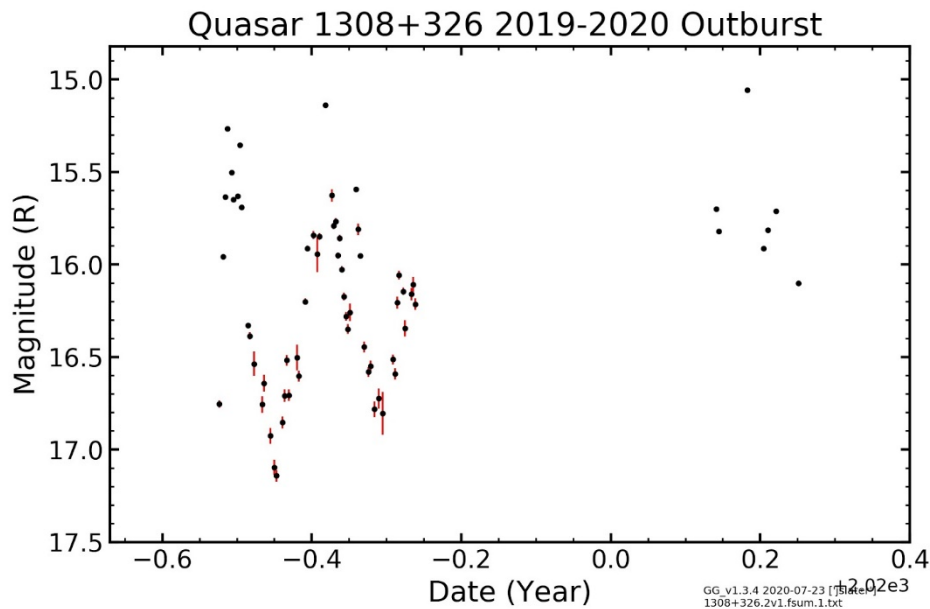
Last summer, Colgate's Foggy Bottom Observatory (FBO) began to regularly observe quasar 1308+326 after it began to flare. Quasars are supermassive black holes in the center of galaxies that expel light-emitting jets perpendicular to the plane of the galaxy. We see the light from both these jets and the accretion disks of the objects, which are the disks of superheated material that the black hole pulls in around its center. From FBO, we use the 16-inch telescope to collect data through optical imaging. Since the beginning of its flare, observers including Professor Tom Balonek and myself have been taking data whenever possible.

1308+326 has peaked our interest. While we have a list of quasars to observe, we noticed a pattern in its outbursts. We stayed on the object for the rest of the summer and continued observation during the school year until the coronavirus interrupted this. This flare-up is still going. Hopefully we will be able to continue to observe it soon. This summer, we had the goal of reducing all new (from the last year) data in addition to all FBO 1308+326 data, which is covered by my research partners.

To reduce this newer data, we used the program astroimagej. This program takes all images from a sequence and uses a template of object positions to determine where each object is in relation to each other in order to find each object's apparent magnitude and error based off of a comparison star we know the brightness of. We processed all spring 2020 data and added it to last summer's data. To combine with the rest of the data from FBO's history, we had to adjust data because the outputs from astroimagej do not match the outputs from the program that gives us data from the old CCD (imaging device). To do so, we converted Julian Day to years, months, etc. The below graph shows just this most recent outburst over time from the apparent magnitude obtained from astroimagej.

Most importantly, this has not just been another observation of a flare up. It has given us more of an opportunity to do outside study. Through past observation, there seems to be a semi-consistent period of somewhere between 17-19 years. This is not exact yet while we continue research.

In the future, there's a lot more we need to do. This past year, Professor Balonek has senior thesis students that did a lot of image reduction and literature searches. We get to now combine all of our data. We need to continue to analyze every image so we can minimize our error bars in reported graphs. Most importantly, we need to try to narrow down a period from all of the data we have. In another summary belonging to my co-researcher, we combined all Foggy Bottom Observatory data to get a full light curve of everything we have from 1989-2020. Soon, we will be able to add to this, both through continued observation and by combining all other outside data we can get our hands on.



Research Fellow: Miranda Smith (2021)

Concentration(s): Environmental Studies; Biology

Faculty Mentor: Linda Tseng

Department(s): PHYS; Environmental Studies

Title of Project: A review of microplastics and their impact on biota

Funding Source: UNST Division

Project Summary:

Many academics have proposed that a new geological epoch began with the establishment of humanity on earth. This era of human influence, or the Anthropocene, is defined by human interaction and shaping of the natural world. One significant modern impact of the Anthropocene is the invention and environmental introduction of plastics. These materials have infiltrated even the remote reaches of water resources (Rubiano 2020). This summer, I conducted remote research with Dr. Tseng in an effort to understand what exactly a microplastic is, and how it can impact the environment around it. Establishing a clear definition of microplastics is a critical first step to then understanding the intake of these particles by biota and the interactions that occur when harmful chemicals or bacteria leach from or establish themselves on these particulates. In my research this summer, I compiled and connected journal articles addressing these various topics and identified trends in research as well as potential future avenues of exploration in the field of microplastics.

There are a number of varying definitions of what exactly a “microplastic” is. A NOAA international workshop on microplastic marine debris provides a definition that is most often cited in other works: a microplastic is any plastic particle smaller than 5 mm, and while there is no official lower boundary, this committee used 333 µm as a lower limit for practical application because of 333 µm nets commonly in use (Arthur et al. 2009). Though the most common definition is this one presented by NOAA, it is not an industry-wide standard. The definition of “microplastic” differs across state water boards, international groups, and published journal articles. One group of researchers proposed a definition for microplastic for the European Water Framework Directive establishes a distinction between a microplastic (1 mm to 5 mm) and a “small” microplastic (25 mm up to 1 mm) (Galgani et al. 2013). There are those, however, who believe that smaller particles should not be encompassed in the microplastic definition, but be labeled under their own subgroup of “nanoplastics”; one article defines this distinctive group as “ particles within a size ranging from 1 to 1000 µm resulting from the degradation of industrial plastic objects” (Giguault et al. 2018). This inability to identify a singular definition of microplastics can exacerbate issues when comparing results between studies and is an area that the community of researchers must work towards clarifying; a consensus must be reached in order for microplastic research to be effectively and efficiently communicated.

Often when microplastics are discussed, they are viewed in relation to marine organisms. My research led me to examine how microplastics interface with the entirety of the ecosystems they pervade. These miniature plastic particles are formed and interact with biota in a variety of ways (Figure 1). Microplastics can enter our environment that are initially formed at the microscale for products like cosmetics and drug vectors (primary microplastics), or they can be formed from the splintered remains of larger pieces of plastic that underwent fragmentation and degradation (secondary microplastic) (Cole et al. 2011). These plastics can interact with biota in a number of ways, but the most examined interaction in the literature is ingestion. Microplastics interact with digestive processes and can leach harmful chemicals such as phthalates, which interrupt endocrine pathways in male zebrafish and are connected to Non-Alcoholic Fatty Liver Disease in the species (Huff et al. 2018), and can deplete energy sources in creatures such as lungfish through gut residence times and reducing feeding activity (Wright et al. 2013). A less considered pathway of interaction is ventilation: microplastics can enter into a marine organism through the gills and lingers in the ventilation system for longer than it would in the digestive system (Watts et al. 2014). This prolonged residence in the organism provides a longer period for predators up the food chain to potentially consume a fish with microplastics and this contributes to a greater bioaccumulation risk. Microplastics not only cause problems by themselves; potentially harmful hydrophobic organic chemicals, like PBT, adsorb onto microplastics and can be carried into biota via the aforementioned pathways (Wang et al. 2018). The risks that microplastics present to biota are great, and future avenues of research should continue to identify potential impacts of chemicals both present in the degrading microplastic and those that adhere to the surface.

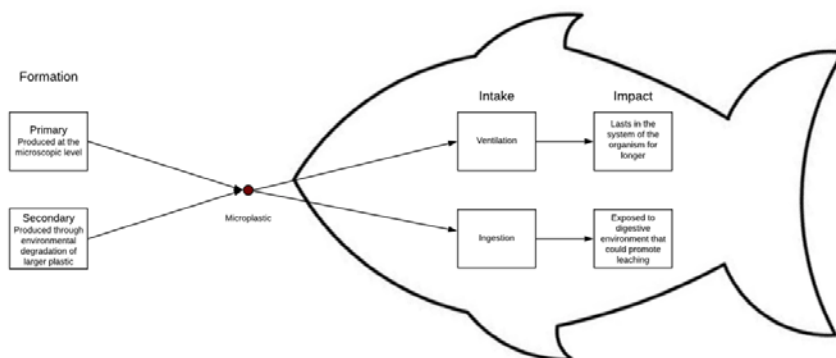


Figure 1: Pathways of microplastic formation indicate that more will flood the system over time and identified pathways of interaction have different outcomes that potentially endanger the individual, as well as the marine food web at large.

Research Fellow: Abigail “Abby” Sotomayor (2020) Concentration(s): Environmental Studies; BIOL

Faculty Mentor: Julie Dudrick

Department: Upstate Institute

Title of Project: Summer Field School Fellowship

Funding Source: Upstate Institute

Project Summary:

Through the Upstate Institute Field School, this summer I was able to join the ADK Action pollinator project which has been a longstanding initiative of the Adirondack based nonprofit ADKAction. ADKAction is in the Adirondack Park region which is the largest publicly protected area in the contiguous United States. ADKAction has many projects aimed to protect and maintain the incredible diversity of the Adirondack ecosystems as well as to connect and integrate community members with the environment. Some of these initiatives include a road salt project which my peer, Kelsey Bennet '21, worked on which aims to reduce road salt in the winter time in favor of a more integrated road maintenance plan to keep roadways safe in the winter time.

The project I joined this summer was the Pollinator Project, which is multifaceted in terms of its strategies for outreach as well as its projects. The projects include a native plant sale, seed packet distribution, installing pollinator gardens, and pollinator education among other start up projects such as the roadside pollinator project. My main involvement included creating engaging and accessible content for the local public on native pollinators and strategies for creating pollinator habitat in homeowners' yards or local business. One of the goals of the Pollinator Project is to get as many homeowners and landowners as possible aware of and engaging in the project. Caring for pollinators is an extremely important and easy thing for individuals to participate in. Homecare in terms of pollinator health involves mostly reducing the amount of work a homeowner does to the yard. Mowing less often, leaving plant tissues and leaves, and using little to no pesticides and herbicides are all strategies that will transform a homeowner's yard into a pollinator space. Other slightly more involved strategies include planting native plant species or dispersing native wildflower seeds to attract native pollinators. The actual action involved in creating more pollinator spaces is not difficult or complex. However, the awareness regarding the importance of pollinators and how to care for them is important information that is missing for many people. I mostly created content to address these issues.

First, I worked on a pollinator stewardship calendar and accompanying seasonal blog posts that outlined the strategies a homeowner can take during each season to accommodate pollinators. The calendar gave brief points about what to do generally during the season to help pollinators, and the blog post gave more detail about specific strategies or interesting pollinators and added a storyline to the calendar. I also created pollinator host plant guides which are graphics that provide a quick and easy overview for gardeners about which plants to establish in their pollinator garden to attract specific native pollinators. The content I created was meant to be accessible, visual, and hopefully, convincing homeowners to consider pollinator friendly landscaping.

Another initiative that I began to work on was the roadside pollinator project, which involved raising awareness about the potential for pollinator habitat along roadsides in the Adirondacks. Turning the three meters or so of grassy area along roadsides into flourishing pollinator habitat is not only simple, cost efficient, and labor efficient, but is also a huge amount of pollinator habitat in total. I worked on creating maps and informational brochures to send to local citizens to encourage them to speak up in their local municipalities. Roadside maintenance is an easy transition for municipalities to make, but local encouragement and education is hugely important to making these changes. The pollinator project on roadside maintenance used infographics and economic analysis to convey important numbers and also supplemental information on what actions individuals and the community can take. Overall, my summer work with ADKAction through the Upstate Institute Field School allowed me to hone my research, writing, and visual design skills while also learning to collaborate with my coworkers and various stakeholders in the community.

Research Fellow: Dvorah Southland (2021) Concentration(s): REST; International Relations

Faculty Mentor: Jessica Graybill

Department(s): Geography; REST

Title of Project: Power at the Pole: Who Studies the High North?

Funding Source: SOSC Division

Project Summary:

This summer, my research project focused on the social dynamics of social science research related to the High North. While the original proposal included observation of a major conference in Arkhangelsk, Russia (International Conference of the Arctic Social Sciences), as well as the interview of researchers in Northwest Russia and Scandinavia, the suspension of nearly all in-person work created an opportunity for remote research. I worked together with my advisor, Professor Jessica Graybill, to rework our original plan. Rather than using participant observation and surveys and interviews, I learned the basics of Social Network Analysis. Social Network Analysis uses graphs to investigate paths of communication and collaboration in social groups.

The program I am using for organizing and mapping these social networks is NodeXL, a free Excel extension. It allows for the arrangement of nodes and edges, as well as the generation of visual maps in random configurations. The nodes consist of conferences, research groups, institutions, and individual researchers conducting social science research in the high north. The ability to configure a map randomly allows the researcher to look for patterns they otherwise may not have noticed. As far as data goes, I first searched for conference programs, in order to find out which projects and researchers were represented at which conferences, and which organizations were attached to which institutions. The next step is examining the social networks of individual Arctic researchers.

