Laila C. Johnston

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Education

2018 – 2023 University of Central Florida (UCF) | Orlando, FL
Bachelor of Science (B.S.) in Mathematics
Minor in Computer Science, Minor in Philosophy

Research Interests

computational cognitive science ~ probabilistic programming ~ compositional concepts ~ concept learning ~ probabilistic language of thought ~ relationship between conceptual representation, language, and thought ~ program induction ~ question asking ~ learning from explanation

Research Experience

2021 – present ***CoCoSci Group***, Department of Brain and Cognitive Sciences, Massachusetts Institute of Technology, Cambridge, MA
Undergraduate Researcher (Sep. 2022 – present)
Research Fellow, MSRP Bio/Neuro (Summer 2022)
Visiting Student (Aug. 2021 – Dec. 2021)
Advisor: Prof. Joshua B. Tenenbaum
- Used WEBPPL to build probabilistic models that capture the compositional and probabilistic nature of human concepts
- Investigated how these models can form and reason with novel concepts in the domain of tug of war
- Used R to analyze experimental data and model predictions
- Conducted a large-scale sensitivity analysis (grid search) of the hyper parameters of the WEBPPL model
- Investigating how large language models, in particular OpenAI's GPT-3 model, can reason with concepts in the domain of tug of war

Summer 2021 **Research Fellow**, MSRP Bio/Neuro, Center for Brains, Minds, and Machines, *Computational Cognitive Neuroscience Lab*, Harvard University, Cambridge, MA
Advisor: Prof. Samuel J. Gershman
- Created models of human visual working memory in the domain of human faces
- Learned and used SCALA to generate faces using the Basel Face Model
- Designed a change-detection experiment, collected the data, and analyzed the results

2020 – 2021 **Carnegie Mellon University**, *Center for the Neural Basis of Cognition*, Pittsburgh, PA
Undergraduate Researcher (Sep. 2020 – Feb. 2021)
Research Fellow, Undergraduate Program in Neural Computation (Summer 2020)
Advisor: Prof. David Danks
- Investigated individual human differences in causal learning patterns and how certain causal learning models could best describe the ways individuals make causal inferences
- Collaborated on developing previously known causal learning models as computational models
- Created seven novel causal learning models
- Developed code in PYTHON to find and analyze causal learning models of best fit for a set of experimental data
- Wrote and submitted a research paper to the 43rd Annal Conference of the Cognitive Science Society; read paper reviews and edited paper accordingly

2019 – 2020 **Undergraduate Research Assistant**, *Laboratory for Autonomy-Brain Exchange (LabX)*, University of Central Florida, Orlando, FL
Advisor: Prof. Ben D. Sawyer

- Assisted in conducting a driving simulation experiment by ensuring informed consent from participants, explaining the procedures of the experiment, and recording data
- Learned the foundations of coding an artificial neural network
- Explored representing and extending the O-Ring Theory of Economic Development as a computational simulation

Publications

Johnston, L.*, Hillman, N.*, Danks, D. (2021). Individual Differences in Causal Learning. ***Proceedings of the 43rd Annual Conference of the Cognitive Science Society.***

** co-author*

Presentations

Johnston, L.C. [Δ], Siegel, M.H., Tenenbaum, J.B., Gerstenberg, T. (2022, October). Reasoning with Compositional Concepts in the Probabilistic Language of Thought. ***SACNAS NDiSTEM Research Conference.*** Poster presentation.

Johnston, L.C. [Δ], Siegel, M.H., Tenenbaum, J.B., Gerstenberg, T. (2022, August). Reasoning with Compositional Concepts in the Probabilistic Language of Thought. ***Center for Brains, Minds, and Machines Summer Research Poster Session.*** Poster presentation.

Johnston, L.C. [Δ], Siegel, M.H., Tenenbaum, J.B., Gerstenberg, T. (2021, September). Reasoning with Compositional Concepts. ***MKN McNair Heartland Research Conference.*** Oral presentation (15 minutes).

Johnston, L.C. [Δ], Bates, C.J., Egger, B., Gershman, S.J. (2021, August). Scaling Models of Visual Working Memory to Natural Images: A Case Study in Human Faces. ***Center for Brains, Minds, and Machines Summer Research Poster Session.*** Poster presentation.

Johnston, L. [Δ], Hillman, N., Danks, D. (2021, March). Individual Differences in Causal Learning. ***UCF Student Scholar Symposium.*** Poster presentation.

Johnston, L. [Δ], Hillman, N. [Δ], Danks, D. (2020, August). Individual Variation in Causal Learning. ***Center for the Neural Basis of Cognition Undergraduate Summer Research Showcase.*** Poster presentation. Video presentation.

