Alexandra Maria Proca

(+44) 7521 454552 | a.proca22@imperial.ac.uk | aproca.github.io

Education

Imperial College London — Oct. 2023 – Present
Doctor of Philosophy in Theoretical Neuroscience and Machine Learning; President's Scholar — *London, UK*

University College London — Sept. 2020 – Dec. 2021
Master of Science in Machine Learning with Distinction; Dean's List Laureate — *London, UK*

University of North Carolina at Chapel Hill — Aug. 2016 – May 2020
Bachelor of Science in Computer Science, in Neuroscience with Honors, Minor in Music — *Chapel Hill, NC*

Research Experience

Research Assistant — Jan. 2022 – Jan. 2023
ETH Zürich Department of Computer Science (Lab: Dr. João Sacramento) — *Zürich, CH*
- Conducted research studying the use of hypernetworks for meta-learning

Master's Student — May 2021 – Dec. 2021
UCL Department of Computer Science (Lab: Dr. Jun Wang) — *London, UK*
- Conducted research studying the partial information decomposition of multitask neural networks across varying task settings in supervised and reinforcement learning models

Research Intern — June 2019 – Aug. 2020
MIT Brain and Cognitive Sciences (Lab: Dr. Tomaso Poggio) — *Cambridge, MA*
- Completed the Massachusetts Institute of Technology Summer Research Program for two summers
- Conducted research adversarially reprogramming recurrent neural networks across task domains

Research Assistant — May 2018 – May 2020
UNC Department of Mathematics (Lab: Dr. Peter Mucha) — *Chapel Hill, NC*
- Conducted statistical research analyzing changes in neural morphology of infant fMRI data

Research Assistant — Jan. 2017 – May 2020
UNC Department of Psychology and Neuroscience (Lab: Dr. Sylvia Fitting) — *Chapel Hill, NC*
- Conducted behavioral research in animal models, studying HIV-1 Tat's effects on operant conditioning tasks and how endocannabinoids can be used to protect against assessed behavioral deficits

Research Intern — May 2015 – Aug. 2015
OSU Department of Computer Science (Lab: Dr. Radu Teodorescu) — *Columbus, OH*
- Conducted research using Arduino accelerometers to create motion-detection gloves, designed to teach middle and high-school students basic programming skills

Honors and Awards

Imperial College London President's PhD Scholarship (Full PhD Tuition & Stipend) — January 2023
UCL Dean's List Laureate: Awarded to Top 5% of Graduating Class — March 2022
UCL Friends and Alumni Association Scholarship ($20,000) — May 2020
Honors Carolina Laureate — May 2020
Graduated with Honors in Neuroscience from UNC — May 2020
David Bray Peele Memorial Research Award ($220) — Oct. 2019
Carolina Research Scholar — Jan 2019
Lindquist Undergraduate Research Award ($350) — Nov. 2018
Office of Undergraduate Research Travel Award ($300) — Nov. 2018
Psi Chi Psychology Honor Society — March 2018
Honor's Carolina Membership — Sept. 2017
Sigma Alpha Lambda Honor Society — May 2017
The National Society of Collegiate Scholars — May 2017
UNC Dean's List — Dec. 2016 – May 2017

Publications and Theses

1. *Learning dynamics in linear recurrent neural networks.* **A.M. Proca**, C.C.J. Dominé, M. Shanahan, P.A.M. Mediano. **Under review**, 2025.

2. *From Lazy to Rich: Exact Learning Dynamics in Deep Linear Networks.* C.C.J. Dominé[*], N. Anguita[*], **A.M. Proca**, L. Braun, D. Kunin, P.A.M. Mediano[**], A.M. Saxe[**]. **ICLR**, May 2025.

3. *Flexible task abstractions emerge in linear networks with fast and bounded units.* K. Sandbrink[*], J.P. Bauer[*], **A.M. Proca**[*], A.M. Saxe, C. Summerfield, A. Hummos[*]. **NeurIPS Spotlight**, December 2024.

4. *Training the next generation of NeuroAI researchers: Trainees' perspectives.* A. Luppi[*], J. Achterberg[*], S. Schmidgall, I. Poyraz Bilgin, P. Herholz, M. Sprang, B. Fockter, A. Siyoon Ham, S. Thorat, R. Ziaei, F. Milisav, **A.M. Proca**, H. M. Tolle, L. Suárez, P. Scotti, H. M. Gellersen. **Nature Communications**, October 2024.

5. *Synergistic information supports modality integration and flexible learning in neural networks solving multiple tasks.* **A.M. Proca**, F.E. Rosas, A.I. Luppi, D. Bor, M. Crosby[*], P.A.M. Mediano[*]. **PLoS Computational Biology**, May 2024.

6. *Discovering modular solutions that generalize compositionally.* S. Schug[*], S. Kobayashi[*], Y. Akram, M. Wolczyk, **A.M. Proca**, J. Von Oswald, A. Steger, R. Pascanu, J. Sacramento. **ICLR**, May 2024.

