

## Curriculum Vitae

1) DATE: Jan 15, 2024

2) PERSONAL DATA:

Name: G. Sean Escola, M.D., Ph.D.  
Address: Jerome L. Greene Science Center  
3227 Broadway, Room L6.075  
New York, NY 10027  
Phone: +1-917-587-4371  
Email: gse3@columbia.edu

3) WORK EXPERIENCE:

*Assistant Professor*, Nov 2014-present  
Department of Psychiatry, Division of Systems Neuroscience  
Columbia University, New York, NY

*Co-founder*, Jan 2024-present  
Fauna Robotics, Inc.  
New York, NY

*Co-founder*, Jan 2017-present  
Herophilus, Inc.  
San Francisco, CA

*Co-founder and Board Member*, Apr 2020-present  
Neuromatch, Inc.  
Irvine, CA

*Psychiatry Faculty Practice Office Attending*, and 2021-present  
ColumbiaDoctors, New York, NY

*Emergency Room Psychiatry Attending*, 2014-2017 and 2021-2022  
New York Presbyterian Hospital, New York, NY

4) EDUCATION:

*College of Physicians and Surgeons*, Jul 2003-May 2010  
Columbia University, New York, NY  
M.D., May 2010

*Graduate School of Arts and Sciences*, Jul 2005-Dec 2008  
Integrated Program in Cellular, Molecular, and Biomedical Studies  
Columbia University, New York, NY  
Ph.D., Feb 2009

M.Phil., Oct 2008

Thesis: *Markov chains, neural responses, and optimal temporal computations.*  
Columbia University, 2009

Awarded: “**with distinction**”

Advisor: Dr. Liam Paninski

*School of Engineering and Applied Science*, Sep 2001-Dec 2002

Columbia University, New York, NY

M.S., Computer Science, Feb 2003

*Columbia College*, Sep 1997-Aug 2001

Columbia University, New York, NY

B.A., Biochemistry and Computer Science, Oct 2001

#### 5) POSTGRADUATE TRAINING:

*Resident House Officer*, Jul 2010-Jun 2014

Department of Psychiatry

New York Presbyterian Hospital, New York State Psychiatric Institute, and

Columbia University, New York, NY

ACGME Program ID #: 4003521138

#### 6) GAPS IN WORK, EDUCATION, OR TRAINING:

None.

#### 7) LICENSURE:

*New York State Medical License*, Jun 2011-present

License #: 261908

*DEA License*, Jun 2011-present

Registration #: FE3336092

#### 9) ACADEMIC SERVICE:

*Co-founder and Board Member*, Apr 2020-present

Neuromatch, Inc.

Neuromatch is a nonprofit that seeks to democratize and globalize neuroscience.

Founded in response to the Covid-19 pandemic when most neuroscience conferences and summer schools were cancelled, Neuromatch Academy was organized as team of >100 volunteer faculty and 200 Teaching Assistants to teach an online neuroscience summer school to 2000 students around the world for 3 weeks in July 2020. Follow up courses were run in 2021, 2022, and 2023.

Additionally, Neuromatch Conference replaced the cancelled SfN for 2020 and organized >100 talks and several thousand posters in Nov 2020. There have now been four Neuromatch Conferences to date. Neuromatch is adding a journal and a science consulting program to its portfolio of activities and intends to continue to

grow in 2023 and beyond. I personally raised >\$2m in operating funds over 2020–2023.

*Associate Editor*, 2018-present  
Neuron, Behavior, Data Analysis, and Theory

#### 10) PROFESSIONAL ORGANIZATIONS:

*Society for Neuroscience*

*American Psychiatric Association*

#### 11) FELLOWSHIP AND GRANT SUPPORT:

Active support:

*NIH U01*, Apr 2024-Mar 2027

Understanding sensorimotor control through realistic neuro-biomechanical simulation

Direct support: \$250,000 / year x 3 years

Role: Lead PI

Grant #: 13502347

*NIH R01*, Apr 2024-Mar 2029

Translational studies in humans and mice to test a circuit-level computational model of auditory hallucinations

Direct support: \$100,000 / year x 5 years

Role: PI

Grant #: 13954396

*NSF AI Institute for Artificial and Natural Intelligence*, Jun 2023-May 2028

Direct support: \$100,000 / year, renewable annually

Role: Key personnel

Grant #: 2229929

Pending support:

