INAUGURAL TUFTS LAIDLAW RESEARCH DAY

October 19, 2019

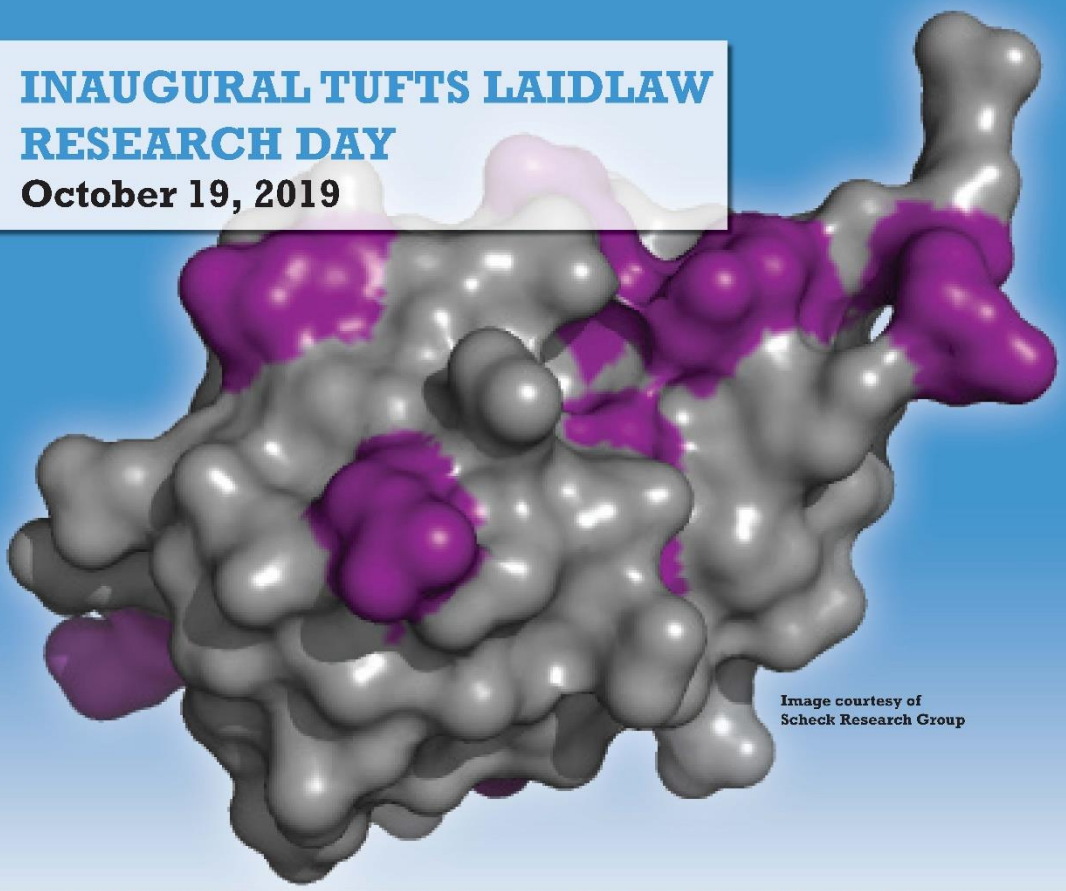


Image courtesy of
Scheck Research Group

Laidlaw Undergraduate Scholarship Program in Research and Leadership

2018-2020: Lightning Talks

2019-2021: Posters Session

LAIDLAW FOUNDATION

Tufts UNIVERSITY

Science and Engineering Complex, 200 College Avenue, Robinson 253, Medford

Tufts

LAIDLAW FOUNDATION

TUFTS LAIDLAW SCHOLAR RESEARCH DAY

October 19, 2019

Science and Engineering Complex, Robinson 253, 200 College Avenue, Medford

Lightning Talks: Robinson 253 **Posters:** Atrium

LIGHTNING TALKS (COHORT 1/2018-2020) Robinson 253):

9:30 a.m. **WELCOME AND INTRODUCTORY COMMENTS: DAWN TERKLA**

9:45 a.m. #1
Scholar: **CLAIRE DAVIDSON**
Mentor: Elizabeth Byrnes
Project: *A Study on Opioid Receptor Expression in Transgenerational Mice*

10:00 a.m. #2
Scholar: **MRUGANK BHUSARI** **ZOOM**
Mentor: Justin Hollander
Project: *Urban Planning in Extreme and Uninhabitable Conditions*

10:15 a.m. #3
Scholar: **FRANCESCA DEIESO-FRECHETTE**
Mentor: Amy Yee
Project: *Effects of Epigallocatechin-3-Gallate and 5-Aza-2-Deoxycytidine Novel Combination Treatment on Triple Negative Breast Cancer*

10:30 a.m. #4
Scholar: **MACKENZIE PARMENTER**
Mentor: Stephen Fuchs
Project: *Using CRISPR-CAS9 to Study Repetitive Proteins*

10:45 a.m. #5
Scholar: **AMEL HASSAN**
Mentor: Jivko Sinapov
Project: *Autonomous Intelligent Robots*

11:00 a.m.	#6	**Scholar:**	**KEYA VISWANATHAN**
		Mentor:	Mitch McVey
		Project:	*A Novel Assay to Characterize CAG Trinucleotide Repeat Expansions*
11:15 a.m.	#8	**Scholar:**	**NORA MAETZENER**
		Mentor:	Hilary Binda
		Project:	*The Critical Intersection of Higher Education In Prison*
11:30 a.m.	#9	**Scholar:**	**JONATHAN RODRIGUEZ** **ZOOM**
		Mentor:	Lenore Cowen
		Project:	*Majority Vote Cascading: A Semi-Supervised Framework for Improving Protein Function Prediction*

NOON LUNCH AND POSTER SESSIONS (ATRIUM)

1:15 p.m.	#10	**Scholar:**	**MAGNIFIQUE MUKUNDWA**
		Mentor:	Daniele Lantagne
		Project:	*Assessing the Status of Water, Sanitation, Hygiene, and Nutrition (WASH-N) in Rural Areas: Mbuye Sector as a Case Study*
1:30 p.m.	#11	**Scholar:**	**SARAH MARKOS**
		Mentor:	Diana Chigas
		Project:	*The Coloniality of Humanitarian Aid: Sexual and Gender-Based Violence in Refugee Camps*
1:45 p.m.	#12	**Scholar:**	**DESMOND FONSECA**
		Mentor:	Kamran Rastegar
		Project:	*A Luta Continua: Angola in the Black Radical Imagination*
2:00 p.m.	#13	**Scholar:**	**JOSUE LLAMAS RODRIGUEZ**
		Mentor:	Michele Jacob
		Project:	*The Neuroscience of Intellectual Disability: Learning Impairments and Molecular Changes in the Brain Caused by B-Catenin Network Malfunction*

2:15 p.m.	#14	**Scholar:**	**DANIELA SANCHEZ**
		Mentor:	Deborah Donahue-Keegan
		Project:	*Language and the Letter of the Law: Probing the Dynamics of Legal Language Justice IN New Mexico*
2:30 p.m.	#15	**Scholar:**	**RAE DEVENEY**
		Mentor:	David Proctor
		Project:	*Church and State in Byzantium*
2:45 p.m.	#16	**Scholar:**	**STEVEN SCHWAB**
		Mentor:	Rebecca Scheck
		Project:	*Modulating Selective Protein Chemistry*
3:00 p.m.	#17	**Scholar:**	**ANEYA SOUSA**
		Mentor:	Shameka Powell
		Project:	*Analyzing Anti-Blackness and Antagonism Against Black LGBT Youth in Mental Health Services*
3:15 p.m.	#18	**Scholar:**	**ISABELLA SPAULDING**
		Mentor:	Lisa Shin
		Project:	*Brain Responses to Ambiguous Facial Expressions in Individuals with Post-Traumatic Stress Disorder*
3:30 p.m.	#19	**Scholar:**	**VIRGINIA ULICHNEY**
		Mentor:	Nathan Ward
		Project:	*The Specificity of Cognitive Interference in Cognitive-Motor Dual-Tasking Through the Lifespan*
3:45 p.m.	#20	**Scholar:**	**GIAN MARCO VISANI**
		Mentor:	Soha Hassoun
		Project:	*Predicting Enzyme Classes Using Hierarchical Classification*
4:00 p.m.	#21	**Scholars:**	**ARAM LEE and PETER LAM**
		Mentor:	Robin Kanarek
		Project:	*Innovative Design: Modernizing CBT-E Through Advanced EMA in Mobile App Development*
4:30 p.m.	#24	**Scholar**:	**PLEARN AROONCHOTE**
		Mentor:	Jonathan Lamontagne
		Project:	*Is Thailand Queen Sirikit Dam Robust to Climate Change?*

4:45 p.m.	#25	**Scholar:**	**GRACE SCHUMAKER**
		Mentor:	Jennifer Allen
		Project:	*Brazilian Women's Health Study*
5:00 p.m.	#26	**Scholar:**	**RACHEL KLEIN**
		Mentor:	Dawn Terkla
		Project:	*The Application of Religion in Environmental Peace Building in Israel*
5:15 p.m.	#27	**Scholar:**	**SAM WEIDNER**
		Mentor:	Rosemary Taylor
		Project:	*Treating AIDS: A Study of Innovation and Regulation in the Pharmaceutical Industry*

POSTERS (COHORT 2/2019-2021): SEC ATRIUM

Scholar:	**RAVI BAJPAI**	Poster #1
Mentor:	Joshua Kritzer	
Project:	*Targeting EPS15-Stonin2 Interaction Through Metcaptoproline Stapling*	
Scholar:	**CASSANDRA (Cassie) CANCEMI**	Poster #2
Mentor:	Joshua Kritzer	
Project:	*Using the Chloroalkane Penetration Assay (CAPA) to Study the Uptake of Peptide-Oligonucleotide Conjugates*	
Scholar:	**MIKAYLA BARREIRO**	Poster #3
Mentor:	David Proctor	
Project:	*The Investiture Controversy in England*	
Scholar:	**PETER BIXLER**	Poster #4
Mentor:	Luke Davis	
Project:	*Sustainable High-Spin Molecular Light Emitters*	
Scholar:	**ALLISON CULBERT**	Poster #5
Mentor:	Timothy Atherton	
Project:	*Girih Tiles on Curved Surfaces*	

Scholar:	**YANCHEN DONG**	Poster #6
Mentor:	Sergei Mirkin	
Project:	A Study of CAG *Trinucleotides Repeat Expansion in Mammalian Cells*	
Scholar:	**MATEO GOMEZ**	Poster #7
Mentor:	Daniele Lantagne	
Project:	*A Systemic Review of Arsenic Leaching from Ceramic Pot Filters*	
Scholar:	**MOLLY GOULD**	Poster #8
Mentor:	Daanika Gordon	
Project:	*An Intersectional Analysis of Racialized and Gendered Media Portrayals of Criminality*	
Scholar:	**CLAUDIA GUETTA**	Poster #9
Mentor:	Hilary Binda	
Project:	*Real Rehabilitation: Education for Incarcerated Adults*	
Scholar:	**YING-JIE (TIM) LING**	Poster #10
Mentor:	Yu-Shan Lin	
Project:	*Rational Design of Macrocycles for Inhibiting Cancer*	
Scholar:	**XUANJIANG (WILLIAM) LIU**	Poster #11
Mentor:	James Intriligator	
Project:	*Soft Robotics Exosuit*	
Scholar:	**VALERIA LOPEZ**	Poster #12
Mentor:	Anne Fulton	
Project:	*Effect of Topography in an In Vitro Keratoconus Tissue Mode*	
Scholar:	**KATHERINE (Katie) MCMURPHY**	Poster #13
Mentor:	Charles Mace and William Masters	
Project:	*Improving the Quality of Infant Food in Ghana: Accessible Testing with Colorimetric Devices*	
Scholar:	**PHILIP MILJANIC**	Poster #14
Mentor:	Charles Mace	
Project:	*Dried Blood Spot (DBS) DSevices Design and Manufacturing*	

Scholar: **ALEKYA MENTA** Poster #15
Mentor: Nathan Ward
Project: *A Community-Based Exercise Intervention for Older Adults With Motoric Cognitive Risk Syndrome*

Scholar: **THEOFANI (NINA) PITTAS** Poster #16
Mentor: Madeleine Oudin
Project: *Evaluating the Effect of the Extracellular Matrix on Chemoresistance in Triple Negative Breast Cancer*

Scholar: **SERRA MUFTU** Poster #17
Mentor: Mitch McVey
Project: *The Effect of CAG Trinucleotide Repeats on DNA Double-Stranded Break Repair in Drosophilia Melanogaster*

Scholars: **PARAS PATNAIK, EMILY TAKETA, MIRANDA YU** Poster #18-20
Project: *Chimpanzee Genetic Analysis*
Mentors: Stephen Fuchs & Zarin Machanda

Scholar: **PHOEBE SARGEANT** Poster #21
Mentor: Steve Cohen
Project: *Revolutions Remembered: An Analysis of History: CURRICULA in Boston-Area Schools*

Scholar: **OLIVIA WARD** Poster #22
Mentor: Eileen Crehan
Project: *Who Knows You Best? Adult Self Report vs. Sibling Report Vs. Parent Report*

Scholar: **SCARLET BLISS** **SKYPE** Poster #23
Mentor: Amy Pickering
Project: Prevalence of Antibiotic Resistance in the Environment: Analysis of Emergent Markers in Soil

Scholar: **JACOB RUBEL** **SKYPE** Poster #24
Mentor: Peter Levine
Project: *Reinvigorating Federalism: Civic Education for Local Politics*

Cohort 1: In lieu of lightning talk.

Scholar: **CLAIRE DUNN** Poster #25
Mentor: Madeleine Oudin
Project: *Designing a Platform to Study the Role of Proteases in Cancer Growth, Invasion, and Response to Therapy*

RECEPTION AND DINNER: Curtis Hall, 474 Boston Avenue

5:45 p.m. RECEPTION
6:15 p.m. DINNER

CERTIFICATE PRESENTATIONS:

Congratulations Plearn Aroonchote, Mrugank Bhusari, Claire Davidson, Francesca DeIeso-Frechette, Rae Deveney, Claire Dunn, Desmond Fonseca, Amel Hassan, Rachel Klein, Peter Lam, Aram Lee, Nora Maetzener, Sarah Markos, Magnifique Mukundwa, Mackenzie Parmenter, Jonathan Rodriguez, Josue Llamas Rodriguez, Daniela Sanchez, Grace Schumaker, Steven Schwab, Aneya Sousa, Isabella Spaulding, Virginia Ulichney, Gian Marco Visani, Keya Viswanathan, Sam Weidner

Thank you to all who participated in the organization of this inaugural Laidlaw Research Day at Tufts University.

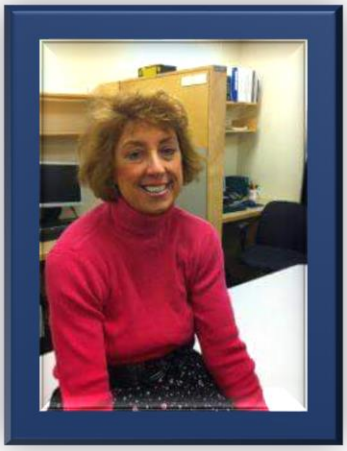
DAWN GERONIMO TERKLA. As Associate Provost, Dr. Terkla oversees the Office of Institutional Research (OIR) and the Center for Enhancing Teaching and Learning (CELT), serves as the university's Monitoring and Evaluation (M&E) team leader for the USAID funded EPT2 One Health Workforce Project; provides guidance across the university on issues relating to institutional research, outcomes assessment, and evaluation; works with schools and departments on various initiatives, e.g., strategic planning, outcomes assessment, fact finding, program reviews; serves as the institutional coordinator for selected university-wide initiatives; provides critical management information to senior administrators; and serves on university-wide committees (Academic Council, Administrative Council, Social Science IRB, Tufts IT Steering Committee, Information Stewardship Sub-committee, Student Information Steering Committee

Dr. Terkla is the University Accreditation Liaison Officer to the New England Commission of Higher Education (NECHE). In addition, she participates in school-level accreditations, providing support as needed. She has held leadership positions in several organizations serving as President of both the North East Association for Institutional Research and the Association for Institutional Research, as well as the Chair of the US Department of Educational National Postsecondary Executive Committee (NPEC) Council on Postsecondary Education Statistics. In addition, she has served on the Higher Education Data Sharing Consortium Board of Directors, the UCLA/ACE Cooperative Institutional Research Program Advisory Committee, National Association of Independent Colleges and Universities Commission on Policy Analysis, the National Student Clearinghouse Advisory Committee and numerous National Center for Education Statistics technical review panels. In December, she will begin a three-year term on the Planning Accreditation Board.

Dr. Terkla earned a doctorate in higher education research from Harvard University, a Masters of Public Policy from the University of California Berkeley, and a Bachelor's degree from Ohio Wesleyan University where she majored in politics and government. In addition, she was awarded a management certificate from the Management Institute for Women in Higher Education. Dawn administers the Laidlaw Scholars Program and is a Faculty mentor to approximately 50 Laidlaw Scholars at Tufts University.

PROGRAMMING MESSAGE: Congratulations to the graduating inaugural Laidlaw scholars from the 2018-2020 programming at Tufts University and to the 2019-2021 scholars for completion of their first year. The efforts by both cohorts we have gleamed from the deliverables of research papers, videos, lightning talks, and posters are consistent with the leadership attributes of a Laidlaw Scholar. Thank you to all who have coordinated, volunteered, and participated in the Inaugural Laidlaw Research Day at Tufts. The various research projects showcased in the lightning talks, videos, essays,

and research posters are the product of outstanding talent and the exceptional guidance the scholars received from their mentors. We are excited about the Inaugural Laidlaw Research Day on October 19th.



We are grateful to the Faculty and administrators who continue to volunteer as reviewers in the selection process and as speakers at our leadership events. Diana Capone (Administrative Coordinator), Vice Provost Kevin Dunn, and I have accomplished a great deal in the past two years with the generous contributions of others.

Significant contributors have been Greg Victory (Executive Director, Tufts Career Center) and Alice Shaughnessy (Project Administrator, Tufts Student Services). Greg Victory is the champion of Strength Finder assessments. In November, he is also moderating a workshop (Dining with Confidence: A Business Etiquette Dinner). Both Greg and Alice contributed substantially to the previous two-day Laidlaw retreats held at the Warren Conference Center in Ashland.

Andrew Singleton has recently joined our Team as a Program Administrator and is excited to work with us to continue to elevate the Laidlaw Programming for current and future scholars. Andrew joins us from Venture Café, which works to connect and educate the entrepreneurial and innovation community in Boston and many other cities around the world. He is looking forward to bringing his experience to the Laidlaw Scholars at Tufts.

Other Faculty and staff who have contributed to Laidlaw leadership programming have included Kylie Burnham (Preparation and Creation of TED Talks and research papers); Robert Burdick (Importance of Art of Negotiation. Leaders as Negotiators); Thomas Cox (Design Thinking. Mindset of Solving Complex Problems); Jonathan Garlick (Inclusive Science Dialogue); Lauren Garlick (The Art of Communication); Diane Ryan (Peer Coaching); Lara Sloboda (IRB: Research Ethics and Review); Rosemary Taylor (Data Organization); and Ashley Wilcox (Fulbright Research). Tisch Library sponsored a summer event entitled the Next Library edition. The efforts of various faculty in the recruitment, screening, and program panels is appreciated.

Several scholars received accolades. In November of 2018, Magnifique Mukundwa received the Anne E. Borghasani Memorial Prize. Then in December of 2018, Magnifique won the Montle Prize for her work entitled “To the Waters”. The Montle Prize is awarded for best entrepreneurial ideas. Amel Hassan was highlighted by Tufts during Engineering Week for her work in robotics. Several of our

Scholars have studied abroad in Chile, Copenhagen, Costa Rica, England, France, Germany, Ghana, Hong Kong, Indonesia, Israel, Latin America, London, Madrid, Scotland, Syria, Thailand, Scotland, and Sweden. At least two other scholars also completed internships last year. Last October two Laidlaw scholars -- Desmond Fonseca and Sam Weidner -- attended the Laidlaw Scholars Research Meeting held at the University of St. Andrews in Scotland.

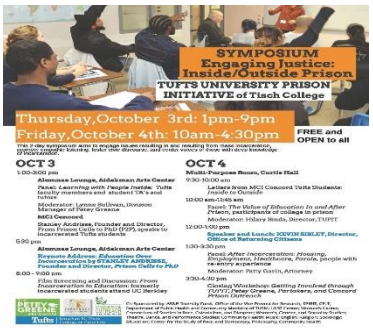
In April, there was a Laidlaw Foundation Site Visit at Tufts by Chief Executive Susanna Kempe at Tufts University. Susanna met with administration, Faculty, and scholars throughout the day. Susanna returned in June to observe the two-day Laidlaw Retreat held at the Warren Conference Center in Ashland, MA. Our students are actively supporting the Program and raising the awareness of the value of being a Laidlaw Scholar. Tufts has generous scholars who volunteer when opportunities arise. Cohort 1 scholars held monthly leadership meetings wherein they discussed their projects and study abroad (October 2018 – March 2019). Meeting leadership was based on volunteer opportunities. Francesca DeIeso-Frechette and Sam Weidner mentored the new scholars at the two-day summer Laidlaw retreat. On September 22nd, Scholars Alekya Menta, Nina Pittas, Daniela Sanchez, Molly Gould, Mateo Gomez, and Mikayla Barreiro volunteered and participated on behalf of the Laidlaw Program at Tufts Community Day. They set up a themed table entitled "Penny for Your Thoughts" and engaged the community to write leadership messages. The messages have been transcribed and uploaded to the Laidlaw Foundation Networking Website. Scholars have been available to promote the Program to potential future scholars at various Tufts information sessions.

September was a very busy and productive month. On September 11th, Dean John Issberner from the University of St. Andrews was our guest for three days. He met with many of the scholars during that time to discuss the Laidlaw Program and study abroad.

While Dean Issberner was at Tufts, we kept him very busy. He met with several current Laidlaw Scholars and a few potential future scholars. He also met with Professor Barry Trimmer with whom he is a former Tufts colleague. He observed Laidlaw research posters.

Dean Issberner participated in a Laidlaw Workshop on Peer Mentoring held by Diane Ryan, Associate Dean of Programs and Administration at Tisch College. Recommended reading from this workshop is **"Triggers"** by Marshall Goldsmith. Scholars have been paired for continued programming this year with Diane Ryan.

Jonathan Rodriguez and Lenore Cowen published ***"Majority Vote Cascading: A Semi-Supervised Framework for Improving Protein Function Production"*** in the Associate for Computing Machinery. Josue Llamas and Michele Jacob contributed to the publication ***"Learning Impairments and Molecular Changes in the Brain Caused by β-Catenin Loss"*** in Human Molecular Genetics 2019; 28 (17):2965-2975.



In October, Hilary Binda, Nora Maetzener, and Claudia Guette organized a two-day Symposium at Tufts University entitled **"*Engaging Justice: Inside/Outside Prison*"** in collaboration with the Tufts University Prison Initiative of Tisch College. Of note, this was Nora and Hilary's second conference.

UCL Laidlaw Research and Leadership Programme Conference, London, October 12, 2019. This year (month) Laidlaw scholars Scarlet Bliss and Keya Viswanathan attended the UCL Laidlaw Research and Leadership Programme Conference in London along with Kevin Dunn and Dawn Terkla.

TUFTS SCHOOLS: ARTS AND SCIENCES AND ENGINEERING:

PLEARN AROONCHOTE (2018-2020). I am majoring in environmental engineering and graduating in 2021. My hometown is Bangkok, Thailand, but I have also spent significant parts of my life in Qatar and India. Outside of classes, I spend time doing fun science presentations to high-schoolers in STEM-Ambassadors, and am involved in the Tufts Asian Student Coalition, Tufts Thai Students Association, and am a part of the Tufts Sunrise Movement hub. My research interests lie in how to use environmental engineering and water resources principles to improve the quality of life of people in developing nations like Thailand. I applied to the Laidlaw Scholar's program in 2018 because I wanted to learn more about and do environmental engineering research related to a topic that I was passionate about. For me, it was a unique opportunity to research Thai environmental problems academically. My research with my mentor, **Professor Jonathan Lamontagne**, in the Laidlaw scholars' program looks at how to best optimize the operations of Thailand's largest dam to for flood protection, energy generation, and irrigation. The lowlight of my research experience has been the hours spent debugging my code and trying to make the optimization run. The highlights are when the program works, specifically the first time my program produced an optimization graph that made sense with my background research in to the Bhumibol dam operations. In my free time, I like to listen to podcasts, eat good food, and follow Thai politics. I have had an internship with Land Process, a landscape architecture company in Thailand that designs public parks and resilience building projects. My favorite color is blue. I have not studied abroad but I spent some time visiting the Bhumibol Dam during the summer and taking to the engineers that work there. In five years from now, I hope to be working on and researching environmental problems that sprawling mega-cities such as Bangkok are facing. My advice to future scholars is to break your project in to manageable chunks when you are thinking about it and working on it as it will make it all seem much less daunting.

JONATHAN LAMONTAGNE. I received my M.S. and Ph.D. in environmental water resources systems analysis from Cornell University in 2014 and 2015, respectively. My graduate studies focused on flood frequency analysis and the incorporation of uncertainty in hydropower systems planning. Following my graduate studies, I worked as a postdoctoral research associate at Cornell University, studying uncertainty and robustness issues for models of the integrated human-climate system. I joined the Tufts Department of Civil and Environmental Engineering in 2017. I am the Faculty mentor to **Plearn Aroonchote's** Laidlaw Research.

RAVI BAJPAI (2019-2021). I am a Tufts University Junior majoring in biochemistry and a 2019 Laidlaw scholar from Natick, MA. My project is aimed at researching how to inhibit the protein-protein interaction between EPS15 and Stonin2, that initiates endocytosis, using a new type of stapling technique involving artificial amino acids under **Professor Joshua Kritzer.** The highlight of my research has to be whenever I get good data but that can also be a double-edge sword if everything doesn't go right. However, this is all part of the process and part of the reason I first applied to Laidlaw is to get experience leading my own independent project. My advice though would not get discouraged over bad results and if you get stuck to reach out to someone like your mentor or a coworker. The great thing about working in a lab is that you are surrounded by experts who have went through the same trials as you, which is a very valuable support system. Outside of Laidlaw I am a big baseball fan and do a lot of long-distance running. I also did martial arts for 10 years, eventually getting my black belt and even becoming an instructor. I have not gotten to study abroad, though most of my family lives overseas so I have gotten to travel a lot just through seeing them, especially to Australia and India, where I have citizenship. In five years, I plan on doing some sort of clinically applicable medical research using the skills I developed at Tufts, and hopefully Laidlaw is the first step to that goal.

CASSIE CANCEMI (2019-2021). I am a rising junior from Long Island, NY. At Tufts, I am a biochemistry major in the class of 2021, and am also a member of the women's varsity softball team. I became a Laidlaw Scholar in the summer of 2019 with the help and encouragement of my mentor Dr**. Joshua Kritzer**. For me, the program was an incredible opportunity to dive into my own research while learning from my peers and their projects as well. I am currently working in Dr. Kritzer's chemical biology lab, studying the cell penetration of peptide-oligonucleotide conjugates, which are a class of molecules that can be used to treat disease by altering gene expression. I have really enjoyed being able to focus on research this summer; without the added stress of classes I've been able to read, learn and grow as a scientist in ways I wasn't expecting. I've learned that setbacks, failed experiments and a lot of trouble shooting are all part of the process, but that all of these things make the small successes even more exciting! As of now, I am hoping to continue onto graduate school after Tufts to pursue a PhD in either chemistry or biochemistry. In terms of more long-term goals, I would love to stay in academia and have the opportunity to teach and continue research. I've had so many amazing professors at Tufts that have greatly impacted my academic experience, and I would love to be able to do the same for someone else one day too.

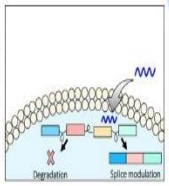
JOSHUA KRITZER, PHD. I am an Associate Professor of Chemistry at Tufts University in Medford, Massachusetts. Using techniques spanning chemistry and biology, the Kritzer Lab discovers new molecules and applies them to answer basic questions about human biology and disease. The Kritzer Lab is funded by multiple federal research grants, and our research has been recognized with several awards including the Smith Family Award for Excellence in Biomedical Research and the NIH New Innovator Award. I teach undergraduate Organic Chemistry and Biochemistry, and my excellence in the classroom has been recognized with a Teaching with Technology Award and the Undergraduate Initiative in Teaching Excellence Award. The support of the Laidlaw program has allowed Kritzer Lab undergraduates **Cassandra Cancemi** and **Ravi Bajpai** to launch ambitious, independent research projects at a relatively early stage. These projects are developing new molecules and new biological tests that will improve drug development for cancer and rare genetic diseases.

Using the Chloroalkane Penetration Assay (CAPA) to Study the Cytosolic Localization of Peptide-Oligonucleotide Conjugates

Cassandra N. Cancemi, Kirsten L. Deprey, Joshua A. Kritzer
Tufts University, Department of Chemistry

Background

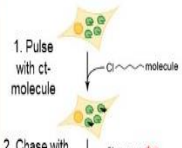
Antisense oligonucleotides: ASOs are short sequences of nucleic acids that can bind mRNA or pre-mRNA by Watson-Crick base pairing, ultimately modulating protein expression. Nucleic acids have been used as a therapeutic approach to target diseases such as Duchenne Muscular Dystrophy, Spinal muscular atrophy, as well as certain gastrointestinal and autoimmune disorders.[1-5]



Current obstacles: Poor cellular uptake continues to be a major obstacle to the widespread clinical implementation of ASOs, and we are still in need of a more direct and quantifiable means to measure cytosolic penetration.

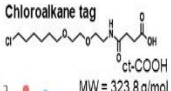
Our Approach: We plan to use the Chloroalkane Penetration Assay (CAPA) to improve upon these setbacks. This assay was developed as a high throughput way to quantify cytosolic penetration, while excluding material trapped in endosomes. [7]

Chloroalkane Penetration Assay

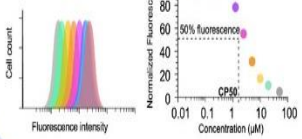


HeLa cells stably express HaloTag-GFP on the outer mitochondrial membrane.

HaloTag reacts covalently with chloroalkane ligands



MW = 323.8 g/mol

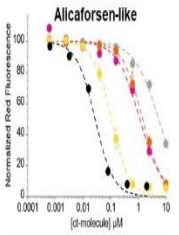


Abstract

Overexpression or improper splicing of proteins can cause a variety of different genetic diseases, and antisense oligonucleotides have become an exciting area of drug development for the treatment of these disorders. Despite immense potential, poor cellular uptake and nuclease sensitivity have proven to be major obstacles to the widespread clinical implementation of nucleic acid therapies. In an effort to improve upon these concerns, different structural modifications have been explored, including peptide-oligonucleotide conjugates. These molecules seek to increase the uptake of the nucleic acid sequence through the attachment of cell penetrating peptides. There have been a number of exciting improvements using peptides as delivery vectors, however, current methods to study cellular uptake are often indirect and qualitative. To address this, we hope to use the Chloroalkane Penetration Assay (CAPA), which was developed by the Kritzer lab as a way to more directly report on cytosolic uptake.

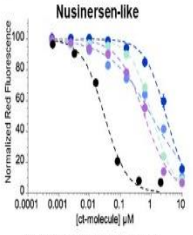
Applying CAPA Oligonucleotides

We have used CAPA to profile the cell penetration of a variety of different peptides, including well-studied CPPs such Tat, antennapedia and polyarginine.[7] *We are now using CAPA to study the internalization of therapeutically relevant, chemically modified oligonucleotides.* [8]



ct-GCCCAAGCUGGCAUCCGUCA

Backbone	2' mod.	CP_{50} (µM)
PO	H	5.6 ± 0.6
PS	H	1.1 ± 0.1
PO	OMe	1.5 ± 0.3
PS	OMe	0.11 ± 0.02



ct-UCACUUUCAUAAUGCUGG

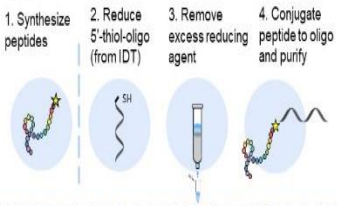
Backbone	2' mod.	CP_{50} (µM)
PO	H	3.1 ± 0.3
PS	H	1.07 ± 0.03
PO	OMe	1.12 ± 0.08
PS	OMe	0.6 ± 0.1

☆More highly-modified oligos are more cell-penetrant, consistent with literature trends.

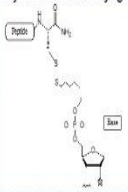
☆The sequence and/or length of the oligo seems to have an impact on cytosolic uptake

Results

Conjugation strategy



Synthesis of conjugates: Disulfide formation



ct-Tat-S-S-DNA	
Sequence	ct-YGRKKRRQRRRC-S-S-CCTCTTACCTCAGTTACA
Calc. MW	7513.40
Obs. MW	7513.181

Disulfide-linked peptide-DNA conjugate: Purity was assessed by RP-HPLC. Identity was confirmed by MALDI-TOF-MS.

Synthesis of conjugates: Maleimide-thiol conjugation

ct-Tat-Maleimide-S-DNA	
Sequence	ct-YGRKKRRQRRRK-Mal-S-CCTCTTACCTCAGTTACA
Calc. MW	7733.66
Obs. MW	7733.44

Maleimide linked peptide-DNA conjugate: Purity was assessed by RP-HPLC. Identity was confirmed by MALDI-TOF-MS.

Future Directions

☆ Prepare a panel of peptide-oligonucleotide conjugates with different peptide and nucleic acid components.

☆ Compare the uptake of different conjugates side-by-side in CAPA to determine which peptides (or chemical and structural characteristics) are most successful at delivering nucleic acids to the cytosol.

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MIKAYLA BARREIRO, (2019-2021). I am a second cohort Laidlaw Scholar from Cape Cod, Massachusetts. I am majoring in History with a minor in Medieval Studies, and, for me, Laidlaw is a unique opportunity for paid humanities research. In providing me with the opportunity for long-term research, Laidlaw helps me clarify my own plans post-graduation, and investigate a topic I've long been interested in. My project centers around the twelfth-century Investiture Controversy- a medieval conflict between the burgeoning papal powers and Europe's feudal kings. While this dramatic showdown has long been studied in terms of its German incarnation, the English side is seldom researched despite the uniquely large body of primary sources. With the help of my mentor, **David Proctor**, I've had the opportunity to dive into these sources and have already developed a strong understanding of the events and people I'm studying. Of particular interest to me have been the letters of England's Queen Matilda, who completely defies expectations in terms of her humanistic education, political influence, and role in the conflict. Too often the real power exacted by medieval women has been diminished by later historians, and it is exciting to re-introduce this important aspect of the narrative. Without the support of the Laidlaw Scholars Program, I would not have had the opportunity for such detailed work, and this important historical reality would have gone unnoticed. In addition to historical research, I enjoy teaching horseback riding as well as reading and writing novels. Going forward, I hope to continue my creative writing and pursue a Ph.D., perhaps even combining the two into historical novels. My best advice for future scholars would be not to fear disagreeing with 'experts'. When your research has a different focus than theirs, there will be facts you know that they don't. Allow yourself to be confident in your unique knowledge and enjoy the feeling of being the honest 'expert' on your project.

RAE DEVENEY (2018-2020). I am a Junior from Grafton, MA, and am majoring in history. Being a Laidlaw Scholar has been revolutionary for me- it has given me a chance to do historical research in a topic I developed, something that I did not think was possible to do as an undergraduate. Researching church and state relations in Byzantium has led me to study this relationship through the study land and tax policies in Byzantium, creating a truly all-encompassing study of Byzantine culture and society, and I am constantly astounded by political mechanisms of the Empire, and how relevant they are to politics and church and state relationships in our country today. My mentor, **Dr. David J. Proctor**, and I are continuously finding differences in political opinion from my primary source research documents, working to understand the religious and personal motivations of the authors and how they differ from the Westernized view of Byzantium so

prevalent in society today. I entered Tufts viewing Byzantium as a theocracy with a Western European feudal society, but the Laidlaw Research Program has given me the ability to now see the minute details and complexities within the Empire, an autocracy that was born and evolved nearly simultaneously with Christianity, an autocracy that was solely its own empire, and not just a continuation of the Roman Empire with a few Greek influences. The leadership aspects of the Laidlaw Scholars Program have helped me enormously as well, as I now see myself as a scholar capable of anything, and it has given me the background and courage to become a leader on campus as well. As Secretary of Tufts Democrats for the past year, I have enjoyed being on the executive board of one of Tufts' largest student political organizations, and love being able to help coordinate local political action in the community as well. As Vice President of Risk Management for the Tufts chapter of Alpha Phi, I am passionate about working with student groups and administration to develop our campus' Greek life culture and working to create a safer, more inclusive social life for all students. I plan on using my new passion, developed from this research, about church, politics, and taxation, after graduation by applying to law school and using my background to apply my skills to political life today. Outside of Tufts, I am an avid reader, and love to hike with my dogs, Tycho and Fidel, and am excited to be studying abroad in Paris in the Spring of 2020.

