

# Eric Elmoznino

Artificial Intelligence  
Cognitive Neuroscience

## Contact

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## Websites



## Education

PhD | Computer Science  
Mila (Université de Montréal)  
2022-Now GPA: 4.3/4.3

MA | Cognitive Science  
Johns Hopkins University  
2019-2020 GPA: A+

BASc | Computer Engineering  
University of Toronto  
2014-2019 GPA: 3.95/4.0

DCS | Health Sciences  
Dawson College  
2012-2014 GPA: 96/100

## Skills

### Languages/Frameworks

Python, PyTorch, JAX, TensorFlow,  
sklearn, Matlab, C++, C, C#, Swift,  
JavaScript, HTML, CSS, LaTeX

### Subjects/Techniques

AI, Deep learning, Computational  
neuroscience, Linguistics,  
Kolmogorov complexity

### Spoken Languages

English, French (Fluent in both)

## Interests

### Mind, Brain, and AI

Consciousness, Compositionality,  
In-context learning, Causality,  
Knowledge acquisition, OoD  
generalization, Lifelong learning

### Public Speaking

Technical presentations, Teaching

### Other Disciplines

Data Science, Genetics, Astrophysics,  
Philosophy of mind, Epistemology

### Hobbies

Reading, Piano, Meditation,  
Snowboarding, Tennis, Basketball

## Research Positions & Work Experience

- 2022-Now **AI Researcher (PhD)** Mila (Université de Montréal), Montreal, QC  
Development of AI with inductive biases from conscious higher-level cognition, supervised by Profs. Guillaume Lajoie and Yoshua Bengio
- 2024-Now **AI Student Researcher** Google – Paradigms of Intelligence, Remote  
Unifying action and prediction in large generative sequence models, supervised by João Sacramento
- 2020-Now **Data Science Instructor** Lighthouse Labs, Remote  
Teach lectures on machine learning topics at a full-time data science bootcamp to students with no prior coding experience
- 2019-22 **Cognitive Science Researcher (MA)** Johns Hopkins University, Baltimore, MD  
Research on information representation and algorithms in the visual system of the human brain with Prof. Michael Bonner
- 2021 **Computational Neuroscience TA** Neuromatch Academy, Remote  
Lead groups of students through tutorial exercises ◦ Review lecture material and answer student questions
- 2017-19 **Machine Learning Researcher** ModiFace, Toronto, ON  
Work on computer vision machine learning models for the beauty industry ◦ Research papers on makeup rendering and skin condition diagnostics using deep learning
- 2018 **Computer Vision Contractor** Precious, Remote  
Work on computer vision machine learning models related to facial perception for a mobile app that automatically makes photo albums of babies for new parents
- 2016 **Software Developer Intern** Orbis Investments, Vancouver, BC  
Full-stack web development using AngularJS, Angular Material, ASP.NET MVC, Web API, and SQL Server in order to improve internal workflow efficiency for financial reporting
- 2012-14 **Private, Infantry Division** Canadian Armed Forces (Reserves), Valcartier, QC  
Discipline and weapons training ◦ Participation in combat and recon-naissance exercises

## Highlighted work

- 2023-Now **Representational complexity and compositionality**  
Deriving a formal quantitative definition of compositionality using ideas from algorithmic complexity theory
- 2023-Now **Compositional attractor models of human thought**  
Learning discrete and compositional models of conscious human thought using neural network attractor dynamics ◦ Accounting for ineffability in explaining away the “hard problem” of consciousness
- 2024-Now **In-context learning and Occam’s Razor**  
A normative theory of in-context learning as a meta-learning algorithm for fitting the simplest model that explains the training data
- 2022-23 **Sampling compositions of modular neural networks**  
Jointly learning a set of neural network modules and how to sample context-conditioned compositions of them using GFlowNets
- 2021-22 **Dimensionality and Manifold Geometry of Visual Representations**  
Quantifying the relationship between the geometry of neural network representations and their similarities to visual cortex
- 2019-20 **Stimulus Synthesis for Brain Region Manipulation**  
Generative model of images that would elicit a desired pattern of brain activity in a given region ◦ Behavioural experiments
- 2020 **Language Model With Inductive Bias For Compositional Grammar**  
Tree-RNN provided part-of-speech tags and sentence parses in order to learn compositional representations of language