As the paper is finalized, it will hopefully prove beneficial to the community of Arctic social scientists, helping them to see areas in which the field may be falling behind; for example, in diversity of individual researchers. As Arctic Social Science tends to study and affect communities that are, by definition, peripheral, the field itself must strive for inclusivity in the name of quality research. It will also help identify “major players”- those groups and institutions that, through their social connections, make a far greater impact in the field than others might. Meanwhile, certain circles in the community may use this research to make inroads in connecting with other groups they have neglected to cooperate with in the past.

Research Fellow: Samuel “Sam” Stuttard (2020)

Concentration: Art and Art History

Faculty Mentor: Carolyn Guile

Department(s): Art and Art History; REST

Title of Project: Gothicists: Ruskin, Pugin, and Gothic Architecture in Upstate NY

Funding Source: Center for Freedom and Western Civilization

Project Summary:

This project’s aim was to document, chronicle, and understand the development of a Gothic vernacular ecclesiastical architecture in the United States, using Upstate New York as a representative (and convenient) geographical parameter. It began with the hypothesis that American Gothic architectural forms would have been significantly influenced by the writing and thought of the nineteenth century architectural historian and critic, John Ruskin. This assumption came from the fact that Ruskin lived a long life, wrote large and polemical works, and was Protestant in his faith, thereby increasing his impact and receptivity in the United States. However, it was actually the shorter-lived and Catholic architect, Augustus Welby Northmore Pugin, who had a greater impact on the American Gothic, because he lived and wrote earlier than Ruskin (writing in the 1840s, rather than the 1850s), and his works were published, both in Britain and in New York, by Anglican or Episcopal ecclesiastical societies, interested in architectural reform as a means for liturgical reform. Pugin argued for the adoption of Medieval Gothic as a style of architecture due to its perceived moral and spiritual qualities, particularly its close relationship with pious Medieval Christianity. This stood in contrast, in Pugin's mind, with the then-reigning Greco-Roman Classical style, which he associated with pre-Christian paganism and moral degeneration.

Beginning in the postbellum period, architects in Upstate New York increasingly took inspiration from Pugin and the English Gothic tradition as it was diffused through various trade magazines and building publications. Three distinct forms emerged: the wood or "carpenter Gothic," the rusticated stone church, and the red-brick with light-colored stone versions. Wooden churches took some of their forms and detailing from Andrew Jackson Downing’s wooden cottage designs; many were designed for poorer, smaller, and rural parishes, even by "big name" architects, such as Richard Upjohn of New York City. However, in many cases, they were replaced by brick or stone structures because wood was seen as too impermanent and undignified a material for a place of worship. Brick structures, which were almost invariably of a general red-brick material, off-set by limestone or sandstone details, proliferated, possibly due to the lack of trained stone masons and the relative inexpensiveness of the material. They sometimes took unconventional plans and elevations, with extremely tall towers, multiple transepts, asymmetrical plans, and various interior vaulting designs. There were also two versions of a stone type that arose in the 1870s and persisted until the 1910s. The earliest of these might simply be called the rusticated stone type, with used rough-cut exterior stone of any color, with more finely cut, ashlar details and ornaments. A second version, based on the Richardsonian Romanesque style, developed in the 1890s, that differed in its use of heavier and reddish-brown colored stone masonry. Gothic-styled churches persisted into the twentieth century, but they became smaller, converged upon the brick type, and were somewhat simplified. The churches of the architect, Edward Berg, are excellent examples of this shift in style and scale. The Gothic also gained a secondary connotation with education, probably through an association with Oxford, Cambridge, Yale, etc., and so Gothic-styled schools and public libraries are also seen in the twentieth century.

All told, this development reveals the close connection between architectural language, style, and history with social desires, goals, and spirituality. The architecture of a church, or any other building, is closely connected with its typology and function, and the choice of the Gothic by Americans, even if it took unconventional and vernacular forms, was an attempt to preserve a vital connection to traditions, beliefs, and a faith that transcends time and boundaries.

Research Fellow: Mengqun Sun (2021)

Concentration: Philosophy

Faculty Mentor: Laura Tomlinson

Department: Philosophy

Title of Project: Reasons for Action

Funding Source: J. Curtiss Taylor '54 Endowed Student Research Fund

Project Summary:

Whenever we deliberate on what to do, there are always some considerations that are relevant and some considerations that are irrelevant to our practical reasoning. Usually, it is quite clear to us what the relevant ones are. For example, when you are considering whether to go to the beach this weekend, the fact that the weather will be nice at the beach and the fact that there is a high chance of getting and spreading the coronavirus are some of the relevant considerations, while the fact about the number of grains of sands there on the beach is not a relevant consideration. There are also times when it is hard to tell what the relevant considerations are. For example, when you are facing an important life decision, the situation might be quite complex that it is not clear to you what to think of it and what factors to consider. You might start by deliberating on some considerations and later find that there are other relevant ones once you get a clear picture of the situation. Had you made a pros-and-cons list, the hardest part might not be determining whether a specific consideration goes in the pros or the cons column, but coming up with the relevant considerations that are apt to be put in either of the columns.

In this paper, I am interested in the question of whether all relevant considerations bear some relation to the agent's motivational facts. Many relevant considerations certainly seem to be partially determined by the agent's desires and goals. For example, if you don't care about the weather at the beach, then what the weather would be like is not a relevant consideration for you. Suppose you just want to go there because they happen to sell the best ice cream in the state there, then the fact about whether the ice cream shop is open or not is a relevant consideration for you, but not for your friend who is lactose intolerant. Against the intuitive view that all relevant considerations are determined by the agent's motivational facts, I argue that there are some relevant considerations that bear no relation to the agent's motivational facts. I argue that for each kind of action, there are some considerations that are relevant to the agent's practical reasoning no matter what the agent's motivational facts are.

My argument has three premises. The first premise is that (1) for an action-type ϕ , there are some facts, p_ϕ 's, that for any circumstance an action-token exemplifies ϕ , p_ϕ 's holds. Consider the action of comforting. If an agent is comforting Jim, it has to be the case that Jim is feeling down. Had Jim not be feeling down, we would say something false when we describe the action as comforting Jim. Similarly, if an agent donates something to Kevin, then it has to be the case that Kevin is in need. If an agent kills Bob, then Bob must be alive. These observations point to the fact that for each action-type (such as comforting, donating, killing), there are some facts that always hold in a circumstance where an action-token exemplifies that action-type. Let's call such facts " p_ϕ 's" (or " ϕ facts") for their corresponding action-type ϕ .

Besides being the facts that always hold for the action-type ϕ , p_ϕ 's also plays an important role in one's practical reasoning concerning ϕ . The second premise is that (2) if a practical reasoning for or against ϕ is a good practical reasoning, then among its steps, there must be at least one step that either entails p_ϕ or entails $\neg p_\phi$. The thought is that had nothing in a practical reasoning for ϕ entails p_ϕ , a fact that is always true for the circumstance where an action-token exemplifies ϕ , that instance of practical reasoning cannot be a sound one.

The third premise relies on an intuitive connection between good practical reasoning and relevant considerations. I argue that (3) if a fact is a step in a good practical reasoning for an action, then that fact is a relevant consideration for that action. It follows from (1)-(3) that for any practical reasoning concerning ϕ , either a fact that entails p_ϕ or a fact that entails $\neg p_\phi$ must be a relevant consideration, regardless of the agent's motivational facts. A more detailed argument and responses to objections can be found in the paper.

Research Fellow: Rebecca Sweigart (2023)

Concentration: Art and Art History

Faculty Mentor: Mary Simonson

Department(s): Film and Media Studies; WMST

Title of Project: Staging Cinema: Performance, Vocality, and Liveness in 1920s Cinema

Funding Source: UNST Division

Project Summary:

The summer research project, “Staging Cinema: Performance, Liveness, and the Transition to Sound” is a book project examining the centrality of live performance and new audio recording and broadcasting technologies to silent film presentation and the experience of American filmgoers from 1916-1926. Long before the American film industry’s “transition to sound” in the late 1920s, filmmakers, entrepreneurs, and exhibitors were exploring ways to use both live performance and new technologies to make films with sound and particularly, ways to give cinema voice. Film studios and particularly film exhibitors regularly invented and experimented with ways of incorporating voices and other sounds into films. Films were made in which the sounds of voices, radio broadcasts, and telephone conversations were central to the plot; these voices were depicted dramatically using visual means, and at times were made audible in film theaters. As radios became popular in the early 1920s, exhibitors eagerly installed both receivers and transmitters in their theaters, in order to receive broadcasted music, synchronized dialogue, and synched sound effects to accompany films, and to broadcast film programs from their theaters. These experiments are endless, but little has been written about their details. Our research uncovers the experiments, figuring out what was involved and piecing together the details, and then thinking about trends and audience experiences. Taken together, these experiments expand narratives of the silent era, shedding new light on contemporary debates about technology, perception, and sensation. They also reimagine film’s transition to sound not as a rapid technological conversion managed by studio executives, 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.

In order to uncover more about the transition to sound in filmmaking, our group began to survey trade journals in Lantern for broad trends and phenomena. We looked through journals containing or referencing “Radio,” looking for anything interesting related to sound in film exhibition, and in particular related to vocal sound in film exhibition. When we did find something relevant to our research, for example a silent film that deals with radio as a plot point, we searched for more information on the film in other databases. Utilizing Lantern, Google and Google Scholar, the Colgate library catalog, Proquest Historical Newspapers, and the Library of Congress’s Historical American Newspapers to dive deeper and uncover details that may not be widely available or obvious. We documented this information and cataloged it into a dropbox group, constantly reviewing and revising each other’s work and discussing the research on a weekly basis via Zoom, or as needed via email or GroupMe. Towards the end of our research, we uncovered similarities between the current COVID-19 pandemic and the 1918 Influenza, which occurred during the timeline we were researching. As a group, we wrote a paper on COVID-19, the Influenza, and how this has impacted theaters and the production of films. We considered this a capstone to our project, summarizing and documenting the silent films we had discovered and tying our research into modern sound films today.

Research Fellow: Unal “Gunes” Tiryaki (2023)

Concentration: History

Faculty Mentor: Noor-Aiman “Noor” Khan

Department: History

Title of Project: Analyzing Military Correspondence Between the Mughal and Ottoman Empires

Funding Source: SOSC Division

Project Summary:

The term “gunpowder empire” is used to refer to the Mughal, Safavid and the Ottoman Empires. In this project, we aimed to create parallels between the two of these empires, namely the Mughals and the Ottomans. Both empires had a Turkic Muslim dynasty ruling large groups of non-Muslims, Christians for the Ottomans and Hindus for the Mughals, and therefore faced similar challenges. This research was limited to the 16th and 17th centuries, where both empires were still gaining territory and growing.

The term ‘gunpowder empire’ is a misnomer. However, even though the term is not useful in describing these three empires, a comparative study between them is useful in showing how they dealt with very similar problems facing their respective empires and what this says about the ruling dynasties. In my research, I tried to focus on the differences between the gunpowder empires rather than the similarities between them.

While the Mughal Empire incorporated its Hindu majority and free-born Muslims to the ruling class, the Ottomans extensively used devshirme, as in Christian children taken into state care and brought up as Muslims, in their bureaucracy. The ruling classes of both empires shared a Turco-Persian culture, such as using Persian in literature. However, the origins and the material conditions of the two dynasties, such as their neighbors, the wars they fought and the different groups they ruled, led them to have different identities and different ways of dealing with their subjects.

The Mughal ruling family had Timurid roots that influenced the culture of its members. Perhaps the most obvious example of this is the difference between how the two dynasties treated their women, especially in the case of the early Mughal Empire and their Ottoman contemporaries. The women of the Mughal line were able to exercise power without having to rely on the power of their offspring or wait until they became old women as Ottoman harem dwellers did. However, this did not mean that the women were treated equally. Both empires had complicated and strict borders around the harem, where eunuchs, who themselves were not allowed to mix with the women, stood guard. Any male that had to go into the harem (such as doctors) would be blindfolded and led by a eunuch.

Perhaps the biggest challenge that the Ottoman Empire faced in the sixteenth century was the rise of the Safavids in the East. With the messianic figure of Shah Ismail going on a campaign of conquest, the Safavids became a formidable opponent. With many Turkic Ottoman subjects starting to follow a leader that was aiming to conquer most of the Ottoman territories, and the Shia Turkmens in Anatolia effectively working as a fifth column, the Empire faced an existential threat. The answer to this was the use of state sponsored ulema, religious suppression and outright war against the Shia population of Anatolia. Partly as a response to the rising Safavid threat, the Ottoman authority was increasingly tied to Sunni Islam.