ABSTRACT. RAE DEVENEY. ***Church and State in Byzantium***. The central question of my research paper is the question of how, exactly, the church and state in the Byzantine Empire interacted with each other. Through my research into the time period, I have decided to examine this question through the policy of imperial land donation in the Byzantine Empire, specifically from 920-1118, focusing on imperial donations of land to the church. Through the examination of land policy, I have been able to analyze the evolution of this relationship within this time period, showing a dependency of the imperial government on the support and allegiance of the church, while also showing a dependency of the church on the imperial government for security and political stability. This has led me to form research conclusions regarding the relationship as a near codependency between the two institutions during a precarious point in Byzantine political history, while the supreme autocracy and power under the Emperor was never lost during this time.

DAVID PROCTOR. I am a triple Jumbo, receiving my B.A., M.A., and Ph.D. from Tufts. I have taught at Tufts as a Senior Section Instructor and Lecturer since 1996 specializing in the history of Europe, Byzantium, Southeastern Europe and papal-imperial relations. I am currently a Senior Lecturer in the Department of History and serve as adjunct Senior Lecturer in the Department of Classics and a member of the Core Faculty of the International Relations Program, the Archaeology Program, the Middle Eastern Studies Program, and the Medieval Studies Program. I volunteer for many aspects of Laidlaw Programming in addition to mentoring Laidlaw Scholars **Rae Deveney and Mikayla Barreiro**. I served on the 2019 Laidlaw Retreat Faculty panel and held a Laidlaw Information Session for 2020 recruitment.

THE INVESTITURE CONTROVERSY IN ENGLAND

Mikayla Barreiro
Tufts University

Investiture was the act of a lord giving a vassal the symbols of his office. The 11th and 12th century conflict over whether kings or clerics must invest new bishops is known as the investiture controversy.

1059
Lateran Synod prohibits lay investiture

1076
German controversy begins

1093
Anselm becomes Archbishop of Canterbury

1098
Anselm hears a papal decree against investiture

1100
Henry I becomes King
Anselm refuses investiture

1103-1106
Anselm's exile

1106
Henry and Anselm reconciled

1107
Settlement of Bec finalized

1122
Concordat of Worms ends German conflict

HENRY I

King of England from 1100-1135 and the third son of William the Conqueror. Henry needed the influence of the Church, and Anselm in particular, to maintain the throne from his older brother, the Norman Duke. However, he was also concerned with maintaining the traditional powers of England's king over her church.

ST. ANSELM

Archbishop of Canterbury from 1093-1109, Anselm was a moderate reformer but fanatically devoted to Papal authority. His refusal to be invested by King Henry began the controversy in England. Investiture itself was of less importance to him than unwavering submission to the Pope, but as the conflict protracted, he grew more steadfast in his opposition to royal investiture.

PASCHAL II

Pope from 1099-1118, he was far more radical than his predecessor, Urban II. While he did not initially push the question of investiture in England, he backed Anselm strongly once it was proposed. Though firm believer in the importance of investiture, Paschal's primary focus on ending the German crisis left him open to negotiation and compromise.

Causes of Conflict

1. Differing understandings of the papacy- Henry once wrote to Anselm that there were 'two popes' and therefore they might want to settle the matter between them
2. Reform vs. Traditional rights
3. Paschal could not seem hypocritical to the German Emperors
4. Differing beliefs in the holiness of kings

Causes of Compromise

1. Paschal's papacy depended on England not joining the German rebellion
2. Henry needed Anselm's support as he fought his brother for Normandy
3. Paschal hoped for English knights to go on crusade
4. England was perceived as backwater permitting more leniancy than in Germany

Sources

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LAIDLAW SCHOLARS

Laidlaw Scholars Program, Tufts University, Medford, MA

Church and State in Byzantium

Rae Deveney, advised by Dr. David J. Proctor

Background

The Byzantine Empire was exemplified by its political and cultural relationship with Orthodox Christianity and the institution of the Christian Church, but it was not a theocracy as has been commonly alleged. Through my research, I hoped to understand more clearly this intricate relationship between Empire and Church and role land ownership and land policy played in that relationship.

Research Objectives

The goal of this research paper is to analyze the evolution of the relationship between the branch of the Christian Church centered around the Patriarch in Constantinople and the imperial Byzantine government from a period between 9201118, specifically the reigns of Emperors Romanus Lecapenus through Alexius I Comnenus. The objective of the research is to better understand the complexity of the relationship through the examination of imperial land policy during this time period, and how the imperial government either gave or took away political power from the Church through its policies on land ownership and taxation.

Methods

In order to research this question, I first made use of secondary sources in order to better understand the cultural and political background that surrounded my question, which led me to decide to examine this question through terms of land policy. I then made use of primary sources, which included works of contemporary historians and surviving administrative documents to fully understand this question.

Image left: Emperor Alexius I Comnenus shown in rich gold manuscript illumination, along with imperial purple and religious symbolism, showing a personal triumph over both church and state. https://en.wikipedia.org/wiki/Alexios_I_Komnenos#/media/File:Alexios_I_Komnenos.jpg

Image top: Emperor Basil II, shown in the imperial purple with subjects bowing at his feet, and with religious iconography showing him to be crowned by angels, and overseen by Jesus, giving the Emperor both political and spiritual validity and authority. *From Menologium of Basil II* https://en.wikipedia.org/wiki/Menologium_of_Basil_II

Tax codes and Critical Edicts

Allelengyon: Initially, the allelengyon was a shared responsibility for taxation among the peasant landowning class which obligated a community to pay the portion of taxes poorer members of their community were unable to pay. In 1002 Basil II altered the allelengyon passing a law which placed required the dynatoi (landholding aristocracy, including monastic landholders) to be responsible for land taxes that were unpaid rather than the peasant landowners.

Pronoia: An imperial grant of land, usually given for service to the empire, or as a "divine" pronoia, in which land was given to the church. Began in the 11th century and gradually became hereditary by the 13th century. Originally intended as a reward for services to the Empire, usually in the form of military service, pronoia eventually became a tool which was used in order to strengthen the Empire's barriers and ensure loyalty to the imperial government.

Charistikion: A lifetime grant of land usually associated with monasteries, began by Nicephorus II Phocas in order to rehabilitate failing monasteries. However, this became a tool under Alexius I in the 1080s as a way to support the Empire during times of extreme land vulnerability. However, Under Alexius I Comnenus, the Charistikion became a tool used by the imperial government to tie the allegiance of the church to the imperial government, by linking the church's land and consequently power to the Byzantine Empire, eventually becoming a strongly political tool with little religious connotations. This shows the evolution of the politicization of religiously-intended political maneuvers, while also the continued dependence of the emperor on the church's support.

Edict of 922: Issued by Romanus I Lecapenus as the first serious act of legislation by the imperial government noting the critical centrality of peasant landholdings and is the first major legislative attempt to protect these landholdings from being acquired by the dynatoi and the church.

Edict of 944: Romanus I Lecapenus issued this edict in order to restrict dynatoi's landholdings by ordering that land originally held by peasants before a certain period had to be returned to original ownership.

Edict of 964: Issued by Emperor Nicephorus II Phocas, forbidding the increase of any church property, especially the donation of private land to monasteries, in order to create more taxable land which could be given to thematic soldiers. This was followed by a second edict of 934 continuing the work of restoring peasant lands that had been bought by the dynatoi.

Edict of 996: Enacted by Emperor Basil II, this edict holds as the highest point of imperial power restricting ecclesiastical landholdings and the church's ability to gain more land, showing the most extreme fission between church and state relationships in the Byzantine Empire. This edict marks heavily the imbalance that the overgrowth of ecclesiastical landholdings results in for the Empire, including against the ability of the dynatoi to now hold land in order to aid the Empire

Results

Through the examination of both primary and secondary sources, I found that a new and interesting way to look at the relationship between church and state in Byzantium was to evaluate this relationship via the role land ownership played in it. By examining the ways in which emperors either gave or took away land from church property, or from monasteries in particular, gave critical insight into what that meant for the needs of the empire. By noting when emperors took away land from church holdings, it shows that the empire was looking to strengthen its physical barriers to invaders, and when donating land to the church, it shows that the Emperor needed the church's support.

Limitations

I was limited by the fact that I do not read Byzantine Greek or Latin, so my depth of sources was limited to English-translated texts.

Conclusions

Byzantium is not the theocracy that is popularly portrayed in both Western culture and general academia, nor is it solely a continuation of the Roman Empire. Byzantium was a complex empire that could not have existed without the Church in Constantinople, but that did not mean that the Empire relied entirely on the Church, as it was still possessed a strong imperial administration. However, the empire leaned heavily on the Church, and the Church on the strength of the empire as well, creating a codependency that came at times most clearly to a head over the Empire's other most powerful, and most vulnerable, asset- its land. The functions within the relationship depended primarily on the political and cultural reality, and the abilities and attitudes towards the church of the current emperor, showing that there cannot be a truly continuous validation of one trend of thought in regards to the relationship between church and state in Byzantium. However, when looking at the time period of 9201118 and contextualizing the political needs of that time, the trend shows a growing reliance of the emperor on the church's support, won through gifts of land in order to foster the growth of the church's finances and physical presence. In order to continue the cultural and political identity of a physically shrinking Empire that was still expanding in religious culture and identity.

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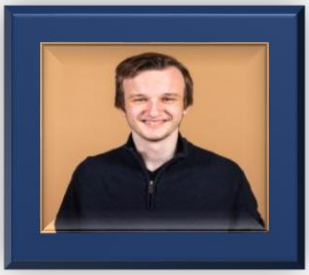
MRUGANK BHUSARI (2018-2020). I am a rising Junior from Mumbai, India. I am studying the classic Jumbo combination of Quantitative Economics and International Relations with a concentration in Economic Development. I am currently finishing my second summer as a Laidlaw Scholar where I have been working with **Professor Justin Hollander** in the Urban & Environmental Policy and Planning Department. Professor Hollander is currently working on a project wherein he examines mankind's aspirations to settle on Mars by conceptualizing what a settlement on Mars would entail. I am working on a specific sub-topic of this project wherein I explore how urban planning has been conducted elsewhere on Earth with comparable extreme and uninhabitable climatic conditions and the unique physical and social challenges they pose. Having taken the 'Introduction to Urban Studies' course in Fall 2017 with Professor Hollander and having worked for him as a Research Assistant in Spring 2018, I am thankful to the Laidlaw program which offered me an excellent opportunity to conduct independent research under the close supervision and mentorship of an expert in the field. Prior to attending Tufts, I spent two years at Mahindra United World College in India. I will be studying abroad this year in the Philosophy, Politics and Economics program at Oxford University. I hope to pursue higher education in the field of international relations or economics and would like to pursue a career in international policymaking. I am particularly interested in how the theory and methods of economics can serve as a means to achieving an evidence-based and informed policymaking mechanism at the international stage. In line with this pursuit, I worked as a Research Assistant for Professor John A. List, Professor of Economics at the University of Chicago this summer. Apart from academics, I enjoy playing soccer, watching stand-up comedy and traveling.

ABSTRACT. MRUGANK BHUSARI. ***Urban Planning in Extreme and Uninhabitable Conditions.*** Urbanization in different parts of the Arctic has historically emerged from colonial motivations and state intervention for short-term military, scientific or economic interests. Little considerations were paid to unique climatic conditions like winter and ice that have a great influence on use of outdoor spaces, accessibility and transport patterns. In extremely cold climates, where survivability is the priority, inattention to environmental and geographic conditions can render a settlement impractical. There is however a lack of literature on how these processes, or geo-climatic conditions, can influence urban form. In this paper I have begun by exploring and synthesizing the principles and approaches to best practices in urban planning and design in extreme climates. Next, taking winter conditions of cold temperatures, limited sunlight, wind, snow as a starting point for planning, I have explored two different conceptual models of planning in these conditions: the conventional and a non-conventional one. The conventional model explains how typical features of contemporary settlements – buildings and streets – as well as other aspects including land use and transport can be oriented and designed for optimizing livability in accordance with these principles. Its main advantages are its capacity to accommodate a large volume of people and activities and its familiarity in that it requires a few tweaks to the conventional system to suit the specific conditions. However, it demands a huge endowment of natural, human and material resource capital. Underground buildings and structures, a non-conventional approach, on the other hand can utilize the

landscape itself as a building form and does not necessitate as many resources. However, it has a considerably lower capacity to host people and activities. Moreover, the lack of familiarity with this idea means several experiments would need to be conducted over time for this model to evolve and be functional. Finally, I will elaborate on the need for intersections of the conventional and non-conventional models for optimizing livability in extreme conditions.

JUSTIN B. HOLLANDER, PHD. I am a Professor of Urban and Environmental Policy and Planning at Tufts University in Medford, Massachusetts. I am an internationally renowned expert on the planning and design of human settlements, having written seven books and over fifty journal articles, book chapters, and essays. My research has been supported by numerous government agencies and private foundations and my urban planning and design work have received awards from a variety of local, state, and national organizations. At Tufts, I teach graduate courses on the history of urbanization and early colonization, as well as the theories of community design. I very much enjoyed the chance to collaborate with **Mrugank Bhusari** over the last two years in the Laidlaw program. We worked together to understand ways that cities manage and thrive in extreme climate conditions, extracting lessons and best practices. The outcome of this work is the subject of a new book I am writing, and the new knowledge will be an important feature of an undergraduate course I teach, ***"Introduction to Urban Studies".***



PETER BIXLER (2019-2021). I am involved in the Laidlaw Scholars Program at Tufts University in Boston, Massachusetts. I am currently a Junior and am on track to graduate in 2021 I applied to the program in early 2019, the spring of my Sophomore year and spent that summer doing my first summer of research. I am a Chemistry Biology double major but the majority of the research project I am pursuing as part of the program falls within the field of Chemistry. The name of the project is Sustainable High Spin Molecular Light Absorbers and Emitters and the mentor is **Luke Davis**, a professor here at Tufts. I've been involved in research for a while now. I first started working in a lab in my Junior year of high school and I have been ever since. Research has been a great way to not only learn chemistry and expand my knowledge but to also see how a career in chemistry would look after I graduate. It's because of this that the Laidlaw Program is such a great opportunity to not only continue my research in chemistry, but to also learn some new strategies and techniques when it comes to leadership as well. After I graduate, I'm not entirely sure what the future holds for me. I might apply to go to graduate school to get a PhD in chemistry, but I also may go into industry to see what doing work in that field is like. My advice to future scholars is to pick a project that

they are passionate about, as that passion will definitely come through your application as well as making the research project much more enriching and enjoyable.

Tufts UNIVERSITY

High Spin Molecular Light Absorbers and Emitters

Peter Bixler and Luke Davis

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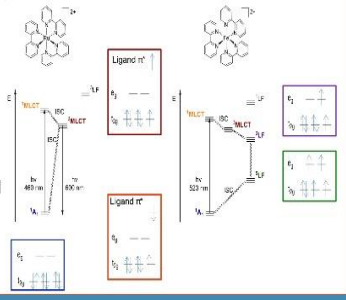
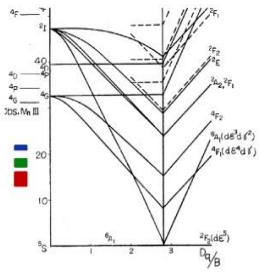
Theory and Rationale

Light emitters and absorbers play in increasing role in consumer and industrial technology, but as of now most of them are centered around expensive and rare metals like ruthenium, platinum, and iridium. The goal of this project is to replace those metals with more abundant ones such as iron.

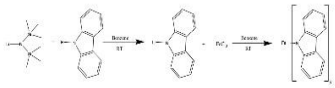


Instead of raising the ligand field strength to access the same electronic region as iridium and platinum compounds, as can be seen on the accompanying Tanabe Sugano diagram, lowering the ligand field strength, along with changing the coordination number can mimic the same functionality. This can be done by interrupting the geometry by adding bulky groups, as well as disrupting the donating character of the ligand.

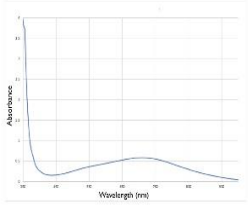


Iron(III) Carbazolide

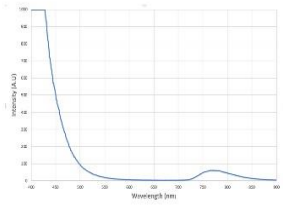
The compound of interest, iron(III) carbazolide was synthesized using the method shown to the right.



Below can be seen some of the early data collected from the synthesized iron(III) carbazolide. On the left is the UV/Vis absorbance of the compound. There is a broad peak throughout the visible spectrum and a much sharper peak as the wavelength approaches the UV. On the right can be seen the fluorescence data for the compound. Once again there is a sharp peak near the UV, likely due to the carbazolide ligand (see PIB), there is also a smaller peak in the red end of the visible spectrum. This peak is interesting as it could be due to a MLCT transition or a metal centered excited state. These could both lead to longer lifetimes. These data are very promising as they display a compound which both absorbs and emits light. Further study is needed to discover the excited state lifetimes and structure.



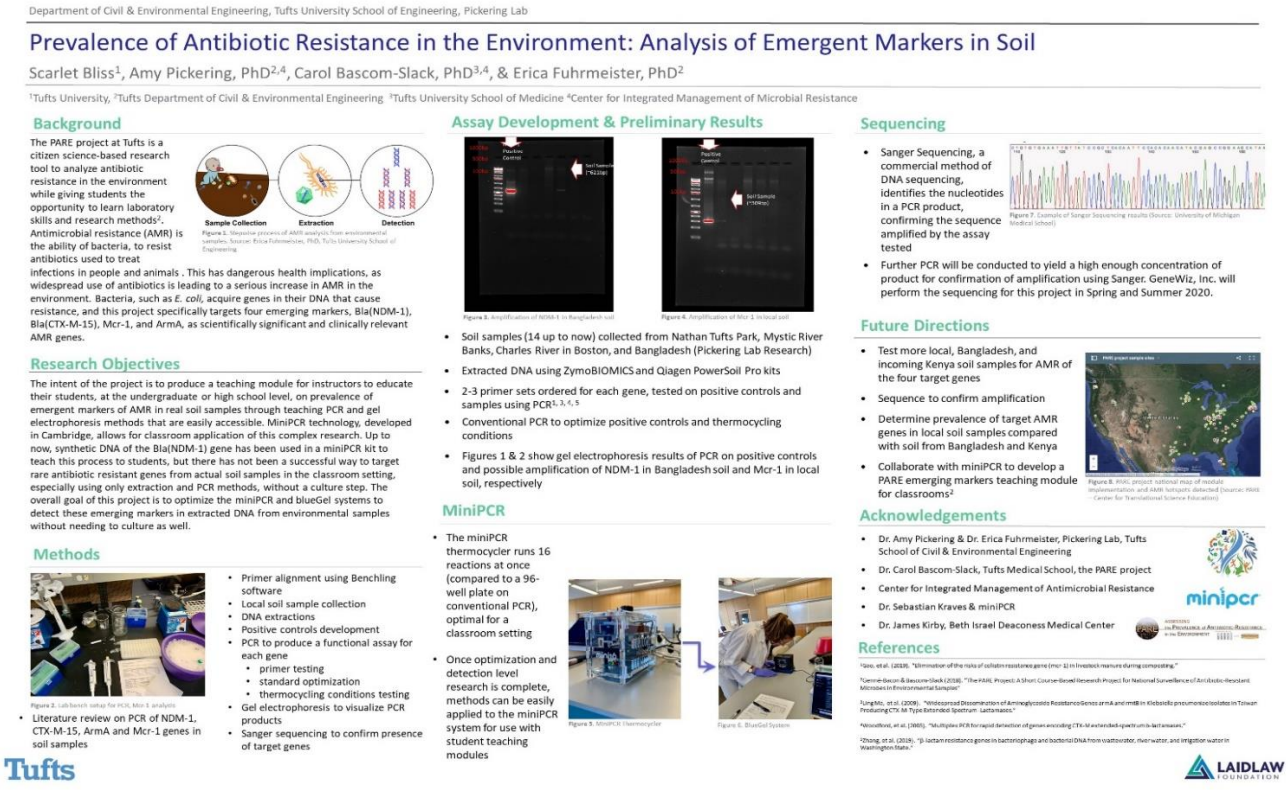
UV/Vis Spectroscopy



Fluorescence Spectroscopy

SCARLET BLISS (2019-2021). I am from Northampton, Massachusetts. I'm a rising junior (class of 2021) at Tufts and became a Laidlaw Scholar in Summer 2019. Laidlaw has offered generous funding to pursue research in a field that interests me, while also providing leadership training, professional support, and an expansive network of scholars and mentors both at Tufts and around the world. I am a Community Health and Biology double major, working for the Pickering Lab in the School of Civil & Environmental Engineering, with Professor **Amy Pickering** and her post-doc, Erica Fuhrmeister, as well as Dr. Carol Bascom-Slack on the Tufts Medical School campus. The Pickering lab investigates a number of complex environmental health issues in the U.S. and abroad, and my research is part of Dr. Bascom-Slack's PARE project: Prevalence of Antibiotic Resistance in the Environment. This is a citizen science-based research tool to analyze antibiotic resistance in soil and water samples, at the same time teaching undergraduate and high school students applicable laboratory and research skills. Eventually, this PARE project data may be mapped as "hotspots" of AMR (antimicrobial resistance) to support hypotheses of emerging locations of higher AMR and help mitigate future health impacts. I find research challenging when things simply don't work, or small mistakes lead to frustrating setbacks along the way. However, the depth of knowledge and skill base I have attained even in a short few months is far beyond what I anticipated, and the feeling of running a successful experiment or advancing my project entirely on my own is exciting. I hope to publish my work with by the time I graduate and potentially translate it into a senior honors thesis, so I am grateful for finding this incredible program that gives me the opportunity to grow as a researcher and leader. While at Tufts, I have worked for a year and a half as a Communications and Outreach Intern for the Environmental Studies Program, am part of Timmy Global Health, and run for the Women's Track & Field team. For the Environmental Studies program, I've coordinated and advertised the weekly Lunch & Learn series, organized a student internship symposium for ENVS majors and undergraduates, and helped put on other events for the Program as well. Though I am unsure the exact path I plan to embark on after college, I've been interested in a combination of issues - medicine in the context of public health, infectious disease transmission and global health issues, and climate and environmental health, to name a few. I am excited to be studying abroad in Seville, Spain in Fall 2019 as well. I recommend that future Laidlaw scholars continue to foster their portfolio of skills and interests throughout the course of the program instead of worrying that they have to have every detail figured out. The Laidlaw Scholarship offers so many leadership, mentoring, and professional opportunities throughout its two-year course, and I've learned quickly that the more you put in, the more you get out. My advice to future scholars would be: savor it!

AMY PICKERING, Ph.D. I am an Assistant Professor of Civil and Environmental Engineering at Tufts University School of Engineering and a core faculty member in the new Tufts Center for Integrated Management of Antibiotic Resistance (CIMAR). I was a Senior Fellow at the Stanford Center for Innovation in Global Health and a research scientist in Civil and Environmental Engineering at Stanford University, and previously worked as an environmental engineer in the Office of Water for the United States Environmental Protection Agency in Washington, D.C. I received my B.S. from Cornell University, an M.S. from the University of California, Berkeley, and a Ph.D. from Stanford University. My lab uses tools from engineering, epidemiology, and molecular biology to understand enteric disease and antibiotic resistance environmental transmission pathways among households in low-income countries and develop low-cost interventions to interrupt them. I am working with Laidlaw scholar **Scarlet Bliss** on a project to develop new molecular methods to detect antibiotic resistant bacteria in environmental samples. The new tools will be integrated into educational curriculum for undergraduates and high school students to gain authentic research experience and contribute to a national database of antibiotic resistant genes in soil samples.



Department of Civil & Environmental Engineering, Tufts University School of Engineering, Pickering Lab

Prevalence of Antibiotic Resistance in the Environment: Analysis of Emergent Markers in Soil

Scarlet Bliss[1], Amy Pickering, PhD[2,4], Carol Bascom-Slack, PhD[3,4], & Erica Fuhrmeister, PhD[2]

[1]Tufts University, [2]Tufts Department of Civil & Environmental Engineering [3]Tufts University School of Medicine [4]Center for Integrated Management of Microbial Resistance

Background

The PARE project at Tufts is a citizen science-based research tool to analyze antibiotic resistance in the environment while giving students the opportunity to learn laboratory skills and research methods[2]. Antimicrobial resistance (AMR) is the ability of bacteria, to resist antibiotics used to treat infections in people and animals . This has dangerous health implications, as widespread use of antibiotics is leading to a serious increase in AMR in the environment. Bacteria, such as *E. coli*, acquire genes in their DNA that cause resistance, and this project specifically targets four emerging markers, Bla(NDM-1), Bla(CTX-M-15), Mcr-1, and ArmA, as scientifically significant and clinically relevant AMR genes.

Sample Collection | Extraction | Detection

Figure 1. Stepwise process of AMR analysis from environmental samples. Source: Erica Fuhrmeister, PhD, Tufts University School of Engineering

Research Objectives

The intent of the project is to produce a teaching module for instructors to educate their students, at the undergraduate or high school level, on prevalence of emergent markers of AMR in real soil samples through teaching PCR and gel electrophoresis methods that are easily accessible. MiniPCR technology, developed in Cambridge, allows for classroom application of this complex research. Up to now, synthetic DNA of the Bla(NDM-1) gene has been used in a miniPCR kit to teach this process to students, but there has not been a successful way to target rare antibiotic resistant genes from actual soil samples in the classroom setting, especially using only extraction and PCR methods, without a culture step. The overall goal of this project is to optimize the miniPCR and blueGel systems to detect these emerging markers in extracted DNA from environmental samples without needing to culture as well.

Methods

- Literature review on PCR of NDM-1, CTX-M-15, ArmA and Mcr-1 genes in soil samples
- Primer alignment using Benchling software
- Local soil sample collection
- DNA extractions
- Positive controls development
- PCR to produce a functional assay for each gene
  - primer testing
  - standard optimization
  - thermocycling conditions testing
- Gel electrophoresis to visualize PCR products
- Sanger sequencing to confirm presence of target genes

Figure 2. Lab bench setup for PCR, Mcr-1 analysis

Assay Development & Preliminary Results

Figure 3. Amplification of NDM-1 in Bangladesh soil

Figure 4. Amplification of Mcr-1 in local soil

- Soil samples (14 up to now) collected from Nathan Tufts Park, Mystic River Banks, Charles River in Boston, and Bangladesh (Pickering Lab Research)
- Extracted DNA using ZymoBIOMICS and Qiagen PowerSoil Pro kits
- 2-3 primer sets ordered for each gene, tested on positive controls and samples using PCR[1, 2, 4, 5]
- Conventional PCR to optimize positive controls and thermocycling conditions
- Figures 1 & 2 show gel electrophoresis results of PCR on positive controls and possible amplification of NDM-1 in Bangladesh soil and Mcr-1 in local soil, respectively

MiniPCR

- The miniPCR thermocycler runs 16 reactions at once (compared to a 96-well plate on conventional PCR), optimal for a classroom setting
- Once optimization and detection level research is complete, methods can be easily applied to the miniPCR system for use with student teaching modules

Figure 5. MiniPCR Thermocycler

Figure 6. BlueGel System

Sequencing

- Sanger Sequencing, a commercial method of DNA sequencing, identifies the nucleotides in a PCR product, confirming the sequence amplified by the assay tested
- Further PCR will be conducted to yield a high enough concentration of product for confirmation of amplification using Sanger. GeneWiz, Inc. will perform the sequencing for this project in Spring and Summer 2020.

Figure 7. Example of Sanger Sequencing results (Source: University of Michigan Medical School)

Future Directions

- Test more local, Bangladesh, and incoming Kenya soil samples for AMR of the four target genes
- Sequence to confirm amplification
- Determine prevalence of target AMR genes in local soil samples compared with soil from Bangladesh and Kenya
- Collaborate with miniPCR to develop a PARE emerging markers teaching module for classrooms[2]

Figure 8. PARE project national map of module implementation and AMR hotspots detected (Source: PARE – Center for Translational Science Education)

Acknowledgements

- Dr. Amy Pickering & Dr. Erica Fuhrmeister, Pickering Lab, Tufts School of Civil & Environmental Engineering
- Dr. Carol Bascom-Slack, Tufts Medical School, the PARE project
- Center for Integrated Management of Antimicrobial Resistance
- Dr. Sebastian Kraves & miniPCR
- Dr. James Kirby, Beth Israel Deaconess Medical Center

References

[1]Soo, et al. (2019). "Elimination of the risks of colistin resistance gene (mcr-1) in livestock manure during composting."

[2]Cenne-Bascom & Bascom-Slack (2018). "The PARE Project: A Short Course-Based Research Project for National Surveillance of Antibiotic-Resistant Microbes in Environmental Samples"

[3]Ling Mo, et al. (2009). "Widespread Dissemination of Aminoglycoside Resistance Genes armA and rmtB in Klebsiella pneumoniae Isolates in Taiwan Producing CTX-M Type Extended Spectrum -Lactamases."

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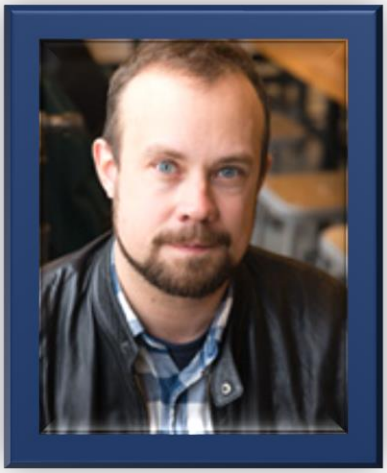
Tufts

LAIDLAW FOUNDATION

ALLISON CULBERT (2019-2021). I am a member of the class of 2021 majoring in physics. I am from Lynnfield, MA on the North Shore. I applied for Laidlaw Scholars because I wanted to experience what it was like to be a part of the research community. I was also excited by the idea of creating my own research project that I would be able to explore for two (!!!) whole summers. My project is called "Girih Tiles on Curved Surfaces" and I am working with **Professor Timothy Atherton**, a soft matter physicist in the Tufts physics department. The goal of my research is to find if tiles used in Islamic art in the 14th and 15th centuries can be used to model an unsolved soft matter physics problem called the "sphere packing" problem. The highlight of my summer was learning how to create a computer model of spherical projections of polyhedra, and then 3D printing them. My lowlight was trying to recreate the dome of the Shah Nematollah Vali Shrine and failing, which made me realize that the parameters for the tiles I was using were completely incorrect. The most interesting place I have been to is Rwanda, which I went to with the Tufts program Tufts with Rwanda in May 2019 (a program that I cannot recommend highly enough!). It is the most beautiful place I have ever been to in my life, and I learned so much. Five years from now, I see myself in grad school working towards my physics Ph.D. Advice I would give to a future scholar would be to ask every question that you think of when you are doing your research. Ask your professor, a grad student, another undergrad, and if no one is around, write it down. I've learned the most from the questions I've asked.



TIMOTHY ATHERTON. Soft matter physics is the study of matter that is all around us in everyday life: soaps, oil, foods, sand, foams, and biological matter. All of these are readily deformable at room temperature and combine properties of both fluids and solids. Despite their ubiquity, these materials are extremely complicated. Unlike simple fluids like water, they have rich internal structure; unlike crystalline solids they are typically not periodically ordered. Moreover, they exist in long-lived metastable states far from equilibrium and respond to stimuli such as applied electric and magnetic fields, temperature and pressure. My work seeks to understand how these materials respond to shape: how they self-organize on curved surfaces or in complex geometries and how this knowledge can be used both to sculpt desirable shapes at the microscopic scale and create shape changing systems like soft robots. We use high performance computing to simulate and predict these behaviors and work closely with experimentalists at Tufts and beyond. I am a Tufts Faculty mentor to Laidlaw Scholar, **Allison Culbert.**

Girih Tiles on Curved Surfaces

Allison E. Culbert and Timothy J. Atherton

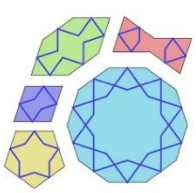
Dept. of Physics and Astronomy, Tufts University, Medford MA 02155

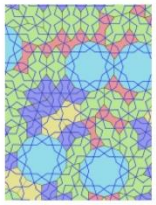
1. Introduction

This project explores arrangements of Girih tiles on curved surfaces. The tiles were used in Islamic architecture during the 14th and 15th centuries and in flat two dimensional space can be used to create quasi-crystalline tessellations only rediscovered in modern mathematics in the 20th century. While curved geometries are a common feature in Islamic architecture, how the Girih can be adapted to curved space has not yet been explored.

2. Two-Dimensional Girih

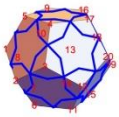
There are five Girih tiles whose side lengths, angles, and decorative lines are chosen to facilitate packing as illustrated below.





3. Three-Dimensional Girih

We found that the largest possible polyhedron that can be created using Girih tiles is the dodecahedron. Hence, the designers of



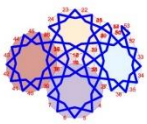
buildings must have turned to other strategies, including adding different tiles, deforming the shape of the tiles or bending them.

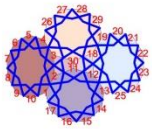
4. Shah Nematollah Vali Shrine

This result motivated us to look at architectural examples of 3-D Girih tiles on domes. We recreated the Shah Nematollah Vali Shrine in Mahan, Iran using the rules of the Girih tiles.

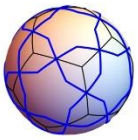
We identified 7, 9, 10, 11 and 12-sided tiles that were added to the regular Girih tiles that accomodate the curvature. We recreated the dome in cardboard,

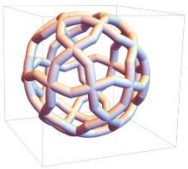
5. Modified Tiles





Changing angles of tiles We developed a computer program to help create polyhedra with collections of Girih tiles. The first figure shows two nonagons and two decagons joined by a bent bowtie in the middle with 144/72 degree angles. (Note unjoined vertices) The second shows the same figure with bowties that have 140 and ~71 degree angles (note joined vertices)





Curved tiles From the photographs of domes with Girih-style iles in the Middle East and Northern Africa, it seems probable that the tiles are curved. To model this, we created projections of decorative lines on a dodeacahedron onto a sphere. The last photo is a 3-D printed model of this.

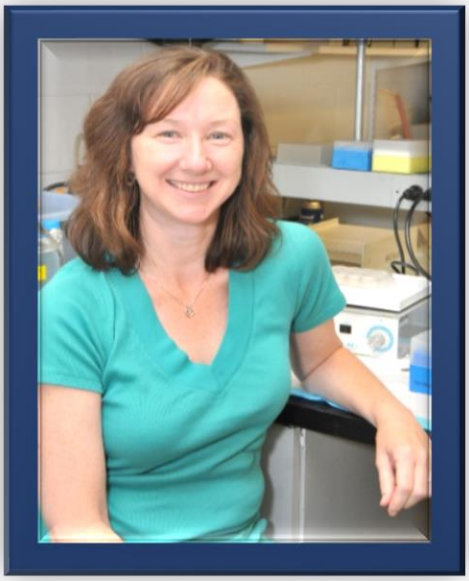
This is the first Girih tiling on a curved surface created in the modern era. We are now trying to build bigger structures by exploiting the strategies identified in this project.

Acknowledgements. A.C. is a Laidlaw Scholar supported by the Laidlaw Foundation. T. J. A. is supported by the National Science Foundation under grant DMR-1654283. We are also very grateful to XXX director of the NOLOP Makerspace for assistance in preparing the models.