*Simons Collaborations in Neuroscience*, in review

Solving sensorimotor control through realistic neuro-biomechanical simulation

Direct support (if funded): \$250,000 / year x 10 years

Role: PI

Prior support:

*NIH BRAIN U19*, Sep 2017-Jul 2022

“Computational and circuit mechanisms underlying motor control”

Direct support: \$250,000 / year x 5 years

Role: PI

Grant #: 5U19NS104649

*NIH R01 / NSF CRCNS*, Jun 2017-Sep 2022

“Refining computational models of motor sequence learning and execution”

Direct support: \$250,000 / year x 5 years

Role: PI

Grant #: 5R01NS105349

*NIH Director’s Early Independence Award (DP5)*, Sep 2014-Sep 2019

“The internal states of neural circuits: data analysis, modeling, and disease”

Direct support: \$250,000 / year x 5 years

Role: PI

Grant #: 1DP5OD019897

*Leon Levy Fellowship*, Jul 2010-Jun 2014

Private grant providing salary and research support during psychiatry residency training

*Medical Scientist Training Program*, Jul 2003-May 2010

Federal NIH grant providing full tuition plus stipend during M.D.-Ph.D. training

*Master’s Student/Graduate Research Assistant*, Jan 2002-Dec 2002

Columbia University Department of Computer Science grant providing full tuition plus stipend during M.S. training for students actively involved in research

*Master’s Student/Teaching Assistant*, Sep 2001-Dec 2001

Columbia University Dept. of Computer Science grant providing full tuition plus stipend during M.S. training in exchange for certain teaching obligations

## 12) EDUCATIONAL CONTRIBUTIONS:

*Course director, Experimental and Analytical Approaches to Neuroscience Research*, Spring 2021

Department of Neuroscience

Columbia University, New York

- Designed the curriculum, assignments, and organized the lecturers for a new 25-person graduate-student class that meet once weekly during the semester

*Instructor, Introduction to Theoretical Neuroscience*, Spring 2015; Spring 2017; Spring 2021; Spring 2022; Fall 2022

Department of Neuroscience

Columbia University, New York

- Designed the curriculum, homework, and gave lectures for a 25-person graduate-student class that meet twice weekly during the semester

*Course director, Topics in Systems Neuroscience*, Spring 2015; Spring 2018

Department of Neuroscience

Columbia University, New York

- Designed the curriculum, homework, and gave the lectures for a 10-person graduate-student class that meet once weekly during the semester

*Instructor, Advanced Theoretical Neuroscience, Spring 2016*

Department of Neuroscience

Columbia University, New York

- Designed the curriculum, homework, and gave lectures for a 15-person graduate-student class that meet twice weekly during the semester

*Teaching Assistant, Introduction to Theoretical Neuroscience, Spring 2013*

Center for Theoretical Neuroscience, Department of Neuroscience

Columbia University, New York, NY

- Graded problem sets and facilitated small groups for a 30-person class that met twice weekly during the semester

*Instructor, Introduction to Physics, Summer 2008*

Summer Medical and Dental Education Program

Columbia University, New York, NY

- Designed the curriculum, homework, and exams, and gave the lectures for a 40-person class that meet twice weekly during the summer

*Instructor, Student Success Network Course, 2004-2005*

College of Physicians and Surgeons

Columbia University, New York

- Prepared and gave review lectures of 20-person group of medical students eight times throughout the academic year

*Instructor, Introduction to Programming in C, Fall 2001*

Department of Computer Science

Columbia University, New York

- Designed the curriculum, homework, and exams, and gave the lectures for an 80-person class that meet twice weekly during the semester

*Teaching Assistant, (i) Introduction to Programming; (ii) Data Structure and Algorithms; (iii) Discrete Mathematics; (iv) Artificial Intelligence; (v) Computational Complexity; (vi) Programming Languages and Translators, 1998-2001*

Department of Computer Science

Columbia University, New York

- Graded problem sets and exams, and facilitated small groups for a range of introductory through advanced classes with varying class sizes

### 13) CLINICAL AND PUBLIC HEALTH ACTIVITIES AND INNOVATIONS:

None.

### 14) PATENTS AND INVENTIONS:

None.