As a conclusion, this background research can, with the use of national archives and primary sources, lead to several papers. How the two empires dealt with new religious movements that challenged their authority can be examined in a comparative study between the way the Ottoman Empire dealt with the Safavid Empire and their followers within its borders and how the Mughal Empire dealt with the rise of the Sikh religion. As both empires had Turkic nomadic roots that lost its influence over time, “A Comparative Study of Mughal and Ottoman Empires on the Loss of Turkic Nomadic Influence on the Ruling Class” can be a good title for a future paper. Many topics that were only briefly touched upon on this research can be expanded upon to become fully fledged papers of their own, such as “The Case of Forced Conversion and Apostasy in the Greek, Armenian, and Jewish Populations of the Ottoman Empire,” “The Evolution of Anti-Alevi Sentiment in Anatolia” and “A Comparative Study of the Lower- and Upper-Class Women of the Ottoman Empire.” Another additional research area could be the inclusion of the Safavid Empire. As it bordered both the Mughal and the Ottoman Empire, the inclusion of the Safavid Empire and its relations with the two empires could add to the research.

Research Fellow: Tedi Totojani (2023)

Concentration: Undeclared

Faculty Mentor: Alice Nakhimovsky

Department(s): Russian and Eurasian Studies; JWST

Title of Project: Dostoevsky as a Religious and Political Thinker

Funding Source: Center for Freedom and Western Civilization

Project Summary:

My research paper, titled “Dostoevsky, Russia and Modernity: The Debate between Conservatives and Modernizers” looks at the work of Fyodor Dostoevsky as a window into nineteenth century Russia, in the middle of the debate about reason, revelation, dogma, freedom and liberalism that had been spurred by the importation of modernity two centuries earlier. The paper is framed in terms of the debate between the so-called conservatives, such as Dostoevsky himself, and the modernizers, often liberals of the classical sort that he is responding to through his books or that appear as characters in the books themselves. The argument is that Fyodor Dostoevsky falls into the conservative side of the spectrum and that much of his criticism is aimed towards liberalism as it was understood in the 19th century. This paper will also explore the arguments for and against each position, and will consider the validity of Dostoevsky’s conservative position, especially in light of the unfortunate events of the 20th century.

Since Dostoevsky never wrote a philosophical treatise, for the most part, his personal opinions have to be extrapolated from the opinions that his characters hold. Luckily, they do not usually hesitate to talk to one another about politics and philosophy; events are often interrupted by chapter-long monologues about God and modernity. Many of Dostoevsky’s characters give the impression that they were initially devised as embodiments of ideologies and political positions. They live by them and take them to their logical conclusion. Their personal failure is to be taken as evidence of the flawed nature of the ideology that guides them. Ivan, Smerdyakov and Raskolnikov and the Underground Man are the liberals that are led, in one way or another, into dangerous conclusions of their ideologies, and Alyosha and Elder Zosima are the two embodiments of religious conservatism.

The comparisons with Friedrich Nietzsche are hardly avoidable since the two of them are so similar in essence. Nietzsche’s famous “God is dead” signifies none other than the modern skepticism towards Christianity and how this phenomenon has undermined the value system that emerged with it, which sets the stage for how Dostoevsky thinks about modernity and religion. First, he associates modernity with the rejection of God and with man’s elevation in his place, or with the Tower of Babel as he likes to put it in his books. Second, he understands God in relation to the values that its particular religion seeks to uphold. Dostoevsky is not arguing that about the existence of God as much as he is arguing about the utility of God.

This paper will dive inside the conservative mind of Dostoevsky and will enumerate some of its fundamental assumptions: that man is inherently lawless and selfish, that religion is a prerequisite to civilization, that human freedom can be restricted for the greater good, that reason alone cannot create values and that order is preferable to the chaos that change can bring about. This paper will also argue that The Grand Inquisitor poem in *The Brothers Karamazov*, a milestone of European thought, is a critique of conservatism’s totalitarian and elitist tendencies.

Research Fellow: Quang-Anh “Alex” Tran (2022) **Concentration(s): Educational Studies; PSCI**

Faculty Mentor: Rebecca Shiner

Department: Psychological and Brain Sciences

Title of Project: The Effects of Intolerance of Uncertainty on Self-Control

Funding Source: NASC Division

Project Summary:

People vary widely in the extent to which they are distressed and impaired by the presence of uncertainty in their lives. Psychologists have studied individual differences in the tendency toward “intolerance of uncertainty” (IU) and have pinpointed two important components of this tendency: (1) *prospective IU*, which reflects approach-oriented responses to uncertainty, desire for predictability, propensity for active information seeking to reduce uncertainty, and preference for knowing what future events entail, and (2) *inhibitory IU*, which reflects avoidance-oriented responses to uncertainty and difficulties functioning in the face of uncertainty (Carleton, Norton, & Asmundson, 2007). The present studies were designed to test the hypothesis that IU is associated with problems with self-control in many different guises, particularly difficulties with delay of gratification and self-control under extreme stress. We hypothesized that inhibitory IU, in particular, would be associated with self-control difficulties because inhibitory IU reflects impaired functioning in the face of uncertainty. We tested these hypotheses across three studies: (1) cross-sectional correlational data examining the association between IU and various trait-level indicators of problems with self-control; (2) an experimental study examining whether increased IU causes lower delay of gratification; and (3) a longitudinal study looking at the relationship between IU and self-control during the pandemic, a time of high stress.

In Study 1, 367 students completed questionnaire measures of IU, self-control, and a related construct called *negative urgency*--the tendency to behave impulsively when experiencing negative emotions (Lynam, Whiteside, Smith, & Cyders, 2006). Consistent with our hypotheses, overall and inhibitory IU were both negatively related to self-control and positively related to negative urgency, and prospective IU was associated with negative urgency as well. All correlations were modest to moderate.

In Study 2, 253 students participated in an experiment in which, first, they underwent an experimental manipulation of IU, and, second, they completed a task in which they indicated their willingness to wait for a possible monetary reward, an indicator of their willingness to delay gratification. As predicted, participants in the low IU condition (who were induced to be more tolerant of uncertainty) were more willing to delay gratification than participants in the high IU condition. We also examined whether participants’ trait tendencies toward IU affected their response to the manipulation of IU. Participants who were higher in trait IU showed overall lower delay of gratification, regardless of what condition they were in. In contrast, people low on trait IU were more strongly affected by the manipulation, such that they delayed gratification less in the high IU condition than in the low IU condition.

In Study 3, 205 participants completed a trait measure of IU before the COVID-19 pandemic and then follow-up measures of IU and self-control two to six months later, during the pandemic. Inhibitory IU predicted self-control during the pandemic: Participants higher in trait IU before the pandemic reported greater problems with self-control and more problems with procrastination during the pandemic, and they spontaneously mentioned more problems with self-control in response to a narrative question about how they had been impacted by the pandemic. Further, mediational analyses indicated that these links between pre-pandemic trait IU and self-control problems during the pandemic were mediated by the effects of trait IU on symptoms of depression and anxiety and on state levels of IU during the pandemic.

Taken together, these three studies provide support for the claim that IU may play a causal role in problems with self-control, which has important clinical implications. These results suggest that people with IU may need additional support in developing greater skills in self-regulation, particularly during times of stress.

Research Fellow(s): Quang-Anh “Alex” Tran (2022)
Shimiao Zuo (2021)
Jailekha Zutshi (2021)

Concentration(s): Educational Studies; PSCI
Concentration(s): International Relations; PSCI
Concentration(s): Economics; PSCI

Faculty Mentor: Rebecca Shiner

Department: Psychological and Brain Sciences

Title of Project: Intolerance of Uncertainty Predicts Coping, Depression, and Anxiety During the COVID-19 Pandemic

Funding Source: NASC Division; Science and Math Initiative-SMI (NASC Division)

Project Summary:

People vary widely in the extent to which they are distressed and impaired by the presence of uncertainty in their lives. Psychologists have studied individual differences in the tendency toward “intolerance of uncertainty” (IU) and have pinpointed two important components of this tendency: (1) *prospective IU*, which reflects approach-oriented responses to uncertainty, desire for predictability, propensity for active information seeking to reduce uncertainty, and preference for knowing what future events entail, and (2) *inhibitory IU*, which reflects avoidance-oriented responses to uncertainty and difficulties functioning in the face of uncertainty (Carleton, Norton, & Asmundson, 2007). The COVID-19 pandemic has introduced a high level of uncertainty into all people’s lives, and this uncertainty may be especially challenging for people with trait tendencies toward high levels of IU.

Using a longitudinal design, this study sought to examine whether IU measured before the pandemic and state IU during COVID-19 predicted internalizing symptoms (depression and anxiety), coping strategies, social relationships, and COVID-related thinking and behaviors 1-2 months after the pandemic began to have a significant impact on the participants’ daily lives. Participants of this study were 205 college undergraduates from Colgate University. The participants completed a trait measure of IU during a pretesting session in either Sept. 2019 or February 2020, and then completed an online set of questionnaires and narrative measures in late April/early May 2020, to assess their coping and internalizing symptoms during the pandemic.

The results point to five significant patterns. First, in terms of the stability of IU over time, the three trait IU scores (overall, prospective, and inhibitory) showed moderate rank-order stability from October to the pandemic and strong stability from February to the pandemic, and overall mean levels of IU increased moderately from pre- to post-pandemic. Second, participants experienced more increases in IU from pre- to post-pandemic the higher they were before the pandemic in several tendencies: unhealthy perfectionism, motivation to prevent negative outcomes in their lives, and an inflated sense that they are responsible for making sure their decisions turn out alright.

Third, higher trait IU before the pandemic predicted higher levels of depression and anxiety during the pandemic, as well as greater worries about the effects of the pandemic, and these effects were mediated by state levels of IU during the pandemic. Participants who were higher in state IU during the pandemic also spontaneously described themselves as experiencing higher levels of impairing negative emotions in their narratives about the impact of the pandemic uncertainty on them. Fourth, in terms of coping with the pandemic, higher trait IU before the pandemic predicted higher levels of disengagement (or avoidant) coping strategies and less success in creating self-disciplined structure and healthy routines during the pandemic. These links between higher trait IU before the pandemic and problems with coping were mediated by state IU during the pandemic. Further, problematic coping during the pandemic mediated the relationship between pre-pandemic trait IU and depression/anxiety during the pandemic.

Fourth, state IU was associated with both trying to stay on top of COVID news and avoiding thinking about it and was negatively correlated with optimism about gaining from the pandemic. Fifth, for social relationships, higher state IU predicted reaching out more for social support but also predicted feeling less supported, a lower sense of communion, and more loneliness during the pandemic.

In general, the present study details a comprehensive set of associations between IU and key outcome variables that include mental health and social support, and overall well-being in an uncertain and stress-inducing environment. These results may offer longitudinal insights into individuals’ outcomes, particularly given they are college students, a period usually associated with increased growth and development. In addition, these links may be important when planning for pandemics in the future.

Research Fellow: Van Tran (2021)

Concentration: Computer Science

Faculty Mentor: Ahmet Ay

Department(s): Biology; Mathematics

Title of Project: Deciphering Cancer with Biological Networks

Funding Source: Michael J. Wolk '60 Heart Foundation

Project Summary:

Introduction:

Helicobacter pylori (*H. pylori*) is a gram-negative bacterium that resides in the stomach and can cause inflammation leading to long term effects. The approximate global prevalence of *H. pylori* infection is 50%. Identifying factors causing *H. pylori* can be helpful in combating this disease. To our knowledge, no study has attempted to investigate *H. pylori* risk factors using a machine learning approach. Machine learning is a branch of artificial intelligence based on the idea that systems can learn from data, identify patterns and make decisions with minimal human intervention. In this study, our aim was to construct the model that best predict the *H. pylori* status as well as identify the most important risk factors that cause *H. pylori*.

Data Source:

Our data were derived from a two-part cross-sectional survey conducted amongst school children in Ethiopia in the towns of Ziway and Sululta. The survey included 954 samples and included demographic data concerning lifestyle and behaviors as well as experimental testing results for *H. pylori*.

Method:

We processed our dataset before feeding it into the classifier to reduce the effects of impurities in our data. Any samples without any *H. pylori* status and any feature with more than 5% of data missing were removed. After that, we normalized continuous features and transform variables with multiple categories into binary variables using one-hot encoding.

Univariate and Multivariate Logistic Regression:

We conducted Univariate and Multivariate Regression to get the p-values and odds ratios for each variable which enabled us to identify significant features (p-values <0.05) and also their direction of association with *H. pylori*. Those with odds ratio >1 increased the odds of *H. pylori* while those with odds ratio <1 decreased the odds.

Feature Selection and Classifier:

The processed data would then be split using stratified k-fold cross validation into different splits. Any missing data for each split would then be imputed using Iterative Imputer. The imputed data would be used for feature selection, followed by classification and scoring. Scoring will be based on accuracy and F1 score.

Feature selection was conducted to reduce the number of redundant features and subsequently, the dataset's dimensionality to improve the classifiers' accuracy. The different feature selection methods we utilized can be classified into 2 categories: ranking based methods include Information Gain and ReliefF. Since these methods only helped us in ranking importance of each feature, we chose the top 10 and 20 features for our different runs. Subset based methods include Correlation-based Feature Selection (CFS), Minimum Redundancy Maximum Relevance (MRMR), Fast Correlation Based Filter (FCBF) and Sequential Feature Selection. We specifically used a variant of SFS called Sequential Floating Forward Selection (SFFS). CFS, MRMR, and FCBF use different metrics such as symmetrical uncertainty to find subsets of the feature space highly correlated to the target variable but uncorrelated amongst themselves. SFFS is a wrapper-based method that also take into account the classifier used therefore, when we used SFFS, the classifier for SFFS and the classifier used for classification has to be the same. We used 6 different classifiers on processed data, namely K-nearest Neighbors (KNN), Logistic Regression (with Lasso), Support Vector Machines (SVM), Random Forest, Naïve Bayes and XGBoost.