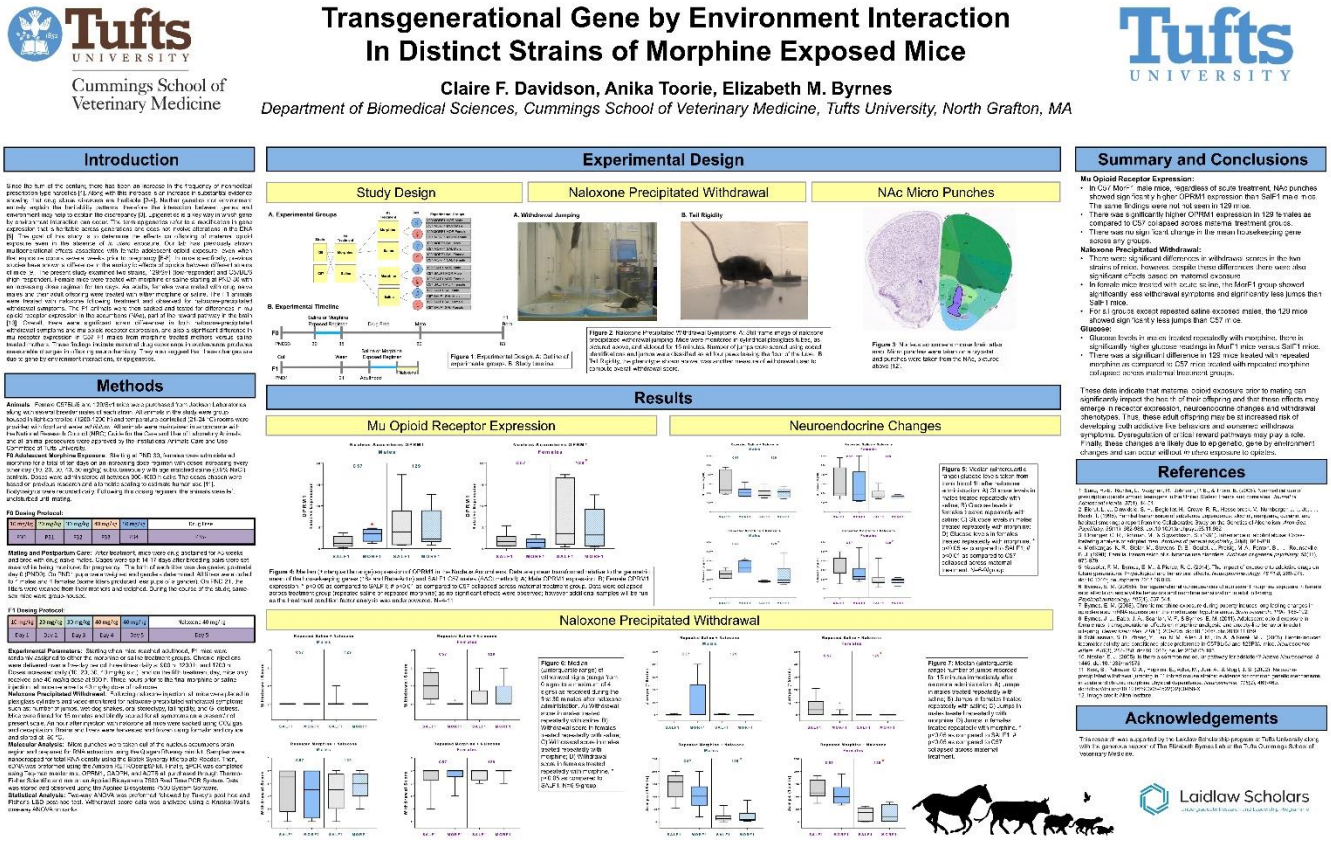
CLAIRE DAVIDSON: I am a senior from Newport, Rhode Island. At Tufts I am a Biopsychology Major in the class of 2020 and am the captain of the women's varsity squash team. I became a Laidlaw Scholar in the summer for 2018 with the help of my mentor **Dr. Elizabeth Byrnes**. The Laidlaw program gave me the unique opportunity to be paid to do cutting edge research at Dr. Byrnes' neuroscience lab at the Tufts Cummings School of Veterinary Medicine. My project was formulated based on a broader scope of research on the transgenerational effect of opioid use. With the help of Dr. Byrnes, along with the help of **Dr. Fair Vassoler**, and **Dr. Anika Toorie**, I was able to gain hands on exposure at a neuroscience lab while still being an undergraduate student. I spent my first summer working with mice and learning proper animal husbandry techniques. My second summer was spent doing molecular work and data analysis. My results will be included in a paper being published by the Byrnes Lab in the future, and I will be

presenting my findings at the Boston Area Neuroscience Group (BANG) conference in November. Throughout the course of my two years as a Laidlaw Scholar I gain immeasurable knowledge and skills which will be extremely beneficial in the next steps of my life and will help propel me into the working world. The Laidlaw program not only allowed me to gain work experience, it also gave me invaluable networking and leadership training. My plans after college are no clear yet, but no matter what path I take I will certainly use the skills gained through the program in every aspect of my life. My advice to a future Laidlaw Scholar is to ask questions every step of the way, there are so many smart people at this university who are excited to teach!

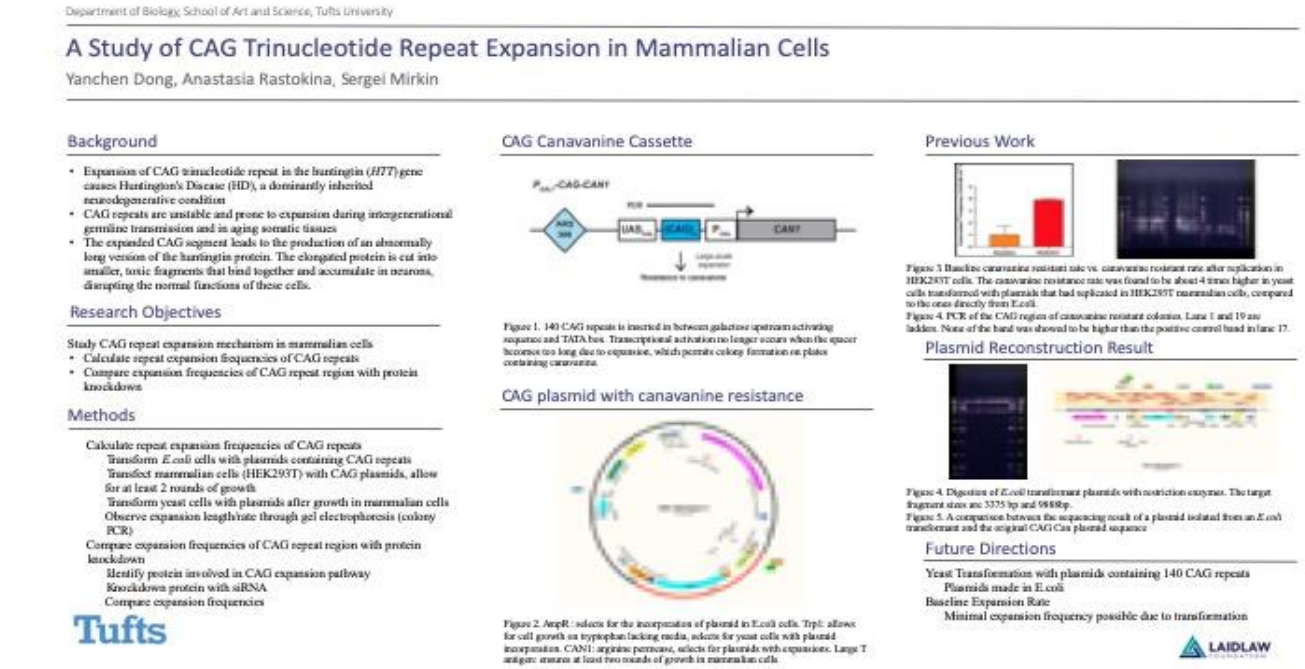
ABSTRACT. CLAIRE DAVIDSON. ***Transgenerational Gene by Environment Interaction In Distinct Strains of Morphine Exposed Mice.*** Drug related deaths involving opioids have increased 200% between the years of 2000-2014. With this continuing rise in opioid use, identifying factors that modify an individual's response to opioids may help both prevention and treatment efforts. Preclinical models have documented significant strain differences in opioid withdrawal, implicating a genetic contribution to this effect. The extent to which experiential factors interact with genetic vulnerabilities to influence opioid withdrawal remains unknown. The goal of this study is to determine the effects on offspring of maternal opioid exposure even in the absence of *in utero* exposure by using two mouse strains that demonstrate significant differences in acute naloxone precipitated jumping, a behavioral measure of opioid withdrawal (C57BL/6 - high responder)/ (129/Sv1- low responder). Female mice were treated with morphine or saline starting at PND 30 with an increasing dose regimen for ten days. As adults, females were mated with drug naive males and their adult offspring were treated with either morphine or saline. The F1 animals were treated with naloxone following treatment and observed for naloxone-precipitated withdrawal symptoms. The F1 animals were then sacked and tested for differences in mu opioid receptor expression in the accumbens (NAc), part of the reward pathway in the brain [10]. Overall, there were significant strain differences in both naloxone-precipitated withdrawal symptoms and mu opioid receptor expression, and also a significant difference in mu receptor expression in C57 F1 males from morphine treated mothers versus saline treated mothers. These findings indicate maternal drug experience in adolescence produces measurable changes in offspring neurochemistry. They also suggest that these changes are due to gene by environment interactions, or epigenetics.



ELIZABETH BYRNES. I am a Professor in the Department of Biomedical Sciences at Tufts University, Cummings School of Veterinary Medicine. Currently the Head of the Section of Neuroscience and Reproductive Biology, I have an active, NIH funded research laboratory examining several research topics largely related to the neurobiology of opioid use disorders. Outside of the lab my interests include both education and community outreach initiatives. In that capacity, I have worked extensively in community-based adolescent substance use prevention and recently served as President of the Boston Area Neuroscience Group, which is the local chapter of the Society for Neuroscience for the Boston area. One major area of focus in the Byrnes' lab involves studies that explore the epigenetic transfer of risk factors from one generation to the next; these studies largely examine the multigenerational impact of female opioid use in the absence of any fetal exposure. As part of my Laidlaw Scholar project, **Claire Davidson** conducted a study examining the interaction between genotype and transgenerational effects of opioids. Working closely with Postdoctoral Associate, Dr. **Anika Toorie**, now a faculty member at Rhode Island College, Claire used behavioral pharmacology coupled with molecular biology to examine transgenerational effects of opioids in two mouse strains. In addition to gaining technical skills, this large, multigroup study required Claire to implement a robust organizational approach to data management. These skills were particularly important in her second summer in the lab, as she worked more independently and experienced firsthand the daily challenges and rewards that come with biomedical research.



YANCHEN DONG (2019-2021). I am a Junior from Beijing, China, majoring in Biology. For the Laidlaw Scholar Program, I am studying trinucleotide repeats, specifically CAG repeat, expansion in mammalian cells under **Dr. Sergei Mirkin and Anastasia Rastokina**. The expansion of CAG trinucleotide repeat in the Huntington gene is known to cause Huntington Disease (HD), a dominantly inherited neurodegenerative condition. The expanded CAG segment leads to the production of an abnormally long version of the huntingtin protein, disrupting the normal functions of neurons. Through this study we aim to calculate the expansion frequency of CAG repeat in HEK239T mammalian cell and investigate how may the knockdown of a protein involved in the pathway affect its expansion frequency.



Department of Biology, School of Art and Science, Tufts University

A Study of CAG Trinucleotide Repeat Expansion in Mammalian Cells

Yanchen Dong, Anastasia Rastokina, Sergei Mirkin

Background

- Expansion of CAG trinucleotide repeat in the huntingtin (*HTT*) gene causes Huntington's Disease (HD), a dominantly inherited neurodegenerative condition
- CAG repeats are unstable and prone to expansion during intergenerational germline transmission and in aging somatic tissues
- The expanded CAG segment leads to the production of an abnormally long version of the huntingtin protein. The elongated protein is cut into smaller, toxic fragments that bind together and accumulate in neurons, disrupting the normal functions of these cells.

Research Objectives

Study CAG repeat expansion mechanism in mammalian cells

- Calculate repeat expansion frequencies of CAG repeats
- Compare expansion frequencies of CAG repeat region with protein knockdown

Methods

Calculate repeat expansion frequencies of CAG repeats
- Transform *E.coli* cells with plasmids containing CAG repeats
- Transfect mammalian cells (HEK293T) with CAG plasmids, allow for at least 2 rounds of growth
- Transform yeast cells with plasmids after growth in mammalian cells
- Observe expansion length/rate through gel electrophoresis (colony PCR)

Compare expansion frequencies of CAG repeat region with protein knockdown
- Identify protein involved in CAG expansion pathway
- Knockdown protein with siRNA
- Compare expansion frequencies

Tufts

CAG Canavanine Cassette

Figure 1. 140 CAG repeats is inserted in between galactose upstream activating sequence and TATA box. Transcriptional activation no longer occurs when the spacer becomes too long due to expansion, which permits colony formation on plates containing canavanine.

CAG plasmid with canavanine resistance

Figure 2. AmpR: selects for the incorporation of plasmid in E.coli cells. Trp1: allows for cell growth on tryptophan lacking media, selects for yeast cells with plasmid incorporation. *CAN1*: arginine permease, selects for plasmids with expansions. Large T antigen: ensures at least two rounds of growth in mammalian cells

Previous Work

Figure 3 Baseline canavanine resistant rate vs. canavanine resistant rate after replication in HEK293T cells. The canavanine resistance rate was found to be about 4 times higher in yeast cells transformed with plasmids that had replicated in HEK293T mammalian cells, compared to the ones directly from E.coli.

Figure 4. PCR of the CAG region of canavanine resistant colonies. Lane 1 and 19 are ladders. None of the band was showed to be higher than the positive control band in lane 17.

Plasmid Reconstruction Result

Figure 4. Digestion of *E.coli* transformant plasmids with restriction enzymes. The target fragment sizes are 3375 bp and 9888bp.

Figure 5. A comparison between the sequencing result of a plasmid isolated from an *E.coli* transformant and the original CAG Can plasmid sequence

Future Directions

Yeast Transformation with plasmids containing 140 CAG repeats
- Plasmids made in E.coli

Baseline Expansion Rate
- Minimal expansion frequency possible due to transformation

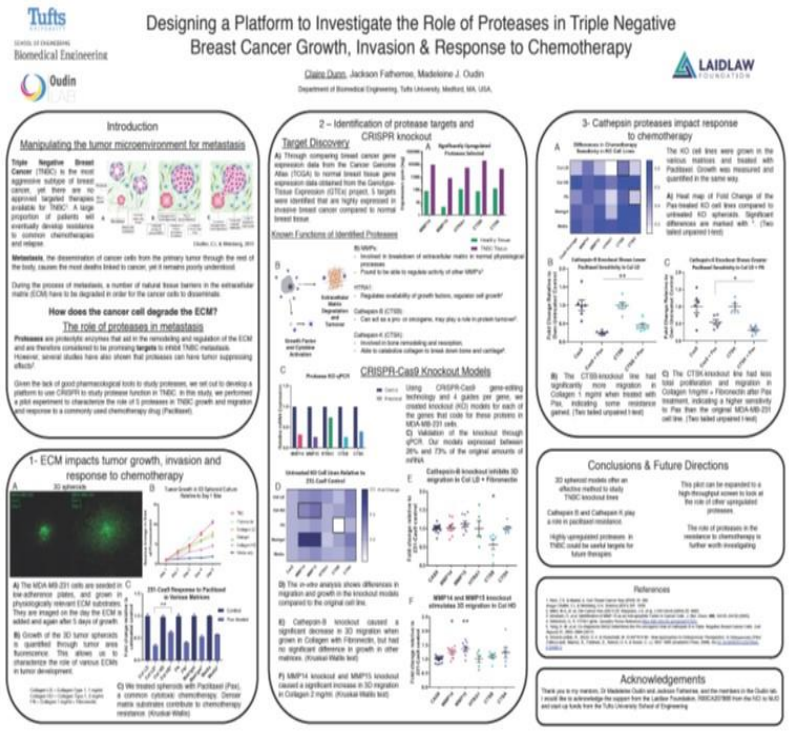
LAIDLAW

SERGEI MIRKIN. My research interests, broadly defined, are in the field of DNA structure and functioning. I am particularly interested in two problems. The first problem is the mechanisms responsible for the genomic instability of various DNA repeats. Uncontrollable expansions of simple DNA repeats cause almost thirty hereditary disorders in humans, including Fragile X mental retardation, Huntington's disease, myotonic dystrophy, and Friedreich's ataxia. My lab was the first to show that progression of the replication fork through those repeats is compromised due to the unusual structural features of repetitive DNA. This led us to propose the replication model for repeat expansions, stipulating that the replication fork stalling and restart are at heart of repeats' instability. We are in the process of substantiating this hypothesis in yeast and mammalian experimental systems. The second problem concerns the interplay between transcription and replication in genome organization. Since both processes share the same template, occasional collisions between the two machineries are inevitable. My lab has found that direct head-on collisions with RNA polymerase are far more detrimental for DNA replication *in vivo*, than co-directional collisions. These data, combined with the known bias towards co-directional alignment of transcription units with the direction of replication in various genomes, makes us to believe that head-on collisions are avoided owing to their inhibitory effect on DNA replication. We are exploring this hypothesis by comparing mutation rates and gross chromosomal

rearrangements in the transcribed areas that are replicated in different directions in bacteria and yeast. I am mentoring Laidlaw Scholar, **Yanchen Dong**.

CLAIRE DUNN (2018-2020). I grew up in the Netherlands and moved to the US for college. I am graduating this year, with a bachelor in Biology. I became a Laidlaw scholar in 2018. I wanted to apply to the program because I was looking for a way to get funding for a research project. I wanted to do in the lab I had started working at. This scholarship allowed me to do a full project start to finish which has been incredibly valuable. My project focuses on the role of certain proteins in breast cancer metastasis. My mentor **is Madeleine Oudin.** She has been a great role model the past two years. The highlight of my project was having an amazing group of people to work with in the lab. The lowlight was that sometimes some aspects of the project did not work out as planned, and it took a fair amount of patience and perseverance to troubleshoot. This project has given me a very deep understanding of what it would be like to have a career in research. This is something I am considering for the future. I am also interested in going to medical school. Finally, my words of advice for future scholars, don't be discourages when things don't go as planned. It is all part of the process.

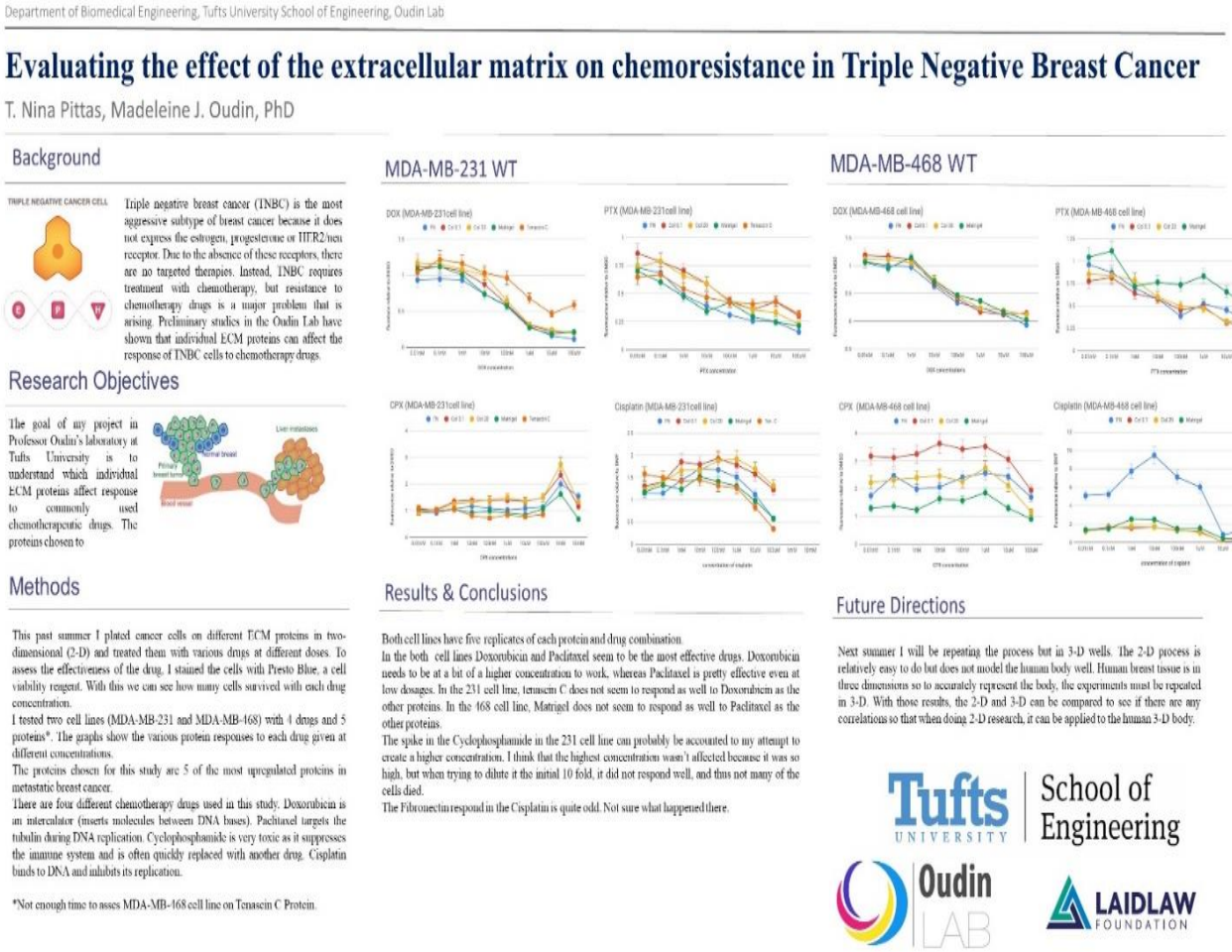
ABSTRACT. CLAIRE DUNN. ***Designing a Platform to Study the Role of Proteases in Cancer Growth, Invasion, & Response to Therapy.*** Triple-Negative Breast Cancer (TNBC) is the most aggressive subtype of breast cancer, yet there are no approved targeted therapies available specifically for TNBC[i]. A large proportion of patients will eventually develop resistance to common chemotherapies and relapse. Metastasis, the dissemination of cancer cells from the primary tumor through the rest of the body, causes the most deaths linked to cancer[ii], yet it remains poorly understood. During the process of metastasis, a number of natural tissue barriers in the extracellular matrix (ECM) have to be degraded in order for the cancer cells to disseminate. Proteases are proteolytic enzymes that aid in the remodeling and regulation of the ECM and are therefore considered to be promising targets to inhibit TNBC metastasis. However, several studies have also shown that proteases can inhibit tumor growth and metastasis by regulating cell surface receptor levels[iii]. Given that non-specific protease inhibitors failed in clinical trials for breast cancer[iv], the opposing roles of these proteases and the lack of good pharmacological tools to study them, we set out to develop a platform to use CRISPR to study protease function in 3D spheroid models. In this study, we performed a pilot experiment to characterize the role of 5 proteases in TNBC growth and migration. This pilot can be expanded to characterize the role of all upregulated proteases in TNBC. Identifying what proteases drive metastasis could lead to the development of new specific drug targets for TNBC, and drastically improve patient outcomes.



NINA PITTAS (2019-2021). I'm from Brookline, MA. I'm a Junior studying Biomedical Engineering. I am working in the laboratory of **Professor Madeleine Oudin** and my Laidlaw-supported project is titled, ***"Evaluating the effect of the extracellular matrix on chemoresistance in Triple Negative Breast Cancer."*** I applied to be a Laidlaw scholar to support my individual summer research project, but an unexpected benefit of the scholarship was the opportunity to join a unique community of students. Research can be rewarding but also slow and frustrating at times and being part of a cohort of students who are going through similar experiences that can help and support each other is one of the best parts of this Laidlaw program. One of the highlights has been becoming friends with the women researchers in my lab. All undergraduates in the Oudin lab are women which is quite unusual in the science world and I feel very lucky to be with such a great team of people. A lowlight has been realizing that although the pursuit of answering important research

question is a collaborative endeavor, the actual conduct of research can be lonely. Specifically, running experiments that require high-degree of concentration can sometimes feel isolating but, at the same time, it offers an opportunity for self-reflection. My research has not been published yet, but I hope to see my work published either by itself or as part of a larger publication. I have not yet completed any formal internships, but last summer I worked part-time in a Biotech start-up company and helped with e-file management using coding skills in excel. A fun fact about me is that I ride a bamboo bike that I built myself! If you are interested in building one yourself, see how I did it at http://www.ninapittas.com/videos-1.html. After work, I go home, put some music on, and chef up dinner with my housemates. I have not yet studied abroad, but I plan to spend a semester in Copenhagen next spring. I do not know what the future will bring but, I look forward to whatever is in store. My advice to future Laidlaw scholars: befriend the members of your cohort! It will make all programming and events more meaningful, and it is also an opportunity to share and compare experiences and help each other out.

MADELEINE OUDIN, Assistant Professor, Biomedical Engineering. I grew up in Paris, France in a multicultural environment, and completed a BSc in Biochemistry at McGill University, a MSc in Pharmacology and a PhD in Neuroscience from King's College London, UK. I was a Post-Doctoral Fellow working in Prof. Frank Gertler's Lab at the Koch Institute for Integrative Cancer Research at MIT for six years, trying to understand how metastasis, the dissemination of tumor cells throughout the body, occurs and working to find better treatments. I received a Breast Cancer Research Department of Defense Post-doctoral Fellowship and is now funded by a K99/R00 Pathway to Independence from the National Cancer Institute. I have also received multiple awards, such as the Women in Cancer Research Award, American Association for Cancer Research Scholar-in-Training Award and the MIT Infinite Kilometer Award, for my accomplishments in research as well as my involvement in the community. I started my own lab at Tufts University in the Department of Biomedical Engineering in January 2018, composed of post-doctoral researchers, graduate students and undergraduate students. Research in my lab is focused on understanding the mechanisms by which the tumor microenvironment contributes to cancer metastasis and resistance to drugs. My research integrates biology and engineering approaches to study cancer across various models, with the goal of developing novel strategies to detect, predict and treat metastatic cancer. I am committed to being a supportive mentor, advocating for women in STEM and participating in outreach activities at Tufts. I have been mentoring two Laidlaw Scholars -- **Claire Dunn** on her Laidlaw Scholars project entitled "Using CRISPR to Study the Role of Proteases in Cell Growth and Migration and Response to Drug Therapy in Triple Negative Breast Cancer Cells" and **Nina Pittas** in her project entitled "Evaluating the Effect of the Extracellular Matrix on Chemoresistance in Triple Negative Breast Cancer."



DESMOND FONSECA (2018-2020). The child of African migrants from born under colonial Portuguese rule, I dedicate my study to the histories that brought me to where I am today; histories which are fundamental to the ordering of the world. Born and raised in the lands historically cultivated by the Wampanoag and Massachusett people and contemporarily occupied by the United States of America, I am a rising senior at Tufts University studying History and Africana Studies. My Laidlaw research, which began in the summer of 2018, uses and interrogates the history of Angola as a means to explore legacies of colonialism, anti/de/post+colonial theory and statecraft, as well as Afro-diasporic solidarity. More specifically, my research-based intervention relates to unearthing a narrative of solidarity between anti-colonial, pro-liberation activists

in the United States and Angola during the mid-1970s. The title of this project is "*A Luta Continua*: Angola and/in the Black Radical Imagination." My mentor **is Dr. Kamran Rastegar,** who is advising me on the uses of memory and visual studies in my work, exposing me to emerging literature and helping with my writing. Studying abroad in Oxford during the 2018-2019 school year, I made significant progress in regard to the historiography of Angola and situating those narratives within historiographies of African politics. This past summer, I used his Laidlaw research experience to secure a fellowship at the Schomburg Center for Research in Black Culture, where he conducted archival research for his project, and gave a presentation at the famed American Negro Theater. Currently, I am revising my Laidlaw research paper to present at a conference at the University of Memphis in October. A critical element of my project is also a supplementary documentary filmed in Angola which I am working on, which gives my research a visual aspect. As for the rest of the year, I am turning my Laidlaw research into my thesis, as well as a proposal for grad school applications. In the midst of all this, I am taking breaks to stop and smell the flowers and candles, to moisturize, to sip my coffee, and breathe my breath.

ABSTRACT. DESMOND FONSECA. *A **Luta Continua: Angola in the Black Radical Imagination.***
This paper explores the theories and practices of international solidarity within the Black radical imagination during the late decolonization period. It does so through a case study of the relationship between the Angolan liberation struggle of the mid 1970s and Black Power/Pan African organizing in the United States. Thus far, the literature surrounding Black Power and Black internationalism has largely failed to give deep consideration to the mid1970s as a period of meaningful ideological and practical struggle among Black radicals. Representative of a tricontinental theorization of blackness and liberation, Huey Newton, Walter Rodney, and Amilcar Cabral serve as contemporaries informing this period of anti-colonial and liberatory thought. Also, yet to be thoroughly considered is the decolonization of the Portuguese African colonies as a momentous event in the anti-colonial struggle. Through archival analysis of Black periodicals, and diasporic correspondence between Black activists, it becomes clear that this Angolan liberation struggle was not only central to the Black radical imagination, but highly contentious within it. Through this archive of Angolan solidarity, the heterodoxy of an often-homogenized Black Radical Tradition becomes apparent not only in the US, but across the Black diaspora. Publications such as *The Black Panther*, the Communist Party USA's *Black Liberation Journal*, and the *New York Amsterdam News*, make this abundantly clear. Angola was anointed the "new Vietnam" in the crosshairs of US empire, became central to the policy of Cuban socialist internationalism, and represented the tensions between a race or class-based analysis of imperialism. Still, the problem of translation — of word and being — remained an obstacle to what solidarity could be across emerging and entrenched states and their Black subjects/citizens.

KAMRAN RASTEGAR. My research encompasses two areas relating to the study of modern Arabic and Persian literatures and cultures. First, I study Persian and Arabic literary history in the late nineteenth and early twentieth century, with a focus on movements of cultural revival or innovation. My first book *Literary Modernity between Europe and the Middle East* explored the origins of the conception of literary modernity in Arabic and Persian literatures, a topic that I have further addressed in articles and as editor of a special issue of the journal *Middle Eastern Literatures*. Second, I research the role of cinema and visual culture in the formation of cultural memory in conflict and post-conflict social settings. This research is reflected in my second book, *Surviving Images: Cinema, War and Cultural Memory in the Middle East*. I a research mentor to Laidlaw Scholar Desmond Fonseca.

Department of International Literary and Cultural Studies, Department of History, Department of Race, Colonialism and Diaspora Studies – Tufts University

A Luta Continua: Angola and/in the Black Radical Imagination

Researcher: Desmond Fonseca; Advisor: Dr. Kamran Rastegar

Selected Bibliography: Robinson, Cedric. *Black Marxism: The Making of the Black Radical Tradition*. Chapel Hill, NC: University of North Carolina Press. 2008; Krug, Jessica. *Fugitive Modernities: Kisama and the Politics of Freedom*. Durham, NC: Duke University Press. 2018; Rickford, Russell. *We are an Afrikan people: Independent Education, Black Power, and the Radical Imagination*. New York: Oxford University Press. 2016; Marcum, John. *The Angolan Revolution*. Cambridge, Ma: MIT Press. 1969, 1978.

Background

Utilizing disciplinary conceptions about and obsessions over origins, the history of the nation state that is Angola occupies a particularly important and understudied time and space. The first European colony in "sub-Saharan Africa," was declared in 1575 in city of Luanda, today Angola's capital; Angola became the last nation-state in Africa to declare independence from Europe exactly 400 years later, in 1975. My research focuses on this latter period, informed by the former, and considers the diasporic theories, practices, and implications of imagining an "Angolan" history as central to histories of Blackness and coloniality.

Research Objectives

This research project aims to accomplish two primary objectives. First, I aim to create a historical narrative of the relationship between black America and Angola in the period surrounding the 1974-5 independence moment, charting the evolution of a heterogenous "Black Radical Tradition." This narrative is written alongside a consideration of the *longue durée* of "Angolan" history and Portuguese colonialism. Second, I will use this narrative as a case study to theorize questions of and resistance to *coloniality*.

Methods

A traditional exploration of Angolan historiography in primarily anglophone academia provided the basis for theorizing about coloniality/colonialism, diaspora, and the Black radical tradition, as they pertain to Angola. Archival research at the Schomburg Center for Research in Black Culture provided my primary site of scholarly intervention. A cursory engagement with visual/literary studies, and trauma theory provides a potential outlet for further research pertaining to the evolution of Angolan film.

Tufts

Sample of Archival/Visual analysis

An anti-war Angolan solidarity march. Image found in the Photographic & Prints Division at the Schomburg Center for Research in Black Culture.

A photo of an Angolan solidarity march I unearthed in the Southern Africa Collective's collection in the Prints & Photographs division highlights the peculiarities of this moment in US, Angolan, and global history. Protest signs held by a multiracial crowd reading "Stop the U.S. Armed Invasion of Angola" and "If You Liked Vietnam, You'll Love Angola" indicate the primacy of the Angolan struggle in a post-Vietnam Cold War world. Concerned activists genuinely believed a direct US invasion of Angola was not only possible but probable. That the US did not launch military action, but was nevertheless involved in the subsequent wars in Angola, highlights the successes of an anti-war , pro-Angolan movement. A sign held up by a Black activist reading "Hey, **Apathy** Isn't Where's It At. **Independence** is. Support the Angolain [sic] movement! (MPLA)" highlights the ways in which radical ideology — in this case supporting the socialist MPLA over other nationalist organizations — was fundamental to ideas of Pan African and Third World solidarity. Alongside a sign which reads "USA out of Angola. MPLA will win!" this does two things. First, it signifies the fundamental role the US government played in the trajectory of Angolan independence, which organizations like the ALSC, BPP, and CPUSA readily acknowledged. However, it also does the work of conflating the independence of Angola with the supremacy of the MPLA — an organization with a contested history and legitimacy — hinting towards potential limits of this solidarity work in achieving decolonial futures. Again, this raises the question: what is the role of the Black activist in Pan African liberation?

Some Conclusions

- The modern/colonial trappings of nationalism in Angola, amidst the permanence of US imperial efforts, and inheritances of Portuguese colonialism, were incommensurable with Black liberation
- The decolonization of the Portuguese colonies was a monumentous event in the trajectory of anti-colonial struggle
  - When formal decolonization and "native" rule was essentially finalized on the African continent, struggles for decoloniality – or mental/epistemic/economic decolonization – were radically and irreparably altered
  - Angola, in the Black radical imagination, served as a particular contested site of ideology, politics, and meaning-making.
  - Through a specific analysis of the second liberation war in Angola, informed by the history of what would become that nation-state, the heterogeneity of the Black radical tradition becomes clear.

Limitations

- A lack of fluency in Portuguese to cover a wider range of archival material.
- Complete illiteracy in any indigenous Angolan language (a result of the modern/colonial project)
- The lack of written material in English covering Luso-Africa, compared to other colonized spaces of the continent.

Further Investigation

- How can we integrate a history of actual and aborted settler-colonialism into this particular narrative of Angolan, African, Afro-Atlantic and Afro-American radicalism? Furthermore, how can a history of settler states such as the USA, Israel, South Africa and the Estado Novo inform
- How can the national and diasporic silences surrounding the *Vinte e Sete de Maio* be read and incorporated into a narrative of Black radicalism.

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FRANCESCA DEIESO-FRECHETTE (2018-2020). I am an inaugural Tufts Laidlaw Scholar and Senior at Tufts who joined the Laidlaw Program in the summer of 2018. I have been working on my research project in **Dr. Amy Yee's Lab** since my freshman year in 2017, testing the effects of a novel combination treatment on Triple Negative Breast Cancer (TNBC) in a mouse model. My project specifically looks at the treatment's effects on the tumor's gene expression and immunogenicity, trying to determine the mechanism for how the treatment works. When I was six years old my mother was diagnosed with TNBC, and as I grew older I always dreamed about doing TNBC research. Even though my mom is now a fifteen- year survivor, TNBC is the most aggressive form of breast cancer and many others are not as fortunate as her. I applied to the Laidlaw program in order to really dive into the research at the Yee lab, further progressing their work with this promising new treatment. I have loved that the Laidlaw program has allowed me to take on more personal responsibility, and it has inspired me to complete a Senior Honors Thesis at the Yee lab as well as pursue global health research at Boston Children's Hospital and the Harvard T.H. Chan School of Public Health. My Laidlaw results will also be included in a research article that we hope will be published soon! A lowlight of my work so far has been pursuing hypotheses that were later proven false. Even though this was frustrating, ultimately it helped me to eliminate incorrect answers. For any future scholars, don't let dead ends deter you, just shift your focus and keep trying! I am hopeful that by completing my Senior Thesis work I will be able to help progress the project further and get one step closer to a clinical trial. Outside of the lab, I am a senior premed student from New Hampshire majoring in Biology as well as Child Studies and Human Development. On campus I am a Women's Club Lacrosse Captain, Chief Administrative Officer for Kappa Alpha Theta, and a council member for the Club Sports Student Council. In the greater Tufts community, I also volunteer for Junior Jumbos, Somerville Parks and Rec Youth Basketball Program, and Tufts Medical Center. I am passionate about medicine, oncology, and children, and dream to become a pediatric oncologist or pediatric emergency medicine physician.