## 15) PUBLICATIONS:

\* indicates (co-)first or (co-)senior author

Submitted and Accepted:

Kevin Mizes, Jack Lindsey, **Sean Escola\***, and Bence P. Ölveczky. “The role of motor cortex in motor sequence execution depends on task demands.” 2<sup>nd</sup> round review at *Nature Neuroscience*

Kaushik Lakshminarasimhan, Marjorie Xie, Jeremy Cohen, Britton Sauerbrei, Adam Hantman, Ashok Litwin-Kumar, and **Sean Escola\***. “Specific connectivity optimizes learning in thalamocortical loops.” Accepted at *Cell Reports*

**Sean Escola\***, Kaushik Lakshminarasimhan, and Laureline Logiaco. “Models of thalamocortical interactions in motor control.” In Martin Usrey and Murray Sherman (Eds.), “The Cerebral Cortex and Thalamus”, 2023

Kevin Mizes, Jack Lindsey, **Sean Escola\***, and Bence P. Ölveczky. “Dissociating the contributions of sensorimotor striatum to automatic and visually guided motor sequences.” *Nature Neuroscience* 2023 <https://doi.org/10.1038/s41593-023-01431-3>

Anthony Zador, **Sean Escola\***, et al. “Toward Next-Generation Artificial Intelligence: Catalyzing the NeuroAI Revolution.” *Nature Communications* 2023 <https://doi.org/10.1038/s41467-023-37180-x>

Alex Rogozhnikov, Pavan Ramkumar, Saul Kato, **Sean Escola\***. “Hierarchical confounder discovery in the experiment–machine learning cycle.” *Cell Patterns*, 2022 <https://doi.org/10.1016/j.patter.2022.100451>

Laureline Logiaco, Larry Abbott, **Sean Escola\***. “A model of flexible motor sequencing through thalamic control of cortical dynamics.” *Cell Reports*, 2021 <https://doi.org/10.1016/j.celrep.2021.109090>

Tara van Viegen, Athena Akrami, Kate Bonnen, Eric DeWitt, ..., **Sean Escola\***, Megan Peters. “Neuromatch Academy: Teaching Computational Neuroscience with global accessibility.” *Trends in Cognitive Science*, 2021 <https://doi.org/10.1016/j.tics.2021.03.018>

James Murray, **Sean Escola\***. “Remembrance of things practiced with fast and slow learning in cortical and subcortical pathways.” *Nature Communication*, 2020 <https://doi.org/10.1038/s41467-020-19788-5>

Brian DePasquale, Christopher Cueva, Kanaka Rajan, **Sean Escola**, Larry Abbott. “full-FORCE: A target-based method for training recurrent networks.” *PLoS ONE*, 2018 <https://doi.org/10.1371/journal.pone.0191527>

James Murray, **Sean Escola\***. “Learning multiple variable-speed sequences in striatum via cortical tutoring.” *eLife*, 2017 <https://doi.org/10.7554/eLife.26084.001>

**Sean Escola\***, Alfredo Fontanini, Don Katz, Liam Paninski. “Hidden Markov models for the stimulus-response relationships of multi-state neural systems.” *Neural Computation*, 2011 [https://doi.org/10.1162/NECO\\_a\\_00118](https://doi.org/10.1162/NECO_a_00118)

**Sean Escola\***, Michael Eisele, Ken Miller, Liam Paninski. “Maximally reliable Markov chains under energy constraints.” *Neural Computation*, 2009 <https://doi.org/10.1162/neco.2009.08-08-843>

Ilya Nemenman, **Sean Escola**, WS Hlavacek, PJ Unkefer, C Unkefer. “Reconstruction of metabolic networks from high-throughput metabolite profiling data: in silico analysis of red blood cell metabolism.” *Annals of the New York Academy of Sciences*, 2007 <https://doi.org/10.1196/annals.1407.013>

Unpublished pre-prints:

Mizes, Kevin GC, Jack Lindsey, **Sean Escola\***, and Bence P. Ölveczky. “Motor cortex is required for flexible but not automatic motor sequences.” *bioRxiv* 2023 <https://doi.org/10.1101/2023.09.05.556348>