Results:

The highest accuracy obtained is 77%, a 13% improvement from random guessing by using XGB classifier. The highest F1 score obtained is 70%, 16% improvement from the base case. XGB was the best classifier for this dataset while KNN was the worst. To obtain the set of most relevant features, we compared the results obtained from feature selection step and univariate and multivariate logistic regression. We selected the features that appeared both in univariate and logistic regression as well as machine learning.

Research Fellow: Jack Tregidga (2021)

Concentration(s): Physics; MIST

Faculty Mentor: Kenneth “Ken” Segall

Department: Physics and Astronomy

Title of Project: Numerical Simulation of Artificial Neurons Using Superconductors

Funding Source: Volgenau Wiley Endowed Research Fellowship

Project Summary:

The first transistor was created in 1947. This electronic device is behind current dominant computers and the rapid development of this technology has driven the development of computing devices. 73 years later, we have lithographic technology that allows us to create transistors with a feature size on the scale of tens of nanometer scale (~ 1 millionth of an inch). The further reduction of transistor size becomes challenging on such a small scale, limiting the further improvement of traditional computing devices. One alternative being explored is neuromorphic computing; systems that mimic the function of biological neural networks. This lab has previously demonstrated that circuits using the Josephson Junction (JJ), a superconducting electrical component, can mimic the pulse creation and transmission of biological neurons. Further, a design for a system which mimics several key properties of a biological synapse (timed learning, forgetting, pulse attenuation) has been proposed. In this project, I explored, through simulations, the behavior of networks created from multiple JJ neurons and synapses.

The JJ neural model we used contains three components, which have been designed by previous members of the lab. Each is analogous to a component of a biological neural network. The JJ soma pulses periodically, with the pulsing dependent on the input. The JJ axon divides and transmits this neural pulse. The Synapse, which consists of two learning input loops and a memory loop. The current in the memory loop is analogous to the synaptic strength, increasing with correlated pulses in both learning inputs and decreasing gradually over time. The memory loop inductor is coupled with another inductor which allows the size of the synapse output pulse to increase as learning increases, and vice versa. The program WRSpice was used to create circuits consisting of these basic components and simulate their behavior.

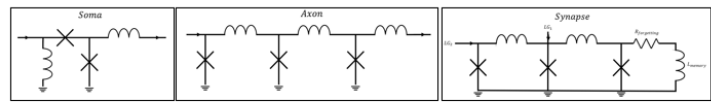


Fig. 1: Circuit diagram of the three main components of system

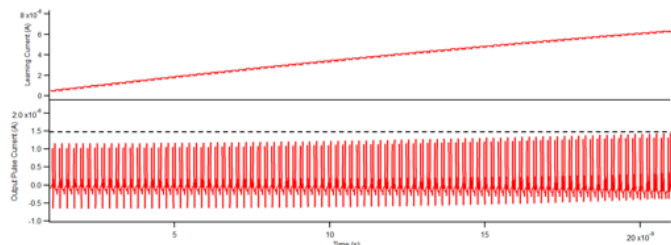


Fig. 2: Increased synaptic output with increased learning

In this research we focused on a system consisting of three neurons and two synapses (as shown in figure three), as this is one of the smallest systems in which non-trivial learning can be demonstrated. By varying the pulsing of the two upstream neurons and axon lengths (in order to control pulse delays) we were able to achieve learning responses in the synapses which depended on the current state of one another. Shown in figure four is the memory current in the two synapses, demonstrating learning over time in this system.

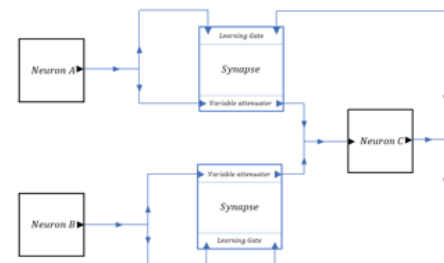


Fig. 3: Schematic of 3 neuron 2 synapse system

Our long-term goal is to demonstrate learning behavior in a real circuit in the lab. However, the JJ synapse functionality had not been verified experimentally, so this is the next step before creating more complex circuits.

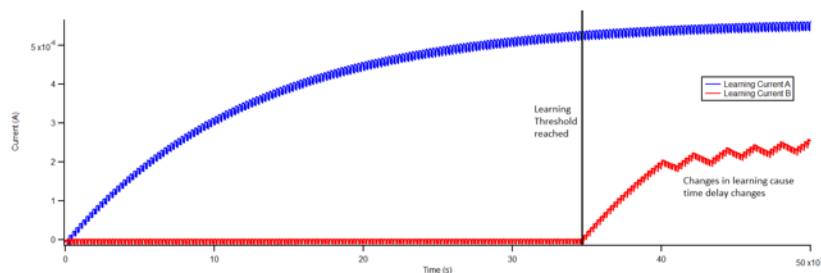


Fig. 4: Learning behaviour demonstrated in system by currents in memory loop

Research Fellow: Jenifer “Jen” Trujillo (2022)

Concentration: Peace and Conflict Studies

Faculty Mentor: Mary Simonson

Department(s): Film and Media Studies; WMST

Title of Project: Staging Cinema: Performance, Vocality, and Liveness in 1920s Cinema

Funding Source: UNST Division

Project Summary:

Long before the American film industry’s “transition to sound” in the late 1920s, filmmakers, entrepreneurs, and particularly exhibitors were exploring ways to use both live performance and new technologies to make film “sound,” and particularly, ways of giving cinema voice. Film studios and particularly film exhibitors regularly invented and experimented with ways of incorporating voices and other sounds into films, both figuratively and literally. Using trade journals, newspaper articles, advertisements, our task was to research the extensive experiments to uncover their purpose and effect on the audience experiences.

Before “talkies,” exhibitors began to experiment with sound and liveness to enrich films. Lots of films were made in which the sounds of voices, radio broadcasts, and telephone conversations were central to the plot; these voices were depicted dramatically using visual means, and at times were made audible in film theaters. Often, film exhibitors staged prologues to the films that incorporated dialogue, song, dances, and music to introduce the films. Meanwhile, liveness was utilized through “interludes” in which a film would be paused while live actors enacted moments from the film’s diegesis onstage. Many short films were made to accompany popular songs, and audiences were encouraged to sing out loud or in their heads, thereby including the audience in the process of giving the films voice.

As radios became popular in the early 1920s, exhibitors eagerly installed both receivers and transmitters in their theaters, in order to receive broadcasted music, synchronized dialogue, and synched sound effects to accompany films, and to broadcast film programs (with lots of descriptions) from their theaters. And around the same time, theaters also began installing PA and microphone systems to both speak directly to theater audiences and to assist with vocal communication behind the scenes during rehearsals.

This research helped expand our narratives of the silent era, shedding new light on contemporary debates about technology, perception, and sensation. They also enable us to reimagine film’s transition to sound not as a rapid technological conversion managed by studio executives, 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.

In addition to archival research about liveness, sound, and broadcasting technologies we also conducted research about the 1918 Flu Pandemic and COVID-19 to draw parallels between the film industry and filmgoing culture then and now. With the information we gathered, we wrote an essay that will be made available to the Colgate community. This research project allowed us to perceive the transition to sound as the continued exploration of liveness, sound, and vocality through the lens of exhibitors, performers and filmmakers, and the American audiences whose contributions shaped the evolution of cinema.

Research Fellow: Victor Unnone (2023)

Concentration: Undeclared

Faculty Mentor: Thomas Balonek

Department: Physics and Astronomy

Title of Project: Optical Variability of Quasars and Stars at the Colgate Observatory, Outbursts of 1308+326 in 2003 and 2007

Funding Source: Justus '43 and Jayne Schlichting Student Research Fund

Project Summary:

This summer, I worked on reducing the archival images and data from the Foggy Bottom Observatory over the past decades. A quasar is a supermassive black hole found in the center of galaxies. They emit jets of plasma out of the center, which are caused by the interaction between its accretion disk and a large magnetic field. As a result, quasars are incredibly bright, and can be observed from billions of light years away. For additional details on the research project, see the summaries by M. Sampson, C. Malinowski, and J. Slater.

Quasar 1308+326 was the subject of our research, and this focuses on the outbursts of the quasar observed by the Foggy Bottom Observatory telescope in 2003 and 2007. These outbursts are theorized to be due to the precession of the quasar itself. Shown in Fig A. and Fig B. are the light curves of quasar 1308+326, and the spike in magnitudes during 2003 and 2007 are very apparent. In 2003, it rose to a magnitude of approximately 15.5, dropping down to roughly the 18th magnitude. 2006 showed a high errorbar range. In 2007, it rose to the mid-15th magnitude again, which was indicative of another outburst.

The archival data had some gaps, which made my job much more interesting, allowing myself to hunt through every image, making sure no dates and images were left out of the final light curve. The data from 2007 is of particular interest, as Colgate seemed to be the only institute with this information about the outbursts. Previously, the data had not been analyzed for this period, and I reduced and added this outburst into the light curve, filling in a substantial gap. Other groups that were studying this quasar such as at St. Petersburg State University did not start observing until 2008.

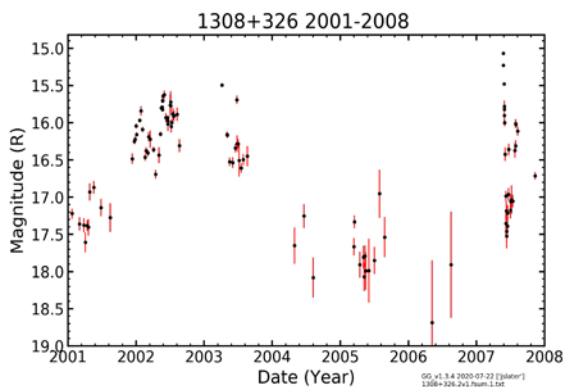


Fig. A: The light curve of quasar 1308+326 from 2001-2008

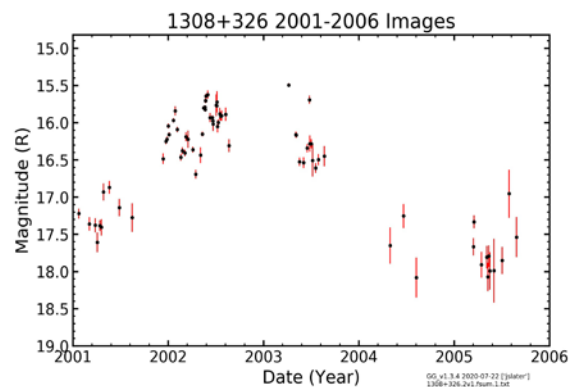


Fig. B: The light curve of quasar 1308+326 from 2001-2006

Research Fellow: Cole Ventresca (2023)

Concentration: Undeclared

Faculty Mentor: Rebecca Ammerman

Department: Classics

Title of Project: North Urban Paestum Project 2020: Reconstructing the History of the Sanctuary of Athena

Funding Source: AHUM Division

Project Summary:

This past summer I was honored to be selected for a research internship working under Professor Rebecca Ammerman in the North Urban Paestum Project (NUPP) in Italy. My directives would have included documenting, photographing, and cataloguing a portion of the considerable amount of data and artifacts recovered during the projected 2020 excavation season at Paestum as well as during previous years at the same location. Following this I would have returned to Colgate to aid in the processing and archiving of documents and photographs to aid in further building and organizing Professor Ammerman's already considerable database of results from her excavations at Paestum. In preparation for these activities I bolstered my knowledge about Paestum, the investigations at the Temple of Athena, and archaeological methods by reading various publications and manuscripts on the state of the excavations at Paestum. These included a detailed report about the 2019 excavation of Trench 6 by a Colgate student who had previously conducted research under Professor Ammerman.

Unfortunately, COVID-19 made traveling to Italy dangerous for both ourselves and Italian collaborators working on the North Urban Paestum Project. The excavations and travel to Italy were therefore necessarily postponed until such a time when it would be safe to proceed with the research in the field. My summer experience changed radically, but it was very far from being unproductive or non-educational.

For the safety of all concerned, the presence of staff on the campus of Colgate was also strictly limited during the summer months. This was necessary but did pose issues with accessing the archaeological artifact databases of NUPP stored on campus. As such, research continued but the focus shifted to a different project that Professor Ammerman could access more readily: the preparation of a publication on the practice of ancient religious cult in caves and grottoes in southern Italy. Her study of more than two dozen caverns where rituals were performed by the Italic, Messapic, Greek, and Roman peoples who inhabited southern Italy between the 9th c. BCE and the 3rd c. CE was based on her own archaeological research as well as numerous publications. To aid Professor Ammerman with her research I worked with the substantial bibliography that contained mostly sources in Italian or German. First, I made scores of requests for books, book chapters, and articles through Colgate's interlibrary loan service. As the countries of origin varied, so too did the citation styles of the sources. It was my task to organize these citations into a single stylistic format for the bibliography of Professor Ammerman's publication. This required me not only to become more familiar with multiple foreign languages but also to learn about significant scholarly organizations, authors, and publishers within these foreign countries.