## Publications

- 2024 **A Complexity-Based Theory of Compositionality.** [Eric Elmoznino](#), Thomas Jiralerspong, Yoshua Bengio, Guillaume Lajoie *Preprint*
- 2024 **In-context learning and Occam's razor.** [Eric Elmoznino](#), Tom Marty, Tejas Kasetty, Leo Gagnon, Sarthak Mittal, Mahan Fathi, Dhanya Sridhar, Guillaume Lajoie *Preprint*
- 2024 **Multi-agent cooperation through learning-aware policy gradients.** Alexander Meulemans, Seijin Kobayashi, Johannes von Oswald, Nino Scherrer, [Eric Elmoznino](#), Blake Richards, Guillaume Lajoie, Blaise Aguera y Arcas, João Sacramento *Preprint*
- 2024 **Amortizing intractable inference in large language models.** Edward J. Hu, Moksh Jain, [Eric Elmoznino](#), Younesse Kaddar, Guillaume Lajoie, Yoshua Bengio, Nikolay Malkin *ICLR talk – best paper honorable mention*
- 2024 **Sources of Richness and Ineffability for Phenomenally Conscious States.** [Eric Elmoznino](#), Xu Ji, George Deane, Axel Constant, Guillaume Dumas, Guillaume Lajoie, Jonathan Simon, Yoshua Bengio *Neuroscience of Consciousness*
- 2024 **High-performing neural network models of visual cortex benefit from high latent dimensionality.** [Eric Elmoznino](#) & Michael F. Bonner *PLOS Computational Biology*
- 2024 **Does learning the right latent variables necessarily improve in-context learning?** [Eric Elmoznino](#), Sarthak Mittal, Leo Gagnon, Sangnie Bhardwaj, Dhanya Sridhar, Guillaume Lajoie *ICLR Workshop poster*
- 2024 **Convolutional architectures are cortex-aligned de novo** Atlas Kazemian, [Eric Elmoznino](#), Michael F. Bonner *Preprint*
- 2023 **Discrete, compositional, and symbolic representations through attractor dynamics.** Andrew Nam, [Eric Elmoznino](#), Nikolay Malkin, Chen Sun, Yoshua Bengio, Guillaume Lajoie *NeurIPS Workshop talk*
- 2023 **Consciousness in Artificial Intelligence: Insights from the Science of Consciousness.** Patrick Butlin, Robert Long, [Eric Elmoznino](#), Yoshua Bengio, Jonathan Birch, Axel Constant, George Deane, Stephen M. Fleming, Chris Frith, Xu Ji, Ryota Kanai, Colin Klein, Grace Lindsay, Matthias Michel, Liad Mudrik, Megan A. K. Peters, Eric Schwitzgebel, Jonathan Simon, Rufin VanRullen *Preprint*
- 2023 **Scene context is predictive of unconstrained object similarity judgments.** Caterina Magri, [Eric Elmoznino](#), Michael F. Bonner *Cognition*
- 2023 **Learning Macro Variables with Auto-encoders.** Maitreyi Swaroop, [Eric Elmoznino](#), Dhanya Sridhar *Neurips Workshop poster*
- 2020 **Visual representations derived from multiplicative interactions.** [Eric Elmoznino](#) & Michael F. Bonner *NeurIPS Workshop poster*
- 2019 **A new procedure, free from human assessment that automatically grades some facial skin structural signs. Comparison with assessments by experts, using referential atlases of skin ageing.** Jiang R., Kezele I., Levinshstein A., Flament F., Zhang J., [Elmoznino E.](#), Ma J., Ma J., Coquide J., Arcin V., Omoyuri E., Aarabi P. *International Journal of Cosmetic Science*