Lakshminarasimhan, Kaushik, Marjorie Xie, Ashok Litwin-Kumar, and **Sean Escola\***. “How Corticothalamic Connectivity Influences Thalamocortical Learning.” *bioRxiv* 2022 <https://doi.org/10.1101/2022.09.27.509618>

Alex Rogozhnikov, Pavan Ramkumar, Saul Kato, **Sean Escola\***. “Demuxalot: scaled up genetic demultiplexing for single-cell sequencing.” *bioRxiv*, 2021 <https://doi.org/10.1101/2021.05.22.443646>

Laureline Logiaco, **Sean Escola\***. “Thalamocortical motor circuit insights for more robust hierarchical control of complex sequences.” *arXiv*, 2020 <https://arxiv.org/abs/2006.13332>

Kevan Shah, Rishi Bedi, Alex Rogozhnikov, Pavan Ramkumar, Zhixiang Tong, Brian Rash, Morgan Stanton, Jordan Sorokin, ..., Gaia Skibinski, Saul Kato, **Sean Escola\***. “Optimization and scaling of patient-derived brain organoids uncovers deep phenotypes of disease.” *bioRxiv*, 2020 <https://doi.org/10.1101/2020.08.26.251611>

Thesis:

Escola S. *Markov chains, neural responses, and optimal temporal computations*. Dissertation of Columbia University in the City of New York, 2009.

#### 16) INVITED AND PEER-SELECTED POSTERS AND TALKS:

Escola S. Learning and dynamics in neural systems with low-rank structure. *Brown University*. 2023 Sep 21.

Escola S. Subcortical consolidation of motor sequences. *Northwestern University*. 2023 May 12.

Escola S. Subcortical consolidation of motor sequences. *University of Chicago*. 2023 May 11.

Escola S. Motor learning and virtual neuroscience. *Cold Spring Harbor Laboratory*. 2022 Dec 5.

Escola S. What is the computational role of the BG in motor function? *Champalimaud Center for the Unknown*. 2022 Mar 23.

Escola S. Circuit level theories in motor learning. *Columbia Dept of Psychiatry Grand Rounds*. 2022 Feb 2.

Escola S. Circuit level theories in motor learning. *Mount Sinai School of Medicine*. 2021 Nov 17.

Escola S. Thalamic control of cortical dynamics in a model of flexible motor sequencing. *Neurotuscan*. 2021 Aug 27.

Escola S. Thalamic control of cortical dynamics for sequence behaviors. *New York Genome Center*. 2021 June 21.

Escola S. Thalamic control of cortical dynamics in a model of flexible motor sequencing. Oral presentation at: *Neuromatch 3*. 2020 Oct 17.

Escola S. Practice and the corticostriatal and thalamostriatal pathways. Oral presentation at: *Gordon Research Conference: Thalamocortical interactions*. 2020 Feb 17; Ventura, CA.

Escola S. Practice makes perfect. Oral presentation at: *Harvard University*. 2019 Oct 25; Cambridge, MA.

Escola S. Recurrent inhibition in striatum enables transfer of time-flexible skills to basal ganglia. Oral presentation at: *Baylor University*. 2017 Jan 27; Houston, TX.



Escola S. Recurrent inhibition in striatum enables transfer of time-flexible skills to basal ganglia. Oral presentation at: *The University of California at San Francisco*. 2017 Jan 13; San Francisco, CA.

Escola S. Temporal scaling and learning in basal ganglia. Oral presentation at: *The University of Oregon*. 2016 Oct 6; Eugene, OR.

Escola S. Temporal scaling and learning in basal ganglia. Oral presentation at: *The Gatsby Tri-Center Meeting 2016*. 2016 Jun 7–9; London, UK.

Escola S. Sequence generating recurrent neural networks: a novel view of cortex, thalamus, and the basal ganglia. Oral presentation at: *Harvard Center for Brain Science*. 2016 May 18; Cambridge, MA.

Escola S and Abbott LF. Sequence generating recurrent neural networks: a novel view of cortex, thalamus, and the basal ganglia. Poster session presented at: *Swartz Meeting 2015*. 2015 Aug 2–Aug 5; Janelia Farms, VA.

Escola S. Sequence generating recurrent neural networks: a novel view of cortex, thalamus, and the basal ganglia. Oral presentation at: *Champalimaud Centre for the Unknown*. 2015 Jul 24; Lisbon, Portugal.