Additionally, I spent time researching recently published books on archaeology conducted within Italy, focusing on the Roman remains, in order to help Professor Ammerman acquire materials needed for other aspects of her work.

Later in the summer, Professor Ammerman arranged for me as well as some of my student colleagues to receive training from Professor Jesi Buell of Case Library in the electronic resources available to students of the Classics at Colgate. These meetings served as a starting point for my own research on how to improve the visibility and accessibility to students of new resources as well as those currently available for the study of different areas within the interdisciplinary field of the Classics. During this process I came upon inconsistencies and shortcomings of the current Classics website and began to seek ways to improve it. My efforts included receiving training in modification of the Colgate website from Gordon Brillon and exploration of the resources offered by other departments at Colgate as well as by top universities from around the country.

Research Fellow: Cecilia Vu (2022)

Concentration: Environmental Biology

Faculty Mentor: Linda Tseng

Department(s): PHYS; Environmental Studies

Title of Project: Microplastic chemical retention

Funding Source: UNST Division

Project Summary:

Plastics were first mass produced in the late 1940s and early 1950s¹, and there has been an increasing production ever since their first global introduction due to their convenience and low cost in making. Although it has been a few decades since plastics have been first discovered, there is still much unknown about them. However, arguably, the most important discovery about plastics has been found in which they can break down indefinitely into smaller fragments. Any fragment smaller than 5 mm has been termed a microplastic. The first reports of plastic pollution appeared in scientific literature in the 1970s.² Although not much research has been conducted since this first finding, it indicates that there is an opportunity for scientists to conduct research to discover yet unbound information.

Today, plastic has been polluting practically every kind of environment, whether it be marine or terrestrial, that it seems to be ubiquitous. Plastics have been mostly used in the packaging sector. As of 2015, 146 Mt of plastics have been used in the packaging sector³ (Fig. 1), and it is likely that this amount has only increased over the years due to increasing reliance in online shopping. This is concerning because plastics used in packaging are typically disposed of immediately which indicates more plastic waste that could potentially enter the environment.

There is limited data on recycling plastics due to the complications during the process. There are four different processes of recycling: primary, secondary, tertiary, and quaternary. Primary recycling, also known as closed-loop recycling, is the mechanical reprocessing of materials into products with equivalent properties as their virgin material while secondary recycling, also known as open loop recycling, reprocesses materials into products with lower properties. Tertiary recycling is utilized to recover chemical constituents of the material, and quaternary recycling recovers the energy of the material.⁴ It can be difficult to recycle plastics due to contamination and simply because different kinds of plastic polymers are not compatible with each other and need to be processed differently. Mixing different polymers can lead to a decrease in both technical and economic value.⁵ According to the EPA, recycling plastics did not begin until the 1980s, several decades after they were first mass produced. There has been a general increase in the amount recycled from 1980 to 2016 but decreases in 2017, and there is unfortunately no data provided after that year (Table 1).⁶



Figure 1: Amount of plastic by weight in municipal solid waste in the United States generated vs recycled from 1950-2017.

Some of the most common sources studied include land run-off, wastewater effluent, industrial effluent, and fragmentation of mismanaged plastic waste.⁷ Primary microplastics are intentionally produced in factories while secondary microplastics are any fragments broken down from macroplastics.⁸ Primary microplastics tend to have more predictable shapes such as beads or spheres, but secondary microplastics have more random and diverse shapes and sizes.⁹ Flatter pieces of microplastics have been observed to have more photodegradation on one face while the other side has more biofilm. Cubic shaped microplastics have been found to have all faces to be evenly photodegraded and less colonized. The carbonyl index determines the age of oxidation in polymers. It has been discovered that in flatter microplastics, the carbonyl index is higher at the edges but decreases rapidly towards the inside.¹⁰

Year	1960	1970	1980	1990	2000	2005	2010	2015	2016	2017
Plastic Recycling Recovery Rate	N/A	N/A	0.293%	2.16%	5.79%	6.06%	7.96%	9.05%	9.29%	8.37%
Difference from Previous Year	N/A	N/A	+0.293%	+1.867%	+3.63%	+0.27%	+1.9%	+1.09%	+0.24%	-0.92%

Table 1: The middle row shows the plastic recycling recovery rate for each year. The bottom row shows the difference of the plastic recycling recovery rate from the previous year. There is no data available for 1960 and 1970.

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1. DOI:10.1098/rstb.2009.0054
2. DOI: 10.1126/science.1260352
3. <https://doi.org/10.3184/003685018X15294876706211>
4. DOI:10.1098/rstb.2008.0311
5. DOI: 10.1126/sciadv.1700782
6. <https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/plastics-material-specific-data>
7. WHO 2019; DOI: 10.1126/science.1260352
8. <http://dx.doi.org/10.1016/j.envint.2017.02.013>
9. <http://dx.doi.org/10.1016/j.marpolbul.2016.11.024>
10. DOI: 10.1021/acs.est.6b00594

Research Fellow: Brian Weber (2022)

Concentration(s): COSC; Film and Media Studies

Faculty Mentor: Mary Simonson

Department(s): Film and Media Studies; WMST

Title of Project: Staging Cinema: Performance, Vocality, and Liveness in 1920s Cinema

Funding Source: UNST Division

Project Summary:

The project I was involved with this summer was called “Staging Cinema: Performance, Vocality, and Liveness in 1920s Cinema” with Professor Simonson. For this project, I researched various films of the 1910s and 1920s, compiling first-hand sources about the production, release, and reception of the films as well as secondary sources that apply. Much of the work was focused on films and technology that presented a specific gimmick that someone would think strange of a silent film such as the use of radio, a sound-based invention, in a silent film. To do this, I utilized numerous databases including <https://lantern.mediahist.org/>, which contains digitized copies of many different film periodical magazines of the time, Proquest Historical Newspapers and the Library of Congress’s Chronicling America newspaper collection, which contained digitized newspapers, and WorldCat as well as Colgate Library Catalogue, both of which are general library search engines. Rounding out this list, I also used simple Google searches and IMDB to find more general information about the credits of a film.

The first part of my job was to scan through the film periodicals in search of films that related to the gimmick we were searching for at that given time (for most of the project, the gimmick was radio). This involved sifting through thousands of pages of periodicals, made more difficult by the infrequently working search engine that hypothetically could highlight where search terms could be found in a specific periodical. Once I found an article I wished to use, I cited where I found the article and wrote a brief summary as well as exact quotes that I found to be most representative or useful to understanding the article in question.

If a particularly interesting article or film was found, my task then became to look up information specific to that film. While some of these films I found myself, others were found by the other researchers as well as by the Professor. When we met as a group, we divided up these films to more evenly split the workload and allow for easy switching of tasks should one researcher’s films prove very research heavy.

The second part of my job was to determine whether a film that I found was worth anything, worth being that the gimmick of the film played some substantial role in the story or was used in a particularly interesting way. The intent of this was to track how features associated with a sound film were used in Silent Cinema in addition to representing a sort of cultural zeitgeist in regard to technology. An example of a film I found that fit both of these points was a film titled *Radio-Mania* from 1923, itself a re-release of *M.A.R.S.* from 1922. The story of the film centers on an inventor who creates a radio device that allows him to communicate with Martians on Mars. Between this premise and the numerous articles, I found documenting the reception and production of the film, much can be learned about the cultural perception of radio in the early 1920s, that is as a fantastical new invention with boundless potential that fascinated the public. This fascination was hoped to be a strong box-office pull.

Research Fellow: Xiyu “Cici” Wu (2021)

Concentration(s): Educational Studies; MATH

Faculty Mentor: Brenda Sanya

Department: Educational Studies

Title of Project: Lessons in Being Yi: Student Experiences with the Trilingual Education Policies at Liangshan Yi Autonomous Prefecture

Funding Source: Lampert Institute for Civic and Global Affairs

Project Summary:

China has always represented itself as a multiethnic country of 56 ethnic groups--the Han majority group and 55 ethnic minority groups. According to the National Bureau of Statistics of China (2010), among the ethnic minorities constituting about 8.4% of the total population in China, 55 groups of whom are officially recognized and over 80 to 120 languages are spoken (State Language Commission, 159). These ethnic minority groups mostly reside in the largely resource-rich yet economically underdeveloped areas near the borders of the country. To unify and modernize the country, the central government of China has stated three national language policy goals for ethnic minority groups: 1) to foster students' ethnic identities through learning the *ethnic minority languages*; 2) to cultivate a sense of national unity, and to help ethnic minority communities with socio-economic integration into mainstream society through learning *Mandarin*; 3) to prepare students to contribute to the national economic development through learning *English* as an international language (Chinese Government, 2005). These goals are central to China's representation of itself as a multicultural nation with 56 officially recognized ethnic groups, harmoniously striving for national prosperity as a united nation. Such an agenda requires societal, if not individual, trilingualism, among ethnic minority groups: competence in Mandarin, English, as well as in the ethnic minority language. While national needs seem to demand societal trilingualism, the political rhetoric in official documents tends to emphasize only bilingualism for minorities: Chinese and a minority language (in actual practice, the minorities have to learn English as well if they wish to succeed in standardized exams, National College Examination in particular).

How has the explicit bilingual but implicit trilingual education in China been experienced by different ethnic minority groups in China? This paper investigates the bilingual education policy for Yi ethnic minority students at Liangshan Yi Autonomous Prefecture, and the impacts its implementation has on local students. The Yi people are the sixth-largest ethnic minority group in China and mainly live in mountainous rural regions in Yunnan Province, Sichuan Province, Guangxi Province, and Guizhou Province. The Liangshan Yi Autonomous Prefecture in Sichuan is home to the largest concentrated community of Yi, with a population of about two million (National Bureau of Statistics of China, 2010). Using two sources of data--bilingual education policy at the prefecture-level and ethnographic interviews with officials, teachers, and students from Xichang (the seat of Liangshan Prefecture)--this paper explains the internal contradictions that render the implementation of the local ethnic educational policy self-contradictory and ultimately unproductive.

Research Fellow: Morgan Wynkoop (2021)

Concentration(s): Spanish; Molecular Biology

Faculty Mentor: Ana Jimenez

Department: Biology

Title of Project: Cellular determinants of aging in large and small breeds of dogs

Funding Source: Beckman Scholar Program

Project Summary:

Organisms use energy for a variety of processes including growth and reproduction. Adenosine triphosphate (ATP) is used as an energy source for these processes and is created through aerobic and anaerobic metabolism. When oxygen is present, glucose is broken down through glycolysis. The enzyme phosphoenolpyruvate carboxykinase (PEPCK) produces phosphoenolpyruvate. The enzyme pyruvate kinase (PK) then forms pyruvate from phosphoenolpyruvate during the final step of glycolysis in aerobic metabolism. Pyruvate dehydrogenase (PDH) converts pyruvate to acetyl-CoA that enters the tricarboxylic acid (TCA) cycle that produces electron carriers. Electron carriers such as NADH deliver electrons to the electron transport chain (ETC) in the mitochondrial membrane and create a proton gradient to power ATP synthase to produce ATP during oxidative phosphorylation. When oxygen is not present in sufficient quantities, anaerobic metabolism occurs. In the cytosol, lactate is formed by lactate dehydrogenase (LDH) during glycolysis rather than pyruvate. Anaerobic metabolism is not as efficient and produces less molecules of ATP per glucose molecule.

Metabolism appears to play an important role in the aging process because organisms that are older tend to produce more energy through anaerobic metabolism have impaired mitochondria and decreased ATP production through oxidative phosphorylation. Also, greater body mass has been associated with greater rates of anaerobic metabolism. Because metabolism changes with age and body mass, the activities of the glycolytic enzymes PK, PEPCK, PDH, and LDH may also change with age and body mass. For the summer, I read through a variety of sources from Google Scholar and PubMed to create spreadsheets recording the activities of these four enzymes, body mass, and age in birds and mammals in order to write a review discussing the relationship between glycolytic enzymes, body mass, and age. Additionally, I reviewed the roles of the four enzymes in cancer because cancer is an age-related disease, and cancer cells tend to show a shift to greater energy production through glycolysis rather than oxidative phosphorylation despite sufficient oxygen levels.

After reviewing the literature available relating the enzymes to body mass, we found evidence that LDH activity increases with body mass in birds and mammals. Emmett and Hochachka (1981) argue that increased LDH activity may be the result of larger organisms requiring more energy through anaerobic metabolism because they require more power to move than smaller organisms. We were able to find evidence suggesting that there is a negative relationship between PK activity and body mass in birds but found no correlation in mammals. Previous research also suggests that LDH activity increases in certain tissues from birds and mammals with age, likely the result of increased anaerobic metabolism and mitochondrial impairment with age. We also found studies suggesting that PK activity increases with age, although this may only be until a certain point in the avian lifespan. The articles we were able to find did not show a specific relationship between PEPCK activity in regard to body mass and age. We were unable to find many sources relating PDH activity to body mass in age in a variety of species. However, we were able to find sources that discussed the various roles of all four enzymes in cancer development. Certain isoenzymes of LDH, PK, and PEPCK appear to promote cancer development and progression. However, previous research shows that PDH is downregulated in cancer cells suggesting the enzyme does inhibit cancer cell growth.