[Δ] *presenter*

Awards and Honors

2023 **National Science Foundation Graduate Research Fellowship**
Summer 2022 **Massachusetts Institute of Technology Summer Research Fellow** (NSF Funded)
Summer 2022 **McNair Summer Research Institute Scholarship**
2022 **Astronaut Scholar Nominee**, University of Central Florida
Feb. 2022 **Mathematics of Collective Intelligence Workshop Travel Scholarship**, IPAM, UCLA
Fall 2021 **Visiting Student Fellowship**, Department of Brain and Cognitive Sciences, MIT
2018 – 2021 **Dean's List** (5 Semesters), University of Central Florida
2021 **Hispanic Heritage Scholarship Fund of Metro Orlando Scholar**
Summer 2021 **Massachusetts Institute of Technology Summer Research Fellow** (NSF Funded)
Summer 2021 **McNair Summer Research Institute Scholarship**
2020 **Ronald E. McNair Scholar**
2020 **Carolyn Euliano Endowed Scholarship in Mathematics**, University of Central Florida
Summer 2020 **Carnegie Mellon University Summer Research Fellow** (NIH Funded)
2018 **EXCEL Scholar**, University of Central Florida

2018 **Pegasus Scholar**, University of Central Florida
2018 **Florida's Bright Futures Academic Scholar**
2018 **International Baccalaureate Diploma Recipient**

Leadership

2020 – present ***Cognitive Sciences Club***, University of Central Florida, Orlando, FL
Presidential Advisor (April 2022 – April 2023)
- Advise, guide, and support the president on club matters
- Actively talk with and guide members of the club on their research goals, research interests, and academic aspirations

President (Dec. 2020 – April 2022)
- Scheduled and supervised meetings, faculty and graduate student panels, and social events
- Delegated responsibilities to executive team

Secretary (July 2020 – Dec. 2020)
- Documented club meetings, discussions, and club attendance
- Updated members through weekly emails about meetings, events, and opportunities for research and conferences in cognitive science

2020 – present ***Artificial Intelligence Club (AI@UCF)***, University of Central Florida, Orlando, FL
Discussions Director (April 2022 – April 2023)
- Lead research paper discussions; biweekly 90-minute meetings
- Actively talk with and guide members of the club on their research goals, research interests, and academic aspirations

Vice President (April 2021 – April 2022)
- Oversaw decisions, activities, event planning and scheduling of club events
- Coordinated a project collaboration with the Institute of Electrical and Electronics Engineers (IEEE) on creating a robot arm that can play chess using machine learning techniques

Coordinator (Feb. 2021 – April 2021)
- Co-planned meetings through discussing topic ideas and attended presentation rehearsals
- Answered questions on coursework, scheduling, and professional development opportunities

2019 – 2020 **Secretary**, ***Collegiate Mathematical Society***, University of Central Florida, Orlando, FL
- Organized workshops, presentations, and events related to topics in mathematics
- Documented club meetings, discussions, and attendance
- Promoted the club by making flyers, sending emails, and tabling at expos

Teaching

Jan. 2022 **Teaching Assistant & Mentor**, *Quantitative Methods Workshop*, Massachusetts Institute of Technology, Cambridge, MA
Supervisor: Dr. Mandana Sassanfar
- Invited to help 80 undergraduate students understand how to solve common problems in biology and neuroscience through writing programs in PYTHON
- Spoke to undergraduate students about summer research programs and shared my experiences as a Visiting Student at MIT
- Reviewed statements of purpose, CVs, and other application materials for summer research programs

Spring 2020 **Undergraduate *EXCEL* Tutor**, University of Central Florida, Orlando, FL
Supervisor: Sarah Evans
- Aided students in UCF's *EXCEL Program* in math and computer science topics
- Guided and supported students on their current and future academic careers

Research Paper Discussions

Oct. 2022 **Human Level Concept Learning Through Probabilistic Program Induction (Lake et al. 2015)**; *Led a paper discussion to 15 students at AI@UCF Discussions Meeting (90 minutes)*

Sep. 2022 **Building Machines That Learn and Think Like People (Lake et al. 2016)**; *Led a paper discussion to 30 students at AI@UCF Discussions Meeting (90 minutes)*

Feb. 2022 **Concepts in a Probabilistic Language of Thought (Goodman et al. 2015)**; *Led a paper discussion to 15 students at AI@UCF Discussions Meeting (90 minutes)*