Escola S. Sequence generating recurrent neural networks: a novel view of cortex, thalamus, and the basal ganglia. Oral presentation at: *École normale supérieure*. 2015 Jul 21; Paris, France.

Escola S and Abbott LF. Sequence generating recurrent neural networks: a novel view of cortex, thalamus, and the basal ganglia. Poster session presented at: *Computational and Systems Neuroscience 2015*. 2015 Mar 5–Mar 8; Salt Lake City, UT.

Escola S and Abbott LF. Sequence generating recurrent neural networks: a novel view of cortex, thalamus, and the basal ganglia. Oral presentation at: *The Gatsby Tri-Center Meeting 2014*. 2014 Jun 1–3; Jerusalem, Israel

Escola S and Abbott LF. Self-monitoring of network activity in multi-state recurrent neural networks. Oral presentation at: *Computational and Systems Neuroscience 2014*. 2014 Feb 27–Mar 2; Salt Lake City, UT.

Escola S and Abbott LF. Sequences and state transitions in neural networks. Oral presentation at: *2013 Sloan–Swartz Meeting for Computational Neuroscience*. 2013 Jul 26–28; Waltham, MA.

Escola S and Abbott LF. A network model for flexible sequence generation. Oral presentation at: *Leon Levy Neuroscience Symposium 2013*. 2013 Apr 29; New York City, NY.

Escola S and Abbott LF. Internally generated transitions in multi-state recurrent neural networks. Poster session presented at: *Computational and Systems Neuroscience 2013*. 2013 Feb 28–Mar 3; Salt Lake City, UT.

Escola S and Paninski L. Hidden Markov models for the stimulus-response relationships of multi-state neural systems. Poster session presented at: *Computational and Systems Neuroscience 2010*. 2010 Feb 25–28; Salt Lake City, UT.

Escola S and Paninski L. Hidden Markov models for the complex stimulus-response relationships of multi-state neurons. Poster session presented at: *Bernstein Symposium 2008*. 4<sup>th</sup> annual conference of the German Bernstein Network for Computational Neuroscience; 2008 Oct 8–10; Munich, Germany.

Escola S, Eisele M, Miller K, and Paninski L. Maximally reliable Markov chains under energy constraints, or How to build a clock. Oral presentation at: *Bernstein Symposium 2008: Bernstein PhD Symposium*. 4<sup>th</sup> annual conference of the German Bernstein Network for Computational Neuroscience; 2008 Oct 10–11; Munich, Germany.

Escola S, Eisele M, Miller K, and Paninski L. Maximally reliable Markov chains under energy constraints. Poster session presented at: *Sloan-Swartz Meeting 2008*. Annual conference of the Sloan-Swartz Centers for Theoretical Neurobiology; 2008 Jul 19–22; Princeton, NJ.

Escola S, Eisele M, and Paninski L. Maximally reliable Markov chains under energy constraints. Poster session presented at: *Computational and Systems Neuroscience 2008*. 2008 Feb 28–Mar 2; Salt Lake City, UT.

Escola S and Paninski L. HMMs applied toward the inference of neural states and the improved estimation of linear RFs. Poster session presented at: *Computational and Systems Neuroscience 2007*. 2007 Feb 22–25; Salt Lake City, UT.

Escola S and Paninski L. HMMs applied toward the inference of neural states and the improved estimation of linear RFs. Poster session presented at: *Grand Challenges in Neural Computation*. 2007 Feb 18–21; Santa Fe, NM.

#### 17) TRIVIA:

*Burning Man Ultra-Marathon 50k*, Aug 2017  
Time: ~4.5 hours

*Burning Man Ultra-Marathon 50k*, Aug 2016  
Time: ~5 hours

*TCS New York City Marathon*, Nov 2014  
Time: 3:40:31

*Bach Society*, Sep 2012-Dec 2013  
Tenor

*Walt Disney World Marathon*, Jan 2012  
Time: 3:44:51

*Columbia Swing Dance Performance Troupe*, Sep 2008-May 2009

*112<sup>th</sup> Boston Marathon*, Apr 2008  
Time: 3:44:17

*Columbia Swing Dance Club*, Sep 2007-May 2010

*Bard Hall Players*, Sep 2003-May 2010