# Mateo Amado Cabusao Umaguing

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| CONTACT INFORMATION | mateouma@bu.edu | 🔗 Mateo-Umaguing |
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| | +1 (626) 650-6081 | 🔗 mateouma |

**INTERESTS**

Neural computation, behavioral neuroscience, state-space modeling, statistical signal processing, machine learning.

**EDUCATION**

*Ph.D. Computational Neuroscience* — 2024 - Present
Boston University, Boston, MA

*B.S. Statistics and Data Science, Mathematical Biology Minor* — 2019 - 2024
UCLA, Los Angeles, CA — 3.9 GPA

**RESEARCH EXPERIENCE**

*Rotation Student* — Jan. 2025 - March 2025
Stephen Group, Department of Mathematics & Statistics, Boston University
Advisor: Emily Stephen, Ph.D.

- Focus: neural signal processing at different spatial scales, statistical model development, conscious and cognitive states.
- Techniques: point process models, electrophysiological data (spikes, LFP, ECoG, EEG, MEG) analysis, spectral analysis, state-space modeling.

*Rotation Student* — Sept. 2024 - Dec. 2024
Chand Lab, Department of Anatomy & Neurobiology, Boston University
Advisor: Chandramouli Chandrasekaran, Ph.D.

- Focus: neural population dynamics, cell types, perceptual decision-making, cognition, dorsolateral prefrontal cortex (DLPFC), dorsal premotor area (PMd).
- Techniques: electrophysiology (Neuropixels, V-Probes), neural networks, dynamical systems modeling, macaque monkey training and behavior analysis.

*Research Assistant* — July 2021 - July 2024
Wilke Lab, Department of Psychiatry, University of California, Los Angeles
Advisor: Scott A. Wilke, M.D., Ph.D.

- Focus: medial prefrontal cortex (mPFC), anterior cingulate cortex (ACC), effort-based decision-making, prefrontal dopamine.
- Techniques: mouse training and behavior analysis, optogenetics, calcium imaging (Miniscopes), fiber photometry, immunohistochemistry.

**SELECTED PROJECTS**

See also my GitHub page.

*Neural Power Spectra Analysis* — Jan. 2025 - March 2025
Stephen Group

- Assessed the effect of neurophysiological processes on neural signal power spectra for Neuropixels recordings.
- Developed generalized linear models for spectral and point process parameter estimation.
- Empirically validated theoretical filtered point process framework for statistical modeling of neurophysiological signals.

*RNN Models of Neural Dynamics*                                    Oct. 2024 - Dec. 2024
Chand Lab
- Trained single- and multi-area recurrent neural networks (RNNs) on the checkerboard perceptual decision-making task using the PsychRNN Python- and tensorflow-based package.
- Adjusted biological constraints including cell type-specific connections, multiple areas reflecting cortical subregions (DLPFC, PMd), and excitatory-inhibitory balance.
- Probed information flow and representation within RNN cortical microcircuit analogues using state-space analysis.

*Miniscope Analysis*                                               July 2021 - July 2024
Wilke Lab
- Extracted neural signals from UCLA Miniscope calcium fluorescence imaging recordings of the mouse ACC using the Minian miniscope analysis pipeline.
- Aligned mouse behavioral epochs to fluorescence using pose estimation software (DeepLabCut) and the BehaviorDEPOT behavior analysis toolbox.
- Developed software for aligning neural activity with specific behaviors, verifying signal quality, and visualizing results.
- Analyzed relation between calcium fluorescence and mouse behavior to discuss hypotheses of ACC involvement with effort-based decision-making.

*Continuous T-Maze*                                                June 2022 - Aug. 2023
Wilke Lab
- Developed software for fully automated T-maze designed to expedite rodent behavior experiments investigating effort-based decision-making.
- Designed Arduino-based communication system that uses GUI-inputted parameters to control PIR sensors, air pressure-operated doors, and reward dispenser pumps. The system is capable of minutely controlling task parameters, continuously running hundreds of trials, and collecting mouse position data with minimal experimenter interaction.