Research Fellow: ChanJu “Zoe” You (2022)

Concentration(s): Physics; Chinese

Faculty Mentor: Isak Isakovic

Department: Physics and Astronomy

Title of Project: Quantum Effects and Noise in Low Dimensional Systems

Funding Source: Science and Math Initiative-SMI (NASC Division)

Project Summary:

The study of spin dynamics has been of great interest in recent years due to the capacity of electron spins to transfer, store, and process information in a quantum manner as qubits in spin-electronic devices. Spin noise and spin relaxation time (rate) among many other aspects of spin dynamics are a crucial factor to spin-based devices.

One way to study spin dynamics is through Spin Noise Spectroscopy (SNS), which is an optical method to map the random spin noise of the sample onto polarized light. Using this method, spin noise in semiconductor samples of various dimensionalities including bulk samples (3D), quantum wells (2D), and quantum dots (0D) were studied. However, not much research was done on spin dynamics in 1D semiconductors, such as quantum wires or nanowires. This led to the current research on spin noise/relaxation in GaAs nanowires, studying the correlation of spin noise to temperature, magnetic field, electric bias, and the geometry of the sample.

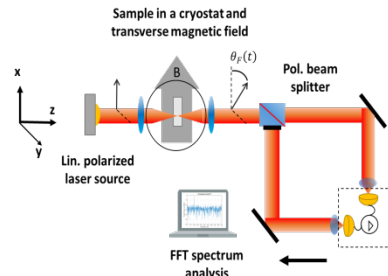


Fig. 1 Experimental setup for spin noise spectroscopy in semiconductor nanowires., S. Castelletto, C. You et al., Prof. Isakovic Lab

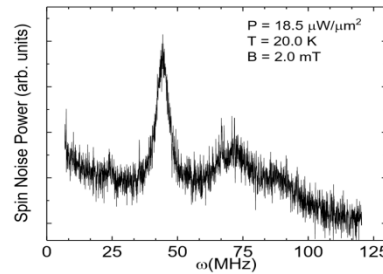


Fig. 2 Measurement of spin noise power in semiconductor nanowires., S. Castelletto, C. You et al., Prof. Isakovic Lab

During the summer, our main goal was to analyze and understand the observed power spectrum (shown in Fig. 2 here) of spin noise in GaAs nanowires, which showed an unexpected small peak in addition to the large one. For further understanding of the peaks, we modeled several individual peaks based on the mathematical model of spin noise.

Initial modeling of spin noise power of GaAs nanowires was performed based on a previously proposed mathematical model:

$$\langle S_z^2 \rangle_\omega = 2\tau_{SR} \text{Re} \left(\frac{1 - i\omega\tau_{SR}}{\omega_0^2\tau_{SR}^2 + (1 - i\omega\tau_{SR})^2} \right)$$

Based on this expression, and an experimentally relevant frequency range, we produced a set of individual peaks of varied intensities and peak locations. The individual peaks increased in intensity as the coefficient of $\langle S_z^2 \rangle$ increased and shifted to the right as the value of ω_0 decreased.

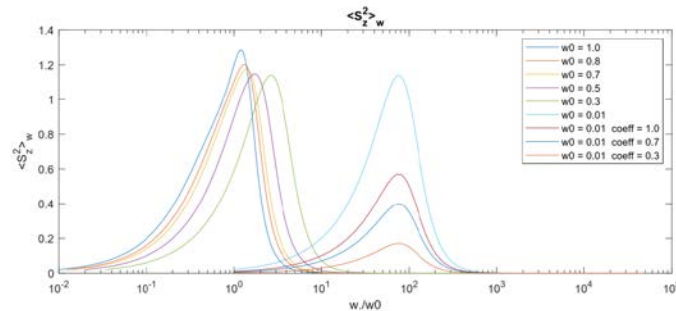


Fig. 3 Mathematical model of spin noise power in semiconductor nanowires.. S. Castelletto. C. You et al.. Prof. Isakovic Lab

Here, we test the hypothesis that the two peaks we observed experimentally in Fig. 2 would be a linear combination of two functions with different ω_0 values ($\langle S_z^2 \rangle_\omega = \alpha \langle S_z^2 \rangle_{\omega_1} + \beta \langle S_z^2 \rangle_{\omega_2}$) and coefficients α and β , where β is $1-\alpha$:

$$\alpha \langle S_z^2 \rangle_{\omega_1} + \beta \langle S_z^2 \rangle_{\omega_2}$$

Research Fellow: Aziz Zafar (2023)

Concentration(s): Biology; Applied Math

Faculty Mentor: James “Eddie” Watkins

Department: Biology

Title of Project: The Ecophysiology of Polyploidy in the Fern Genus Dryopteris

Funding Source: Michael J. Wolk '60 Heart Foundation

Project Summary:

During the summer of 2020, I participated in summer research with my mentor Eddie Watkins. The remote part of the research included taking detailed illustrations of physiological structures of different ferns made by female scientists in the mid-1900s and creating a digital database for them. This database will provide other scholars with very detailed and helpful illustrations with a simple click. In the remaining time, my research partners and I participated in field work, while maintaining strict social distance and wearing face coverings. We used a Li-Cor machine to study the photosynthetic rates of different Equisetum fern species, a genus of ferns that shows unconventional branching structures, under different light intensities. We wanted to find out how the varying branching structures affected the plants' abilities to photosynthesize. I also spent a few days working on data entry and organization for research project we are going to be doing with the NSF's collaboration in the coming semesters on the Dryopteris genus.

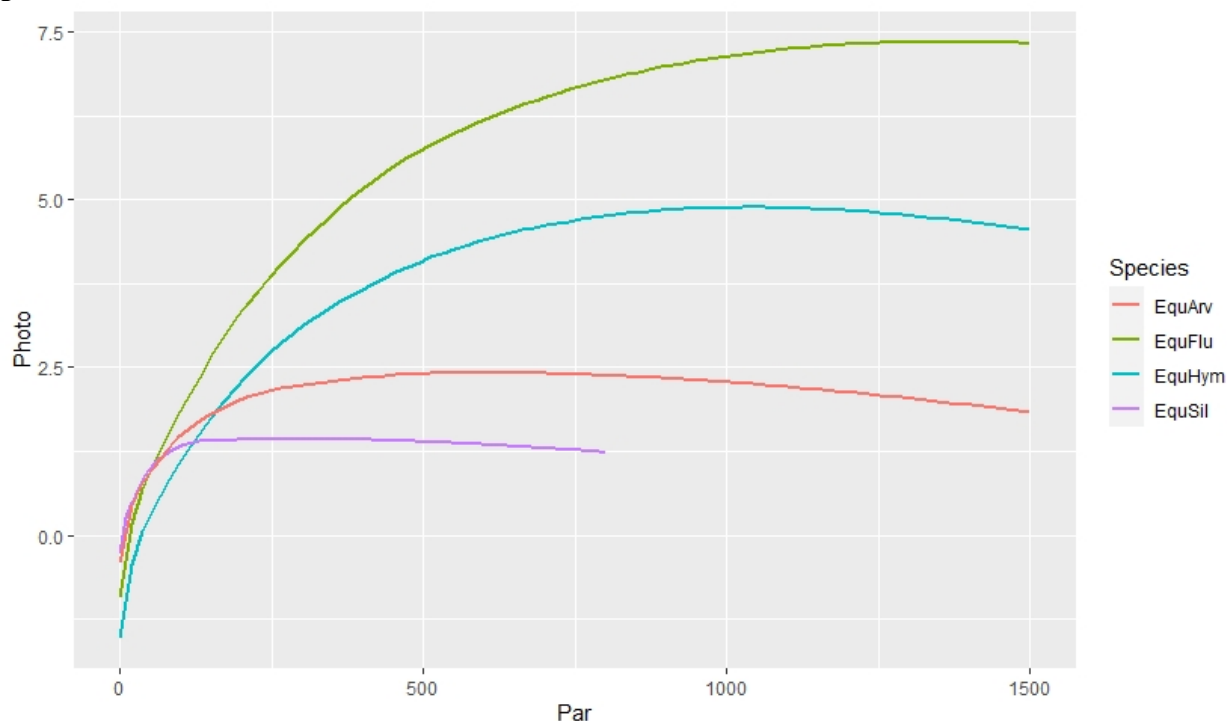


Figure 1. The four light response curves for species *arvense*, *fluviatile*, *hyemale* and *silvaticum* of the Equisetum genus. The x-axis shows the light intensity in Par (light emission between 400nm-700nm) and the y-axis shows the photosynthetic rate in arbitrary units. Equisetum *fluviatile* plateaus at the highest photosynthesis rate of around 7.4 units, meaning it responds to an increase in light intensity the most, and Equisetum *silvaticum* plateaus at the lowest photosynthetic rate of 1.25 units, meaning it responds to an increase in light intensity the least.

As for the online database of illustrations, below is the link for the drive that contains gigabytes of scanned detailed images of different structures of many different genera.

https://drive.google.com/drive/u/1/folders/1p3DsaQrG7UOVxAV7_nXl67Sem7sxWUgn

Research Fellow: Danielle Zarnick (2021)

Concentration(s): Geography; Religion

Faculty Mentor: Andrew “Andy” Pattison

Department: Environmental Studies

Title of Project: The Role of Land-Use Policy on Shaping Biodiversity in the Sierra San Pedro Mártir region of Baja California, Mexico

Funding Source: UNST Division

Project Summary:

In 1947 a national park was established in the Sierra San Pedro Mártir region of Baja California Mexico. As in line with Mexico’s federal environmental legislation, exploitation of natural resources within park boundaries is forbidden. But this conflicts with the preexisting land-use practices of the communal *ejido* lands the park was laid atop of. A series of interviews done by Professors Andy Pattison and Bryan Rasmussen and existing literature on Sierra San Pedro Mártir National Park (SSPM NP), revealed many social conflicts emerging around the economic and scientific value of the land. These conflicts highlight the local power asymmetry promoted by neocolonial notions of environmentalism.

Sierra San Pedro Mártir National Park is known ecologically for being a global biodiversity hotspot, a relict biota of California useful for fire management research, the location of the National Astronomical



Observatory, and recent home of a San Diego Zoo condor reintroduction site. SSPM NP has also seen an increase in tourism since the paving of the main road into the park. All these activities are legal under national environmental policies and practices. Through its de facto exclusionary policies, this national legislation implements a definition of conservation consistent with the goals and priorities of mainstream, US-influenced environmentalism. Land use in SSPM NP cannot be defined without the historic and continued use of the national park for cattle grazing by local people. Local people claim their use of the land is historically justified as well as based on their own notions of conservation and stewardship of the land.

Over the last 6 weeks, I have used MAXQDA to analyze trends in the interviews administered by Professors Pattison and Rasmussen in Baja California. After coding for emergent themes, the interview segments of the most frequent were compiled. These interview segments were then summarized and organized into a summary table format for accessibility and analysis. In my reading of the interviews, I came to understand park management has made concessions to allow local cattle to enter the park freely. The conflict between scientists and local grazers has recently been aggravated by the 2002 introduction of the condor project. Members of the project adamantly oppose cattle in the park, citing them as a threat to the condor and the park’s ecosystem, while local grazers argue their cattle are a part of the park’s ecosystem.



The discourse surrounding cattle in SSPM NP highlights other ecologic and social contests in the region. The interviews revealed that the process for creating a new management program for SSPM NP began in early 2020. Not only did this process expose cattle related concerns in the region, but also other environmental concerns that have remained unresolved due to a lack of long-term data and inclusive stakeholder involvement. However, park management is considering the implementation of a management program that recognizes the historic use of park land while promoting conservation goals outlined in federal legislation. A cooperative management plan such as this could undermine the preexisting definition of a national park, influenced by US ideas of untouched wilderness.

Research Fellow: Lijun “Karen” Zhang (2021)

Concentration(s): History; Philosophy

Faculty Mentor: Andrew “Andy” Rotter

Department: History

Title of Project: Prostitution in Singapore, 1939-1963

Funding Source: SOSC Division

Project Summary:

Since the 1800s, when foreign prostitutes started to arrive in large numbers in Singapore, regulating prostitution has always been one of the major concerns of its ruling power. In the past two centuries, the Colonial governors and the local government have tried different, and often competing methods, to regulate prostitution and control the spread of venereal diseases in this port city, with varying degrees of effectiveness. While scholars have done extensive research in the policing of prostitution in various British colonies, prostitution in colonial Singapore, especially after World War II, is understudied. Existing literature almost exclusively focuses on issues surrounding prostitution from the mid-19th century to the 1930s.

To continue the unfinished story, my research project thus explores the public discussions on prostitution and its regulations in Singapore from 1945 to 1963, from the end of Japanese Occupation to decolonization, when Singapore merged with Malaya. The time period of my research saw both Singapore and Britain undergoing a series of tumultuous and transformative events, which could contribute to changes in the policies of sexual policing in Singapore. An examination of this tumultuous period can offer interesting insights into the changing political concerns of the British over the colonies, the preoccupations of the local population, as well as the perceptions of the British and local community over race, gender, sexuality and morality.

