(MATTHEW) YIZHENG HE

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Education

McGill University   **2023 − 2027 (expected)**
B.A. & Sc. Honours Cognitive Science (Computer Science Focus), Minor Mathematics   *CGPA: 4.0/4.0 (Top 5%)*

Research Experience

Masset Lab   *Research Intern*   **2024–Present**
↪ Prof. Paul Masset   *McGill University, Mila–Quebec AI Institute*
Projects involved:

- **Simultaneous detection and estimation in olfactory sensing (Sep. 2024–Present)**
(Recurrent neural networks; Constrained optimization; Bayesian inference; Mirror-Langevin descent)
Designed, coded, and ran scaling experiments on HPC clusters; refined model variants to improve performance. First author on the accepted abstract and co-first author on the associated preprint (under review at PNAS).

- **Population structure of reward-induced remapping in hippocampal CA1 (Apr. 2025–Present)**
(Representation similairty analysis (RSA); Tensor decomposition; Dimensionality reduction techniques)
Built data pipelines for preprocessed data; performed exploratory data analysis and developed metrics to quantify neural population structure and reward-related remapping. Made figures for the accepted COSYNE abstract.

- **Piecewise deterministic spiking samplers (Nov. 2025–Present)**
(Piecewise-deterministic Markov processes; MCMC sampling algorithms; Spiking neural networks)
Participating in both simulation-based and theoretical investigation.

Research Interests

Computational & Theoretical Neuroscience; Machine Learning Theory

Preprint

Chen Jiang[*], **Matthew Y. He**[*], Venkatesh N. Murthy, Cengiz Pehlevan, Jacob A. Zavatone-Veth[†], and Paul Masset[†] (2025). "Simultaneous detection and estimation in olfactory sensing". In: *bioRxiv*. (Under review at PNAS). DOI: 10.1101/2025.11.01.686013.

[*] Equal contribution.   [†] Co-supervision.

Conference Abstract

Matthew He, Chen Jiang, Venkatesh Murthy, Cengiz Pehlevan, Jacob Zavatone-Veth, and Paul Masset (2025). "Simultaneous detection and mapping in the olfactory bulb". In: *Computational and Systems Neuroscience (COSYNE)*.

Chen Jiang, Adel Halawa, **Matthew He**, and Paul Masset (2026). "Population structure of reward-induced remapping in the hippocampal CA1". In: *Computational and Systems Neuroscience (COSYNE)*.

Awards & Distinctions

Faculty of Science Scholarship   **2025-2026**
Established in 1992 by the University to provide awards based on academic achievement to students in the top 5% of the Faculty of Science.

Dean's Honour List   **2023-2025**
Top 10% of students in the Faculty of Science based on the combined GPA for the fall and winter terms.

Science Undergraduate Research Awards   **2025**
$8950 CAD for 15 weeks of full-time research in the summer of 2025.

SUS Ambassador Fund   **2025**
$750 CAD for traveling to present at Computational and Systems Neuroscience (COSYNE) 2025 conference.

Tomlinson Undergraduate Award   **2025**
Mentoring students in a molecular and cellular biology course.

Conference & Workshop Attendance

Mathematical Foundation for Data Science *Stochastic Optimization; High-dimensional Statistics* **May–June 2025**
↪ Centre de Recherches Mathématiques, Montreal, Canada

Computational and Systems Neuroscience (COSYNE) 2025 *Conference & Workshop* **April 2025**

SynBio Collective Wet Lab Workshop Series *Theme: Expressing recombinant genes in bacteria* **January–April 2024**
↪ McGill iGEM Team

Selected Coursework

Graduate-level	Undergraduate-level (selected)
Stochastic Processes (MATH547)†	Nonlinear Optimization (MATH378)
Computational Neuroscience (NEUR503)†	Honours Applied Linear Algebra (MATH247)
Numerical Analysis (MATH578)†	Honours Nonlinear Dynamics (MATH376)
Expected by Summer 2026	Honours Algorithms & Data Structures (COMP252)
Theory of Machine Learning (MATH562)†	Probability & Statistics (MATH323,324)
Honours Convex Optimization (MATH563)†	Discrete Structures (MATH240)
Representation Learning (IFT6135)†	Cognition (PSYC213)

† Graduate level.

Skills

Scientific Computing	Python (PyTorch, JAX), MATLAB, Linux, HPC clusters (SLURM)
Mathematical Areas (beyond coursework)	Bayesian inference, sampling methods, tensor decomposition, physics-informed neural networks (PINNs)
Neuroscience Knowledge	Hippocampus, olfactory bulb, midbrain dopaminergic neurons; general systems neuroscience knowledge learned through courses