ABSTRACT. **FRANCESCA DEIESO-FRECHETTE.** ***Effects of Epigallocatechin-3-Gallate and 5-Aza-2-deoxycytidine Novel Combination Treatment on Triple Negative Breast Cancer.*** Experiments at the Yee lab have shown that a combination treatment of Epigallocatechin-3-gallate (EGCG) and 5-aza-2-deoxycytidine (Decitabine, or DAC) can decrease metastases and tumor growth in Triple Negative Breast Cancer (TNBC) in xenograft and syngeneic mouse models. TNBC is an aggressive type of breast cancer that lacks overexpression of progesterone and estrogen receptors, and has normal (not overexpressed) HER2, making it extremely difficult to treat. Previously at the Yee Lab, EGCG/DAC has been shown to decrease tumor size, decrease metastases, and decrease Wnt/β-catenin signaling. This report shows the effects of the EGCG/DAC treatment on interferon alpha and beta, T cell infiltration into the tumor microenvironment, antigen presentation, immune checkpoint inhibitor targets, and endogenous retroviral response. EGCG/DAC could be a very promising treatment for TNBC in the future especially in combination with immune checkpoint inhibitors, which could work together with

EGCG/DAC to induce apoptosis of tumor cells, stopping tumor growth and metastasis, and possibly eliminating tumor cells entirely.

AMY YEE. We are investigating new molecular mechanisms of tumor suppression to design new diagnostic and therapeutic strategies in breast cancer. We combine investigations in signaling pathways and in transcriptional regulation with directed clinical studies. We focus on the Wnt pathway, which has emerged as a major pathway in breast and other cancers, and HBP1, as a transcriptional repressor that is also a suppressor of Wnt signaling. HBP1 mutations are clinically associated with invasive breast cancer. Thus, HBP1 is a new tumor suppressor gene with clinical and molecular impact on invasive breast cancer. I am a Tufts Faculty mentor to Laidlaw Scholar **Francesca Deleso-Frechette.**

MATEO GOMEZ (2019-2021). I am a Junior at Tufts University majoring in Environmental Engineering. Originally from Mountain View, California, I am interested in the intersection between Public Health and Engineering. This past summer, through the *Laidlaw Undergraduate Research and Leadership Program*, I studied the removal of arsenic from drinking water by ceramic filtration. Through my research, I hope to promote access to safe drinking water for those living in low-income contexts. During the semester, I assist in research that evaluates the efficacy of water distribution programs in response to emergencies. Outside of academics, I am the Environmental Chair the Tufts' student chapter of the American Society of Civil Engineers (ASCE). I have held roles in student government and works at the on-campus coffee shop. During the 2016-2017 academic year, I was Fellow in Tufts' 1+4 Bridge-Year Program. As a Fellow, I spent nine months as a tutor in an After-School Program for at-risk youth in León, Nicaragua. In my free time, I enjoy reading, going on hikes, and playing the piano. My Laidlaw research project is being mentored by **Dr. Daniele Lantagne.**

A Systematic Review of Arsenic Leaching from Ceramic 'Pot' Filters

Tufts University School of Engineering

Mateo L. Gomez & Daniele Lantagne
Tufts University, Department of Civil and Environmental Engineering

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Background

Ceramic 'Pot' Filters (CPFs) are commonly used for household water treatment due to their low-cost, simple design, and long lifespan [1]. Effective use of CPFs has been been associated with a 49% reduction in diarrheal disease [2].

Ceramic Filters are manufactured using:

- Locally-sourced clay
- Burn-out material (e.g. sawdust)
- Silver (bactericide)

Ceramic Filter concerns:
Trace amounts of arsenic have been measured in water treated by CPFs [3]. Ingestion of arsenic-contaminated water can cause vomiting, diarrhea, and skin lesions. Chronic low-dose exposure increases risk of skin, bladder, and lung cancer [4].

Objectives

1. Identify the source of arsenic in CPFs
2. Assess the amount of arsenic in water treated by CPFs
3. Recommend changes in production that reduce and/or remove exposure to arsenic

Methods

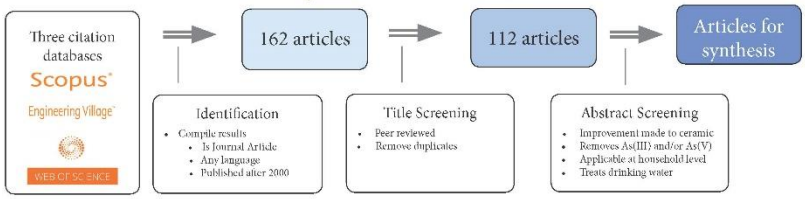
Synthesize existing knowledge → systematic literature review

A protocol for systematic review was developed which included: search strategy, inclusion criteria, and analysis plan.

- Databases searched June 2019
- Keywords:
  - 'arsenic'
  - 'water'
  - 'ceramic'
  - 'adsorption OR coagulation OR electrocoagulation OR precipitation OR filtration OR membrane OR ion exchange OR oxidation'

Results

Systematic literature review



Synthesis from 17 articles

The following key results were found:

Arsenic source:

- Clay is the principal source of arsenic
- Arsenic is bound to clay through the formation of inner-sphere bidentate surface complexes
- Arsenic in filters exists predominantly as hydrogen arsenate [As(V)]

Arsenic concentration:

- Arsenic leaching is rapid & non-linear
- CPFs release 30 –1,000 µg/L into treated water (WHO guideline: 10 µg/L)
- CPFs contain approximately 43.5 mg of leachable arsenic

Production variables:

- Competitive desorption had no observable effect on the release of arsenic
- Fired filter material releases more arsenic than unfired filter material

Areas for further research:

- Reduction of As(V) to As(III) for controlled leaching
- Effect of physical properties (e.g. pore size) on arsenic release
- Potential to treat arsenic-contaminated water using adsorbents

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[4] Smith, A. H., Hopenhayn-Rich, C., Bates, M. N., Goeden, H. M., Hertz-Picciotto, I., Duggan, H. M., ... & Smith, M. T. (1992). Cancer risks from arsenic in drinking water. *Environmental health perspectives*, *97*, 259-267.

We recommend that:

1. Field testing accompany modifications to filter mixture, as kits are low-cost (~ $2) and detect arsenic levels (10 – 50 µg/L) with high accuracy (89 – 92%)
2. Factories flush 2 filter volumes (15 – 20 L) of water before distribution, which would release ~ 1/3 of leachable arsenic
3. More research is conducted on the effects of input materials on arsenic leaching from Ceramic Filters

Acknowledgements: The authors would like to thank the Laidlaw Undergraduate Research and Leadership Program for their financial support in performing the research. The authors would also like to thank the previous researchers whose efforts provided the motivation to do this study and the whole filter pot community.

MAGNIFIQUE MUKUNDWA (2018-2020). I am from Rwanda, and I am a senior (class of 2020) at Tufts University majoring in environmental health – engineering with a focus on social entrepreneurship and water, sanitation, and hygiene (WASH) in Africa. I became a Laidlaw Scholar in 2018. I applied to this program not only because it made it financially feasible for me to do research in WASH, but also because it helps scholars their leadership skills. In first summer, I worked on the efficacy of jerrican cleaning methods, and in the second summer, I worked on the status of WASH-N (nutrition) in rural areas focusing on Mbuye sector, Rwanda as a case study. My Laidlaw mentor is **Dr. Daniele Lantagne**. I studied abroad in Talloires, France in the summer of 2018 and travelled to Rwanda in the summer of 2019 to complete data collection for my Laidlaw project. My highlight for my time in France was definitely improving my French skills, and for Rwanda, it was to do more of water analysis and spending time with family. I did one internship after my first year, and I interned with Clinton Development Initiative (CDI) in Rwanda. In my Tufts career, I have had chances to visit interesting places such as the Old City in Israel, Lion in France, and Antigua in Guatemala. In my spare time, I enjoy playing guitar and singing Christian music, conversing friends, and reading. My favorite color is purple. In five years, I see myself as a women entrepreneur running To the Waters (www.tothewaters.com) and impacting lives through the innovation of (WASH-N). In addition, I want to have gotten advanced degrees in environmental engineering and business. What I can tell future scholars is to have a growth mindset because this incites a spirit of working hard to acquire more research knowledge and skills.

ABSTRACT. MAGNIFIQUE MUKUNDWA. ***Assessing the Status of Water, Sanitation, Hygiene, and Nutrition (WASH-N) in Rural Areas: Mbuye Sector as a Case Study***. Access to safe water, sanitation, and hygiene (WASH) reduces the burden of infectious disease, particularly diarrhea, in children. Poor WASH also serves as a channel for pathogens that inflammate the intestinal walls, which hinders the absorption of nutrients necessary for growth. Known as environmental enteropathy, this process can cause malnutrition and impaired cognitive development. In 2018, 57% of Rwandese had access to clean water located within 30 minutes from their homes, 64% of Rwandese use an unshared latrine in their households, and 5% of Rwandese households have a dedicated place to wash their hands within the home. As a result of different factors such as repeated infection resulting in diarrhea and inadequate diet, approximately 800,000 Rwandese children are stunted. These challenges are worse in rural areas, From June 11th-14th, 2019, I conducted a study in Mbuye sector, a rural region located in Ruhango district, Rwanda, which is composed of 62 villages with approximately 41,000 residents. The purpose of this study was to understand the status of water, sanitation, hygiene, and nutrition (WASH-N) in 8 villages of Mbuye and assess challenges that the residents face associated with WASH-N. To complete the study, we randomly selected 8 villages in Mbuye sector and, from that, sub-selected 241 households. In each household we, conducted a survey on water access and quality, latrine usage, hygiene, self-reported diarrhea and malnutrition, and tested water quality for *E. coli*,

turbidity, temperature, free and total chlorine residuals, and pH using portable field equipment. We found that, for water supply, springs were the most commonly reported source (38%), followed by communal taps (29%) and rivers (28%). The average time to walk to their water source was 33 minutes. Additionally, 77% of respondents reported that they find a line at the water source and wait on average of 92 minutes. In addition, 98% of respondents reported they have a latrine near the household, 92% reported that they wash their hands before eating, and 95% use water and soap for handwashing. Furthermore, 34% of respondents reported that their household has had someone with diarrhea whereas for malnutrition, it is 3%. Microbiological tests revealed that the average CFU/100 mL for *E. coli* was 331 (range 0-120,000). At the village level, Cyanika's households (located in Mwendo cell) had the highest average CFU/100 mL for *E. coli* of 695, and the lowest average, 31 CFU/100 mL, was found in Karama (Gisanga cell). Overall, 41% of households did not meet the WHO standard of <10 CFU/100 mL of *E. coli* in drinking water. In addition, the study revealed that WASH-N status varies by villages. For instance, the average of households who have a special handwashing equipment in villages was 57% (range: 20-100%). The main goal of the study was to assess the status of WASH-N in Mbuye sector using household interviews and water quality analysis. Based on the results of the study, the most pressing issue in Mbuye sector is the lack of access to clean water since the majority of interviewed residents rely on unsafe sources of water. Thus, I recommend that the local government invests efforts in increasing clean water availability in Mbuye sector. Additionally, WASH-N knowledge should be promoted to foster behavioral change around for instance, treating water, having a bathing place, eating a balanced diet, and more.

DANIELE LANTAGNE. I am an Associate Professor in Civil and Environmental Engineering at Tufts University. I am a public health engineer (MIT BS 1996, MIT M.Eng. 2001, PE 2003) who received my Ph.D. in 2011 from the London School of Hygiene and Tropical Medicine. I began working in water, sanitation, and hygiene to reduce the burden of infectious disease while earning my Master's degree, and continued working in this field teaching in the Department of Civil and Environmental Engineering at MIT until I joined the Centers for Disease Control and Prevention in 2003. I completed my post-doctoral work at Harvard's Center for International Development from 2010-2012 and joined Tufts University as a Professor in 2012. Over the past nineteen years, I provided technical assistance or conducted research in more than 50 countries in Africa, Asia, and Central/South America in both development and emergency contexts. I have published over 50 papers on water supply, water treatment, hygiene and sanitation in low-income and emergency contexts. My main research interest is how to reduce the burden of infectious diseases by investigating and evaluating the effectiveness of water and sanitation interventions. I run an active group completing laboratory, field, and policy research and currently supervises three post-doctoral scholars, four PhD students, and undergraduate researchers with funding from agency, government, NGO, foundation, and private sources. I enjoy rocket ashtanga yoga, cooking ethnic and vegan foods, backcountry hiking, state highpointing, and raising my two children with my husband. With Laidlaw, I am working with two fellows. **Magnifique**

Mukundwa is working on water supply, sanitation, and hygiene in Rwanda (laboratory testing and completing a community survey). **Mateo Gomez** is working on arsenic removal with ceramic filters.

MOLLY GOULD (2019-2021). I am a second-year student from Washington, D.C and part of the second cohort of Laidlaw Scholars. Although my major is currently undecided, I am thinking of studying International Relations and Civic Studies. One of my greatest passions is participating in social activism initiatives and finding productive and creative ways to combat pressing issues and work toward positive global change. Through the Laidlaw Scholars program, I was able to explore this passion and develop a project that examines how various socially-constructed systems interlock and affect one another to create concrete patterns that impact people's lived experiences and shape their worldviews. In order to accomplish this goal, I decided to specifically focus on the issue of racial and gender biases within news media by examining how discriminatory patterns of language and imagery can lead to the creation and enforcement of existing systems of oppression. My research focuses specifically on representations of female criminality within popular news media and explores the effects of intersectional social identities on such representation. Working with my mentor Dr. **Daanika Gordon** of the Tufts sociology department, I am in the process of collecting and analyzing video data from various news sources in order to pinpoint racialized and gendered patterns within crime reporting. This project is an incredible opportunity for me to dive deeply into a subject that I am truly passionate about and that also carries great relevance within today's society. In addition to sociological research, I enjoy working with kids and am involved in several education and mentorship initiatives, including the Big Brothers Big Sisters Foundation. I am an academic tutor and a leader of the Tufts International Development club, and I am always looking to form new connections and take on new challenges. I love learning different languages and talking to different people, and in my life, I hope to have the opportunity to continue to learn more about the world and its residents.

DAANIKA GORDON. I am an Assistant Professor of Sociology. My research explores the intersections of race, space, and the law. My current project analyzes the relationships between racial segregation and policing. Using several data sources, including ethnographic observation of police work, I describe how the police respond to and shape unequal urban landscapes. In previous projects, I have studied how racial typifications of

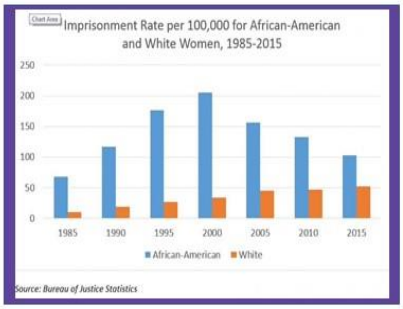
neighborhoods permeate individuals' daily mobility patterns and how institutional practices in a drug court impact clients' pathways through the Program. My research has appeared in journals including *Law & Social Inquiry, Sociological Perspectives, Socius*, and *The South Carolina Law Review*. I am excited to work with **Molly Gould** and future Laidlaw students on projects that critically investigate intersectional inequalities, particularly those that emerge through the narratives and processes underlying criminalization and criminal justice.

An Intersectional Analysis of Racialized and Gendered Media Portrayals of Criminality

Molly Gould

Central Question

News media is able to convey a huge number of both explicit and subliminal messages to large audiences, giving it the power to influence patterns of thought and promote certain behaviors. Because representations of people of color within the news media are so often accompanied by discriminatory rhetoric and racial biases, the news also becomes an agent in the creation and reinforcement of systems of racial oppression. For example, news reporting on crime and criminality contains patterns of language and images that help to project the association between blackness and criminality. This constant media narrative only exacerbates existing racist stereotypes and strengthens systems of societal categorization by forcing groups of people into homogeneous boxes that disregard the vast amount of heterogeneity among people who are often categorized together. My research focuses specifically on representations of women of color within popular media representations of criminality. Past research on crime reporting has consistently failed to provide an adequate foundation as to how non-white women are portrayed within news reporting on crime and how this differs from representations of white women within the same context: what language is used, what images are shown, how much air time is dedicated to each news story? Overall, what explicit and subliminal messages are being conveyed about black women and criminality as opposed to white women?



Women and Criminal Justice: why are we so fascinated with violence?

In order to pinpoint the unique intersection between race, femininity, criminality, and media representations, I decided to specifically examine reports of violent crimes such as homicide, because these fall so far outside of accepted norms of behavior, especially for women. Our society is interestingly intrigued by the idea of female criminality. This fascination and sometimes even fetishization of female crime stems from the fact that is breaks within the standards of normative societal expectations. There are countless dramatizations of female delinquency within widely-consumed entertainment and documentary sources, from television series such as *Orange is the New Black* and *Killing Eve* to YouTube channels such as *Female Killers* and *True Crime Daily*. The traditional construct of criminality does not match with the traditional construct of femininity; however, the construct of femininity also differs depending on other social identities such as race. Because violent crimes are so rarely committed by female perpetrators, when one does occur, it generates particular attention, with the subsequent media representation diverging as consistent with existing power structures. Using MAXQDA analysis software, I am in the process of analyzing video footage from 30 different sources that portray the stories of white women and women of color who have been accused of committing violent crimes, in order to identify racialized and gendered patterns within reporting.

Why do stories matter?

Acts of violence such as murder or homicide are things so far outside of established societal rules that we cannot actually initially comprehend them. Therefore, while attempting to bring the terrible event back into our accepted field of understanding, we inevitably filter it through existing social lenses that create the framework for our collective worldview. In this way, racial and gender bias is inserted into every single case and greatly affects the way it is perceived and conveyed, meaning that women of color are disproportionally affected. The media is an institution that especially showcases this social phenomenon. Is it a "sad" story of a victimized women driven to do a horrible thing by some outside influence? Or is it a "bad" woman who is inherently ruthless, inhuman, and therefore un-feminine? The way that the story is relayed within the media helps to define the overall narrative of the case, which has an enormous effect on the outcome.

> Many stories matter. Stories have been used to dispossess and to malign. But stories can also be used to empower, and to humanize. Stories can break the dignity of a people. But stories can also repair that broken dignity.
> - Chimamanda Ngozi Adichie

The Story of Cyntoia Brown

On August 7, 2019, Cyntoia Brown was released early from a Tennessee prison after being granted clemency by the governor. Brown, now 31, was sentenced originally sentenced to 51 years in prison for killing a man who paid her for sex at age 16. During her initial trial, she was not provided with the protections and support necessary for victim of child sex-trafficking, and her story was represented as one of a disturbed and dangerous person. However, throughout the past decade, her story began to spread and change into one of a survivor of abuse. This is a prime example of how a changing story means changing results: her initial story landed her in prison for her life, while her new story granted her clemency. She is now a free woman, a college graduate, and an advocate for childhood victims of sexual abuse and trafficking. Cyntoia Brown's story inspired this research because it highlights the concrete consequences of disparities in representation and demonstrates one woman's strength and courage that changed her story.

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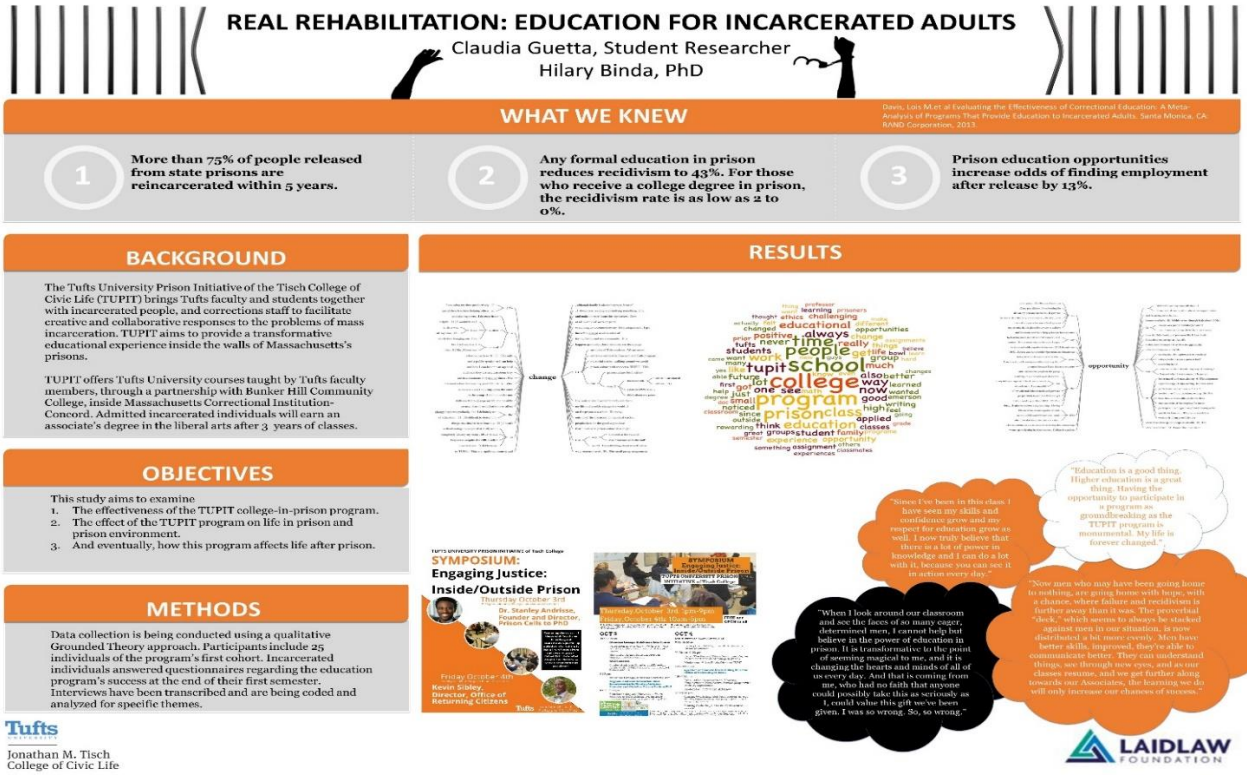
AMEL HASSAN (2018-2020). I am part of the first LaidLaw Scholar cohort, I became a Laidlaw Scholar the summer of 2018. I applied to be a Laidlaw Scholar because I saw it as a great opportunity to pursue research in a more independent manner while gaining valuable leadership skills. I knew the program would provide great networking opportunities and support as scholars, similar to me, would also be going through the learning process and challenges that come along with doing research. I am a computer science major in the school on engineering here at Tufts. My mentor is **Jivko Sinapov**, a robotics professor who specializes in research centered around cognitive and developmental robotics, human-robot interaction, robot learning, and computational perception. The title of my project is "An Augmented Reality Platform for Collaborative Service Robots". I did not study abroad as a scholar, as I was working with robots located in Tufts' Autonomous Intelligent Robotics lab. The highlight of my experience as a scholar has been the autonomy I felt in directing my project, and finding and researching tools that best fit the project. The lowlight has been the times when I would spend countless hours trying to fix a tough bug in my code. My research has been published in the HRI 2019 conference in South Korea and it will be presented in Tapia 2019, a diversity in computing conference. I am from Medford, MA but I grew up in Somerville, MA. I did an internship this past summer in Washington state. I am a senior and I will be graduating in May of 2020. In my free time I like to bike, hike, and figure skate. My favorite colors are burgundy and lavender. In 5 years I see myself working in a tech company while also pursuing higher education by taking some classes on the side. I hope to live in places with a lot of mountains and I'd love to hike and do camping trips on the weekends. My advice for future scholars is that know that there are always roadblocks in research, but that you are qualified as a scholar to overcome them. Also, don't be afraid to ask your mentor for help and branch out to others and ask for help!

ABSTRACT. AMEL HASSAN. ***Augmented Reality Framework for Collaborative Service Robot.*** As robots are becoming increasingly prevalent in society, the view of the future has shifted from being a world dominated by robots, to a world focused on human-robot interaction and collaboration. Humans are mentally and physically constrained while robots are challenged in areas such as creative problem solving, empathy, and intuition. Capitalizing on the strengths and specialized abilities of humans and robots will allow humans to tackle large scale problems more effectively. Augmented Reality (AR), a technology that creates a composite view of the real world and artificial elements, is thought to be capable of bridging the communication gap between humans and robots. This project centers around a framework that was built using AR to create a shared reality between humans and robots for communicating and problem solving. The framework is a translation device; it takes in robotic language, millions of numbers, and translates it to a human readable form; meaningful symbols, colors, and animation. The interface for this framework allows a human to visualize a robot's laser scan, costmap, localization particles, and indented path. The technical aspects of this project included data filtration, coordinate transformation, and editing visualizations.

JIVKO SINAPOV. I received my Ph.D. in computer science and human-computer interaction from Iowa State University (ISU). While working toward my Ph.D. at ISU's Developmental Robotics Lab, I developed novel methods for behavioral object exploration and multi-modal perception. I went on to be a Clinical Assistant Professor with the Texas Institute for Discovery, Education, and Science at UT Austin and a Postdoctoral Associate working with Peter Stone at the Artificial Intelligence Lab. My research interests include developmental robotics, computational perception, autonomous manipulation, and human-robot interaction. Dr. Sinapov is the Laidlaw Faculty mentor to **Amel Hassan**.

CLAUDIA GUETTA (2019-2021). I am in the class of 2022. I have been an EMT in my community in Connecticut for four years and teach STEM curricula to fourth grade students in the Greater Boston Area. I plan to major in Community Health and Sociology, while on the pre-medical track. I'm particularly fascinated with the multidisciplinary nature of these programs, focusing on health and society and exploring health issues from a variety of perspectives. Five years from now, I see myself working at the intersection of public health, medicine, and social justice. I am also a 2019-2020 Laidlaw Scholar. My passion for social justice first motivated me to enroll in an "Inside-Out" course titled Literature of Confinement, with **Hilary Binda**, last semester. My classmates included ten outside (Tufts) students and ten inside (inmates) in a medium security prison in Concord, Massachusetts. While analyzing literature, we learned that the power of knowledge is in learning "how" to think, not "what" to think. It's not just about gaining knowledge, but empowering people to become active in their society. This kind of learning greatly inspired me, and is something that I believe is lacking, but necessary, in our society. The Laidlaw Program fosters this exact kind of learning and exploration and is what motivated me to apply to be a scholar. With my mentor, Professor Binda, I continue to study education in prison, specifically how the Tufts college-in-prison program affects the prison environment and life after prison. There have been challenges with this research: gaining permission with the Department of Corrections to carry out the research project, removing any sampling bias, and ensuring that any observer-expectancy effect is limited. However, learning about how this education has given a sense of purpose to students, changed their attitudes and time usage, and reshaped interpersonal interactions in the prison has been a highlight that outweighs all obstacles.



NORA MAETZENER (2018-2020). I became a Laidlaw scholar in the spring semester of my sophomore year of college in 2018. I applied to the Laidlaw scholarship after learning of this opportunity from a **Professor Hilary Binda** with whom I was working closely to organize a symposium on the intersection of education and incarceration. When I first heard of the Laidlaw research scholarship, I was involved as a research assistant on the research project Professor Binda was focusing on, which involved collecting and coding data from formerly incarcerated students on their experiences with college-in-prison programs. Working alongside the founder and director of the Tufts University Prison Initiative at Tisch College (TUPIT), Hilary Binda, was a terrifically eye-opening experience that has certainly altered my educational and professional course of life. When I learned that I could continue this involvement during the summer through support from the Laidlaw fellowship, I was determined and excited to apply. Upon receiving my acceptance, Professor Hilary Binda officially became my mentor on my project "The Critical Intersection of Higher Education in Prison." Being able to work on this research in an independent and flexible manner has allowed me to pursue and engage in additional work over the summers, thereby further fortifying my career path and experience. For example, last summer, I was able to combine my Laidlaw research

with two other internships; I shadowed physicians in the Anesthesiology Department at New York University Langone Hospital and worked at a non-profit law firm on their Mental Health Project. This summer, I combined my research with being a Teaching Assistant in a summer intensive course on English and Philosophy that was instructed in a correctional facility in Massachusetts (MCI Concord). Although it is difficult to choose a specific aspect, I would identify this remarkable conjunction of exposure and learning as the highlight of my experience as a Laidlaw scholar thus far. As of today, our research has not yet been published, but we intend to submit our paper for publication in the 2019-2020 academic year. I am originally from New York City, and am double-majoring in Psychology and Sociology, and will graduate from Tufts University in 2020. Through the Laidlaw research scholarship, I have had the opportunity to enter some interesting environments. Although it may not be the typical tale of travelling internationally to attend an elite research conference, I have gone inside prisons almost weekly since becoming a Laidlaw scholar (with the exception of the Spring 2019 semester, during which I studied abroad in Stockholm, Sweden). I do not believe that work on prison reform and education can be done in a meaningful way if it relies and focuses solely on theoretical scholarly work that is removed from the realities of incarceration and am very grateful to have the opportunity to cross these boundaries in an intentional way through my work as a Laidlaw scholar. My hobbies include spending time with my dogs, reading, and jogging. My favorite color is grey. In five years, I see myself having graduated law school and working as a criminal defense lawyer in New York City. To future scholars, I would encourage that they find a subject that fills them with passion, and to follow the path that that topic leads them. Although there are always going to be hurdles and difficulties when it comes to research, it is easier to weather the storm and persevere when one is driven by their core passion.

ABSTRACT. NORA MAETZENER*. The Critical Intersection of Higher Education in Prison Leadership.* This research essay focuses on the impact of programs of higher education on incarcerated student participants. Through interviews conducted with a sample of formerly-incarcerated individuals from the Northeast United States on their experience in college-in-prison programs, this research seeks to grasp how participants view the multifaceted influence of receiving a college education behind bars. The study begins with an extensive literature review on existing research conducted on this topic, including studies highlighting personal narratives, as well as those focusing on quantitatively-centered statistics regarding the impact of college participation on recidivism rates. Following, of the qualitative data obtained through interviews is analyzed and presented in the following three areas: self-confidence and agency, interpersonal connectedness, and capacity for leadership. In addition, the coded interviews are utilized to identify four characteristics that were described to be critical to a college-in-prison program's success: academic rigor, professor's respect for students, discussion-based learning, and productive relationship between college and prison personnel. These results are discussed and summarized to illustrate the powerful and often untapped potential of college-in-prison programs.

HILARY BINDA. I have a PhD in English and is a Senior Lecturer in the Visual and Critical Studies Department. I also am the Director of the Program in Women's, Gender, and Sexuality Studies and the Founding Director of the Tufts University Prison Initiative of Tisch College. My research includes a collaborative study with Carolyn Rubin and Jill Weinberg of the impact of college-in-prison on formerly incarcerated people. I work on the relationship between the literary and the visual registers as this productive tension informs the emerging discourse of time in early modern England and as this tension resonates in the contemporary discourses of queer/feminist theory. I am a Tufts faculty mentor to two Laidlaw Scholars – **Claudia Guette and Nora Maetzener.**

Tufts University Prison Initiative of Tisch College, Tufts University, Medford MA

The Critical Intersection of Higher Education in Prison

"You're almost in this place that doesn't exist": The Impact of College in Prison as Understood by Formerly Incarcerated Students from the Northeast U.S.

Hilary Binda, Carolyn Rubin, Nora Maetzener, and Jill Weinberg

Background

Programs of higher education in prisons exist within a critical tension between public safety and the transformations that can occur through education. This tension is often formulated in the popular imagination as a choice between the individual and the wider community, but is in fact a false duality. Statistics on the high rates of recidivism for the general population, after all, suggest that serving time has often left people feeling less useful, more traumatized, and thus even more prone to criminal acts than they had been before their incarceration. The seemingly opposing goals of education and corrections are increasingly coming to be understood by those outside and inside the world of corrections as actually fully aligned. This qualitative study of the impact of participating in college while in prison finds that the personal transformation that can result from such participation fully supports a positive correlation between college programming in prison and increased public safety. This study draws its findings from the reflections of formerly incarcerated students about both the transformational impact of college programming and the specific aspects of programs that facilitate this individual change.

Research Objectives

This study hoped to learn more about how people make sense of their past college in prison experiences once they are out and, more specifically, how they feel it impacted them both while incarcerated and after release. A further aim was to understand what these men found frustrating and what they found most valuable during their program participation, with the goal of publishing what they value most about their college program experience and thus some of what they recommend specifically for the development of college programming inside.

Methods

Through semi-structured interviews with former college in prison students, this qualitative study examines the impact of higher education in prison from the perspective of formerly incarcerated people reflecting on their past experiences. The authors examine the ways that these former students articulate the immediate and lasting changes brought about by their college experiences. In addition to interpreting the impact of these experiences on the individual this study examines what specifically about the program experiences fostered this impact. To glean this information, the overarching question has been twofold:

1. What can we learn about the relationship between education and human transformation from former participants' reflections on the impact of college in prison?
2. How might we imagine building educational programming inside prison with attention to the potential for such transformation?

Table 1. Summary of Study Participants

Study Participant (Study-assigned name)	1 Lawrence	2 John	3 Isaac	4 Morris	5 Ralph	6 Jamar	7 David	8 Andy
Age at time of interview (fall 2017)	74	67	49	53	54	35	47	47
Time served (rounded to years)	37	19	19	33	34	9	17	18
Number of college courses taken in prison	27	32	4	31	32	>25	33	15
Age when first incarcerated	18	18	26	16	20	21	30	18
Number of incarcerations, if more than one	1	1	1	1	1	2	1	1 (served in 2 prisons)
Educational completed before incarceration	11th grade	12th grade	Some Community College	11th grade	12th grade	8th grade	10th grade	9th grade
Self-reported Race/Ethnicity	African American	Black / African	African American	African American	Caucasian	Black	Black Hispanic	Native American / Black

This study entailed semi-structured interviews with 8 men, each given a pseudonym by the authors, who participated in various college degree-granting programs in medium- and maximum-security facilities in the eastern and primarily northeastern United States. The participant characteristics are displayed in Table 1.

Table 2. Description of Coding Scheme by Theme

Theme	Concepts and Codes
Personal Development in College Program	• Self-concept • Relationships with faculty • Relationships with family and friends outside • Outlook on personal capabilities and future possibilities • Experiences of re-entry and the role of college experience
Perception of Impact on Prison Culture	• Relationships • Relationships with classmates • Relationships with corrections officers and administrators • Changes in way time was spent outside of class
Frustration with College-in-Prison experience	• Access to text and materials • Academic Support
Suggestions for Improvement	• Pedagogy or curriculum • Classroom Experience • Instructional support
Perceptions over Time	• Background and Pre-Program • Program Experience • Post-Program Reflection

Table 2 displays the concepts and codes that were used to analyze the data obtained from qualitative interviews conducted with study participants.

Results

The authors found that successful programs were those that cultivated this transformation in three areas:

1. Student's ability to reflect and think critically about themselves
2. Student's interpersonal connections
3. Student's perceived role in and sense of responsibility beyond self to society at large through a greater capacity for civic engagement

The three most statistically significant findings about the transformative potential of college in prison can be organized under the following three headings:

1. Self-confidence and agency
2. Interpersonal connectedness
3. Capacity for leadership

Limitations

Although the sample size is small and thus presents a limitation to our findings, the authors found enough significant points of saturation that we were able to draw some conclusions from the interviews about personal impact and thus to extract several guiding principles for program design and assessment. Findings were based on multiple participants' perspectives: no finding listed in the results section is shaped by fewer than six of the eight participants, and no finding is countered by anyone who did not support the finding explicitly. After presenting and summarizing these qualitative findings on the impact of educational experiences on the individual, the authors discuss how this new knowledge might be used to benchmark high quality in-prison college programming, ultimately with the hope of facilitating the development of more high quality programs.

Conclusions

By examining the structure and impact of college programming in prison, this qualitative study affords a unique opportunity to better understand why personal transformation occurs and what it consists of and to re-prioritize accordingly some best practices in higher education. In examining the impact of individual participation from the perspectives of formerly incarcerated participants, the authors found statistically significant the following three interrelated outcomes and sub-themes which were supported by almost every interview discussion. The most immediately and consistently reported was the increased sense of self-confidence and the ability to re-imagine one's future in a more optimistic light as a result. All study participants also recognized the transformational effect of an increased sense of interrelatedness created by the development of various relationships stemming from program participation – relationships with families, fellow students, the wider prison community including prison staff, college professors and other personnel. These relationships fostered a new sense of belonging and made evident a new capacity for empathy. The newly organized sense of academic efficacy and self-confidence garnered by these relationships fostered an increased sense of agency that the authors and participants understood as a capacity for leadership and a new sense of civic responsibility.

Tufts

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RACHEL KLEIN (2018-2020). This ethnographic research study seeks to understand how larger tensions in Israel regarding the role of religion in society are reflected in and by the Israeli environmental peacebuilding movement. Israel is a complex society, filled with people who relate in deeply different ways to religion, theology, and religious establishments. The environmental peacebuilding movement in Israel has traditionally been a secular, left-wing institution that avoids affiliating itself with religious thought or leadership. However, this study shows that the Israeli conflict over religious rights, powers, and domains is a conflict that cannot practically be relegated to the sidelines of a movement. Consciously or unconsciously, environmentalists and peacebuilders in Israel grapple with and make decisions about religion which affect the shape and inclusivity of their movement. This study aims to paint a realistic picture of the environmental peacebuilding movement in Israel, with specific focus on understanding how religion comes into play, using the data collected from 22 interviews with key stakeholders in the Israeli environmental movement during summer 2019. The PI hopes that this study provides some clarity into the complex ways in which religion functions in Israeli society, as well as offers insights for present or future environmental peacebuilding groups or movements. My Laidlaw Faculty mentor is **Dawn Terkla**.