In my research, I analyzed the changes and continuities in policies and public discourses on prostitution in Singapore, the reasons for such changes and continuities, and their impact on Singapore politics and society. To do this, I explored the digital collection of Singapore newspapers and oral history interviews. I argue that, while prostitution regulations did not undergo substantial changes after the Japanese Occupation, local politicians imbued these regulations with new political meanings. When local political representatives started to participate in policymaking after the war, they saw their ability to effectively suppress prostitution as proof of their capability to self-govern; with the development of the Anti-Yellow Culture Movement, a movement that targeted activities and cultures that were considered morally decadent, and the emergence of the People’s Action Party in power, the effective policing of prostitution gradually became associated with an anti-colonial attitude. By demonstrating changes in the local discourse on prostitution regulations, I assert that in the making of Singapore as a new nation, the state sought political legitimacy by claiming its moral righteousness, which was manifested in its policing of prostitution.

Research Fellow: Yang Zhang (2021)

Concentration(s): Russian and Eurasian Studies; POSC

Faculty Mentor: Alice Nakhimovsky

Department(s): Russian and Eurasian Studies; JWST

Title of Project: Political Systems and Pandemic Responses: A Comparative Study

Funding Source: Center for Freedom and Western Civilization

Project Summary:

The predominant theme of 2020 has to be the Novel Coronavirus 2019 (Covid-19) pandemic that transformed the lives of people around the world. During the time of a global health crisis, I became interested in understanding the differences between states' Covid-19 responses. This paper seeks to understand if regime type is a good predictor of crisis management ability by evaluating the cases of the United States and Russia. Compared to Russia, the United States has been less effective in managing the Covid-19 pandemic due to its inability to identify a crisis, poor crisis communication, and lack of federal level coordination. The US underperformed as a result of overpoliticization that is inherent to a polarized democracy, while Russia kept the Covid-19 a technical issue as failing to do so could undermine the regime legitimacy.

When a systematic disturbance to normal life in a given society is prescribed political meaning, it becomes a crisis. Under such definition, a crisis is inherently political, and the public expects political leaders to lead their state out of it. For the purpose of this essay, political leaders in the United States are defined as the current administration, its political allies, and federal level agencies; In Russia, political leaders are defined to include President Putin, the government, and the regional authorities. Given the inherent political nature of a crisis, political leaders' crisis management responses are evaluated and compared based on their ability to make sense of the crisis when the issue first emerges, to communicate accurate information as well as a convincing political message, and to coordinate nationwide responses. This research assumes that all political actors are rational actors, behaving in their own best interests.

By investigating the political incentives behind the Covid-19 responses of the two states, this essay found that regime type is a good indicator of the crisis-management toolboxes they had available to them. In the United States, the political leaders do not need to worry about regime legitimacy but are incentivized to pursue reelection. Russian political leaders knew that in a time of declining economic performances and when the popularity of its only positively viewed political institution, President Putin, is declining, failing to manage the situation could lead to regime collapse. To the contrary, especially in the early phases of the crisis, political leaders in the United States *performed* the crisis using their usual populist narratives. In a polarized democracy when political competition was elevated to socio-identity significance, its political leaders were also incentivized to politicize their response, further decreasing its ability to respond effectively.

As of August 14th, the cutoff line for data for this research project, it was clear that political leaders in Russia performed better in managing the Covid-19 health crisis than their US counterparts. Cases of Covid-19 per 100k population in the US was 1,613 and the mortality rate was 3.2%; in Russia, the corresponding figures were 629 and 1.7%. Despite concerns about the credibility of Russian data, Russia still performed better as it was able to achieve a steady decline of new cases per day while a second wave of new increases was witnessed in the US around July.

From January to March, US political leaders were not able to understand the significance and denied the potential threat of a domestic epidemic until community-based spreading became reality and the health system was overwhelmed. During that time, Russian political leaders established specialized headquarters for Covid-19 and preemptively increased hospital capacity. In terms of crisis communication, the President communicated false information that contributed to the spread of Covid-19. According to the survey conducted by the Yale Program on Climate Change Communication, only 48% of the population nationwide trusted him. Depending on political affiliation, regions that trusted him did worse in managing the crisis. Russia, on the other hand, provided sufficient public education material and communicated a consistent narrative, in addition to which, information-suppressive behaviors were revealed by the public. Lastly, the administration failed to coordinate responses among different states, which was outlined in the National Health Security Strategy (NHSS) as part of the standard public health emergency response mechanism. They sidelined the Center for Disease Control and Prevention and intentionally stalled support for states based on political alignment. Although Covid-19 situation in Russia also varies by region, it was clear that the Kremlin was coordinating and monitoring regional authorities to perform in a way that enhanced their performance.

Research Fellow: Yuxuan Zhang (2021)

Concentration(s): Economics; Mathematics

Faculty Mentor: Takao Kato

Department: Economics

Title of Project: Factors influencing leadership effects on team performance: A case study on Chinese Manufacturing Plants

Funding Source: Walter Broughton '63 Research Fund

Project Summary:

There is a growing body of research on the importance of team leaders for team performance. Podsakoff et al. (1985) discovered that leader contingent reward behavior is likely related to group drive, cohesiveness and group productivity while non-contingent reward behavior is negatively related to these group criteria. Brandiera et al. (2007) argued that a team leader can affect his/her team performance via two channels: the first is “target effect”, which is taking actions that influence productivity of existing team members by targeting their effort towards the most able team members; the second is “selection effect”, which is affecting the composition of his/her team and raising the proportion of high-ability team members.

The objective of my research project is to provide new evidence and insight on the relationship between incentive for leadership and the effect of leadership on team performance by answering the following two questions:

1. Does the size of compensation for leadership matter for the positive effect of leadership on team performance? If so, how much?
2. Does the positive effect of leadership on team performance increase or decrease when compensation for leadership is tied to team performance?

The results can be helpful in determining the best reward system to motivate leaders to improve team productivity while not compromising the intrinsic motivations in other team members.

The data that I have access to is ideal for answering these two questions (the data was collected by Professor Kato who kindly agreed to share it with me). Detailed daily production data for each individual worker level along with each worker’s personnel records at a manufacturing firm in China were collected from October 1, 2008-March 30, 2010. The firm has two comparable plants, one plant is used as the treatment plant and the other as the control plant. All production workers in both plants are divided into production teams, and each team has a team leader. All production workers, including team leaders, are paid by piece rate (each worker’s wage depends on his/her individual productivity). In addition to piece-rate compensation, each team leader receives leadership pay, either tied to team performance or not, based on different periods of the experiment.

I started the research project by doing basic data analysis on the dataset using STATA and compared the results with the codebook created by previous students that have worked on this dataset. Unfortunately, there has been much discrepancy between the codebook and my analysis. To make up for the discrepancy, I created a new codebook with SAS to lay the foundation for future analysis. In the process of creating the codebook, I have managed to clear several errors in the dataset that could deteriorate the results of the research project.

Then I used SAS to conduct several regressions to acquire findings regarding how the workers’ productivity changes according to team leaders’ incentive pay. The preliminary results appear to be interesting, but I am carrying on with the research project to draw further conclusions.

Citations: Bandiera, O., I. Barankay, and I. Rasul. “Incentives for Managers and Inequality among Workers: Evidence from a Firm-Level Experiment.” *The Quarterly Journal of Economics* 122, no. 2 (January 2007): 729–73. <https://doi.org/10.1162/qjec.122.2.729>. Podsakoff, P. M., & Todor, W. D. (1985). “Relationships Between Leader Reward and Punishment Behavior and Group Processes and Productivity.” *Journal of Management*, 11(1), 55–73. <https://doi.org/10.1177/014920638501100106>

Research Fellow: Yuqi “Angela” Zheng (2023) Concentration(s): Educational Studies; PHRE

Faculty Mentor: Jing Wang

Department: East Asian Languages and Literatures

Title of Project: The Needham Question: Rethinking Methods

Funding Source: AHUM Division

Project Summary:

This summer I conducted research on a project titled “The Needham Question: Rethinking Methods,” with Professor Jing Wang of the Department of East Asian Languages and Literatures. Due to the COVID-19 pandemic, we worked remotely. Throughout the 8-week period, I worked independently on tasks assigned by the professor. We met on Zoom 2 to 3 times per week to discuss the research I have completed. Revolving around methods adopted by researchers of the Needham Question (Why modern science arose in Europe, not China?), my tasks included compiling bibliography, reviewing articles, taking notes, and discussion of my notes with the professor. The discussion very much focused the methodology of the articles reviewed.

In this increasingly globalized world, Western centrism as an intellectual habit requires critical attention. The Needham Question provides a great platform to engage in such critical thinking.

I reviewed two groups of articles. The first group was by authors mostly took Western viewpoint, intellectual framework, and terminologies for granted and universal (without contextual awareness) and applied them to Chinese society and culture to prove their pre-supposed conclusions about China. This calls the validity of their research into question, because they had answers before they investigated. The second group was by authors more open to worldviews, methodologies and socio-historical “fields” other than Western. The authors are much more aware of Western assumptions and inbuilt conclusions while engaging with the Needham Question. They do not arrive at definite conclusions; instead, they do thoughtful comparative work between Chinese and Western cultures which open many avenues of inquiry that are prohibited by Western-centric one-way analysis.

To sum up, my summer research experience was very rewarding. At the end of the research, I became a much more competent researcher in terms of various skills, including bilingual academic ability between Chinese and English. Above all, I gained a deeper understanding of the inter-cultural (China & the West) research methods.

Research Fellow: Weiyu “Jessica” Zhong (2022)

Concentration: Chemistry

Faculty Mentor: Ernie Nolen

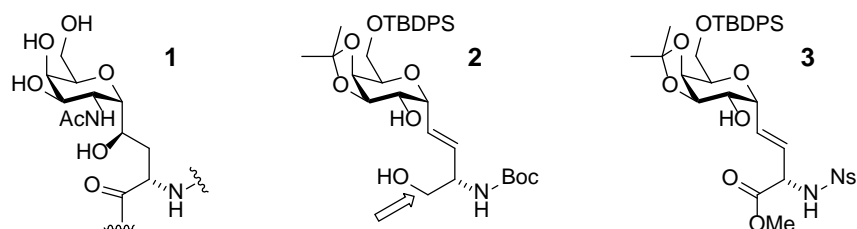
Department: Chemistry

Title of Project: Organic Synthesis of a Tumor-Associated Carbohydrate Antigen Mimic for Immunological Studies

Funding Source: National Institutes of Health (NIH)

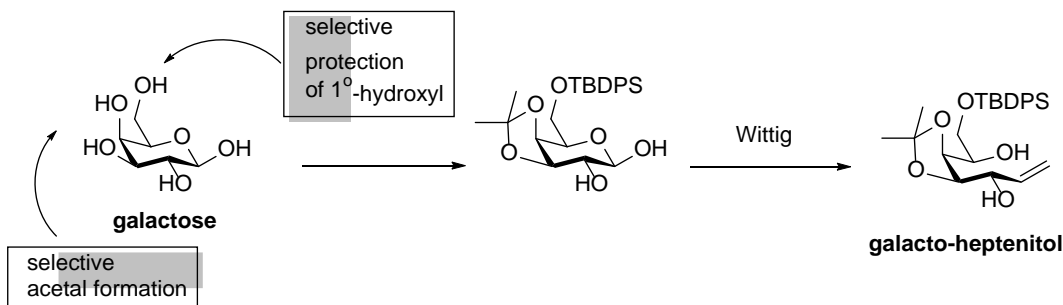
Project Summary:

Tn antigen, expressed by many types of tumors, is a cell-surface carbohydrate that elicits an antibody response. Our research goal is to synthesize the Tn antigen mimic **1** for studies aimed at understanding key factors in immunorecognition with potential for cancer vaccine development. The mimic **1** is structurally similar to Tn antigen and is metabolically more stable.



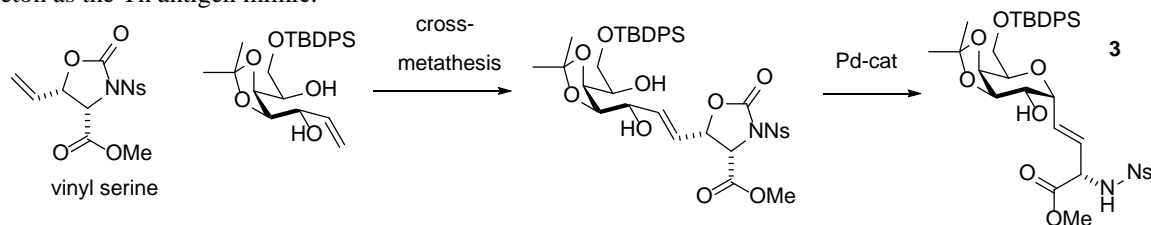
Previously, we came close to the goal by synthesizing the *C*-galactoside **2** that has the correct carbon skeleton of the antigen mimic. However, issues with subsequent oxidation of the primary hydroxyl (see arrow) halted our progress. This summer, with a revised synthetic plan, we sought to oxidize prior to putting the “fragments” together across the double bond, so that *C*-galactoside **3** would be formed.

The starting material, galacto-heptenitol, was synthesized in three steps from galactose according to conditions determined in a previous summer (Scheme 1). This involved selective protections, followed by a Wittig reaction to afford the alkene of the galacto-heptenitol.