SELECTED
POSTERS

**Umaguing, MAC,\*** Ranawat, AJ,\* Yang,\* AJ, Fernandez-Gomez, M, Gupta, TA, Sanchez-Fuentes, A, Veenker, FN, Ahmed, RN, Qi, A, Kashay, AQ, Junaidi, CV, Li, Colavin, S, Wilke, SA. Distinct subpopulations within the anterior cingulate cortex play specific roles in effort-based decision-making.  *UCLA UIRA Poster Day* (2024).

Faith N. Veenker,\* Angela J. Yang,\* Acharya J. Ranawat,\* Russell N. Ahmed,\* **Mateo A. C. Umaguing,\*** Marta Fernandez Gomez, Tanya A. Gupta, Asai Sanchez-Fuentes, Alex Qi, Adrienne Q. Kashay, Christabelle V. Junaidi, Katherine Y. Li, Sophia Colavin, Gabriella Stout, Scott A. Wilke. Role of the Anterior Cingulate Cortex in Effort-Based Decision-Making. *UCLA Semel Undergraduate Research Conference* (2024).

**Umaguing, MAC,\*** Gupta, TA, Fernandez-Gomez, M, Kashay, AQ, Li, KY, Ahmed, RN, Wilke, SA. Distinct patterns of neural activity in the anterior cingulate cortex underlie effort-based decision-making. *California Neurotechnology Conference* (2024).

\*presenting authors

TEACHING          *Discussion Section Volunteer*                   April 2024 - June 2024
UCLA - Math 115A: Proof-based Linear Algebra (Dr. Janina Letz)

- Facilitated learning through assisting students with worksheets in twice-a-week discussion section. Reviewed course material and pedagogy strategies in weekly content meetings with professors.

*Technical and Workshop Coordinator*                         Sept. 2023 - June 2024
CruX UCLA, Neurotechnology Organization
- Designed and delivered weekly neurotechnology workshops focusing on neuroscience, signal processing (digital filtering, independent components analysis, wavelet transforms), and machine learning (neural networks, classification, regression, dimensionality reduction) for up to 200 audience members in preparation for brain-computer interface development.

AWARDS

*Emerging Scientific Scholars Program Member*                         Sept. 2024
Boston University Graduate Medical Sciences
- Professional development program for underrepresented groups in the sciences.

*Student Competition Winner*                         April 2024
California Neurotechnology Conference (CNTC)
- Won first place in the CNTC student organization BCI competition with an emotion state classifier.

*Hackathon Winner*                         Sept. 2023
NeurAlbertaTech natHACKS
- Competed in natHACKS Canadian neurotechnology hackathon amongst 400+ international students and received first place with an EEG-based P300 Truth Elicitor.

SERVICE

*Conference Planning Committee Member*                         March 2024 - April 2024
California Neurotechnology Conference
- Organized logistics, advertising, and fundraising for the 2024 California Neurotechnology Conference in Davis, CA.

PROGRAMMING LANGUAGES

Languages: Python, R, MATLAB, C++, Java, HTML, CSS, JavaScript
Libraries: scikit-learn, PyTorch, tensorflow, NumPy, SciPy, Seaborn, pandas, tidyverse (dplyr, ggplot2, stringr), tidymodels, readr

OTHER SKILLS

Softwares: OpenBCI, BehaviorDEPOT, DeepLabCut, Minian, Fiji ImageJ, Adobe Photoshop, Adobe Illustrator, QGIS
Platforms: Anaconda, Web, Arduino
Relevant Coursework: Neural Signal Processing, Computational Neuroscience, Cellular Neurophysiology, Systems Neuroscience, Cognitive and Behavioral Neuroscience, Neuroengineering, Time Series for Neuroscience, Neural Networks, Advanced Neural Networks, Machine Learning, Computer Vision, Monte Carlo Methods, Systems and Signals, Proof-based Linear Algebra, Probability, Mathematical Statistics, Linear Models, Computational Statistics, Optimization for Statistics, Computational and Systems Biology, Differential Equations, Experimental Design