ABSTRACT. RACHEL KLEIN. ***The Application of Religion in Environmental Peace-Building in Israel.*** This research study explores how environmental and peace activists in Israel think about and use religion in environmental peacebuilding efforts. The Primary Investigator conducted ethnographic interviews with 22 environmental activists, peacebuilders, and researchers in Israel regarding their opinions on the connection, or lack thereof, between religion, the environment, and conflict. The PI hopes that this study will provide insight into the myriad of ways in which environmental and peace activists in Israel think about religion so that those living both in and outside of Israel can better understand the complex roles which religion plays in conflict resolution in Israel and between Israel and its neighbors.

PETER LAM (2018-2020). I'm originally from Stow, Massachusetts, which is quintessential New England apple-picking country. I'm a rising senior at Tufts, double majoring in English and Computer Science. I became a Laidlaw Scholar in 2018, as part of the first cohort at Tufts. I applied because I was hoping to work with Aram and research a product that could help people; during our sophomore year, after finding that there were few eating disorder mobile applications on the market that were accessible to people pursuing independent recovery, we both expressed interest in delving into this topic further. I have a background in Computer Science, while Aram has a background in Psychology, and I was excited to not only further my development skills, but also delve into user interface design and create app interfaces that were improvements over those that already existed. Our project title is "Innovative Design: Modernizing CBT-E Through Advanced EMA in Mobile

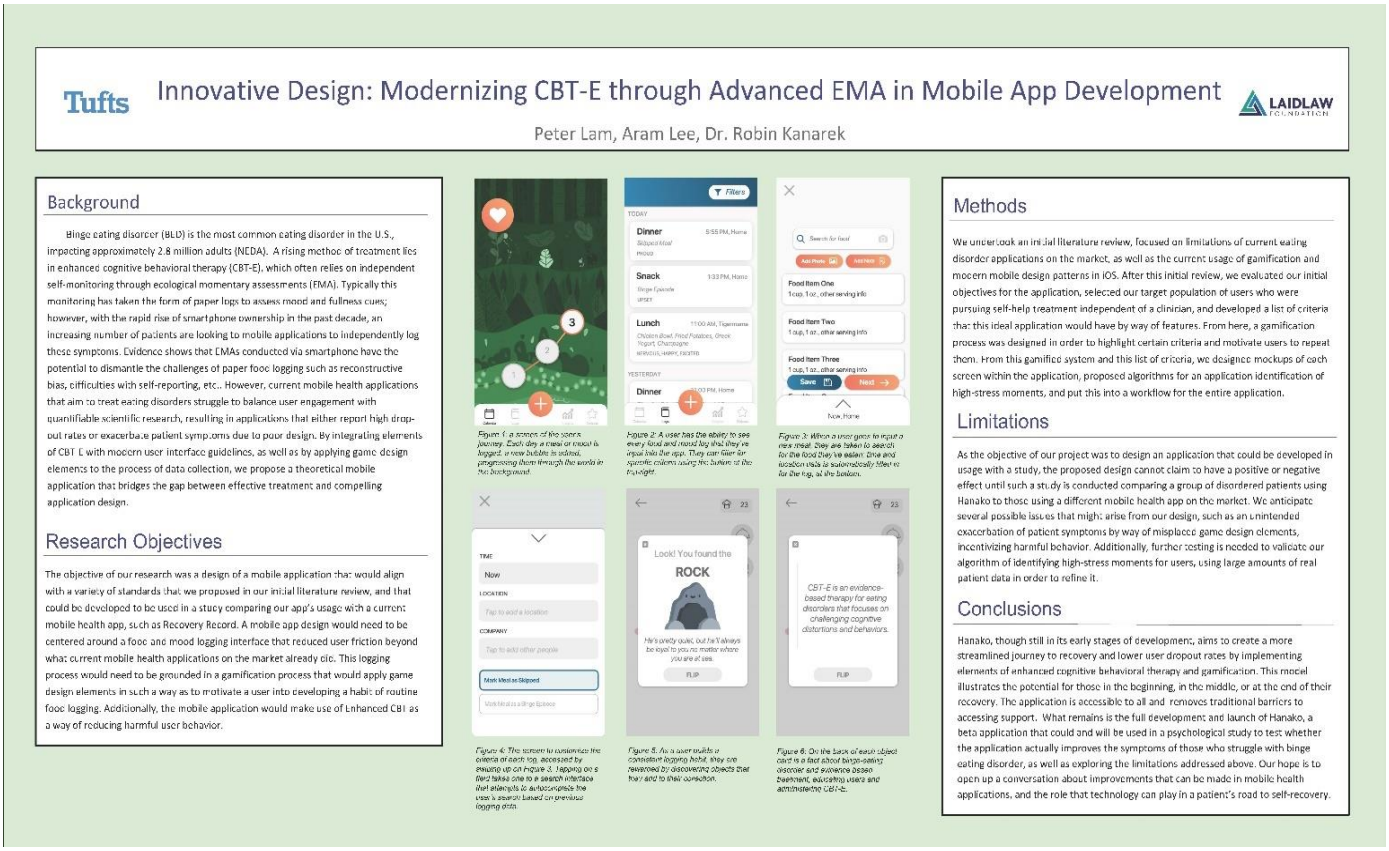
App Development," and our mentor is **Dr. Robin Kanarek**. For me, a highlight of this project has been the ability to combine both healthcare and user experience research with the creativity of designing application interfaces that improve upon existing ones in binge eating disorder mobile applications. Taking our research on engagement and effectiveness and translating it into application screens that can be used has been extremely rewarding. I'm excited to have been a part of this program; helping lead an independent research project has helped me develop both hard skills in software development and design as well as soft skills in the form of time management, communication, and project planning. After college, I plan on going into industry, and I'm certain that the skills I've developed over the past two summers will be a great asset during my job search. Additionally, I'm excited to be a part of the Laidlaw Scholars Network as an active alumnus.

ARAM LEE (2018-2020). I am originally from a small town called Hattiesburg in Mississippi. I'm a Senior at Tufts with a major in Biopsychology and a minor in Education. I became a Laidlaw Scholar in 2018 out of a desire to see the seed of an idea come to fruition. I was and continue to be passionate about creating content that works to destigmatize and promote health and wellness. Though mental health remains a crisis in the United States, there continues to be barriers for access to care for a number of people. That was why it became important to me to create a product, with the help of Peter, that would allow interested parties an accessible, basic level of treatment. My project is titled "Innovative Design: Modernizing CBT-E Through Advanced EMA in Mobile App Development," with partner Peter Lam and mentor **Dr. Robin Kanarek**. Through working on this project, I have been able to research various methods of treatment for eating disorders and use this research to develop a streamlined method of treatment. It has also been fascinating to think of ways to keep users engaged, allowing for aspects of creativity in design. Through the Laidlaw Foundation, I have found myself challenged in methods of thought and communication, and it has enabled me to develop a skill set I have found useful in other aspects of my life, such as my research at Harvard University. The past two summers have been incredibly fulfilling, and I am excited to continue my participation in Laidlaw through mentoring other cohorts.

ABSTRACT. PETER LAM AND ARAM LEE. ***Innovative Design: Modernizing CBT-E Through Advanced EMA in Mobile App Development.*** Binge eating disorder (BED) is the most common eating disorder in the U.S., impacting approximately 2.8 million adults (NEDA). The rapid rise in smartphone ownership among American adults has paved the way for innovative treatment methods for eating disorders (ED), especially in patients seeking recovery independent of a clinician. ED apps are especially well suited for their readiness in conducting ecological momentary assessments (EMAs), as patients can log meals, mood, and behavior both more quickly and more accurately when compared to paper logs (Moskowitz, Young, 2006). Yet despite this opportunity, current mobile health technologies maintain risks in their assessments, often through inadvertently causing users to drop out, or incentivizing adverse symptoms of a patient's condition. Gamification exists as a method for treating the former issue, while careful design patterns can allay the latter. This works at its best when designers use gamification as a way of amplifying persuasive experiences in order to affect motivation and change behavior. Centering this around the food logging process within an eating disorder mobile

application can positively affect user's perceptions around recovery; however, caution is required, as careless design leaves room for the exacerbation of symptoms by way of misapplied incentivization. Additionally, other elements within this application must improve on the design patterns of previous eating disorder applications by reducing user friction where possible, allowing for a powerful opportunity to educate users on their own eating habits and behavior. As the final phase of this project, we assessed our preliminary analysis of existing mobile applications, as well as our research which is derived from a review of both user interface design and eating disorder literature. We then came up with functional criteria for the app which we felt could be cleanly encompassed into a theoretical mobile application. This allowed us to organize these criteria into different possible components of the app and allowed us to determine how each component should interact with each other. Finally, we implemented a possible solution to these criteria by designing prototypes for each screen within the app, which could serve as a blueprint for the development of an initial application.

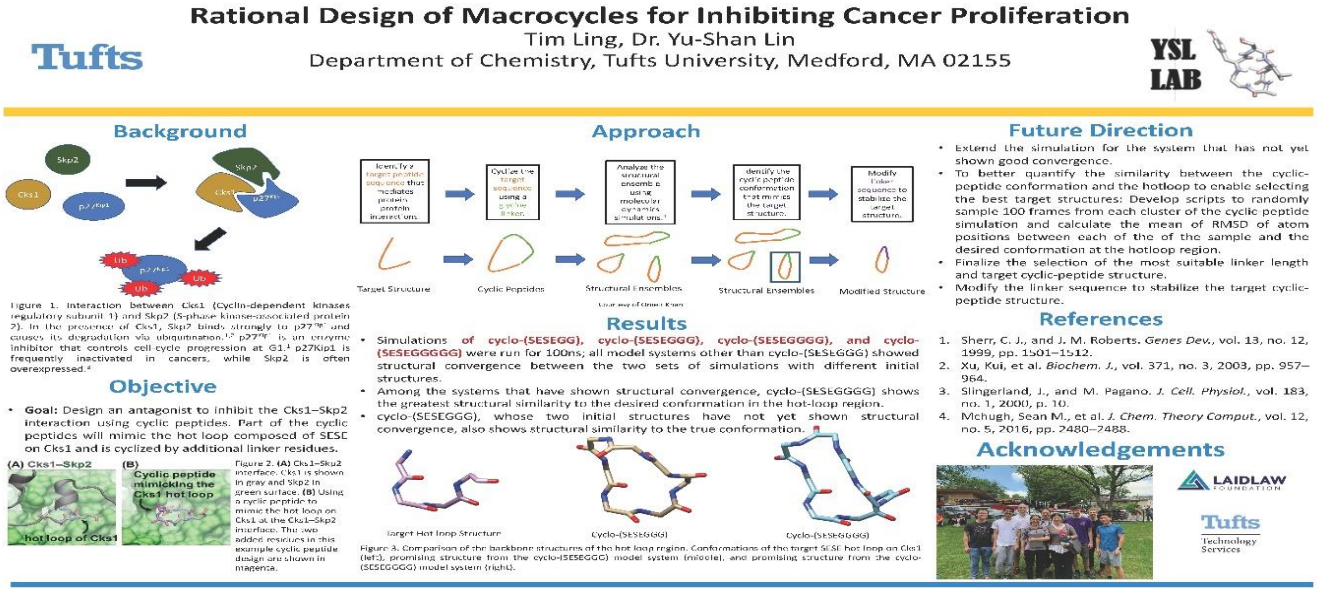
ROBIN KANAREK, PHD. I am a John Wade Professor of Psychology in the School of Arts and Sciences. i served as Interim Dean of the Gerald J. and Dorothy R. Friedman School of Nutrition Science and Policy from 2011 until 2014 and as Dean of the Graduate School of Arts and Sciences from 2002 until 2006. In MY research, I have investigated a range of issues in nutrition, including the effects of nutritional variables on the development of obesity and diabetes, the physiological and behavioral factors influencing diet selection in experimental animals and humans and the roles of nutrients, and physical activity in determining the consequences of psychoactive drugs. Most recently, I have been studying the effects of obesity and diabetes on cognitive behavior, and the relationship between nutritional variables and cognitive behavior in children and adults. I have served as a member of the Committee on Military Nutrition Research for the National Academy of Sciences and on review committees for the National Institutes of Health, the U.S. Department of Agriculture and the National Science Foundation. I am the Laidlaw faculty Mentor to Peter Lam and Aram Lee.



YINGJIE (TIM) LING (2019-2021). I am 颖杰, but people call me "Tim". I am from Shanghai, and I am a third year studying computer science. I love traveling and trying different food from different places; I also enjoy running, biking, and photography. My favorite color is Burgundy red because it has the vividness of life without the loss of a sense of matureness. I was lucky enough to get the Laidlaw Scholarship in my sophomore year and started working on my project, *Rational Design of Macrocycles for Inhibiting Cancer Proliferation*, with **Prof. Yu-Shan Lin** at the chemistry department. We are studying the interaction between $p27^{Kip1}$ and Skp2, two protein complexes involved in cell division. The $p27^{Kip1}$–Skp2 interaction is seen to be over-expressed in cancer cells. And our hope is to develop an antagonist to inhibit such interaction using state-of-the-art computer simulation methods with the eventual goal to provide an answer to one of the hardest problems of this century. Just learning about a tiny part of the latest development in the scientific field is an amazing experience itself, let alone the fact that I can apply the knowledge to solve a real problem. The demanding character of scientific research should not be downplayed nonetheless.

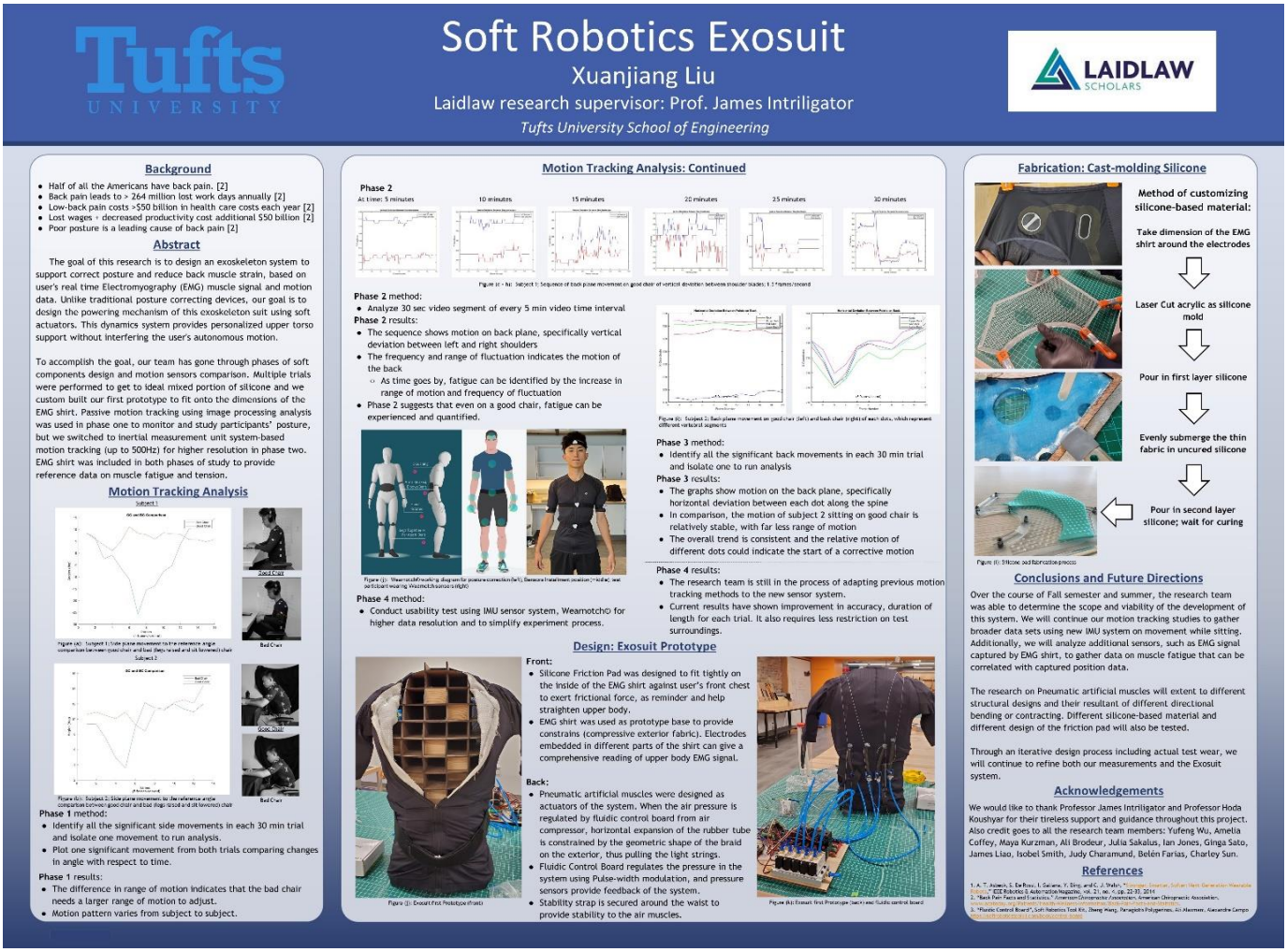
There is no longer a manual that can solve every single problem encountered and maintaining perseverance in the face of this seemingly endless pursuit is easier said than done. But thankfully, I have a supporting mentor who would patiently give guidance and offer invaluable advice. For the future scholars, I would like to say that there might not be an answer your scientific inquiry, but it is the process of exploring and discovering that makes the experience unique and rewarding.

YU-SHAN LIN. My name is Yu-Shan Lin and I am currently an associate professor in the Department of Chemistry. I grew up in Taiwan and went to UW–Madison for my PhD in theoretical and computational chemistry in 2004. After defrosting in California during my three years of postdoctoral fellowship at Stanford, I decided to put my winter coat in good use again and started at Tufts as an assistant professor in 2012. I love my research and can get into "the zone" for hours writing and debugging codes, analyzing and marveling at results, reading and writing papers (and can magically convince my body that going to the bathroom is overrated). I hope all my mentees will also get to experience and enjoy this thrill someday (except the not-going-to-the-bathroom part). I am also spoiled by students like **Tim (Ying-Jie Ling)** – a great planner, deep thinker, and hard-working budding researcher. Through the Laidlaw Program, I have learned a lot about all the research that is going on at Tufts and really appreciate the chance to connect with all the fellows and mentors. I look forward to continuing participating in the Program and working with Tim in his journey of searching and researching.



WILLIAM (XUANJIANG) LIU (2019-2021). I go by William. I become a Laidlaw Scholar in the Spring of 2019. Born and raised in China, I grew up in a family that truly value different voices, and my parents always encouraged me to go out and explore. The international aspect from the Laidlaw Scholar Foundation really fascinates me. I studied abroad at Cambridge University in the UK for a short period of time, and I truly value how different ideas could come together. Thus, within the Scholar Network, I can reach out to and connect with different scholars and labs from all over the world. Moreover, I have received a lot of support helping me to become a better researcher. As a Mechanical Engineering student interested in Biomechanics and Human Factor design, I reached out to **Prof. Intriligator** as a mentor. As the director of Tufts Human Factor Program and Professor of the Mechanical Engineering Program, his interdisciplinary vision have inspired and motivated me. In our Laidlaw collaboration, we envision building an exoskeleton system, wherein every component on it are made from soft material. The model can make adjustment and support upper human body dependence on user body's motion, muscle tension, and location in the space. We call it, "Soft Robotics Exosuit". It's a fusion of what I'm passionate about and an area that I want to grow in. As a Laidlaw Scholar, I am becoming a better communicator, organizer, and -- gradually – a team leader. I will demonstrate the prototype next Fall. Words of advice for future scholars: start early, finish strong.

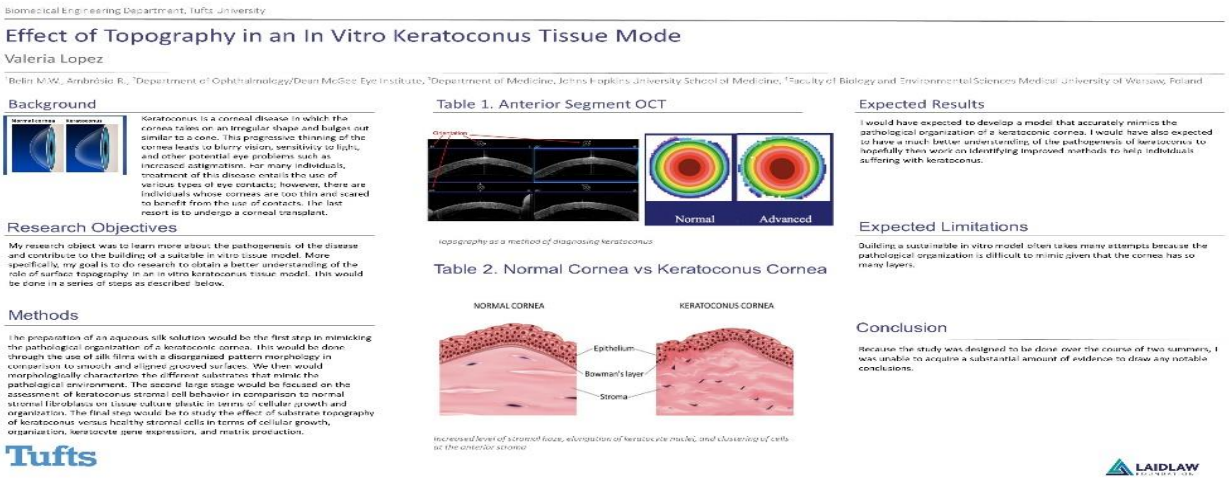
JAMES INTRILIGATOR, PHD, FRSA. I am the Director of Tufts' Human Factors Engineering Program and a Professor of the Practice in the Department of Mechanical Engineering (School of Engineering). An interest in vision and the brain originally brought James to Harvard where he earned his Ph.D. in cognitive neuroscience (1997). After a postdoc in neurology at Beth Israel Deaconess Medical Center, I left academia for five years and worked in venture capital and high-tech consulting firms as an entrepreneur, offerings designer, and innovation catalyst. In 2003, I merged my business experience with his scientific expertise and went to Bangor University (Wales, UK) as a pioneer in the field of consumer psychology. In my thirteen years at Bangor, I created Europe's leading consumer psychology master's programs and co-developed several multidisciplinary design programs (*Enterprise by Design* and *Social Enterprise Accelerator*). I joined Tufts in 2016 to lead the University's renowned Human Factors Engineering Program into its next phase of innovation and growth. Intriligator is the author of over 50 publications in fields as diverse as neuroscience, neurology, consumer psychology, physics, and literary criticism. Since arriving at Tufts I have been nominated for a *Tufts Distinction Award*, shortlisted for *Professor of the Year*, and won a university-wide *Teaching with Technology* Award. I have a new and growing interest in applied soft robotics – an interest that is being fueled and pursued by my Laidlaw Scholar **William (Xuanjiang) Liu.**



VALERIA LOPEZ (2019-2021). I became a Laidlaw Scholar in 2019. I applied to be a scholar because I loved that the program allowed me the freedom to form my own research project. My major is Biology and I am minoring in Child Development. My mentor for my first summer unfortunately moved to a different school, so my new mentor is **Dr. Anne Fulton.** My project for my second summer will be focusing primarily on conditions and diseases that affect the retina beginning in childhood, including retinopathy of prematurity and various inherited retinal degenerations. I have not yet studied abroad but I am planning to do so my senior fall. The highlight for me has been being able to interact with other Laidlaw scholars and having the opportunity to learn about their research and other passions. The lowlight in this experience has been having to unexpectedly deal with my mentor moving to a different school, but I feel so fortunate to be in a city

like Boston where there are many research opportunities available. No, my Laidlaw research has not been published. I am from Melbourne, Florida but my family is from Colombia. I would like to share that I am a first-generation Latinx student and am happy to talk to any first-gen/POC students if they need help navigating research opportunities. This will be my second year, interning with the Tufts Latino Center and Tufts Hillel. I will graduate in 2021. My hobbies include photography and dancing, and my favorite color is blue. In five years, I see myself in med-school studying to become an eye doctor. My advice to future scholars would be to never be afraid to ask questions when you are unsure of something. Anne Fulton, Children's Hospital Boston, is my Laidlaw mentor.

ANNE FULTON. Dr. Fulton, Professor of Ophthalmology at Harvard Medical School and Senior Associate in Ophthalmology at Boston Children's Hospital, is an established investigator of normal and abnormal retinal and visual development, sustained by more than four decades of National Eye Institute support. Her seminal work on human rhodopsin defined constraints on development of key ERG response parameters and continues to guide the investigation of pediatric retinal and visual function. In her clinical practice, she sees infants and children with a broad spectrum of vision-impairing conditions, about half of whom have inherited retinal disorders. Currently active research includes studies of retinopathy of prematurity (ROP) and X-linked juvenile retinoschisis (XLRS). The ROP studies aim to understand the role of the neurosensory retina in the ROP disease process and in determining ROP's consequences for vision and refractive development. The XLRS project seeks to improve management of XLRS by advancing understanding of the molecular and cellular basis for XLRS retinal disease. I am a Laidlaw mentor to **Valeria Lopez.**



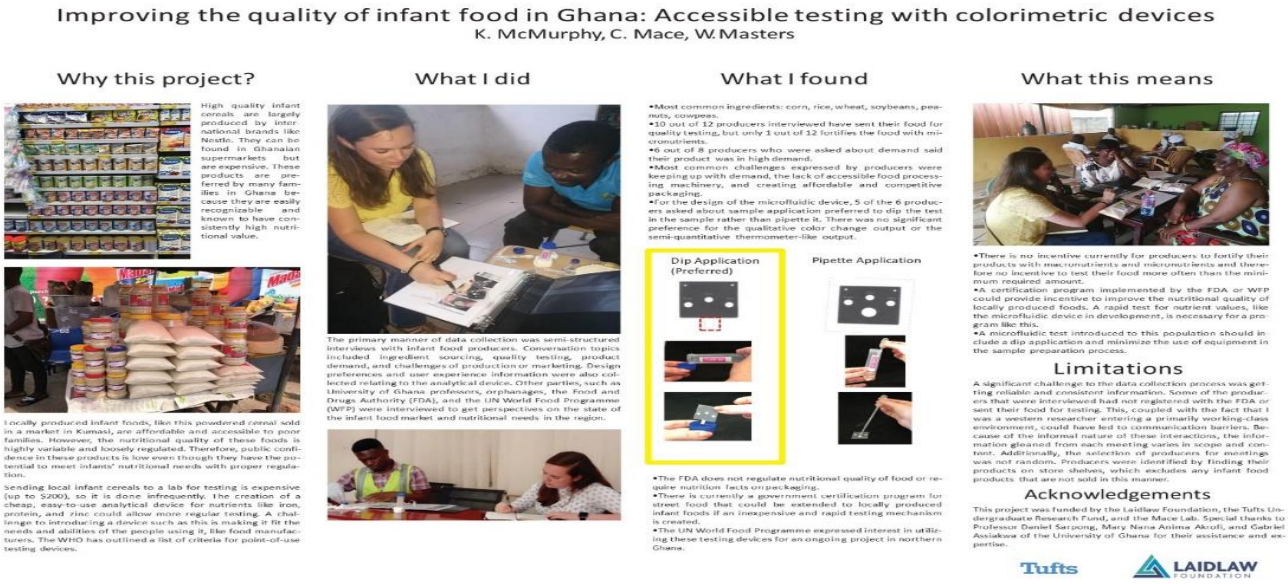
SARAH MARKOS (2018-2020). I am a Senior at Tufts University studying Community Health and International Relations with a particular interest in refugee health and human rights. Originally from the DMV area, I had enjoyed working in various research, communications, and case management positions in her time at Tufts. These engagements have led my pursuit of an independent research topic through the Laidlaw Undergraduate Research and Leadership Program at Tufts University. I collaborate/mentor with Diana Chigas on my project entitled "The Coloniality of Humanitarian Aid: Sexual and Gender-Based Violence in Refugee Camps". Outside of Laidlaw Scholars, I am currently serving as the President of the Minority Association of Pre-Health Students (MAPS) and spent the fall semester of my Junior year studying abroad in Ghana.

ABSTRACT. Sarah Markos. ***Coloniality of Humanitarian Aid: Sexual and Gender-Based Violence in Refugee Camps.*** Humanitarian aid workers perpetrate sexual and gender-based violence (SGBV) against refugees, yet aid agencies still have broad, poorly implemented protocol in place that does not support refugees in these situations. In this paper, the lack of effective systems that hold aid workers accountable for perpetrating SGBV is related back to the colonial roots of humanitarian aid. Dismantling systems that thrive off the exploitation of refugee communities begins with making the connection between SGBV and colonization. Throughout history, there are examples of the connection between colonization, political conflict, wars, and sexual violence, and these connections should be applied to the discourse surrounding SGBV in humanitarian situations. Challenging the humanitarian system as it relates to SGBV in refugee camps begins with questioning its representation of refugees. This paper challenges the generalization of refugees by understanding the historical context and political motives of entities that disseminate knowledge regarding refugee affairs. An exploration of the historical, socio-political, and cultural dynamics of the term refugee illuminates the many contradictions within the term refugee itself. The coloniality of contemporary refugee regime and media portrayal of the "refugee crisis" can in part be understood in relation to international refugee law, thus in this paper legal definitions of "refugee" will be explored. This paper also focuses specifically on refugee camp settings and examines who has authority within this space. This will include an exploration of refugee camp conditions and the power dynamics between aid workers and refugees.

DIANA CHIGAS is Professor of the practice of international negotiation and conflict resolution at The Fletcher School of Law and Diplomacy and also serves as senior international officer and associate provost at Tufts University. As senior international officer, I am also responsible for leading the development and realization of a university-wide global strategy. Prior to joining the Provost's office, I was also Director of the Reflecting on Peace Practice Program and Co-Director of Collaborative Learning at CDA, a non-governmental organization dedicated to working with development, humanitarian and peacebuilding practitioners, as well as the private sector, to improve the effectiveness of international assistance in fragile and conflict-affected contexts. At CDA, I focused on systemic approaches to conflict analysis, the role and impact of the private sector in peacebuilding, strategic planning, reflection and evaluation to improve the impact of peace programming. I was a contributor to the 2012 OECD DAC guidelines on evaluation of conflict prevention and peacebuilding, and to guidance for DFID on evaluation of peacebuilding and conflict sensitivity. I have over twenty-five years of experience as a facilitator and consultant in negotiation and conflict resolution. My work has included the development of strategies, training and advice on preventive diplomacy in the OSCE, training for the United Nations and several regional organizations, "track two" dialogue in El Salvador, in South Africa, Ecuador and Peru and in the Georgia/South Ossetia peace process, and facilitation of inter-ethnic dialogue in Cyprus. My current research interests include cumulative impacts of peacebuilding and understanding the dynamics of corruption in conflict-affected and fragile contexts in order to develop more effective anti-corruption programming. Through the Institute for Human Security at the Fletcher School, I currently co-lead with Cheyanne Scharbatke-Church research in Uganda, DR Congo and Central African Republic on corruption in the criminal justice sector and its relationship to state legitimacy. I became a Laidlaw mentor in 2018 to Sarah Markos.

KATIE MCMURPHY (2019-2021). My experience with Laidlaw so far has been exciting and multifaceted. I have been afforded the opportunity to travel to Accra, Ghana this summer to work with local infant food producers and professionals in the fields of nutrition and food quality. These meetings ranged from small business owners and employees to university professors and FDA department heads. My mentors, **Charles Mace** from the Department of Chemistry and **Will Masters** from the Friedman School of Nutrition Science and Policy, have been extremely helpful in preparing me for my trip. They advised me on how to get contacts in the area and how to conduct productive interviews. I've gotten a lot of meaningful support from both of them throughout this summer, and I am excited to continue working with them next summer. At Tufts, I'm entering my junior year as a double major in Biology and Child Study and Human Development. For two years I've worked on the RISE Project, a research initiative focusing on science learning and home-school

collaboration in Head Start preschool classrooms. This semester I will be doing an internship with a doctor at the Tufts Mother Infant Research Institute focusing on feeding challenges of newborn infants. Outside of academics, my interests include piano and watercolor painting. I'm also a member of the Tufts Quidditch team, which has been a challenging and rewarding activity. In the spring I will be attending the Tufts in Madrid study abroad program, where I hope to develop my Spanish language skills and travel a bit around Europe.



PHILIP MILJANIC (2019-2021). I am majoring in Chemical Engineering and Computer Science as a member of the class of 2021 at Tufts University. I joined the Laidlaw program in my junior year of undergraduate at Tufts as it gave me the opportunity to continue my ongoing research in the Mace Lab. The Mace Lab is an analytical chemistry lab run by **Charles Mace** focused on the development of paper-based microfluidic devices, concentrated on cost effective and accessible healthcare diagnostics. I became a member of the Mace Lab in my freshman year of undergraduate, in part due to my previous research experience interning with a USDA turf lab. My research project seeks to improve the design and manufacturing process of whole blood and plasma storage devices. The project is currently focused on a prolonged study comparing devices currently used to the wax-patterned devices designed in the Mace Lab. Additionally, we are looking for new and better ways to pattern and align these paper devices as traditional methods are no longer viable. On a more personal note, I grew up in the suburbs of DC in a family of six. I enjoy running, skiing, and spend most my time with music playing. As for hobbies, I took up fish keeping in high school and have found it to be great fun. When asked where I

might be in five years, I answer that I hope to be working at the intersection of computational modeling and chemical engineering in the energy industry.

Device Design and Manufacturing of Patterned Dried Blood Spot Cards (pDBS)

Philip R. Miljanic, Keith R. Baillargeon, Daniel J. Wilson, Jessica C. Brooks, and Charles R. Mace

Tufts University, Department of Chemistry, 62 Talbot Avenue, Medford, MA 02155

Abstract

Diagnostic assays are a critical component of health management. Informed treatment decisions rely on the sensitive and specific detection of biomarkers or the quantification of changes in the concentration of a biomarker. In limited-resource settings, healthcare workers lack the proper infrastructure or support to perform many of these vital assays, making diagnoses based on physiological symptoms alone. There is an outstanding need for new technologies that are designed specifically to address the challenges associated with healthcare in limited-resource settings. Paper-based devices offer an attractive option for the development of assays for use at the point-of-care, where speed and ease of use are prioritized over quantification [1].

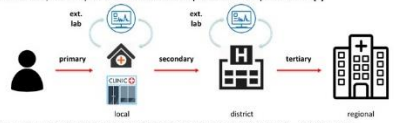


Figure 1. Delocalized healthcare systems add expense, time, frustration, and confusion.

Problem

A delocalized approach is incompatible with the issues that face limited-resource settings, where diagnostic information is needed immediately at the point-of-care. Developed economies have the advantage of centralized healthcare establishments, reliable infrastructure, and well-trained medical staff. By comparison, limited-resource areas are restricted by a lack of funds, unreliable systems, and community health workers, along with difficult patient follow-up. In addition to the highlighted contrast in circumstances, there is also a need for immediate healthcare in emergency situations, first aid kits, and battlefields. Point-of-care technologies have been developed to address the need for rapid, affordable, and operationally simple diagnostics.

Beyond the initial development of these technologies, there is a need to establish methods for large-scale manufacturing [2]. Specifically focusing on maintaining low associated cost and ensuring reproducible lots of devices. Traditional methods for rapidly prototyping paper-based devices by patterning with wax printers is not a viable method for manufacturing as wax printers have been discontinued by larger companies. Additionally, the hydrophobic wax barriers are not compatible with organic reagents and various surfactants typically used in clinical assays (e.g., sodium dodecyl sulfate). Identifying a hydrophobic material that can be used to pattern paper-based devices with adequate resolution that is amenable to large-scale manufacturing would allow for these technologies to be commercialized. Another critical component to this process is the assembly of these devices using semi-automated methods. Currently, these devices are aligned and assembled manually (i.e., by eye). Removing lot-to-lot variability through the use of alignment jigs could address this concern.

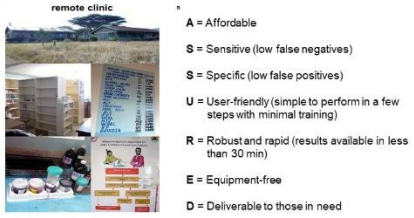


Figure 2. (A) Clinical instrumentation, requires trained personnel and is prohibitively expensive for limited-resource settings. Clinics exist in an attempt to meet that need, but fall short due to a lack of support. (B)The World Health Organization established criteria for the development of point-of-care technologies appropriate for remote clinics with limited resources and volunteer workers.