Invited Talks

Oct. 2022 **How to Get Involved in Undergraduate Research**; *AI@UCF & Cognitive Sciences Club at UCF (60-minute talk)*

April 2022 **Collective Intelligence: Emergence, Swarms, and Cooperation**; *Cognitive Sciences Club at UCF (60-minute talk)*

March 2022 **Reasoning with Compositional Concepts**; *CoCoSci Lab Meeting at MIT (90-minute talk, ~35 person audience)*

Feb. 2022 **Representing Human Thought and Reasoning with Probabilistic Programs**; *Cognitive Sciences Club at UCF & AI@UCF (60-minute talk)*

Feb. 2022 **Concepts: Representational Structure, Learning, and Reasoning**; *Cognitive Sciences Club at UCF (60-minute talk)*

Invited Panels

Oct. 2021 **Undergraduate Research Student Panelist**, *The Undergraduate Research Committee*, San Diego State University, San Diego, CA
- Spoke about why research is important and why others should get involved in research
- Gave advice on how to apply and prepare for an undergraduate research experience

Oct. 2020 **Summer Research Student Panelist**, *The Office of Academic Advancement Programs*, University of Central Florida, Orlando, FL
- Shared experiences from Carnegie Mellon University's Summer Undergraduate Program in Neural Computation
- Advised prospective applicants on preparing for summer research programs
- Discussed the advantages and disadvantages of doing research virtually

Workshops and Conferences

Oct. 2022 **Attendee**, *Brown University Graduate Programs Diversity Preview*, Brown University, Providence, RI
- Accepted and received full funding to attend
- Attended workshops on how to select a graduate program and choose a PhD research advisor
- Spoke to faculty and graduate students in various departments, including the cognitive sciences department

July 2022 **Attendee**, *CogSci Conference*, Cognitive Science Society, Toronto, Canada
- Attended this conference as part of the *CoCoSci Group* at MIT
- Attended talks on concept learning, reasoning in large-language models, and how humans make social inferences
- Networked with grad students, post-docs, and faculty

Feb. 2022 **Attendee**, *Mathematics of Collective Intelligence Workshop*, Institute for Pure and Applied Mathematics, University of California Los Angeles, Los Angeles, CA
- Accepted and received full funding to attend this workshop
- Attended talks on applied category theory, animal intelligence, Bayesian social learning and cooperation, how to model abstract concepts, and institutional intelligence
- Discussed how to build a mathematical language of intelligence, what intelligence even is (and what collective intelligence is), ethical implications of modeling intelligence, and what it means for agents to be goal maximizers

Oct. 2021 **Attendee**, *Princeton Prospective Ph.D. Preview (P3) Conference*, Princeton University, Princeton, NJ
- Accepted to attend workshops on the important elements of research, the graduate school application process, CV and resume writing, and professional development
- Networked with graduate students and learned about life at Princeton
- Visited the psychology, neuroscience, and computer science departments

Jan. 2021 **Attendee**, *Quantitative Methods Workshop*, Massachusetts Institute of Technology, Cambridge, MA
Director: Dr. Mandana Sassanfar
- Accepted and received full funding to attend this workshop
- Attended MATLAB workshops on machine learning, neural spike analysis, analyzing fMRI data using the General Linear Model, and calcium imaging data analysis
- Learned about and coded different data science techniques such as the k-means algorithm, support vector machine algorithm, peri/post-stimulus time histogram (PSTH), and z-scoring
- Attended lectures on quantifying genetic variants, computer vision, functional imaging of the human brain, and convolutional neural networks

Jan. 2019 **Attendee**, *Joint Mathematics Meetings*, Baltimore, MD
- Attended this conference as part of the *Collegiate Mathematical Society* at UCF
- Networked with professors, post-docs, and graduate and undergraduate students
- Learned about mathematical origami and created a stellated octahedron
- Attended lectures on graph theory, differential geometry, coding theory, and topology

Skills

Programming PYTHON, WEBPPL, R, JAVA, C

Relevant Coursework

Mathematics Calculus I – III, Ordinary Differential Equations I, Logic and Proof in Mathematics, Matrix Algebra, Linear Algebra, Probability, Mathematical Modeling I, Introduction to Graph Theory, Mathematical Foundations of Machine Learning and Artificial Intelligence, Advanced Calculus I, Abstract Algebra I, Introduction to Topology

Comp Sci Computer Science I, Object Oriented Programming, Computer Science II (Algorithms)

Other Physics I, Physics II*, Formal Logic I, Philosophy of Love, Philosophy of Mind, Philosophy of Science, Minds and Machines: Philosophy of Cognitive Science, Metaphysics

**To be completed by May 2023*