## Invited Talks & Podcasts

- 2024 **Why can't we describe our conscious experiences? An information theoretic attractor dynamics perspective of ineffability — *Models of Consciousness conference***
- 2024 **Consciousness, ineffability, and AI safety — *Mila AI Safety Reading Group***
- 2023 **Sampling discrete objects through continuous attractor dynamics — *Mila GFlowNet Reading Group***
- 2023 **Why can't we describe our conscious experiences? An information theoretic attractor dynamics perspective of ineffability — *Computational Phenomenology Group***
- 2023 **Why can't we describe our conscious experiences? An information theoretic attractor dynamics perspective of ineffability — *Active Inference Institute podcast***
- 2023 **Why can't we describe our conscious experiences? An attractor dynamics perspective of the ineffability of qualia — *University of Toronto guest lecture***
- 2020 **How does the brain work? Cognitive science research — *SABES***
- 2020 **Introduction to Programming with Python — *UofTHacks***

## Supervision

2023	<b>Maitreyi Swaroop</b> Masters (Mathematics and Computing)	Mila, Montreal, QC
2021-22	<b>Atlas Kazemian</b> Masters (Cognitive Science)	Johns Hopkins University, Baltimore, MD
2020-21	<b>Adyant Balaji</b> Undergraduate (Computer Engineering & Cognitive Science)	Johns Hopkins University, Baltimore, MD
2019-20	<b>Maro Maged Doce</b> Undergraduate (Neuroscience)	Johns Hopkins University, Baltimore, MD

## Patents

2022	<b>System and method for image processing using deep neural networks.</b> Levinshtein A., Chang C., Phung E., Kezele I., Guo W., <u>Elmoznino E.</u> , Jiang R., Aarabi P. <i>U.S. Patent No. 11216988</i> . Washington, DC: U.S. Patent and Trademark Office
2021	<b>Image-to-image translation using unpaired data for supervised learning.</b> <u>Elmoznino E.</u> , Kezele I., Aarabi P. <i>U.S. Patent Application No. 17096774</i> . Washington, DC: U.S. Patent and Trademark Office
2020	<b>System and method for augmented reality using conditional cycle-consistent generative image-to-image translation models.</b> <u>Elmoznino E.</u> , Ma H., Kezele I., Phung E., Levinshtein A., Aarabi P. <i>U.S. Patent Application No. 16683398</i> . Washington, DC: U.S. Patent and Trademark Office
2020	<b>Machine image colour extraction and machine image construction using an extracted colour.</b> Elmoznino E., Aarabi P., Zhang Y. <i>U.S. Patent Application No. 16854975</i> . Washington, DC: U.S. Patent and Trademark Office
2020	<b>Automatic image-based skin diagnostics using deep learning.</b> Jiang R., Ma J., Ma H., <u>Elmoznino E.</u> , Kezele I., Levinshtein A., Charbit J., Despois J., Perrot M., Antoinin F., Flament R.S., Parham A. <i>U.S. Patent Application No. 16702895</i> . Washington, DC: U.S. Patent and Trademark Office

## Scholarships & Awards

2024	UNIQUE Conference Travel Award (\$1,000 value)
2023	Vanier Canadian Graduate Scholarship (\$150,000 value)
2022	UNIQUE Neuro-AI Excellence Scholarship (\$15,000 value)
2016	Class of 4T3 Engineering James Ham Award (\$10,000 value)
2015	Class of 5T6 Award of Merit (\$15,000 value)
2013	First Choice Science Award
2012	McGill Science Award and Scholarship
2012	A.J. Grant Shield and Scholarship
2012	Quebec English Public Speaking (Provincial Finals) — Bronze Medal
2012	Governor General of Canada Academic Medal
2012	Royal Bank of Canada Shield
2012	Davies Family Shield
2012	Eakeley Shield
2011	Quebec French Public Speaking (Provincial Finals) — Silver Medal

## Other Activities

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|---------|--|---|
| 2018    | <b>Instructor for ECE1780</b>  | University of Toronto, Toronto, ON                    |
|         | Taught lectures for a graduate course on DNNs deployed to mobile devices under Prof. Parham Aarabi |   |
| 2015-16 | <b>Finance Chair</b>   | Electrical and Computer Engineering Club, Toronto, ON |
|         | Elected by peers at the University of Toronto to manage the club budget and plan social activities |   |
| 2014-15 | <b>Class Representative</b>  | Electrical and Computer Engineering Club, Toronto, ON |
|         | Elected by peers at the University of Toronto to represent student interest at faculty meetings    |   |