Approach

Paper-based devices represent a potential solution for the issues related to current point-of-care devices as they are inexpensive, easy-to-use, disposable, and require no advanced training. Paper-based microfluidic devices can successfully incorporate liquid handling, reagent storage, and signal transduction within a singular device, enabling complex measurements without sacrificing performance. We designed our pDBS cards in Adobe Illustrator and patterned hydrophobic wax barriers using a Xerox ColorQube 8570 printer [3]. Since TFN chromatography paper is thick (470 µm), we pattern a layer of wax on both sides using laminate transfer sheets. Following the deposition of wax, the front and back designs are aligned and the wax is heated using a Promoheat T-shirt press at 138° C for 45 seconds.

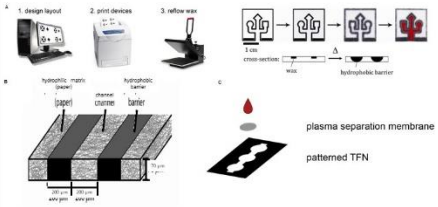


Figure 3. (A) Workflow for patterning paper using simple established methods. (B) Patterned paper with hydrophobic wax barriers. (C) Layer map for a plasma storage device.

Manufacturing Devices

As traditional methods for patterning are becoming unavailable, screen-printing is being explored as a possible replacement. To form barriers through the paper, a hydrophobic substance must be applied through the screen and permeate the paper. Carnauba wax is a natural wax found in Brazil that is well suited to patterning paper due to its relatively high melting point (82°C) and ability to self-emulsify in alcohols (e.g., ethanol and isopropyl alcohol). Alcohol emulsions are favorable as they dry much faster than water and are fairly inexpensive. Unfortunately, these emulsions quickly settle which can lead to inconsistent manufacturing success. Due to the larger particle size of the wax emulsions, patterning devices requires a heat source to melt the wax through the paper, similar to traditional wax patterning. Remaining challenges include (i) improving the resolution of the design by limiting undesired spreading of the wax and (ii) the alignment of layers when creating more complicated devices.

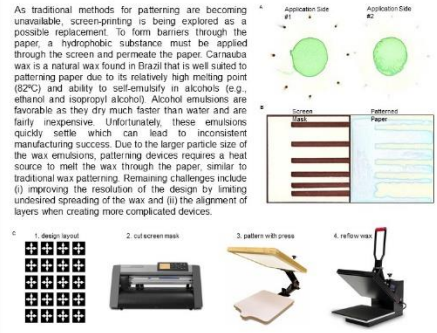


Figure 4. (A) Carnauba wax patterning showing the formation of a solid hydrophobic barrier in a two step application. (B) An initial attempt to quantify the resolution of the patterning process. (C) Workflow for patterning paper using a non-traditional screen printing approach.

Whole Blood Storage

Assays that detect and quantify biomarkers in blood rely on the viability, and therefore storage, of the sample. We investigated the use of our paper platform to improve upon existing whole-blood storage devices, introducing volume control and distinct sample collection zones. Patterning TFN grade chromatography paper using a wax printer allowed an increased number of sample collection zones in comparison to unpatterned paper. The concern of sample stability in our devices has pushed for the evaluation of several biomarkers over an extended period. Initial evaluation of sodium concentration found in blood—an essential mineral for nerve and muscle function—when eluting from the punched pucks was successfully contrasted with respective liquid samples.

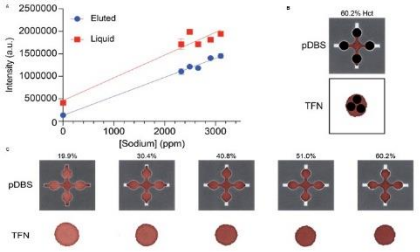


Figure 5. (A) Calibration of liquid and eluted blood samples over a range of sodium concentration values. (B) Scan demonstrating the improvement made upon the whole blood storage device. (C) Scan of comparison between patterned whole blood storage device and unpatterned TFN over a hematocrit range (19.9 – 60.2%).

Conclusions

Paper is an exciting alternative to current approaches for diagnostics at the point-of-care. We have developed a patterned paper-based device that stores whole blood with improved volume control independent of hematocrit over a physiological range (20–60% Hct). Additionally, we have innovated the manufacturing process of these paper-based devices using carnauba wax-alcohol emulsions. With this, we are attempting to establish better manufacturing practices to ensure more accurate alignment both in the patterning and layering of devices.

Future Work

We plan to evaluate the stability of blood samples during storage over eight weeks in our patterned, paper-based device. This study will incorporate assays to evaluate hemoglobin, sodium, and amino acid concentrations over time. We also plan to incorporate active sensing and distance-based measurements into our pDBS card to provide additional health information including blood typing.

While carnauba wax has been used to pattern paper successfully, a wax with a lower boiling point (e.g., beeswax or sunflower wax) may form a more stable emulsion and thus be better suited for patterning paper-based devices. Additionally, adjusting mesh and particle size can be done to provide for a more consistent design. Finally, decreasing variability in manufacturing using alignment jigs has the potential to improve device success rate.

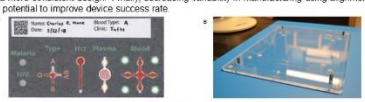


Figure 6. (A) A suite of tests on a singular device would be able to provide patients with a range of information. (B) An acrylic jig offers an affordable means of better alignment.

References

[1] S. Smith, et al. *RSC Adv.*, 2018, 59, 33574-34181
[2] S. Fernandes, et al. *J. Vis. Exp.*, 2017, 121, e55287
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Tufts

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CHARLES MACE. I earned my BS in Physics from Le Moyne College in 2003, followed by an MS (2006) and PhD (2008) in Biophysics from the University of Rochester in the laboratory of Prof. Benjamin Miller. I was then a postdoctoral research assistant in the laboratory of Prof. George Whitesides in the Department of Chemistry and Chemical Biology at Harvard University from 2008–2011. Prior to joining the faculty at Tufts in 2013, I was a senior scientist at Diagnostics for All where he led programs to develop point-of-care diagnostics for limited resource settings. The Mace Lab at Tufts focuses on creating low-cost and user-friendly devices that can process, stabilize, and analyze blood in order to reduce disparities in global healthcare. In 2019, I was a recipient of a Faculty Early Career Development Award from the NSF and was named an Analytical Methods Emerging Investigator. I joined the Laidlaw Foundation as a faculty co-mentor to Katie McMurphy and Philip Miljanic in 2019.

WILL MASTERS. I am a Professor at Tufts University, in the Friedman School of Nutrition with a secondary appointment in the Department of Economics. My research concerns the role of incentives and interventions to improve agriculture, food and nutrition, focusing on diet quality especially for children. My work as a Co-Mentor with **Katie McMurphy**, 2019 Laidlaw Scholar, builds on a partnership with analytical chemist Charlie Mace aimed at developing low-cost tests for quality assurance of infant cereals, building on past research such as Nutrient composition of premixed and packaged complementary foods for sale in low- and middle-income countries: Lack of standards threatens infant growth. His most recent paper is First Foods: Diet Quality Among Infants Aged 6–23 Months in 42 Countries, in the journal *Food Policy.* Other recent publications include "Measuring the affordability of nutritious diets in Africa", "Agricultural transformation, food policy and the nutrition transition in Africa", and "Climatic conditions and child height" as well as an undergraduate textbook co-authored with George Norton and Jeff Alwang, *Economics of Agricultural Development: World Food Systems and Resource Use* (Routledge, 3rd ed. 2014). From 2006 through 2011 he edited *Agricultural Economics*, the journal of the International Association of Agricultural Economists. In 2010 I was named an International Fellow of the African Association of Agricultural Economists and have won AAEA awards for Quality of Research Discovery (2019), Publication of Enduring Quality (2014), and the Bruce Gardner Memorial Prize for Applied Policy Analysis (2013). Details online at: http://sites.tufts.edu/willmasters.

ALEKYA MENTA (2019-2021). I am a rising Junior at Tufts University planning to graduate in 2021. I am studying Biopsychology, with a minor in Cognitive and Brain Sciences. I became a Laidlaw Scholar in 2019, joining the second cohort of students pursuing individual research projects. I applied to be a Laidlaw scholar because I was excited by the prospect of taking initiative and leadership on my own project and getting involved with each step. I was eager to work closely with faculty mentors on campus and connect with my peers also doing research over the summer in a variety of different departments and fields on campus. My project is titled, "A Community-Based Exercise Intervention for Older Adults with Motoric Cognitive Risk Syndrome". My mentor is **Dr. Nathan Ward,** who is the Principal Investigator of the Tufts Applied Cognition Lab, where we study multitasking and attention. The highlight of my project was being able to learn how to do data analysis with new software I have never used before. The lowlight was not knowing exactly how to do that in the beginning and struggling with learning new technology. I have not studied abroad during my time at Tufts but hope to do so next summer. I am from Orange, Connecticut (a town outside of New Haven, home to the best ranked pizza in the United States!) My internship during my time at Tufts has also been with the Tufts Applied Cognition Lab, where I have been a research assistant since the spring of my first year. I also had a summer internship in 2018 at the Haskins Laboratories in New Haven, which studies the science of the spoken and written word- I tried my hand at some psycholinguistics research for a bit! I have been fortunate enough to have traveled to many different places, but the coolest have been Cancún, Switzerland, and Puerto Rico. A big hobby of mine is dancing! I love all kinds of dance, but I've been classically trained in Indian dance for most of my life. Looking forward, in five years, I will hopefully be studying in medical school, and ideally still pursuing research on the side! Words of advice to future scholars would be to accept the fact that you won't know everything that's going on, and that it is okay to ask for help or clarification from your mentors – they won't know how to help unless you tell them. I have learned a great deal also by leaning on my peers for support and talking to others in my lab, so I also would recommend doing so.

A Community-Based Exercise Intervention for Older Adults with Motoric Cognitive Risk Syndrome

Alekya Menta[1], Dr. Nathan Ward[1], Kell Grandjean da Costa[1], Eduardo Fontes[1], Ginny Ulichney[1]
[1]Tufts University

INTRODUCTION

- Older adults are often at risk for cognitive decline, and it has been shown that there is a critical need for intervention plans to maintain cognitive function in older adults.
- Adults with MCR (motoric cognitive risk syndrome) tend to have slow gait and lesser cognitive functions. MCR has been shown to be a pre indicator of early onset dementia.
- Exercise has been shown to improve cognitive function as well, and this study aims to determine the extent to this effect and the effect of a community based approach.
- Through this study, we hope to understand and characterize the effects of a community based intervention on the mobility of these adults affected with MCR.
- Measuring their cognitive function with fNIRS will show differences in activity over the six month intervention and also across participants. fNIRS will show us brain cortical activity by measuring changes in blood oxygen levels in the brain during exercise.
- fNIRS technology works with neurovascular coupling and the hemodynamic response.
- fNIRS technology is more precise than EEG and can be used while the subject is moving, but doesn't give as much detail as fMRI.
- Hypotheses of this study: We are hoping to isolate cortical activity associated with cognitive function during exercise.
  1. Does exercise change oxygenation in the brain?
  2. Does this relate to cognitive tests/any cognitive improvements?
     - Do people who increase oxygenation perform better on cognitive tests?

METHOD

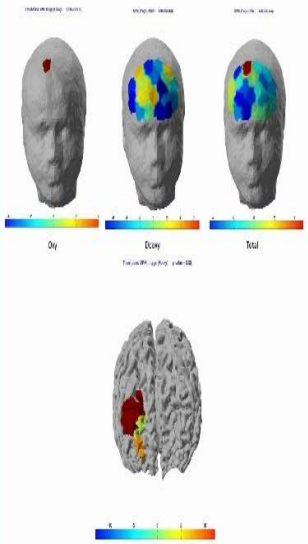
- This study will include about 30 participants in total. All participants are over the age of 55 and at risk for MCR.
- All participants will go through a screening process that includes a physical and cognitive test to ensure they are at risk for MCR.
- Once approved to participate in the study, they will be placed in one of two six month long interventions- either an exercise intervention program, or the active control of a nutritional counseling program.
- Each visit will include fNIRS testing on a stationary bike, as well as a 22 minute battery of cognitive testing.

An exercise-based intervention plan has been shown to **increase neural activity** in the brain of older adults with MCR.

Poster template: https://osf.io/ayjzg/

smithar3@appstate.edu

RESULTS



- These result support our first hypothesis, showing how the "hot" and "cold" activation spots are in areas of the brain that were more active during exercise.
- These spots show areas of significant change between the baseline and exercise of one participant, where we can see that it increased the amount of oxyhemoglobin and decreased the amount of deoxyhemoglobin.

DISCUSSION

- Though all participants have not been run and all data analysis has not been completed, we can see primary results of how neural activation could be changed in the brain of the older adults during exercise when compared to their baseline.

GINNY ULICHNEY (2018-2020). I am a senior from Villanova, Pennsylvania graduating in Spring 2020. At Tufts, I am majoring in International Relations (focused on global health, nutrition and the environment), Spanish and Psychology. Apart from classes and research, I love spending time outside, hiking, fitness, and cooking vegetarian food, and I worked as a personal trainer the summer before starting research. I just got back from a semester abroad in Madrid, and my favorite place I traveled to while abroad was Granada. I became a Laidlaw Scholar in the summer of 2018 and applied to be a Laidlaw Scholar in order to pursue cognitive-motor dual-tasking research that I had become interested in and had discussed with Professor Ward while taking his Multitasking seminar. The title of my project is "The specificity of cognitive interference in cognitive-motor dual-tasking paradigms through the lifespan" and my mentor is Dr. Nate Ward. I did my project in Dr. Nathan Ward's lab, the Tufts Applied Cognition Lab. The highlight of my Laidlaw research has been the opportunity to be involved in psychology research through the entire development of a study, from initial literature review and study design to data collection to data analysis and write-up. It is an incredibly valuable experience to have the ability to be so involved in research this way as an undergraduate and to be able to contribute to the field I am passionate about. My Laidlaw research has not yet been published but it will be submitted to a variety of journals this coming Fall for publication. I am writing my senior honors thesis on my Laidlaw research.

ABSTRACT. GINNY ULICHNEY ***The Specificity of Cognitive Interference in Cognitive-Motor Dual-Tasking Through the Lifespan***. Standing upright is a challenging task involving attentional control and the addition of a secondary cognitive task creates dual-task costs. These costs become more dramatic with age, leading to an increase in dangerous and costly fall-risk. The objective of the current study was to determine the specificity of cognitive interference in costs resulting from cognitive-motor dual-tasking scenarios and whether results varied in older adults. Data was collected from 93 participants (60 younger adults ages 18-35, 33 older adults over age 65). Mobility tasks included standing upright for up to 2 minutes at a time on a firm (stable) or foam (unstable) surface. Motion sensors tracked postural sway through measuring amplitude, sway area, and overall/coronal/sagittal mean velocity. Cognitive tasks included a speed-of-processing task and three executive function tasks: the Stroop test, task-switching test, and the dual N-Back test. Cognitive measures were accuracy and response time and were measured through software on an iPad. Participants completed mobility baseline tasks and each of the four cognitive tasks on both mobility surfaces, followed by surveys to account for established possible confounds. Data processing pipelines have been finalized and results will be forthcoming.

<Psychology Dept., Tufts University, Applied Cognition Lab>

The Specificity of Cognitive Interference in Cognitive-Motor Dual-Tasking Paradigms through the Lifespan

Virginia Ulichney, Tufts University, Laidlaw Scholar; Dr. Nathan Ward Ph.D., Tufts University, Laidlaw Mentor

Background

Standing upright is a challenging task itself[1] requiring constant control.[2] Age impairs balance control.[3] Executive functions, similar but clearly separable attentional tools, may govern attention required to control balance during complex mobility tasks.[4, 5] Executive functions are divided into mental set shifting ("shifting"), information updating ("updating"), and inhibition of unnecessary responses ("inhibiting").[6] Executive functions can be isolated in a laboratory setting.[7, 8, 9, 10]

Simultaneous cognitive and mobility tasks create cognitive-motor dual-tasking. Cognitive-motor dual-tasking affects performance in both tasks,[7, 11] called the "dual-tasking effect". Dual-tasking effects can be magnified in challenging mobility settings and are greater with age causing increased fall-risk.[12, 13, 14] Awareness of fall-risk is important: falls are the main cause of injury-related death in older adults, and medical care bills for falls totaled $19.5 billion in 2000 alone.[15]

It has been established that cognitive-motor dual-tasking interference exists, older adults suffer greater performance costs in cognitive-motor dual-task paradigms relative to younger adults, and that costs can be dangerous by increasing fall-risk. The specificity of cognitive interference increasing dual-task costs during cognitive-motor dual-tasking is yet unknown.

Research Objectives

1. Determine specificity of cognitive task interference with mobility
   1. We predict that balance performance in both demographics would be impacted by a secondary, cognitive task regardless of the properties of that task.
      A. Balance performance in both demographics will be selectively impacted by executive function tasks compared to a speed-of-processing task, and that balance would be more variable on unstable ground than firm ground.
      B. An interaction will exist between these factors such that cognitive tasks will have the most impact on balance in the unstable ground condition.
2. Determine whether any dual-task effects are varied in older adults compared to younger adults
   a. We predict that older adults would have more pronounced results than younger adults
      A. Cognitive performance will be worse in both dual-tasking conditions.
      B. Postural sway will be greater than younger adults in executive function tasks.[17]
3. The study uses executive function tasks that have not been tested all at once and on the same standing participant in combination with postural sway, nor in a way in which these results can be compared across ages.

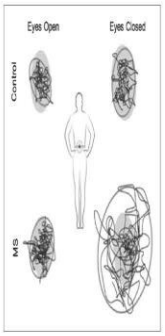
Methods

Subjects

- Participants: 60 healthy younger adults and 33 healthy older adults came to a total of 93 participants. 18 participants were excluded post-data collection. Of the 75 remaining subjects, 21 were male, 53 were female, and 1 did not report gender. Younger adult ages were 18-35 (mean= 22.83), older adult ages were over 65 years old (mean= 74.27).

Postural Sway and Cognitive Measurement

- Mobility Data (Postural Sway)
  - Materials: Six wearable APDM sensors, a compatible HP Laptop, 2.5" thick foam
  - Measures: Amplitude, sway area, and overall/coronal/sagittal mean velocity
- Cognitive Data
  - Materials: Brain Baseline Lab software administered via an iPad
  - Tasks: A Stroop test measures inhibition,[8] a dual-N-back test measures updating,[10] task-switching measures shifting,[10] and a reaction task measures processing speed.
  - Measures: Accuracy, response time



Procedure

1. Baseline postural sway measurements were taken as participants stood on a foam (unstable) and a firm surface for one minute each.
2. Subjects' postural sway measurements were collected while completing each of the 4 cognitive assessments once in each mobility condition. Practice* was mandatory on all trials.
3. Participants repeated the baseline postural sway task to gauge fatigue effects.
4. Participants completed a series of surveys in order to account for possible factors in their results: the ABC, a Falls Incidence survey, a modified Mobile Device Proficiency questionnaire, a Body Mass Index questionnaire, and an employment questionnaire.[20, 21, 22, 23]
   1. Older adult subjects additionally completed a modified MoCA, the Godin Leisure survey and a Geriatric Depression Scale.[24, 25, 26, 27, 28]
5. Participants were compensated for their participation and thanked for their time.

*More rest was given to older adult subjects to prevent fatigue and prevent injury[19]

Results

A data analysis pipeline is being created through R-studio. All possible patterns of results are meaningful.

- If balance performance is hurt when performing any secondary cognitive task, existing findings on dual-task costs will be supported. If a secondary cognitive task enhances or shows no impact to balance, secondary tasks may not consistently hurt mobility.
- If balance performance is more impacted by executive function tasks than the speed-of-processing task, postural control may be closely related to executive function. If balance performance is equally impacted by all cognitive tasks, executive functions may not play a large role in postural control. If balance performance is more impacted by the speed-of-processing task, postural control may be related to processing speed.
- If balance is more variable on unstable ground than firm ground, ground stability is important in balance control. If ground stability has no significant impact to balance, ground stability may not greatly impact balance control. If balance improves on an unstable surface, management of multiple attentional demands may activate balance.
- If older adults have more pronounced results and display greater dual-task costs than younger adults, existing findings on age and dual-task costs will be supported. If older adults display similar or reduced dual-task costs, they may better be able to activate attention in dual-tasking situations or the nature of dual-tasking may change with age.

Limitations

- Lack of a cognitive baseline with which to compare cognitive performance. Cognitive performance results are relative.
- Potential lack of technology proficiency as a limitation for older adults interacting with visual cognitive tasks on an iPad
- Mobility manipulation may be insufficient and fail to to induce unfamiliarity; rather mobility manipulation may more closely mimic real-life.

Conclusions

Future directions in determination of the specificity of cognitive interference in cognitive-motor dual-tasking are great and incredibly important. A better understanding of the workings of cognitive-motor dual-tasking might raise awareness of potentially dangerous situations that people might be putting ourselves in daily and that might be compromising attentional function. The results have even greater implications for healthy older adults and even more so for demographics suffering from cognitive or vestibular limitations. Understanding of the specificity of cognitive-motor dual-tasking might allow us to avoid and prevent dangerous dual-tasking situations.

1. Winter et al. (1990) Gait & Pos 3:193-214. 2. Shumway-Cook et al. (2000) Jour. of Gerontology 55:10-6. 3. Abdollahi et al. (2008) Physio. Res. 57:957-64-4. Takakusaki et al. (2017) Jour. Mov. Dis. 10 (1):1-17. 5. Rodriguez-Jiménez et al. (2009) Ir. Medpha et al. (2000) Cog. Psych. 41: 49-100 7. Woollacott et al. (2016) Neurosci. 318:166-177 8. Barra et al. (2006) Exp. Brain Research 174 (4):734-745 9. Redfern et al. (2009) Jour. of Geron. 64 (3) 369-76 10. Salminen et al. (2012) Front. Human Neuro. 6:1-14 11. Andersson et al. (2002) Brain Research Bul. 59:135-139 12. de Souza Fortaleza et al. (2017) Gait & Pos. 56:76-81 13. Sia et al. (2007) Gait & Pos 25:101-126 14. Bergamin et al. (2014) Front. in Aging Neuro. 6:1-7 15. Da Pasquale et al. (2003) Neuro. Clin. 33:213-220 16. Stevens et al. (2005) MSC 36: 489-411 17. Beurskens et al. (2017) PLoS ONE 12:1-15 18. Van Bastian et al. (2017) Jour. of Exp. Psych. 146 (9):1266-1285 19. Hankey et al. (2011) Clin. Interventions in Aging 6:19-25 20. Roguelli Bort (2018) Jour. Applied Geron. 37:131-136 21. Powell & Myers (2015) Jour. of Geron. 50:28-34 22. Rodriguez-Aldhenn et al. (2017) PLoS ONE 12:1-12 23. Cohen et al. (2015) Stroke 46 (6):1099-1104 24. Sheikh et al. (2001) Clin. Geron. 5(1):2 25. Rosenberg et al. (2013) Archives of Phys. Med & Rehab. 94:731-6 26. Godin et al. (1997) Med. Sci. in Sports Med. 27. Weig et al. (2015) Stroke 46:1079-1084 28. Blanton et al. (2016) Gait & Posture 46:26-29 29. Yardley et al. (2001) Jour. of Neuro & Psych. 71:48-52 30. Gero et al. (2010) Jt. Lee et al. (2012) Computers in H. Behavior 28:1934-1946

NATHAN WARD. My research is focused on understanding and improving the ability to manage multiple streams of information (i.e., multitasking) both in the lab and in real-world settings. My work aims to unpack the cognitive mechanisms that support multitasking, such as task switching and dual tasking, as well as to understand whether these and other mechanisms are differentially engaged across the lifespan. To this end, I use several approaches, ranging from simulated environments to speeded response times, in order to assess real-time multitasking performance in younger and older adults, which is part of the research he is conducting with Laidlaw Scholars **Ginny Ulichney** (right) and **Alekya Menta** (left).

SERRA MUFTU (2019-2021). I am from Brookline, Massachusetts. I am in the second cohort of the Laidlaw Scholars, and I am in the class of 2021 at Tufts University. I am a biology major and I am considering adding biotechnology as a second major. I have been doing research in the **Mitch McVey** Lab since May 2018 and I am doing my Laidlaw project in the lab this summer and the summer of 2020. I applied to be a Laidlaw Scholar because another student in my lab had a really positive experience in my first year. The leadership component of Laidlaw was also appealing to me because developing my leadership skills, even if research isn't a stereotypical leadership environment, is important to me. The McVey lab uses *Drosophila Melanogaster* as a model for studying DNA damage and repair mechanisms. More specifically, the assay I use studies a specific DNA repair pathway, homologous recombination, and its potential role in facilitating expansion of CAG repeats in the genome. Trinucleotide repeats exist naturally in an organism's genome. However, at certain length dependent thresholds, these repeats can cause diseases such as Huntington's disease and Spinocerebellar Ataxia. I am also beginning another project investigating the protein Poldip2 (Polymerase delta interacting protein 2) and its potential role in recruiting and switching polymerases in *Drosophila Melanogaster* DNA repair. Poldip2 has shown to interact with polymerase delta, as well as having other roles in oxidative stress, vascularization, and mitochondrial functions. Laidlaw has given me the opportunity to continue researching over the summer which has been fulfilling to pursue an independent project. My advice to future Laidlaw scholars would be allow the summer time to dig deeply into your project, read a lot, and enjoy yourself. Other campus activities that I am involved in is Peer Health Exchange and volunteering at Brigham and Women's hospital. In my free time I enjoy running, reading books outside, and baking with friends.

The Effect of CAG Trinucleotide Repeats on DNA Double Strand Break Repair in *Drosophila Melanogaster*

Serra Muftu, Keya Viswanathan, Mitch McVey

Background

CAG trinucleotide repeats (TNRs) in the genome can cause a host of diseases including Spinocerebellar Ataxias and Huntington's Disease. Depending on where the repeats lie in the DNA, they can cause gene expression issues if they are in the promoter, or RNA and protein toxicity issues if they are located in the coding sequence of DNA. Huntington's disease is a neurodegenerative condition where one's nerve cells in the brain undergo apoptosis over a long period of time. Huntington's disease is caused by CAG trinucleotide repeats in the exon of the HTT gene. Healthy individuals have CAG trinucleotide repeats, however Huntington's disease and other TNR disorders have a length dependence threshold that results in a disease phenotype. Our overall goal in this project is to explore how homologous recombination (HR), a double stranded break repair mechanism, can promote genomic instability during repair of TNRs, and therefore result in expansions of CAG and CTG repeats that promote disease phenotypes observed in Huntington's disease. We have created an assay to investigate how can affect how homologous recombination can facilitate genomic instability in the context of CAG trinucleotide repeats in *Drosophila*.

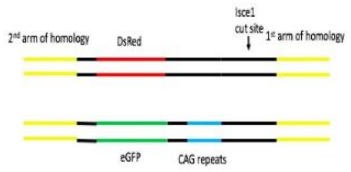
Research Objectives

The research objective of this project is to use a phenotypic fluorescent scoring assay to measure homologous recombination repair events of an induced double stranded break using an endonuclease. Homologous recombination is a homology directed repair event that repairs double stranded breaks by using the homologous sister chromatid or chromosome as a template to repair across the break. There is a tendency of single stranded DNA containing repeats to anneal to itself and form hairpins, a secondary structure, in the DNA. Depending if the secondary structure forms on the leading or lagging strand, it can result in a contraction, or an expansion of the DNA sequence, respectively. When DNA hairpins form and result in repeat expansions in gametes, the allelic DNA sequence is passed onto the progeny. By isolating homologous recombination repair events by fluorescence and analyzing them via PCR, we can quantify how HR facilitates instability of CAG trinucleotide repeats.

Methods

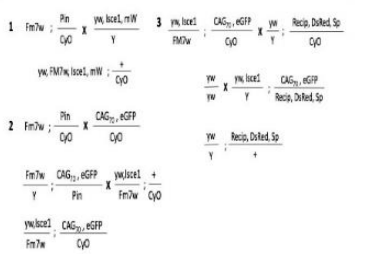
The *Drosophila* used in this experiment were created by microinjecting flies with a constructed DNA sequence. A backbone, PBJ027 created by Jane Blackner, had the IsceI cut site, arms of homology, and fluorescent markers within it. The CAG repeats were then inserted into the backbone using cloning methods. The construct was made so the different repair events (NHEJ, MMEJ, and SDSA) could be visualized through fluorescent markers. It was also constructed to bias the system towards HR mechanisms. The two arms of homology in the construct facilitate HR because of its homology dependent strand invasion process. The recipient chromosome has a red fluorescent marker, DsRed and the IsceI cut site. The donor chromosome has a green fluorescent marker, eGFP and the CAG repeats. As seen in figure 1, a genetic cross occurs so that a single fly has both the donor and the recipient constructs on their 2nd chromosomes. If NHEJ occurs, ligase 4 ligates the two ends of the DSB and a red fluorescence is visible under a fluorescent scope. If MMEJ or aborted HR occurs, no fluorescence occurs. If SDSA occurs, the strand is elongated through the CAG repeats and the eGFP so a green fluorescence occurs.

Genetic Construction of PBJ027



This assay allows different DSB events to be visualized from the presence or lack of fluorescent markers (dsRed, eGFP, or neither). A HR mediated repair event moves in the direction of first arm of homology to the second. The first arm of homology is 975 base pairs (bp) long, the second arm of homology is 1005 bps, eGFP is 720 bps, dsRed is approximately 1kb, and CAG70 is 210 bp. ong.

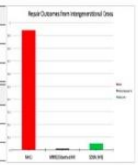
Genetic Cross Scheme for Intergenerational Cross to Observe Genetic Instability Caused by CAG Repeats



Cross 1 fly progeny have the IsceI endonuclease gene on the first chromosome balanced over FM7w which prevents recombination and is phenotypically marked with mini white (mW) eyes and a CyO curly winged balancer on the second chromosome. Cross 2 fly progeny are crossed to cross 1 progeny to create flies with the endonuclease, the CAG/CTG trinucleotide repeat sequence, and eGFP as a fluorescent phenotypic indication of the repeats. Cross 3 progeny are mated with cross 2 progeny to create flies with the recipient chromosome, marked by DsRed as a fluorescent phenotypic indication. In these male flies the repair event outcomes are scored using a fluorescent microscope.

Repair Events Indicated in Flies Scored by Fluorescent Markers

Phenotype	Type of DSB Repair Event
dsRed+/GFP-	c-NHEJ
dsRed-/GFP-	MMEJ/aborted HR
dsRed-/GFP+	SDSA (type of HR)
Repair Outcome	**Percentage**
NHEJ	94%
MMEJ/incomplete SDSA (HR)	1%
Complete SDSA (HR)	5%



These are the results of the intergenerational assay where individual flies were scores based off of the fluorescent markers they displayed. Red indicates c-NHEJ (94%), green indicates SDSA (5%), and neither indicated MMEJ/aborted HR (1%).

Results

As seen in table 1, 94% of the repair events were NHEJ, 1% were MMEJ/aborted HR, and 5% were SDSA. The overwhelming majority of repair events being NHEJ was unexpected. The percentage of NHEJ events should be around 70% according to other literature so the 94% NHEJ was higher than expected (Engels). This experiment needed to be redone to be able to gather more statistically significant data on HR. With more HR events, the presence or absence of changes in CAG repeat length can be observed. This was on an intra sister chromatic assay rather than an intrachromosomal assay, however 94% was still a surprising outcome.

Conclusions

The hypothesis that there will be less dsRed *Drosophila*, indicating that there is less NHEJ, is going to be tested. If TEJ events are upregulated, we will explore the effects of the HR pathway on genomic instability during DSB repair. In the future to facilitate more instability, we will clone longer repeats into the next iteration of this assay. The longer sequences are more likely to form larger and more frequent secondary structures that can lead to expansions and contractions of the CAG repeat sequence. In the current construct, the site where the endonuclease (IsceI) induces a double stranded break is about 220 nucleotides away from an area of homology. These areas of homology are crucial to the HR mechanism. This distance may not be energetically favorable or possible for HR to repair the break. Therefore, when reckoning this plasmid the cut site is going to be moved about 15 nucleotides away from the area of homology. Eventually, the mechanisms of what genetic factors facilitate genomic instability will be studied because of their broader implications on DNA repair and diseases.

Tufts

LAIDLAW FOUNDATION

KEYA VISWANATHAN (2018-2020). I am from Bangalore, India. Currently I am a senior (Class of 2020) at Tufts University and I am a Biology and Biotechnology double major. I am part of the first cohort of the Laidlaw Scholars. I worked in the lab of **Dr. Mitch McVey** from Jan of 2018 to August of 2019. I have had a very positive experience as a Laidlaw Scholar. My Laidlaw research project was creating an assay to assess the role of DNA double strand break repair mechanisms, specifically homologous recombination, in promoting instability of CAG trinucleotide repeats. The results of this project could lead to better understanding of how diseases such as Huntington's develop. Laidlaw allowed me to not only dive deep into my project but also be exposed to so many interesting fields and research that my peers in the program are working on. On campus, I am also involved in Tufts American Society of Biochemistry and Molecular Biology and Tufts Association for South Asians. Currently, I am working in a lab at Brigham and Women's Hospital, studying Thyroid Cancer.

ABSTRACT*: "A Novel Assay to Characterize CAG Trinucleotide Repeat Expansions"*

.Trinucleotide repeats (TNR) are known to be the underlying molecular cause of over two dozen neurodegenerative disorders in humans. CAG/CTG repeats in particular are the cause Huntington's Disease and many other neurodegenerative diseases. When the number of repeats is below a certain threshold, they are not pathological. If they expand beyond this threshold, however, these repeats cause disease. There are many suggested causes of these expansions, most of them based on the fact that CAG/CTG repeats form hairpin structures. Previous studies in yeast have reported that expansion of CAG/CTG repeats can be dependent on homologous recombination. The goal of this experiment was to execute a novel assay in which a double-strand break (DSB) is created in the male germline of Drosophila melanogaster and repaired via Homologous Recombination with DNA synthesis going through CAG/CTG trinucleotide repeats. Results of the assay show most break repair events at one particular locus were end joining, with a small percentage of repair events being completed synthesis-dependent strand annealing.

MITCH MCVEY. I am currently a Professor of Biology at Tufts University. I earned my Ph.D. from the Massachusetts Institute of Technology in 2001, studying the relationship of genome instability to aging in budding yeast. I then moved to Chapel Hill, North Carolina for my postdoctoral research, where I investigated mechanisms of DNA double-strand break repair. I arrived at Tufts in 2005 and started a lab using Drosophila to investigate the ways that error-prone DNA repair can destabilize genomes. In the past decade, the Lab has demonstrated that rapidly dividing cells in fruit flies share many characteristics with cancer cells and has leveraged this discovery to identify proteins that are promising targets for cancer chemotherapies. Recently, Laidlaw Scholars **Keya Viswanathan and Serra Muftu** initiated a project in the lab to test the hypothesis that DNA recombination promotes the instability of CAG trinucleotide repeats in the

genome. Their research could elucidate a key mechanism that underlies the development of Huntington's disease and various spinocerebellar ataxias.

MACKENZIE PARMENTER (2018-2020). I am a Laidlaw Scholar from Cohort 1. I applied to be a Laidlaw Scholar because I wanted to explore my own independent research project and develop my leadership skills. I am going to be a senior this year, studying biology at Tufts University. My mentor for my Laidlaw research project is **Dr. Stephen Fuchs,** who is the principal investigator of the Fuchs Lab, which broadly studies repetitive proteins and protein function. My project uses CRISPR-Cas9 gene editing technology to study repetitive proteins and more specifically, how repeat variation affects the function of the protein. The first summer I focused on perfecting the process of making variants with the CRISPR-Cas9 vector by working with the phenotype of wrinkly colony morphology in yeast. The second summer I examined a certain repetitive region of a known prion forming protein to see if more or less repeats affect the prion forming ability under different conditions. Outside of doing biology research, I am involved in advocating for the Tufts Peer Crisis Hotline and tutoring my peers in introductory level biology classes. Apart from biology I am passionate about thrift shopping/sustainable fashion, dogs and John F. Kennedy! I went abroad the spring semester of my junior year to Copenhagen where I stayed with a Danish host family and studied medical biotechnology and drug development. In five years, I see myself in grad school studying molecular biology in preparation for a career in research!

ABSTRACT. Mackenzie Parmenter. ***Using CRISPR-CAS9 to Study Repetitive Proteins.***
Repetitive Proteins are regions that have one or several amino acids repeated more than three times. I hoped to study how variation in repeat length affects protein function. The first part of my project was to create a method using CRIPSR-Cas9 genome editing technology to create these repeat length variants and then figure out how to identify them. This included selection and then counter selection for the CRIPSR-Cas9 machinery, running phenotypic assays and then finally sequencing these mutants. This process allowed me to study two different repetitive proteins- Flo11p and Azf1p. Flo11p is a protein with a large repetitive region involved with wrinkly colony morphology. With this protein and the CRISPR-Cas9 system we could see phenotypic variation- different degrees of "wrinkliness"- but because of the size of the repetitive region and difficulty with PCR and sequencing, were unable to see if there were expansions or contractions in the region. My second target was Azf1p which is a transcription factor that has been shown to have prion-like behavior. I hope to compare growth in a drug that favors prion-like behavior with sequencing data to elucidate the relationship between repeat length variation and prion formation, but preliminary results have come back inconclusive. In the future, I hope to create a background in which I can create expansions in the region, create and test more mutants to elucidate the relationship between repeat length formation and prion formation as well as create mutants in another repetitive region in the protein to see if prion formation is affected by changes in other regions. This work creates a novel method for creating repeat length variants in the genome as well as having important implications in understanding prion biology.