Scheme 1: Preparation of the galacto-heptenitol from galactose

With the galacto-heptenitol in hand, we conducted a cross-metathesis reaction with a β -vinyl serine, which the Nolen group previously prepared. The reaction was carried out using two different catalysts - Grubbs II and the nitro-Grela – under a variety of conditions. The best yield we have obtained so far is 60%, but other variations of reaction conditions will continue to be explored, which will hopefully give better yields. The cross-metathesis product then underwent Trost-Tsuji cyclization catalyzed by palladium (0) to form **3** that has the correct carbon skeleton as the Tn antigen mimic.



Scheme 2: Cross-metathesis and Trost-Tsuji cyclization

Research Fellow: Zhelun Zhou (2020)

Concentration(s): History; PHRE

Faculty Mentor: Julie Dudrick

Department: Upstate Institute

Title of Project: Alice's Wonderland: The Art of Alice Hudson

Funding Source: Upstate Institute

Project Summary:

This summer I worked with the Upstate Institute. As an Upstate Summer Fellow, I worked as the curatorial assistant for the Chenango County Historical Society Museum. My job was to research, plan and design an exhibition to commemorate and present the works of local artist Alice Hudson. The exhibition will demonstrate that Alice Hudson is not only a creative artist, but a teacher and a storyteller as well. At the same time, the exhibition also commemorates the hundredth anniversary of the rectification of the nineteenth amendment of the United States Constitution.

Because of the current COVID-19 pandemic, I have conducted my work in a remote setting. Most of the research process was conducted through email correspondence, phone calls, and zoom meetings. In the process, I have made contacts with Alice Hudson's friends such as Sydney Walker, David Wilson, Neva Setlow, Pamela Cooley, and Willow Silver, and Alice Hudson's daughter Elizabeth Bronson. They have generously helped me by answering my questions, sharing their experience with and stories about Alice, as well as the artworks created by Alice during her stay in Norwich, New York since 1983. Meanwhile, I have also consulted several exhibition catalogs to compose an exhibition catalog draft for the upcoming exhibition. In addition, I have also made contacts with the staff at San Diego Mingei International Museum and archivist at the New York State Library.

The entire fellowship experience was rewarding. I learned much more about artist Alice Hudson and her whimsical yet progressive art styles. Her floppy books and "dolls" are spellbinding. Throughout the research process, I have built connections with staffs and participants in the fellowship. My fellowship helps me to know more about the local museums in the Upstate region of New York. It was a unique experience in that it provides me with more insight on exhibition planning and museum activities. Furthermore, viewing the works of Alice Hudson, though only through photos, is always a bonus for my fellowship. Had COVID-19 not been an issue, I wish I could do more during the fellowship research.

To conclude, I want to thank both Julie Dudrick, Director of Upstate Institute, and Professor Lynn Schwarzer from Art and Art History Department, for their help. I equally want to thank my supervisors at the Chenango County Historical Society, both Jessica Moquin and John Antonowicz, for their unconditional help, support and encouragement. Equally, I also want to extend my appreciation to David, Eric, Sydney and Elizabeth, for all their support, suggestions, and recommendations. I am deeply indebted to all of them.



Research Fellow: Ryan Zoellner (2020)

Concentration(s): PHRE; Political Science

Faculty Mentor: Valerie Morkevičius

Department: Political Science

Title of Project: Survey of Western Christian Just War Theory Compared to Islamic Notions of JWT & Governance

Funding Source: Center for Freedom and Western Civilization

Project Summary:

My project for the James Madison this year began as a survey of just war theory in Christian and Islamic thinking. Through the course of my reading, I became interested in what is known as the “responsibility to protect” doctrine. An advent of the late 1990’s (and response to the unique nature of global conflict at that time) R2P is the idea that in cases of grave human rights violations, the sovereignty of a state unable to prevent those abuses is transferred to the international community. The international community then becomes responsible for ending the abuses and restoring the legitimacy of the state. R2P is really two-pronged in that it suggests states have a responsibility to ensure the individual rights of their citizens, and to say that when states fail to meet this objective, the international community acquires that responsibility. I decided to make this a sort of sub-section of my research and increasingly, began to see parallels and prototypes of R2P in many of the classical and medieval thinking on just war I was reading. This interest grew, and my project became a study on the Christian, Islamic and modern approaches to justified humanitarian intervention in foreign states.

My survey of the Christian and Islamic canons of just war followed a fairly well-worn path, but one that was new and exciting to me. For the Christian half, I began with the secular Greeks. Thucydides and then, in many ways, his contradictors in Plato and Aristotle followed by the summation of those works with Cicero (a Roman). Many of the principles developed here are found across just war thinking—about sparing innocents, the status of non-combatants, and the goals of war (establishing peace). Next, I read the Pentateuch followed by the early Church fathers (Tertullian and Origen). A striking contrast becomes apparent here, as the initial law of the Old Testament the *lex talionis* (“law of retaliation”) prescribes war and conquest for the sake of communal purity, whereas the Church fathers believed they were following the new paradigm of Christ’s non-violence, the *lex Evangelica*. However, as the Christian Church rose to global power with the conversion of Rome, pacifism was no longer a sufficient doctrine to govern the state. Thus, a new generation of scholastics, embodied by Augustine and Aquinas in my study, emerged to synthesize the knowledge of the ancient Greeks with scripture and Church law. Finally, for the Christian tradition, I read Francisco de Vitoria and Hugo Grotius, both of whom worked to bring the sum of these past teachings into their modern world (fifteenth century Europe).

For the Islamic tradition, I began with sections of the Quran often used in discussions of war. I next looked into the number of meanings and interpretations of the phrase *jihad* (“striving” used to intimate both spiritual and military struggle against heresy, often modified by the phrase “in the path of God”) and to consider the contextual significance of the phrase in the Quran. One such consideration is what can be termed “the post-Hijra turn” from pacifism to a theory of just war following the Prophet Muhammad’s flight from Mecca to set up a state in Medina. This transition can be found in both hadith (sayings and teachings of the Prophet) from the period, as well as in justifications by later exegetes; and closely resembles the Christian turn from pacifism to political administration, however on a much shorter timeline. Next, I read Malik Ibn Anas, an 8th century jurist who lays out many of the rules for *in bello* (“in combat”) conduct and proposes an interpretation of legal authority which centers Islamic unity and sacred history under a political authority. I then read Muhammad al-Shaybani, a student of Malik’s and author of *al-Siyar*, or the Islamic law of nations. This work presents the crucial distinction between the *dar al-Islam* (“world of peace” or Islamic community) and *dar al-Harb* (“world of war” or disbelief and disorder) and the responsibilities of an Islamic state to attempt to bring its neighbors into sustained order. Finally, I read al-Mawardi whose work in the 10th delineates how proper authority can be delegated in a theory of state.

Ultimately, my project was one of comparison and contrast between Christian, Islamic and R2P thinking on the justified use of force and intervention. My paper first considers the obligations, restrictions, and motivations of each tradition. In each case, a striking similarity is the emphasis given to order and the restoration of that order which just war (should it be just) is intended to attain. For each, the nature of this order looks a bit different; yet each marks out a clearly defined state of peace and order which serves as the objective for justified war. In its conclusion, my paper argues that the structure and incentives of R2P are not only informed by religious just war traditions, but that R2P is itself a secular doctrine of just war for the modern era.

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: 160**Distribution of Students by Concentration (students with double majors are included twice)**

Anthropology	3
Applied Math	5
Art and Art History	3
Arts & Humanities	1
Astrogeophysics	4
Astronomy/Physics	6
Biochemistry	10
Biology	12
Chemistry	6
Chinese	1
Classical Studies	1
Classics	2
Computer Science	12
Economics	10
Educational Studies	4
English	4
Environmental Biology	2
Environmental Economics	1
Environmental Geography	1
Environmental Geology	1
Environmental Studies	8
Film and Media Studies	1
French	1
Geography	4
Geology	2
German	1
History	7
International Relations	7
Mathematical Economics	3
Mathematics	7
Middle Eastern and Islamic Studies	4
Molecular Biology	4
Natural Sciences	2
Neuroscience	4
Peace and Conflict Studies	4
Philosophy	9
Philosophy & Religion	3
Physics	15
Political Science	8
Psychological Science	3
Religion	2
Russian and Eurasian Studies	3
Sociology	4
Spanish	5
Undeclared	18
Women's Studies	1

Arts and Humanities	33
Art and Art History	3
Arts & Humanities	1
Chinese	1
Classical Studies	1
Classics	2
English	4
French	1
German	1
Philosophy	9
Philosophy & Religion	3
Religion	2
Spanish	5
Natural Sciences and Mathematics	95
Applied Math	5
Astrogeophysics	4
Astronomy/Physics	6
Biochemistry	10
Biology	12
Chemistry	6
Computer Science	12
Geology	2
Mathematical Economics	3
Mathematics	7
Molecular Biology	4
Natural Sciences	2
Neuroscience	4
Physics	15
Psychological Science	3
Social Sciences	47
Anthropology	3
Economics	10
Educational Studies	4
Geography	4
History	7
International Relations	7
Political Science	8
Sociology	4
University Studies	26
Environmental Biology	2
Environmental Economics	1
Environmental Geography	1
Environmental Geology	1
Environmental Studies	8
Film and Media Studies	1
Middle Eastern and Islamic Studies	4
Peace and Conflict Studies	4
Russian and Eurasian Studies	3
Women's Studies	1
Undeclared	18

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
Philosophy	2
Natural Sciences and Mathematics	85
Biology	12
Chemistry	19
Computer Science	8
Geology	13
Mathematics	1
Neuroscience	3
Physics and Astronomy	26
Psychological and Brain Sciences	3
Social Sciences	30
Anthropology	2
Economics	6
Educational Studies	2
Geography	2
History	7
Political Science	10
Sociology	1
University Studies	11
Environmental Studies	5
Film and Media Studies	3
Russian and Eurasian Studies	2
University Studies	1
Other	40
Center for Freedom and Western Civilization	12
Lampert Institute for Civic and Global Affairs	4
University Libraries	1
Upstate Institute	23

Distribution of Students by Funding Source

Internal	83
Center for Freedom and Western Civilization	12
Division of the Arts and Humanities	5
Division of Natural Sciences and Mathematics	14
Division of Social Sciences	17
Division of University Studies	8
Lampert Institute for Civic and Global Affairs	4
Upstate Institute	23
Endowed	60
Bob Linsley/James McLelland Fund	1
Doug Rankin '53 Endowment-Appalachian Research	3
Doug Rankin '53 Endowment-Geology Research	2
Endowed Fund for Peace Research	2
Hackett-Rathmell 1968 Memorial Fund	1
Holden Endowment Fund	3
J. Curtiss Taylor '54 Endowed Student Research Fund	2
Justus '43 and Jayne Schlichting Student Research Fund	12
Michael J. Wolk '60 Heart Foundation	16
Miller-Cochran Fund	1
Norma Vergo Prize	2
Oberheim Memorial Fund	2
Volgenau Wiley Endowed Research Fellowship	11
Walter Broughton '63 Research Fund	1
Warren Anderson Fund	1
External	23
Beckman Scholar Program	3
NASA Mars Data Analysis Program	1
NASA New York Space Grant	2
National Institutes of Health (NIH)	1
National Science Foundation	14
University of Colorado Foundation	2

Total Number of Participating Faculty: 78

Distribution of Faculty by Division and Department:

Arts and Humanities	7
Art and Art History	1
Classics	2
East Asian Languages and Literatures	1
English	1
Philosophy	2
Natural Sciences and Mathematics	29
Biology	5
Chemistry	6
Computer Science	3
Geology	4
Mathematics	1
Neuroscience	1
Physics and Astronomy	8
Psychological and Brain Sciences	1
Social Sciences	23
Anthropology	2
Economics	4
Educational Studies	3
Geography	2
History	4
Political Science	7
Sociology	1
University Studies	5
Environmental Studies	2
Film and Media Studies	1
Russian and Eurasian Studies	1
University Studies	1
Other	14
Center for Freedom and Western Civilization	8
Lampert Institute for Civic and Global Affairs	4
University Libraries	1
Upstate Institute	1

Distribution of Faculty by Funding Source

(Faculty with more than one funding source are counted multiple times)

Internal	42
Center for Freedom and Western Civilization	8
Division of the Arts and Humanities	3
Division of Natural Sciences and Mathematics	10
Division of Social Sciences	12
Division of University Studies	4
Lampert Institute for Civic and Global Affairs	4
Upstate Institute	1
Endowed	35
Bob Linsley/James McLelland Fund	1
Doug Rankin '53 Endowment-Appalachian Research	1
Doug Rankin '53 Endowment-Geology Research	2
Endowed Fund for Peace Research	1
Hackett-Rathmell 1968 Memorial Fund	1
Holden Endowment Fund	2
J. Curtiss Taylor '54 Endowed Student Research Fund	2
Justus '43 and Jayne Schlichting Student Research Fund	6
Michael J. Wolk '60 Heart Foundation	7
Miller-Cochran Fund	1
Norma Vergo Prize	2
Oberheim Memorial Fund	2
Volgenau Wiley Endowed Research Fellowship	5
Walter Broughton '63 Research Fund	1
Warren Anderson Fund	1
External	14
Beckman Scholar Program	3
NASA Mars Data Analysis Program	1
NASA New York Space Grant	1
National Institutes of Health (NIH)	1
National Science Foundation	7
University of Colorado Foundation	1

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