PARAS PATNAIK (2019-2021). I was born and raised in Littleton, Massachusetts and my parents are originally from India. I am a biology major and a child studies and human development minor. I am also pre-med and plan on attending Tufts University School of Medicine after completing my undergraduate coursework at Tufts in 2021. My hobbies include playing the piano and the guitar, reading and playing tennis. My favorite color is green. One piece of advice I'd give to future Laidlaw scholars is to take advantage of all the resources around you, including your mentor and your fellow scholars. I became a Laidlaw Scholar in the spring of 2019. I applied to the Laidlaw Scholars program because I wanted to explore an exciting and nuanced topic while gaining the skills necessary to become a successful scientific researcher and leader. My project, Genetic Analysis of Primate Social Interactions, is primarily focused on chimpanzee paternity and the determinants of reproductive success for male chimpanzees. This project falls within the scope of both molecular biology and anthropology and I am lucky enough to have two faculty mentors with expertise in these different fields. Dr. Stephen Fuchs runs a molecular biology lab at Tufts and has guided me through both the technical and big picture aspects of DNA isolation and genetic analysis. **Dr. Zarin Machanda**, an anthropologist who specializes in the study of chimpanzees, has given me a great deal of insight into chimpanzee reproductive behavior, which has informed my research greatly. The highlight of the project so far has been working with Emily Taketa and Miranda Yu, two other Laidlaw scholars whose projects are closely connected to mine, to find novel solutions to efficiently and safely isolate DNA from fecal samples. I look forward to continuing to work with them during the second summer of the Laidlaw program.

EMILY TAKETA (2019-2021). I became a Laidlaw Scholar in the Spring of 2019. I applied to be a Laidlaw Scholar because I wanted to learn valuable skills through research, build meaningful relationships with professors and apply my leadership in this new environment. I'm a double major in Biology and Child Studies & Human Development on the pre-medical track. My project on Genetic Markers Associated with Aging is part of the group Kibale Chimpanzee project. Our group has **Dr. Stephen Fuchs and Dr. Zarin Machanda** as mentors. We plan to continue and expand our research in our second summer in the Uganda conservatory. I have greatly enjoyed learning not only from my encouraging mentors but also from my peer researchers. There are challenges surrounding the extent of biological analysis we can extract from our samples. I am from Thousand Oaks, California. Recently, I have done internships at a private oral surgery office and the Painted Turtle Camp. I will graduate from Tufts in spring 2021. I have

volunteered in the Dominican Republic and have traveled to see family in South Korea. My favorite part of my week is volunteering at Tufts Floating Hospital for Children through the Kids Kicking Cancer program. Through this organization, I empower and encourage children with cancer by teaching them martial arts. I also enjoy running and pottery. My favorite color is sky blue. As an aspiring pediatric oncologist, I hope to be in medical school in five years. I would hope future scholars remember that they do not need to know all the answers in research, they just need the drive and curiosity to try to learn something new. Also, your amazing mentors and Laidlaw administrators believe in you, so you should believe in yourself too.

MIRANDA YU. My name is Miranda Yu, a member of the Tufts University class of 2021, and a current biology major. While I am originally from the States, I have spent most of my life abroad in Shanghai. This international experience has opened my eyes to the various cultural and biological facets that affect the human experience of health. For this reason, my current research interests are in genetic and nutritional (viewing nutrition as a facet of culture) effects on human health and behavior. It is my hope that in the future, I may incorporate my knowledge in both of these areas of science into my medical practice. When I am not running to and from lab, in my free time I enjoy cooking/eating/learning about foods from all cultures with friends or oil painting. Stephen Fuchs and Zarin Machanda are my Laidlaw mentors.

ZARIN MACHANDA. Zarin's research revolves around understanding the factors that shape the quality and development of social relationships among wild chimpanzees. Her work so far has focused mostly on the evolution of male-female relationships, male-male cooperation (especially cooperative hunting), and how chimpanzees use communication to mediate social relationships. Most recently, she has started a long-term project to study infant and juvenile chimpanzees and how they develop sex-typed adult behaviors. Zarin is the Director of Long-term Research at the Kibale Chimpanzee Project, an organization that for the last 30 years has conserved and protected the Kanyawara community of chimpanzees living in Kibale National Park, Uganda. She is also on the Board of the Kasiisi Project, a community development organization in Uganda that works with over 9000 school children living around Kibale National Park. Zarin holds a secondary appointment in the Department of Biology. Zarin is a Faculty mentor to **MacKenzie Parmenter**, **Paras Patnaik, Emily Taketa, and Miranda Yu.**

Chimpanzee Genetic Analysis Group Poster Outline

Paras Patnaik, Emily Taketa Miranda Yu

Background

Joint Background:

- Studying noninvasive, fecal, chimpanzee samples from Kibale Chimpanzee Project
- Genetic similarities between chimpanzees and humans, so research has possibilities of human application
- Can isolate genetic information from fecal samples
- Tandem repeat sequences in certain genes → different number of repeats (genetic variation) → can be analyzed to gain knowledge about many different aspects of, and relationships between, chimpanzee biology and behavior

Research Objectives

- Emily: Identify the age of the noninvasive chimpanzee samples through the methylation of specific gene sequences.
- Paras: Determine the paternity of 4 infant chimpanzees; use pre-existing and new paternity data to identify potential links between male behavioral tendencies and the number of offspring sired
- Miranda: Investigate the correlation between genetic variation in 8 genes and aggressive behavior

Methods

Joint Methods:

- Minipreps
- Multiplex PCR + gels
- Illumina sequencing

Independent Methods

- Emily: Bisulfite conversion before multiplex PCR to observe methylation of samples.
- Paras: Amplify 19 microsatellite regions for each infant chimpanzee and compare the lengths of the amplified sequences to existing genetic data for potential fathers to determine paternity
- Miranda: Amplify and sequence specific areas of target genes, and compare individual variation within each gene to aggressive behavior.

Figures

No figures have been made yet but figures will be ready by October

Emily's Potential Figures:

- Images from multiplex PCR showing the specific sequences were effectively extracted and amplified.
- Graph of relationship between methylation levels and age for specific chimpanzee samples from varied years.

Paras Potential Figures:

- DNA sequencing results verifying that chimpanzee genomic DNA was successfully extracted from fecal samples and one paternity microsatellite region was amplified
- Microsatellite region sequence lengths of mother, father and offspring → showing how paternity is determined

Results

- No definitive results have been obtained yet for any of our projects
  - However, an important breakthrough is the attainment of DNA from our samples (a feat in and of itself!)
- Preliminary data and results should be obtained by October for all projects

Limitations

- Emily: DNA of samples is variable and less reliable than blood, so methylation could be degraded. This process has not been done with fecal samples before, so limited guidance from prior research.
- Paras: Not all 19 microsatellite regions are amplifying successfully via PCR so paternity may have to be determined using a limited number of sites.
- Miranda: Limited samples size means correlations may not be detectable

Next Steps

- Emily: Continue testing the PCR and bisulfite conversion process to design the most effective protocol.
- Paras: Send amplified microsatellite regions of the infant chimpanzees for illumina sequencing in order to determine their exact lengths. Subsequently use this data to determine paternity.

Citations

- Kibale Chimpanzee Project
- Multiplex PCR procedure
- Independent sources: journal articles

Acknowledgements

- Kibale Chimpanzee Project
- Professors Fuchs and Machanda
- Laidlaw Foundation

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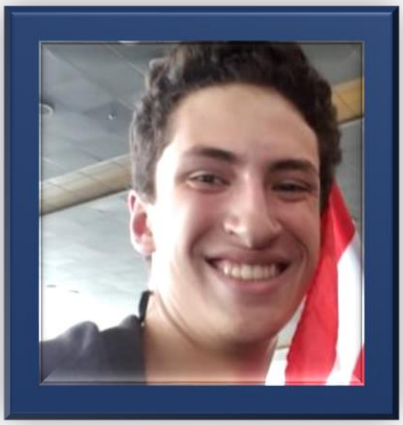
JOSUÉ LLAMAS RODRIGUEZ (2018-2020). I'm a Senior majoring in Cognitive and Brain Sciences in the Tufts School of Arts and Sciences. I applied to become a Laidlaw Scholar in the spring of 2018 because I knew I wanted to pursue a research project that was both meaningful and related to my field of study. I knew that I could make the most of it if I had the guidance of a mentor who was an expert in the field and funding that would allow me to do it full time and not worry about research expenses. The original title of my project was *The Neuropathology of Intellectual Disabilities*, later renamed *The Neuroscience of Intellectual Disabilities* to emphasize the fact that my project focused more on the actual molecular processes behind the pathology more than the pathology itself. My mentor is **Michele Jacob,** the principal investigator of the Jacob lab. My research took place at the Tufts School of Medicine in downtown Boston. The highlight of the project was the independence and trust that the lab gave me to join their ongoing research while simultaneously pursuing my individual project. Everyone in the lab was always willing to help and provide explanations for the theory behind the science and the protocols themselves. There is no lowlight that I can think of. The first part of my research has been published in *Human Molecular Genetics*, a high prestige, peer-reviewed scientific journal. The second part of my research is still ongoing but is expected to be published soon. I'm from Guadalajara, México. I attended high school there before being accepted to Tufts University. I developed my passion for the brain and the mind late in high school when I was taking the advanced placement class in psychology and biology. I'd like to thank Michele, Rob, Jon, and all the other members of the Jacob Lab for having the patience and trust to teach me everything I had to learn. I will graduate from Tufts in the Summer of 2020. After graduation I intend to either complete a PhD or Masters program, or continue in my research position. My hobbies include basketball, writing, reading, playing the piano, hiking, and ballroom dancing. My advice to future scholars is to choose to focus on something that truly means something to them and to the world around them. But most importantly, to really seek out people who are enjoyable to work with.

ABSTRACT. JOSUE LLAMAS RODRIGUEZ. ***The Neuroscience of Intellectual Disability***

Intellectual disability (ID, IQ<70) and autism spectrum disorders affect approximately 2.5% of the population, and elucidating their underlying molecular mechanisms is essential for developing therapeutic strategies. ID shows a strong genetic association with β-catenin (β-cat) network malfunction. Our data show that both loss of and excessive β-cat lead to cognitive impairments of different nature and severity. To identify pathological changes caused by β-cat loss, we generated a new conditional knockout mouse (β-cat cKO) with targeted depletion of β-cat in forebrain neurons during the period of major synaptogenesis. Compared to control littermates, β-cat cKOs display severe cognitive impairments and reduced levels of key synaptic adhesion and scaffold binding partners. Unexpectedly, several canonical Wnt target genes were not altered in the β-cat cKOs due to upregulation of γ-catenin (γ-cat), a partial functional homologue whose neural-specific role is poorly defined. Additionally, we created a mouse line overexpressing truncated β-cat (β-cat cOE) to identify novel roles *in vivo* and *in vitro* for β-cat interactions with adenomatous polyposis coli protein (APC). β-

cat cOEs display severe cognitive impairments and drastic reduction in synaptic plasticity and glutamate receptor levels. cOEs show increased association between truncated β-cat with APC, APC hyperphosphorylation, and altered APC RNA-binding and target translation. Truncated β-cat also shows increased association with Fragile X Mental Retardation Protein (FMRP), the leading cause of inherited ID. This interaction is dependent on APC.

MICHELE JACOB, Ph.D. I am a Professor in the Department of Neuroscience at Tufts University School of Medicine in Boston, Massachusetts. I received my B.S. in biology from City College of New York, my Ph.D. from Yale University in cell biology, and I completed postdoctoral training in neurobiology at Columbia University and at The University of California, San Diego. I then headed my own laboratory in the neurobiology group at the Worcester Foundation for Biomedical Research, prior to moving to Tufts University. My research studies, funded by NIH and the CURE Epilepsy Foundation, are defining molecular mechanisms responsible for changes in brain function in neurodevelopmental disorders, including intellectual disabilities, autism, seizures and reduced hearing. Intellectual disability and autism show a strong association with several genes that are predicted to cause malfunction of the □-catenin pathway, including *ctnnb1*, the gene that encodes□□-catenin. However, the underlying mechanisms are poorly defined, this knowledge is essential for developing effective therapeutic interventions. To gain these critical insights, I have generated novel mouse models with genetic manipulations that cause up- or down-regulation of □-catenin pathways in the brain. Her findings are providing new insights into molecular and functional changes that can lead to autism, seizures and learning impairments of different severities. Her research employs molecular, genetic, biochemical, imaging, and behavioral approaches. **Josue Llamas** joined these efforts as a Laidlaw Scholar. His outstanding performance in the Lab and impressive contributions of original data led to him being recognized as a co-author on a ***paper (Wickham et al., 2019, Human Molecular Genetics).***



JONATHAN RODRIGUEZ (2018-2020). I am a member of the class of 2021 at Tufts University studying math and computer science. Before college, I participated in math olympiads in my homeland of Puerto Rico. Eventually I got the opportunity to represent the island in the Central American Math Olympiad, the Ibero American Math Olympiad, and the International Mathematical Olympiad. After this experience, I decided to pursue an education in math to tackle even more challenging and interesting problems. My current interests include graph theory, combinatorics, and geometry. Over the semester, I work as a tutor for Calculus 2, Calculus 3, and Discrete Math. I also worked as a teaching assistant for the Discrete Math course. This was an incredibly transformative experience for me, as I was given the chance to hold office hours and review sessions to

better help students understand the basics of mathematical thought and logic, while simultaneously solidifying the foundations for myself. Since 2018, I have been conducting research in **Dr. Lenore J. Cowen's lab** in the Computer Science department over the summers through the Laidlaw Scholars program. This program has been incredibly helpful for me as it has given me the chance to start pursuing research early on in my career, giving me the confidence that this is the kind of work I want to continue in the future. My project, titled *Majority Vote Cascading: A Semi-Supervised Framework for Improving Protein Function Prediction*, was accepted as a conference paper for ACM-BCB 2019. Looking forward, I wish to devote more time to math and pursue research opportunities in that field. During the Fall 2019 semester, I will be abroad in Budapest, Hungary on an intensive math-focused program. I will have the chance to take challenging courses and interact with eager mathematicians so that I may soon start tackling even more interesting problems.

ABSTRACT. JONATHAN RODRIGUEZ. ***Majority Vote Cascading: A Semi-Supervised Framework for Improving Protein Function Prediction***. Functional label prediction is one of the best-known and most well-studied problems on protein-protein interaction networks. In the functional label prediction problem, the function of a protein is predicted based on the functions of the other proteins that interact with it in its local neighborhood. We study how different measures of confidence in the labels can be incorporated to improve the DSD majority vote algorithm introduced by Cao et al. We then incorporate these confidence predictions into pseudo-labels and extend our predictions over multiple rounds, which we call a cascade. Several cascade variants are tested in a stringent cross-validation experiment on yeast (*S. cerevisiae*) and fly (*D. melanogaster*) PPI networks, and we show that for many different settings with several alternative confidence functions, cascading improves the accuracy of the predictions. A list of the most confident new label predictions in the two networks is also reported. Code, networks for the cross-validation experiments, and supplementary figures and tables appear at http://bcb.cs.tufts.edu/cascade.

LENORE J. COWEN. I received a BA in Mathematics from Yale in 1987 and a Ph.D. in Mathematics from MIT in 1993. I was an NSF Postdoctoral Fellow and then joined the faculty of the Mathematical Sciences Department (now the Applied Mathematics and Statistics department) at Johns Hopkins University, before coming to Tufts in 2001. At Tufts, I am a Professor in the Department of Computer Science, with a joint appointment in the Department of Mathematics. My research interests include graph theory, graph algorithms, network science and computational biology, and I am particularly happy that they all combine for the project that she has been working on with Laidlaw scholar **Jonathan Rodriguez**. This is their second summer working together, and their results have led to a co-authored paper that will appear in the ***2019 ACM-BCB Symposium on Bioinformatics, Computational Biology and Health Informatics.***

JACOB RUBEL (2019-2021). I am a Junior majoring in Political Science from Brooklyn, New York. My primary interests include political philosophy, local politics, and international development. At Tufts, I have been a Mathew Howard Shea Scholar in the Department of Political Science and am currently a Laidlaw Scholar, conducting a research project that studies civic education in relation to low levels of participation in local politics. I lead a sustainable development project in Ecuador which brings E-Library centers to remote areas that lack internet access. I have worked for the NYC Administration for Children's Services as well as the MIT D-Lab. I have also been awarded fellowships as a Hertog Fellow, an IGL Empower Fellow, and a Tisch College Summer Fellow. For the 2019-2020 year, I am studying at the University of Oxford. **Peter Levine** is my Faculty mentor.

PETER LEVINE. I met Laidlaw Scholar, **Jacob Rubel**, when he took the Introduction to Civic Studies, a new course for a new major that I was co-teaching with two colleagues. Jacob and I share interests in local civic engagement and civic education and have enjoyed discussing his research agenda. A lot of my work can be summarized as building the new discipline of Civic Studies. It involves the empirical study of civic engagement and also aims to shift all the social sciences and humanities to take citizens more seriously as agents of positive change. I am currently Academic Dean and Lincoln Filene Professor of Citizenship & Public Affairs at Tisch College. I hold tenure in Tufts' Political Science Department and secondary appointments in the Tufts Philosophy Department and the Tufts Clinical and Translational Sciences Institute. I direct the Civic Studies Major at Tufts. I graduated from Yale in 1989 with a degree in philosophy. I studied philosophy at Oxford on a Rhodes Scholarship, receiving my doctorate in 1992. From 1993-2008, I was a member of the Institute for Philosophy & Public Policy in the University of Maryland's School of Public Policy. I co-founded and led CIRCLE, The Center for Information and Research on Civic Learning and Engagement, which is now at Tufts. I am the author of *We Are the Ones We Have Been Waiting For: The Promise of Civic Renewal in America* (2013), five other scholarly books on philosophy and politics, and a novel.

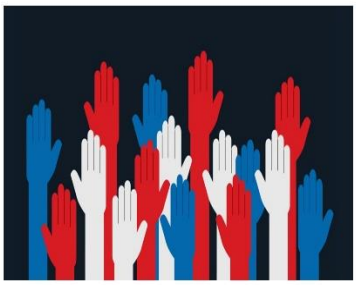
Reinvigorating Federalism: Civic Education for Local Politics

Jacob Rubel

Background

Since the ratification of the constitution, the structure of American government has stayed largely the same, while the animating attachment of its citizenry has mutated continuously. Federalism was a fundamental founding theory embedded in the constitution, which allowed that power be divided among the national, state, and local levels. All three levels were endowed with immense powers, but of varying natures that were deemed best suited to their particular traits. For example, while the national government employs its amassed resources for a purpose such as defense, local levels focus on matters such as education that are more dependent on local preferences.

While the structural division of power has remained largely the same, the energy of citizens that federalist and democratic institutions depend on has deviated. As attention has concentrated on the national government, citizens increasingly neglect their state and local governments. In an average local election, fewer than one in five citizens vote. Furthermore, in what has been referred to as the nationalization of American politics, voting on the local and state level has become merely reiterations of presidential elections. Modern elections for governor are now almost wholly predictable by looking by state at presidential vote share. As a result, citizens are neglecting the most effective means of exercising their political will. Furthermore, local governments are increasingly left to do their work without accountability to engaged citizens. As local politicians have fewer eyes on their actions, they are licensed to engage in corruption without consequences.



Problem Statement

No simple solution can address this immense and structural corrosion in the American political system. Nevertheless, there have been a number of diverse efforts to address the challenge of declining local political participation. In general, the majority of efforts to confront this issue have been focused on adjusting electoral processes in order to boost turnout without fundamentally changing the role of local politics in the mind of a citizen. Nevertheless, civic education is an unexplored but promising arena for confronting this more fundamental and attitudinal challenge.

Civic education in its broadest form is the process and means by which individuals become informed and empowered citizens in their political societies. Since the 1980s, research has found substantial effects of civic education in schools on political behavior. Yet in the growing field of research on civic education, the topic of local politics has gone unexplored. Research tends to focus on measurements based on national politics—such as voting behavior in presidential elections—rather than anything local.

The focus of this research project is to unite the field of civic education with the study of participation in local politics. Though they have been isolated from each other thus far, there is a possible relationship between them that could contribute to reinvigorating participation in local politics.

Research Questions

The study will have two main focuses:

1. Examining the amount that civic education classes teach about local politics, as well as the quality of their teaching methods. Possible questions under this theme include:
   a. How much content do different curriculums devote to national politics, and how much do they devote to state and local politics? How do civics textbooks cover local/state politics compared to national politics?
   b. How are local/state politics taught? Are the topics framed in a way that is proven to be more interesting to students—for example, relating lessons to current events? Do extracurricular activities that are for localized/community contexts have an effect on engagement in local politics?
2. After examining the first topic, analyzing how the varying ways of teaching local politics affect political behavior and knowledge
   a. How do classes that have varying content in relation to local/state politics compare in terms of the political behavior and political knowledge of students?

Methodology

1. *Textbooks and state standards analysis*
   a. Determine how much state/local politics content is given compared to content related to federal government.
2. *Surveys*
   a. A teacher survey: objective is to evaluate both valuing/interest as well as knowledge of local/state politics.
3. *Data Analysis*
   a. National surveys, such as the NAEP survey, include questions that evaluate students' attitudes towards civic education.

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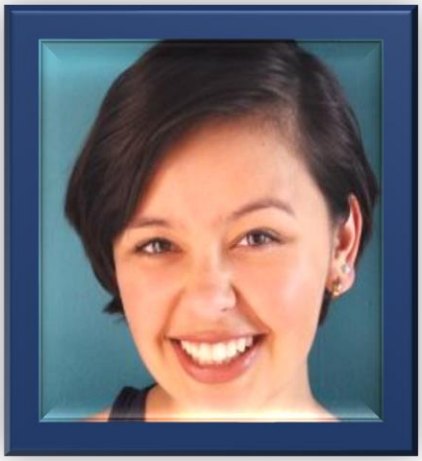


DANIELA LUZ SANCHEZ (2018-2020). I am a senior at Tufts University from Albuquerque, New Mexico. I became a Laidlaw Scholar in 2018, making me a member of the first Laidlaw Scholar Cohort of Tufts. My project, Language and the Letter of the Law: Probing the Dynamics of Legal Language Justice on the Frontera, explores the legal rights and practical implementations of bilingual education (Spanish/English) in my home state of New Mexico. The inspiration for this project came from my family's long ties to education, my own experience in the classroom and my relationship with the Spanish language. Under the guidance of **Deborah Donahue-Keegan** I conducted an extensive literature review on the history of bilingual education in New Mexico, followed by interviews and analysis of former students, parents of students and educators of the Albuquerque Public School system. In the fall of 2018 I was able to present my research on the history of bilingual education at the American Educational Studies Association conference. In addition to the Laidlaw Undergraduate Research and Leadership Program, I am a member of the first Tufts 1+4 Bridge Year cohort, with which I spent one year in Madrid, Spain volunteering with La Fundación Alicia Koplowitz and Payasos Sin Fronteras (Clowns Without Borders) before beginning my academic journey on the Tufts campus. I'm also a Tisch Scholar and will be interning at the MFA doing research on visitor studies. I hope to explore the creation of linguistically and culturally diverse artistic spaces. As a double major in Spanish and Latin American studies, I was able to spend my junior year in Santiago de Chile where I encountered a new academic passion for translation of literary texts. I'm currently beginning my senior thesis which involves translating the works of Mexican playwright Elena Garro. In my free time I am excited to be taking circus classes at Esh Circus Arts in the hopes of one day becoming a clown, and maybe even working with Clowns Without Borders! Other future goals of mine include completing a masters in Translation and Interpretation studies and eventual working as an educator who specializes in language acquisition.

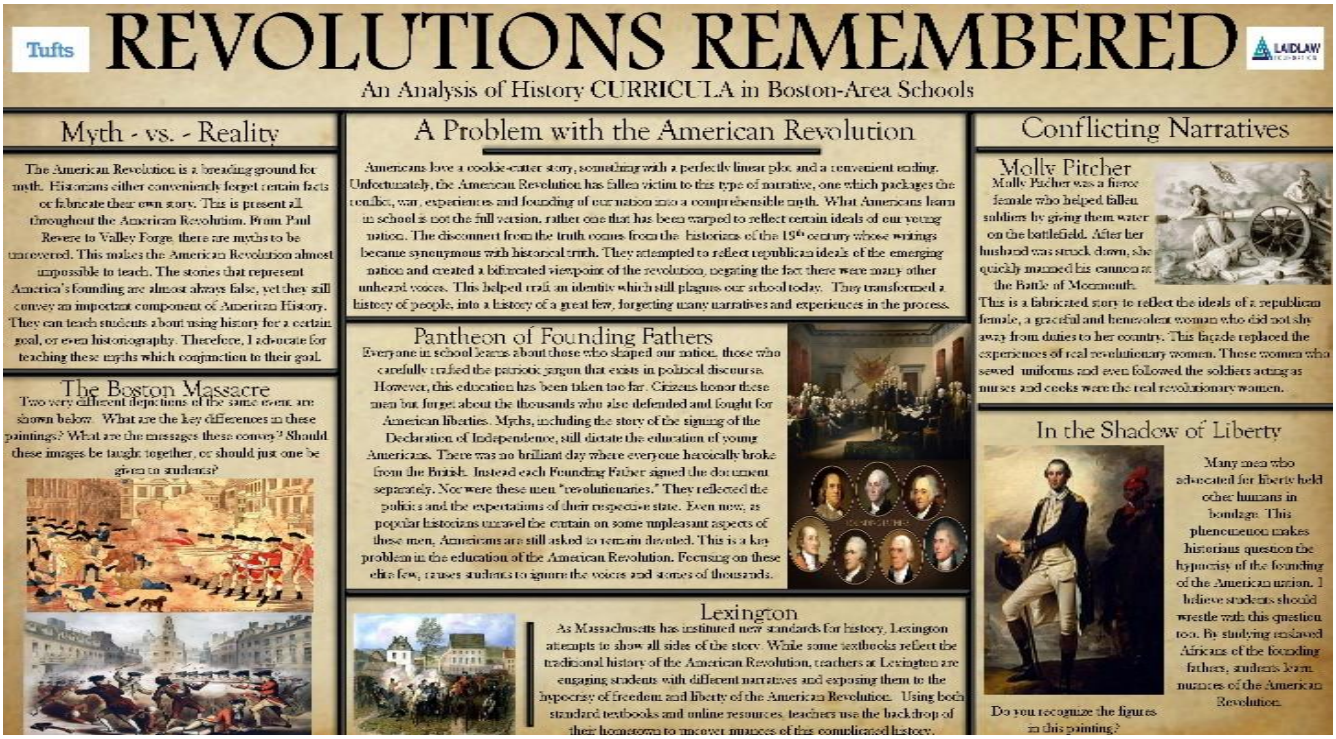
ABSTRACT. DANIELA SANCHEZ ***Language and the Letter of the Law: Probing the Dynamics of Legal Language Justice on the Frontera.*** This paper analyzes the constitutional protections of bilingual education presented in Article XII of the New Mexico state constitution in comparison with real life classroom experiences inspired by the recent court case Yazzie/Martinez v NM. Historically, how have the constitutional obligations of Article XII affected language justice within the New Mexico public education system and how has identity and language usage been affected by experiences within the classroom in regard to lack of resources, professional development and other causes? The target languages of this investigation were Spanish and English. Due to the fact that NM is one of the first and only states to incorporate language protections in the constitution it was imperative to explore the history of the creation and ratification of the constitution as well as the history of public and bilingual education in the state. After compiling data on the historic aspect of the state constitution and bilingual education, I conducted a series of interviews with 3 former students, 3 parents, and 3

educators involved in the Albuquerque Public School system. The results presented in this paper highlight the disparities between policy and implementation in the classroom, the lack of access to information regarding bilingual education and language loss due to systematic oppressions in the classroom.

DEBORAH DONAHUE-KEEGAN. I am a Faculty of Civic Studies, Lecturer in the Department of Education, and the Associate Director of the Tisch College Initiative on Social-Emotional Learning and Civic Engagement (SEL-CE) Initiative at Tufts University. My current research and teaching focus on social-emotional learning (SEL), equity, well-being, and inclusive excellence in education, with a specific focus on faculty professional development in higher education settings. A recognized leader in the SEL field, I am a member of the Advisory Board for SEL4US (Social-Emotional Learning Alliance for the U.S.), a national advocacy organization, as well as a member of the SEL4MA (Social-Emotional Learning Alliance for Massachusetts) Steering Committee. I co-founded and co-lead the Massachusetts Consortium for Social-Emotional Learning in Teacher Education (MA SEL-TEd). I have presented on my SEL-focused research and practice at numerous conferences and thought leader gatherings. I have also authored a number of articles and chapters on SEL and educator professional development. Before coming to Tufts, I was a Visiting Assistant Professor in the Education Department at Wellesley College. I earned my doctorate from Harvard University's Graduate School of Education. I became a Faculty Mentor to **Daniela Luz Sanchez** in the Laidlaw Scholars Program in 2018. I am inspired by Daniela's commitment to and passion for her research project, which focuses on the legal rights and practical implementations of bilingual education (Spanish/English) in New Mexico, her home state. I have thoroughly enjoyed mentoring—as well as learning from—Daniela!

PHOEBE SARGEANT (2019-2021). I am a part of the Cohort two Laidlaw scholars. I am originally from Rutland, VT and majoring in History with minors in both Math and Education. Laidlaw has provided me a perfect opportunity to learn about the fundamentals of research and leadership. Through this program I have been able to solidify my plans from further research and propelled me forward towards graduate programs in Education. My mentor is **Steve Cohen**, and my project centers both around education policies and history. I am studying how middle school curricula surrounding the American Revolution impacts student's development of their own patriotism. Through looking at Boston area public schools, I want to learn about what aspects of the American Revolution are most taught to students and if they are learning any recently debunked myths. Are students learning about different perspectives, or are they learning the traditional narrative of the American Revolution which instills in us an undeniable patriotism? Outside of my project, I am heavily involved in the History department at tufts. I am the Treasurer of the History Society and a senior editor for the Tufts Historical Review. After I graduate from Tufts, I hope to expand my research to the original thirteen colonies and get a Ph.D. in Education and Curriculum building. My advice for future Laidlaw students would be to not be afraid that your research might be different from others or seem uninteresting. We all have different passions and goals, which makes this program so diverse and engaging. We each bring a unique perspective and that is not something to be ashamed of.

STEVE COHEN, Ph.D., B.A. I taught high school history for two decades and have taught at Tufts since 1995. I have also had the opportunity to work on educational projects beyond the classroom. I edited and wrote anthologies to accompany the public television documentaries, "*Vietnam A Television History"* and "*Eyes On The Prize"*. I was a Program Associate with Facing History and Ourselves for many years and have written articles about teaching controversial issues like Vietnam, the dropping of the Atomic Bomb, and the Holocaust. I also do projects for the pbslearningmedia.org website on various historical subjects. I mentor/supervise **Phoebe Sargeant's** Laidlaw research project on how the American Revolution is taught in different communities matches my interest in the politics of memory.



GRACE SCHUMAKER (2018-2020). I became a Laidlaw Scholar during the summer after my sophomore year at Tufts. I am now starting my senior year and I've taken away so much from this program. As a sophomore, I recognized that the Laidlaw Scholars program was a great opportunity to work on a research project with one of my professors. The timeframe of two summers was also appealing since it would allow me to stick with the project for a longer stretch of time. I am a Community Health major and Urban Studies minor, so I was excited to be able to work on a public health focused project. I have been working on **Jennifer Allen's** team on the Brazilian Women's Health Project. This study has been working to identify key health concerns of Brazilian women in the greater Boston area through key informant interviews and focus groups. The best part of this program has been the exposure to research in my field of study. I had little prior research experience and it has been invaluable to work with such a talented team in a field I hope to pursue. In this time, I have learned that research requires much logistical planning and there will always be speedbumps that drag out the timeline. I have gained experience creating materials for the IRB application, implementing recruitment

strategies and research organization. Learning about the research topic through this project has furthered my passion for public health and I'm excited for whatever my path may be once I leave Tufts. For future scholars, absorb all you can from your research experience. The two years fly by and there is so much you can gain from this program.

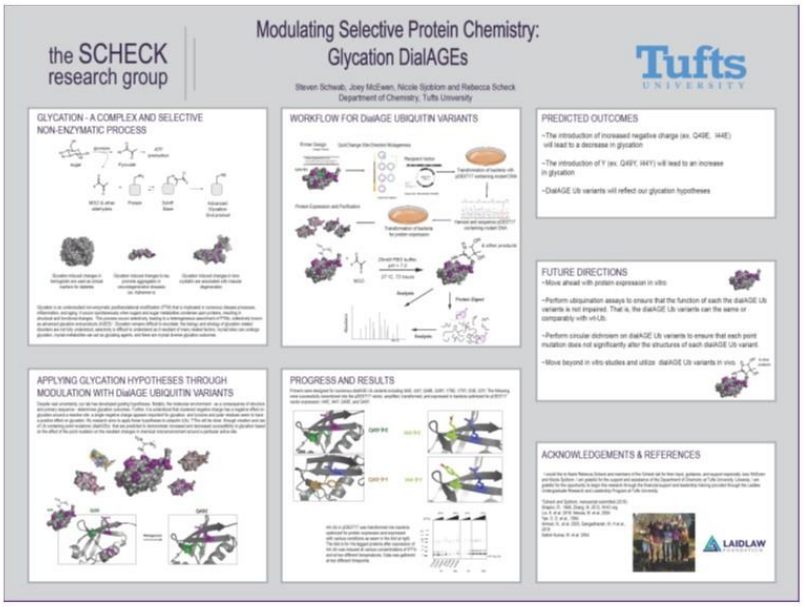
ABSTRACT. GRACE SCHUMAKER. ***Brazilian Women's Health Study.*** Second to Florida, the state of Massachusetts has the largest population of Brazilians in the United States (BPDA, 2017). However, there is currently a gap in the data on health needs, service utilization and insurance status for this population. In the United States, Brazilians are a smaller group relative to other Latino groups and are largely undocumented, both which result in this group being understudied (Joseph, 2011). This is a growing population and little is known about individual, interpersonal, and institutional factors that contribute to health behaviors, health care use and health outcomes among immigrant Brazilian women. To identify key themes of health behaviors and relationships with the healthcare system, we have designed a qualitative research study that uses two types of data collection: key informant interviews and focus groups. The Brazilian Women's Health Study's goal is to gain greater insights, contextualization, and interpretations of the Brazilian women's health, barriers to health care and potential strategies for providing health programs for this population. This study is still in progress and does not currently have results to report. We hope our findings will help inform future interventions or programs if necessary. This study will inform society about the unique and specific health risks and access problems Brazilian women face and could hopefully lead to increased and improved resources that will reduce the burden of physical and/or mental health issues in this community.

JENNIFER ALLEN, SCD, MPH. I am a Professor of Community Health. My research focuses on the development, implementation, and evaluation of community-based interventions to promote cancer prevention and control in underserved populations with an ultimate goal of reducing health disparities. My work emphasizes community-based participatory approaches to identifying community needs and building capacity to implement community-driven solutions. I have developed and evaluated peer-led and e-health interventions to promote cancer prevention and screening in a variety of settings, including worksites, churches, and public housing. I involve undergraduate and graduate students on her research team in each of my research studies. I am currently working with Laidlaw Scholar, **Grace Schumaker** on a study of health priorities of Brazilian and Haitian immigrants in Greater Boston. Grace has worked with the research team on literature reviews, identifying and interviewing community members, and qualitative data analysis.

STEVEN SCHWAB (2018-2020). I'm from Danbury, Connecticut, and I am a senior studying biochemistry. I became a Laidlaw Scholar as part of Tufts' first cohort in the summer of 2018. I applied to become a Laidlaw Scholar not only to pursue my curiosity for complex scientific questions that underlie our collective biochemistry but also to experiment with hands-on independent research. Through Laidlaw, I saw the possibility to grow and develop my leadership skills, gain insight into my career path, and financially support myself during the summer. As a Laidlaw Scholar, I have been researching an understudied spontaneous chemical reaction that impairs protein function and is implicated in numerous chronic diseases in the Scheck Lab in the Chemistry Department under **Rebecca Scheck, PhD.** My project - Modulating Selective Protein Chemistry - has changed and evolved a fair amount over time! During my time as a Laidlaw Fellow, I have been filled with gratitude for the independence in lab that I was granted not only by the support of the Laidlaw Foundation but by my professor, Rebecca. I have enjoyed getting the chance to learn a variety of new techniques and to troubleshoot problems I encountered. I learned a ton about what drew me to research in the first place, the rewards and difficulties of bench research, and valuable insight into my eventual career(s). Outside of Laidlaw, I enjoy reading, playing Pokemon Go, kayaking, weight training, and more. I am presently excited for the half-marathon I will run in November! Beyond Laidlaw, I will continue to tackle big scientific question through my pursuit of an MD at Tufts University School of Medicine. At present, I am most interested in Emergency Medicine and Critical Care. I leave my fellow Laidlaw Scholars - present and future - with a few pieces of advice: every experience can be a learning experience, research takes a lot of time, and research is only one of the ways to explore big scientific questions!

ABSTRACT. **STEVEN SCHWAB.** ***Modulating Selective Protein Chemistry*.** Glycation is an understudied non-enzymatic posttranslational modification (PTM) that is implicated in numerous disease processes, inflammation, and aging. It occurs spontaneously when sugars and sugar metabolites condense upon proteins, resulting in structural and functional changes. Using mass spectrometry, a series of glycating agents were screened against peptides and proteins *in vitro*, resulting in differential glycation patterns by different reactive aldehydes. Previously established glycation hypotheses were tested with ubiquitin and ubiquitin containing point mutations (ubiquitin mutants), which are predicted to demonstrate increased and decreased susceptibility to glycation. Preparatory work was completed including primer design for the various mutants, amplification of mutant DNA in a plasmid, transformation of the plasmid, and harvesting of the mutant DNA. The mutant DNA was subsequently sequenced and transformed for protein expression. Further, preliminary work was completed to optimize expression conditions.

REBECCA SCHECK. Research in the Scheck Laboratory focuses on the development and application of encodable, bioorthogonal chemical strategies. These tools will be used to report on inducible changes in protein function and structure in living cells, particularly posttranslational modifications (PTMs). Our focus is on PTMs that have been particularly difficult to study using traditional approaches. We address this challenge through the development of selective chemistries that offer a new toolkit for understanding how protein function is controlled within a cell. Current efforts in the lab focus on the development of new chemical methods that can be used to study complex post-translational modification networks including glycation, ubiquitination and phosphorylation or to monitor changes in protein-protein interactions or associations. I am **Steven Schwab's** Faculty mentor.



ANEYA SOUSA (2018-2020). I am a current senior at Tufts University from Bridgewater, Massachusetts. I am majoring in Interdisciplinary Studies, as I combine the disciplines of Clinical Psychology, Child Study and Human Development, Women's, Gender, and Sexuality Studies, and Africana Studies. I became a Laidlaw Scholar in 2018, during the end of her sophomore year. I applied to be a Laidlaw Scholar because I was extremely interested in conducting independent research and saw the Laidlaw program as a perfect opportunity to study topics that I am passionate about and having no restrictions or constraints in being able to reach across multiple disciplines within my research. My Laidlaw research project is entitled "Analyzing Anti-Blackness and Antagonism Against Black LGBT Youth in Mental Health Services." My project deals with the realm of psychology and mental health care as it applies to race, gender, and sexuality, specifically looking at how theories and practices have been constructed to deny Black LGBT youth access to necessary mental health care. My mentor is **Dr. Shameka Powell,** who is a Professor in the Education Department at Tufts. Over the past two summers, the lowlight of her experience in the Laidlaw program has been having to find a new advisor halfway through the first summer of the Program, who was not able to start with me until the second summer. However, I fortunately experienced so many highlights that have outshined my lowlight, one of which is being able to have the experience to join a community of wonderful scholars and to be able to make so many new friends and connections in the process. My advice to future scholars would be to not be afraid to take non-traditional paths or partake in areas of research where relatively little work has been done in the past, and to not be afraid to create their own ways of uncovering a topic. When I am not immersed in research and other aspects of my academic life, I love to spend time with friends and family, watch movies and TV, read, shop, and dance. I also really enjoy traveling and hope to do more of it in the future. Some of my favorite places that I have traveled to include Mexico, California, and Florida. I love anywhere there is a beach, which is reflected in my favorite places and favorite colors- -- yellow and light blue. In five years, I hope to be in graduate school, working on a PhD in Clinical Psychology, while also continuing to do work that assists and improves conditions for my community in any way she can.

ABSTRACT. ANEYA SOUSA. ***"Analyzing Anti-Blackness and Antagonism Against Black LGBT Youth in Mental Health Services."*** This study looks at the inherent anti-Blackness and antagonism against LGBT people in various forms that is intertwined with the foundation of the healthcare field. My work applies this specifically to Black LGBT youth and adolescents, displaying how it has impacted and continues to impact their knowledge of their own bodies, which in turn, has a large impact on their mental health. Subsequently, my work looks at this as it manifests in their involvement, or lack thereof, in mental health services and receiving mental health care. I intend to approach this in a three-pronged manner of focusing on theory, policy, and practice, of both the past and present, that have been employed intentionally and designed to silence, erase, dehumanize, pathologize, and sensationalize Black LGBT youth and adolescents and their experiences. I plan to analyze these concepts and read

them along with surveillance and hypervisibility in these same areas, and consider the interplay and cyclical relationship that these concepts produce in their collective disposal of Black LGBT people. I also plan to look at related research that has been done in these fields or similar fields that have looked at similar topics through a critical lens.

SHAMEKA POWELL. I am l an Assistant Professor of Educational Studies and affiliated with the Master of Arts in Teaching program in the Department of Education. My research focuses on equality of educational opportunity and the intersections of race, class, gender in school spaces. Specifically, they interrogate how institutional agents create, exacerbate, and alleviate stratification patterns within schools. Additionally, Dr. Powell examines critical literacy approaches teachers and students employ within classrooms. They situate their research within Critical Race Theory and Queer of Color Theories. I am a Tufts Faculty mentor to Laidlaw Scholar Aneya Sousa.

<Interdisciplinary Studies Department, Tufts University, Laidlaw Scholars Foundation>

Analyzing Anti-Blackness and Antagonism Against Black LGBT Youth in Mental Health Services

Anéya Sousa

Background

When some people think of forms of oppression such as racism, homophobia, transphobia, misogyny, and more, they often imagine these things as existing and operating within a vacuum. They cannot imagine their very real and potent overarching reach, much less the fact that these systems and more like them are the foundation of the way that much of the world operates today. However, this could not be further from the truth. This research intends to zero in on the field of psychology as one of the least discussed examples of these sinister systems at work, and the way that they compound to deny certain groups of people the right to a functional life.

Research Objectives

The main objectives of this research project are to demonstrate the many forms that anti-Blackness and homo and trans antagonism can take. In particular, this research aims to display that the field of psychology is no exception through highlighting the many ways in which anti-Blackness, along with other forms of oppression such as gender-based violence and homoantagonism, are wielded by the state, as well as by healthcare professionals. They are wielded to deny access to mental health care to Black LGBT youth, therefore denying them the right to survive without significant struggle.

Methods

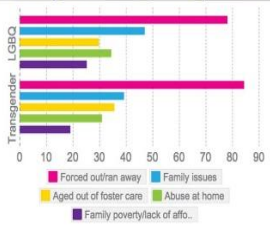
The primary research method used in this study is a descriptive-qualitative method. In this study, a wide range of books and articles have been read and analyzed across a variety of disciplines, including psychoanalytic theory, Black studies, disability studies, and gender and sexuality studies. This project incorporates and compiles documentation of case studies, experiments, ethnographies, and other methods to establish a string sense of credibility to display the ways that Black LGBT youth and adolescents are denied access to appropriate mental health care.

Table 1. "Black and African American Communities and Mental Health"

Chart displaying statistics of Black people in the US reported to be dealing with a diagnosable mental illness in the last year.

"Black and African American Communities and Mental Health." (2019). Mental Health in America. Web. Google Image Search. September 4 2019.

Table 2. "Why Do LGBTQ Youth Experience Homelessness?"



Graph depicting LGBTQ Youth Homelessness and the factors that contribute to it, including factors that contribute to poor mental health.

True Colors United, Inc. "Why Do LGBTQ Youth Experience Homelessness?" (2019). Our Issue. Web. Google Image Search. September 4 2019.

Results

- The anti-Blackness, combined with the antagonism that Black LGBT youth and adolescents face due to their gender and sexual orientations, results in additional complications and obstructions to survival, such as homelessness, further abuse and targeting, increased severity of untreated mental health complications, increased family issues, etc.

Limitations

- There is very little published research that currently exists and is readily available for easy public access that pertains to all of these components combined as one singular topic.
- The scarce research that does exist on this topic is quite difficult to find, and is not present in the mainstream realm of academic work in the field of psychology.
- Limited amount of information can be collected and analyzed when interviews are not directly collected and interpretation is based on previous research done by others.

Conclusions

- Black LGB youth and adolescents struggle with severe mental health issues at much higher rates compared to Black heterosexual youth and adolescents, and at even higher rates compared to non-Black heterosexual youth and adolescents. Similarly, Black trans and non-binary youth struggle with severe mental health issues at much higher rates compared to both Black and non-Black heterosexual youth and adolescents.

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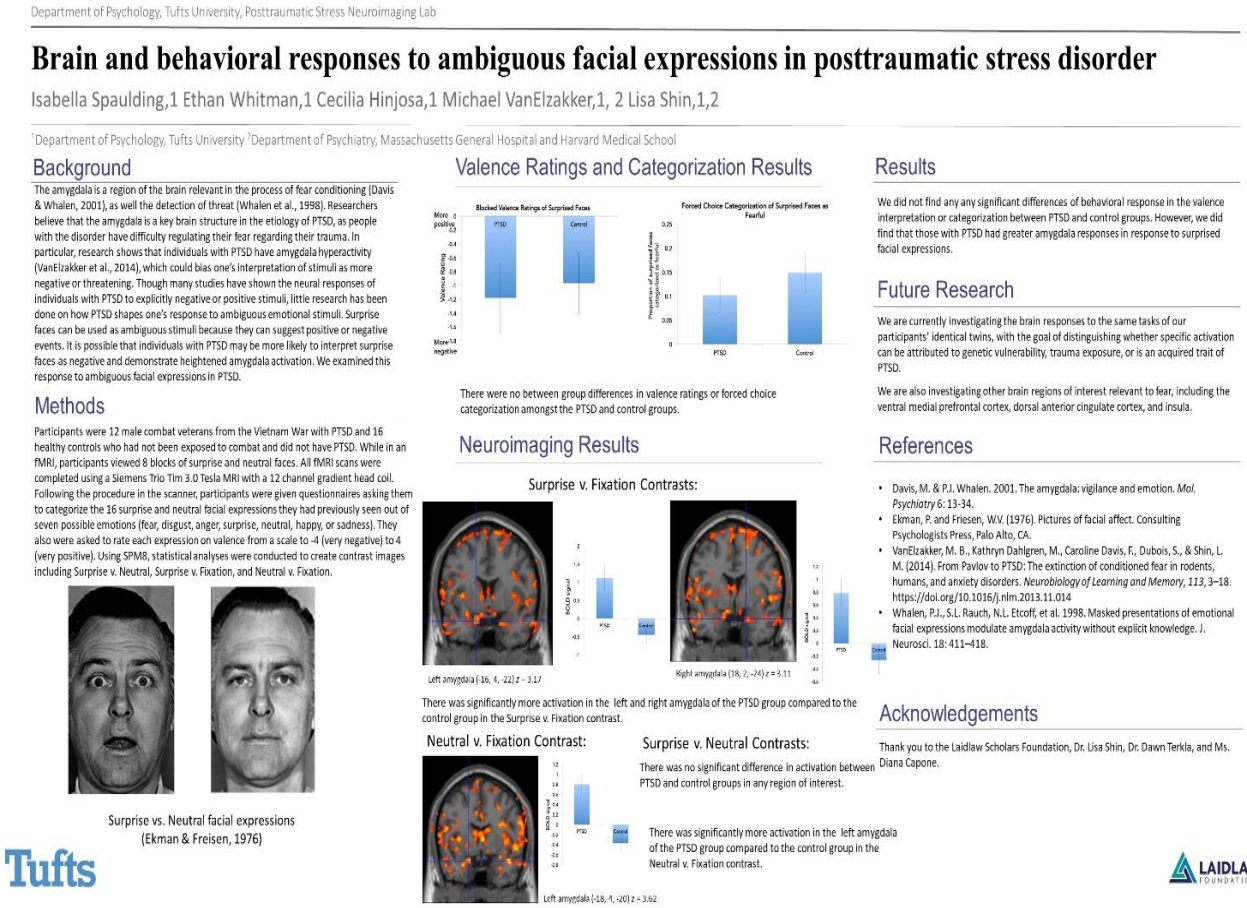
ISABELLA SPAULDING (2018-2020). I'm a rising Senior from Lincoln, Nebraska, double majoring in Clinical Psychology and American Studies. I am currently finishing up my second year of the Laidlaw program and have been working with **Dr. Lisa Shin** in the Posttraumatic Stress Neuroimaging Lab for the past two summers. My research examines brain responses to ambiguous facial expressions in individuals with Posttraumatic Stress Disorder (PTSD), using identical twin veterans as participants in order to determine what traits of PTSD are genetic vulnerabilities and what are acquired characteristics of trauma exposure. I intend to continue my work into the school year, with this research culminating in my Senior Honors Thesis. After working as a research assistant for the past few years in labs at Massachusetts General Hospital, Home Base, and the University of Nebraska, I was incredibly grateful to the Laidlaw Scholars Program for providing an opportunity to conduct my own independent research. After graduation, I hope to pursue a PhD in Clinical Psychology and eventually work as a clinician, providing trauma-focused care to underserved communities of color. In particular, I'm passionate about helping survivors of trauma seek restorative justice and increasing access to evidence-based psychological treatment. This past semester I had the opportunity to study at the School of Oriental and African Studies in London, where I got to take classes in colonialism, film, and religion. I also was lucky enough to travel to Morocco, Spain, Germany, France, and Greece! Outside of academics, I spend most of my time co-leading Action for Sexual Assault Prevention, a student activist group that runs peer workshops on sexual violence, builds support networks for student survivors, and works with administration to provide better care for survivors on campus.

ABSTRACT. **ISABELLA SPAULDING.** ***Brain Responses to Ambiguous Facial Expressions in Individuals with Post-Traumatic Stress Disorder.*** This study examined behavioral and brain responses to ambiguous emotional stimuli in individuals with posttraumatic stress disorder (PTSD) and healthy Controls with no trauma exposure. The study included 12 adult male Vietnam combat veterans with PTSD and 16 adult male Controls. While in an fMRI, participants' responses to neutral and surprised facial expressions were observed. The PTSD and Control group did not differ in their categorization or valence rating of facial expressions. There was no significant difference between groups in amygdala activation while viewing surprised versus neutral expressions. Compared to the Control group, the PTSD group had increased bilateral amygdala activation while viewing surprised facial expressions compared to a fixation point, as well as while viewing neutral facial expressions compared to a fixation point. Though it appears there were no behavioral abnormalities in the conscious categorization of facial expressions for the PTSD group, the group did have neural abnormalities regarding amygdala activation compared to the Controls. This could potentially indicate an underlying negative bias towards ambiguous emotional stimuli shaped by neural, rather than behavioral, response.

LISA SHIN. I received a Bachelor of Arts degree in Psychology at Dartmouth College and a PhD in Psychology at Harvard University. I completed a post-doctoral fellowship at the Massachusetts General Hospital/Harvard Medical School and has been a faculty member at Tufts since 1998. My research involves examining brain function and cognitive processing in patients with anxiety disorders, especially posttraumatic stress disorder (PTSD). Laidlaw scholar **Isabella Spaulding** and I have been investigating the origin of brain abnormalities in PTSD by studying sets of identical twins discordant for trauma exposure and PTSD. Specifically, we are investigating whether functional abnormalities in the amygdala are preexisting vulnerability factors or whether they are acquired after trauma or the development of PTSD. I also served on a 2019 Laidlaw Retreat Faculty Panel.



Department of Psychology, Tufts University, Posttraumatic Stress Neuroimaging Lab

Brain and behavioral responses to ambiguous facial expressions in posttraumatic stress disorder

Isabella Spaulding,1 Ethan Whitman,1 Cecilia Hinjosa,1 Michael VanElzakker,1, 2 Lisa Shin,1,2

[1]Department of Psychology, Tufts University [2]Department of Psychiatry, Massachusetts General Hospital and Harvard Medical School

Background

The amygdala is a region of the brain relevant in the process of fear conditioning (Davis & Whalen, 2001), as well the detection of threat (Whalen et al., 1998). Researchers believe that the amygdala is a key brain structure in the etiology of PTSD, as people with the disorder have difficulty regulating their fear regarding their trauma. In particular, research shows that individuals with PTSD have amygdala hyperactivity (VanElzakker et al., 2014), which could bias one's interpretation of stimuli as more negative or threatening. Though many studies have shown the neural responses of individuals with PTSD to explicitly negative or positive stimuli, little research has been done on how PTSD shapes one's response to ambiguous emotional stimuli. Surprise faces can be used as ambiguous stimuli because they can suggest positive or negative events. It is possible that individuals with PTSD may be more likely to interpret surprise faces as negative and demonstrate heightened amygdala activation. We examined this response to ambiguous facial expressions in PTSD.

Methods

Participants were 12 male combat veterans from the Vietnam War with PTSD and 16 healthy controls who had not been exposed to combat and did not have PTSD. While in an fMRI, participants viewed 8 blocks of surprise and neutral faces. All fMRI scans were completed using a Siemens Trio Tim 3.0 Tesla MRI with a 12 channel gradient head coil. Following the procedure in the scanner, participants were given questionnaires asking them to categorize the 16 surprise and neutral facial expressions they had previously seen out of seven possible emotions (fear, disgust, anger, surprise, neutral, happy, or sadness). They also were asked to rate each expression on valence from a scale to -4 (very negative) to 4 (very positive). Using SPM8, statistical analyses were conducted to create contrast images including Surprise v. Neutral, Surprise v. Fixation, and Neutral v. Fixation.

Surprise vs. Neutral facial expressions (Ekman & Freisen, 1976)

Valence Ratings and Categorization Results

Blocked Valence Ratings of Surprised Faces

Forced Choice Categorization of Surprised Faces as Fearful

There were no between group differences in valence ratings or forced choice categorization amongst the PTSD and control groups.

Neuroimaging Results

Surprise v. Fixation Contrasts:

Left amygdala (-16, 4, -22) z = 3.17

Right amygdala (18, 2, -24) z = 3.11

There was significantly more activation in the left and right amygdala of the PTSD group compared to the control group in the Surprise v. Fixation contrast.

Neutral v. Fixation Contrast:

Left amygdala (-18, -1, -20) z = 3.62

There was significantly more activation in the left amygdala of the PTSD group compared to the control group in the Neutral v. Fixation contrast.

Surprise v. Neutral Contrasts:

There was no significant difference in activation between PTSD and control groups in any region of interest.

Results

We did not find any any significant differences of behavioral response in the valence interpretation or categorization between PTSD and control groups. However, we did find that those with PTSD had greater amygdala responses in response to surprised facial expressions.

Future Research

We are currently investigating the brain responses to the same tasks of our participants' identical twins, with the goal of distinguishing whether specific activation can be attributed to genetic vulnerability, trauma exposure, or is an acquired trait of PTSD.

We are also investigating other brain regions of interest relevant to fear, including the ventral medial prefrontal cortex, dorsal anterior cingulate cortex, and insula.

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Acknowledgements

Thank you to the Laidlaw Scholars Foundation, Dr. Lisa Shin, Dr. Dawn Terkla, and Ms. Diana Capone.

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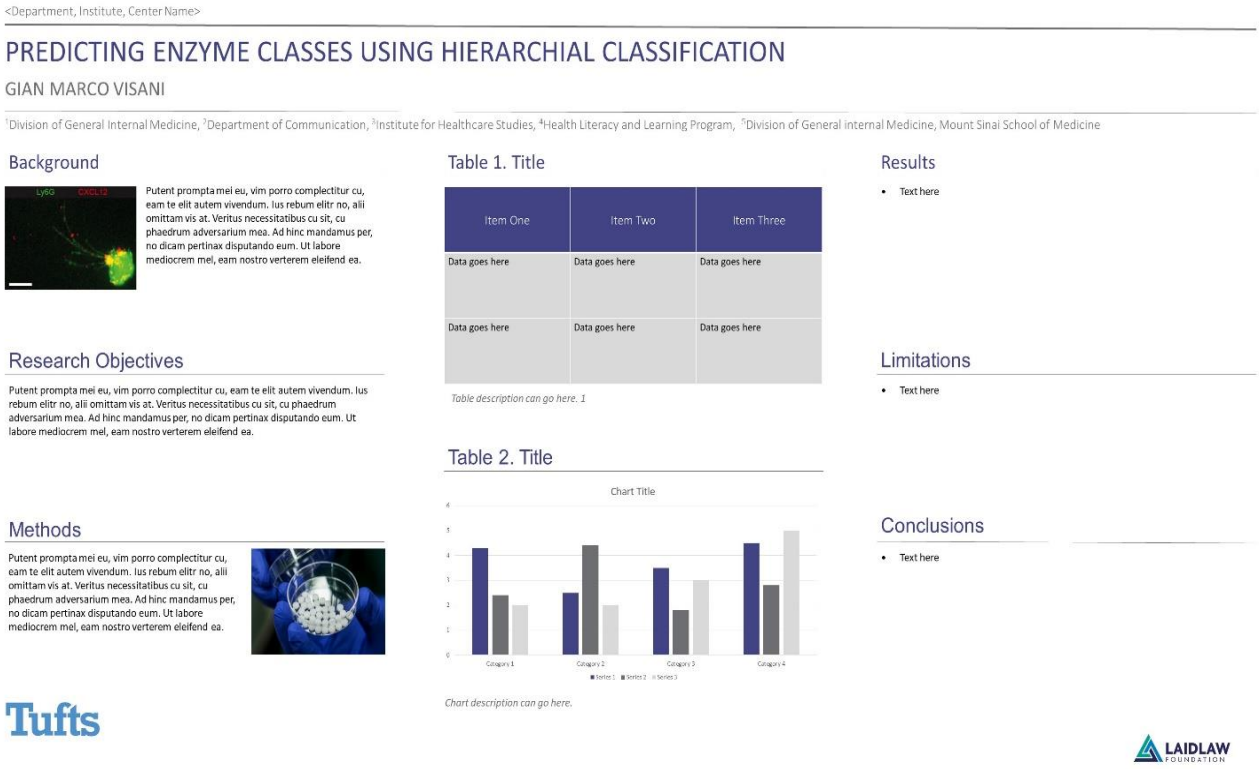
GIAN MARCO VISANI (2018-2020). I am a 2018 Laidlaw Scholar from Faenza, a small town in Italy. I am a Junior at Tufts majoring in Computer Science, also surely minoring and maybe double majoring in Physics. I came across the Laidlaw Scholarship as I was looking for funding for doing research with one of my professors, who had already asked me if I wanted to work with her. I thought that the leadership programming could be a great addition to my research experience. I had an experience in leadership in high school, where I was student body president my senior year, and I knew very well from that experience that I had many things to learn about being a good leader, and I thought that Laidlaw could help me in this pursuit. My project is aimed at understanding enzyme promiscuity, i.e. the ability of enzymes to catalyze reactions that they did not evolve to catalyze in the first place, through a data analysis performed with Machine Learning techniques. My mentor is **Professor Soha Hassoun**, from the Computer Science department. The highlight has been the everyday acknowledgment of what I have learned in the process: the shortcuts I learned, the tools I know how to use, the skills I gained, the confidence I gained in saying my own opinion to my mentor. The lowlight has been writing the paper… I am not very fond of writing. I am never sure of what I am doing, especially in English, which is not my native language. I plan on Publishing my research on the Bioinformatics Journal, hopefully I will send it to review by the end of September. To future scholars I say: don't worry if you don't feel ready. If you are excited about what it is you are researching, if you are eager to learn from every single moment of the research process, if you see failure as exciting opportunities to learn something new, then you have nothing to worry about. Outside of academics, I play waterpolo in the Tufts club team, I am a certified scuba diver, and I am very passionate about cooking. I also love traveling and getting to experience different cultures. However, I believe that every place is interesting if you live it with a critical eye and, most of all, if you get to know the people from there. Boston and Tufts, and the people I find there, are very interesting for me, since I am from Italy. I am currently unsure about where I would like to be five years from now, whether to stay in Academia and immediately pursue a PhD program or try to get to know the Business world of Computer Science through working at a tech company.

ABSTRACT. **GIAN MARCO VISANI.** ***Predicting Enzyme Classes Using Hierarchical Classification.*** Despite significant progress in sequencing technology, there are many cellular enzymatic activities that remain unknown. We develop in this work a new method for training enzyme-specific predictors that take as input a given query substrate molecule and return whether the enzyme would act on that substrate or not. When addressing this enzyme promiscuity prediction problem, a major challenge is the lack of a diverse set of labeled data for negative cases (enzyme-substrate pairs, where the enzyme does not act to transform the substrate to a product molecule). To overcome this issue, our proposed method can learn from molecules known to be catalyzed by an enzyme (positive cases), molecules with unknown relationships (unlabeled cases), and molecules labeled as inhibitors for the enzyme. We refer to inhibitors as hard negative cases because they bind to the enzyme (similar to positive cases) but are not transformed by the enzyme. Our method uses confidence scores derived from

structural similarity to treat unlabeled examples as weighted negatives. Our method gathers statistical strength from known hierarchical relationships of the Enzyme Commission nomenclature to perform hierarchical classification. We compare our proposed hierarchy-aware predictor against a baseline that cannot share information across related enzymes. Using data from the BRENDA database, we show that each of our contributions – hierarchical sharing, per-example confidence weighting of unlabeled data based on molecular similarity and including inhibitors as hard-negative examples – contributes towards a better characterization of enzyme promiscuity.

SOHA HASSOUN. I am Professor and Past Chair of the Department of Computer Science at Tufts University. I hold secondary appointments in the Department of Electrical and Computer Engineering and also in the Department of Chemical and Biological Engineering at Tufts. I received the BSEE degree from South Dakota State University, Brookings, SD, the Masters' degree from the Massachusetts Institute of Technology, Cambridge, MA, and the Ph.D. degree from the Department of Computer Science and Engineering, University of Washington, Seattle, WA. My research interest is in the area of Bio Design Automation**,** where my lab aims to build tools for analyzing and designing complex biological systems. My lab is now focused on using Machine Learning to develop such tools, with a focus on enzyme promiscuity prediction and metabolomics analysis. My prior work included developing algorithms from pathway and modularity analysis and pathway synthesis. I was an integrated circuit designer with the Microprocessor Design Group, Digital Equipment Corporation, Hudson, MA, 1988-1991, and worked as a consultant to several EDA companies including Mentor Graphics and Carbon Design Automation. My research interests in this area include developing algorithmic solutions to facilitate designing integrated circuits and understanding the impact of new technologies such as double-gate devices, carbon nanotubes, and 3-D integration on design. I was a recipient of the NSF CAREER Award, and several awards from ACM/SIGDA for my service, including the Distinguished Service Award in 2000 and 2007, and the 2002 Technical Leadership Award. I held executive and technical leadership positions for several conferences and workshops, including DAC, ICCAD, IWLS, and TAU. I was ICCAD Technical Program Chair in 2005, ICCAD Vice Chair in 2006, ICCAD Chair in 2007, DAC Technical Program Co-Chair in 2011 and 2012, DAC Vice Chair in 2013, and DAC Chair in 2014. I co-founded the International Workshop on Bio-Design Automation in 2009. I was an Associate Editor of the IEEE Transactions on Computer-Aided Design and of the IEEE Design and Test magazine. I was nominated to the Defense Science Study Group, affiliated with DARPA's Institute for Defense Analyses. In 2013, I was recognized by the Electronic Design Automation Consortium as one of thirty-three luminaries in the field of Electronic Design Automation. I served on the IEEE Council on Design Automation and was Director of Educational Activities for ACM SIGDA Special Interest Group on Design Automation for several years. She is a fellow of Tau Beta Pi and a senior member of IEEE and ACM. **Gian Marco Visani** worked with Prof. Soha Hassoun during the past two summers. He used machine learning to predict the likelihood of an enzyme acting on a given molecule, an important task in many biomedical and biological

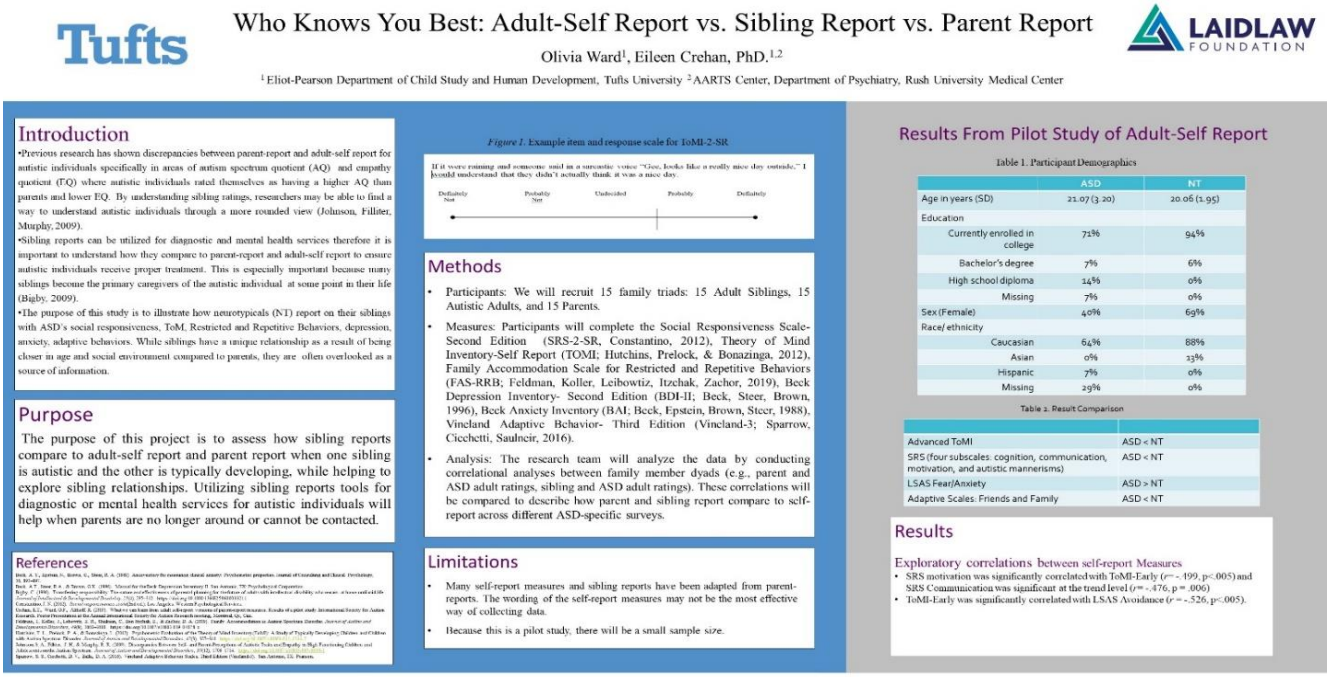
engineering applications. Gian Marco made great progress and he is on his way to publishing his first manuscript.



OLIVIA WARD (2019-2021). After learning about the program from a Cohort 1 Laidlaw Scholar, I applied to the program and was accepted in the spring of 2019. When I began working in a research lab on campus, I was overwhelmed with the time and dedication that is required to lead a research project. My research mentor, **Dr. Eileen Crehan**, told me to keep a notebook of ideas about topics I would be interested in researching. By our next meeting, I found that there were a lot of areas of Autism Spectrum Disorder (ASD) sibling research that have never been explored but would help to shed a light on the sibling dynamics where one sibling has ASD. This summer has allowed me to explore an area of research that I am really

passionate about and connect with other professors and researchers about a common interest. I have also learned that you have to be very flexible with research, because not everything will go as planned. My research project, “Who Knows You Best: Adult-Self Report vs Sibling Report vs Parent Report,” works to explore how sibling relationships differ from parent-child relationships and how this can affect autism research for the future. I am currently studying Clinical Psychology and Child Studies & Human Development. I am originally from New Jersey, where I enjoy spending time with my family at the beach during the summer. In the winter, I enjoy skiing and doing puzzles. However, this summer I worked at a summer camp for teens with a high cognitive autism spectrum disorder or related social profile. During our summer, we challenged the teens to step outside of their comfort zones and practice independent living skills and relationship building. After graduating from Tufts in 2021, I hope to continue working with individuals with ASD in a clinical setting, where I can work hands on with these individuals. For future scholars, it is important to be flexible and understand that not everything will go how you planned, but there are a number of people willing to help you along the way.

EILEEN CREHAN. As a clinical scientist, my research efforts center on social impairments and social functioning of adolescents and young adults with autism spectrum disorder. My work employs eye tracking and psychophysiological monitoring systems to capture the nuances of social perception and response. I have applied these approaches to better understand social cognition in ASD, as well as to examine how social communication and perspective-taking impact gaze behavior, emotion perception, and physiological arousal transdiagnostically. In addition to perception, I am interested in the development of programming relating to sexuality and relationship formation for autistic individuals. I seek to address content limitations and accessibility challenges relating to current sexuality education programs. My work seeks to improve the rigor of sex education research through integration of both clinical trial and implementation research methodologies, with the goal of developing educational programming which addresses critical issues such as sexuality, pursuing and maintaining relationships, and physical and emotional safety. The role of self-advocates and family advocates in the design and implementation of my research is very important to me. I am a Faculty mentor to Laidlaw Scholar **Olivia Ward.**



SAM WEIDNER (2018-2020). I am a Mathematics major in the class of 2020 originally from the suburbs of Chicago. I became a Laidlaw Scholar in the summer of 2018 and am conducting a project titled "Curing Hepatitis C, Treating AIDS: A Comparative Analysis of Innovation and Regulation in the Pharmaceutical Industry". My research mentor Professor **Rosemary Taylor** and I first began working together in the Fall of my sophomore year after I took a class with her my freshman Spring called "Politics and Risk in Science and Technology". I became interested in her project studying how different governments, particularly the US and the UK, responded to the HIV/AIDS and Hepatitis C epidemics. That Spring I decided to apply for the Laidlaw scholarship so I could get funding to continue my work with her over the summers. Laidlaw provided a unique opportunity for me because it allowed me to pursue my project over two consecutive summers, giving me the extra time and flexibility that I needed to really explore and expand my research into something I was interested in. It also pairs your research project with extensive leadership and teambuilding training that has helped me become a better student and researcher and prepared me well for life after college. In my second summer of research, I was able to travel to London for two weeks to conduct research and study documents in multiple libraries and archives. Beyond being a Laidlaw Scholar, I play on the men's club volleyball team at Tufts and I write a weekly column for the student newspaper The Tufts Daily. I also was lucky enough my Junior Fall to

study abroad, taking classes in Berlin. I would like to continue work in health policy and health economics after I graduate and think my Laidlaw project was a great stepping stone towards that.

ABSTRACT. **SAM WEIDNER** ***Curing Hepatitis C, Treating AIDS: A Comparative Analysis of Innovation and Regulation in the Pharmaceutical Industry***. At the onset of the HIV/AIDS epidemic, drug development and approval processes in the United States were slow and inefficient and the antiviral therapy research field was small. This changed as the virus rapidly spread and the death toll rose. The UK based pharmaceutical company Burroughs Wellcome took the lead in the first development of antivirals to treat people with AIDS due to their unique history in antiviral drug development and their research culture. In turn, they kickstarted a rapid and competitive race across the pharmaceutical and biotech industries to develop the next best treatment. Additionally, through protests, a well-educated and mobilized patient base swayed the FDA to create more efficient mechanisms to get drugs to patients and advocated for all experimental therapies to be available. It was a watershed moment for the FDA because of the numerous policies put in place in the following decade to accelerate their approval speeds such as the Prescription Drug User Fee Act of 1992. The three-year period between the discovery of the HIV virus in 1984 and the approval of AZT, the first drug to treat AIDS, in 1987 was a unique period that had a lasting effect on the drug industry in the United States and worldwide. Unfortunately, AZT also set a trend of unprecedented high prices on new breakthrough antiviral treatments, creating a massive obstacle for access that persists even today.

ROSEMARY C.R. TAYLOR. I work on the comparative history of disease and health policy within the framework of political sociology and the sociology of science and technology. My recent research compares U.S. responses with those of the European Union and its member states to cross-border health threats (such as TB, pandemic influenzas, AIDS, Ebola and zika), especially when their carriers are perceived to be migrants. My current book project, "*Risks Unforeseen"*, funded by NIH, is a study of the generation and international transfer of scientific knowledge, and how it is factored (or not) into political decision-making, with an empirical focus on the history of two blood-borne viruses, Hepatitis C and HIV, and subsequent risk regulation in Britain and the United States. **Sam Weidner** and I have worked together as Laidlaw partners over two summers on how drugs were developed for these two viruses, a case study of innovation and regulation in the pharmaceutical industry over the last three decades.