7. *Jack of All Trades, or Master of One: Information Decomposition Reveals Distinct Features of Generalizable vs. Specialized Neural Representations.* **A.M. Proca**. Masters Thesis, University College London, London, UK, December 2021. (Supervisors: M. Crosby, P.A.M. Mediano; Advisor: J. Wang)

8. *Establishing a Contextual Fear Conditioning Paradigm for the Tat Transgenic Mouse Model.* **A.M. Proca**. Bachelors Honors Thesis, University of North Carolina at Chapel Hill, NC, USA, May 2020. (Supervisor: I.R. Jacobs, Advisor: S. Fitting)

9. *Inhibitory control deficits in Tat transgenic mice using the Go/No-Go task.* I.R. Jacobs, D.J. Hermes, A.G. Antonucci, A.B. Ferguson, K.L. Leggette, N.R. Miseo, **A.M. Proca**, C.B. Russell, C. Manjarres, K. Mackie, A.H. Lichtman, B. Ignatowska-Jankoswka, S. Fitting. **Journal of Neuroimmune Pharmacology**. 13, S38-S38 (2018).

[*],[**] Equal contribution

Conference and Workshop Talks

1. *Learning dynamics in linear recurrent neural networks.* **A.M. Proca**. Invited talk at **COSYNE 2025 Workshop on "Causal perturbation based approaches to uncovering neural dynamics"**, Mont Tremblant, Canada, March 2025.

2. *Learning context representations in linear networks.* **A.M. Proca**[*], J.P. Bauer[*], K. Sandbrink[*], A. Hummos. **Junior Scientists Workshop on Recent Advances in Theoretical Neuroscience**, Trieste, Italy, June 2024.

3. *Informational synergy as a link between biological and artificial brains.* P.A.M. Mediano, A.I. Luppi, **A.M. Proca**, F.E. Rosas, M. Crosby, D. Bor. **Conference on Complex Systems**, Palma de Mallorca, Spain, October 2022.

4. *Linking generalizable intelligence to consciousness via information synergy.* **A.M. Proca**. **Association for Mathematical Consciousness Science: Modelling Consciousness Workshop**, Dorfgastein, Austria, August 2022.

5. *Fast deep learning with a simple model of the prefrontal cortex.* **A.M. Proca**, M. Wołczyk, D. Zhao, S. Kobayashi, S. Schug, J. von Oswald, J. Sacramento. **Sinergia Meeting**, Bern, Switzerland, July 2022.

Conference and Workshop Poster Presentations

1. *Learning dynamics in linear recurrent neural networks.* **A.M. Proca**, M. Shanahan, P. Mediano. **Conference on Cognitive Computational Neuroscience**, Boston, Massachusetts, August 2024.

2. *How context representations emerge during training: a linear network perspective.* **A.M. Proca**[*], K. Sandbrink[*], J. Bauer[*], A. Hummos. **COSYNE**, Lisbon, Portugal, February 2024.

3. *Synergistic information supports modality integration and flexible learning in neural networks solving multiple tasks.* **A.M. Proca**, F.E. Rosas, A.I. Luppi, D. Bor, M. Crosby, P.A.M. Mediano. **Analytical Connectionism Summer School**, London, England, August 2023.

4. *Synergistic information supports modality integration and flexible learning in neural networks solving multiple tasks.* **A.M. Proca**, F.E. Rosas, A.I. Luppi, D. Bor, M. Crosby, P.A.M. Mediano. **Conference on Cognitive Computational Neuroscience**, Oxford, England, August 2023.

5. *Jack of All Trades, or Master of One: Distinct Features Between Generalizable and Specialized Artificial Neural Representations.* **A.M. Proca**, M. Crosby, P. Mediano. **Association for the Scientific Study of Consciousness**, Amsterdam, Netherlands, July 2022.

6. *A Picture is Worth 784 Characters: Adversarially Reprogramming a Neural Network.* **A.M. Proca**, A. Banburski, T. Poggio. **MIT Summer Research Programs Poster Session**, Cambridge, MA, USA, August 2019.

7. *Time-Dependent Inhibitory Control Deficits in Female Tat transgenic mice in the Go/No-Go Task.* **A.M. Proca**, I.R. Jacobs, D.J. Hermes, A.G. Antonucci, A.B. Ferguson, K.L. Leggette, N.R. Miseo, C.B. Russell, C. Manjarres, A. Lichtman, B. Ignatowska-Jankowska, S. Fitting. **Society for Neuroscience**, San Diego, CA, USA, November 2018.

8. *Cannabinoid receptor type 1 upregulation of the infralimbic cortex of female Tat transgenic mice following ten months of Tat expression and testing for inhibitory control deficits using the Go/No-Go task.* I.R. Jacobs, D.J. Hermes, A.G. Antonucci, A.B. Ferguson, K.L. Leggette, N.R. Miseo, **A.M. Proca**, C.B. Russell, C. Manjarres, K. Mackie, A. Lichtman, B. Ignatowska-Jankowska, S. Fitting. **Society for Neuroscience**, San Diego, CA, USA, November 2018.

9. *Time-dependent effects of Tat on Go/No-Go performance.* I.R. Jacobs, D.J. Hermes, A.G. Antonucci, A.B. Ferguson, K.L. Leggette, N.R. Miseo, **A.M. Proca**, C.B. Russell, C. Manjarres, S. Fitting. **South Eastern Association for Behavior Analysis**, Chattanooga, TN, USA, October 2018.

10. *Inhibitory control deficits in HIV-1 Tat transgenic mice are sex dependent and alter CB1R expression.* A.B. Ferguson, I.R. Jacobs, D.J. Hermes, A.G. Antonucci, K.L. Leggette, N.R. Miseo, **A.M. Proca**, C.B. Russell, C. Manjarres, K. Mackie, A.H. Lichtman, B.M. Ignatowska-Jankowska, S. Fitting. **South Eastern Association for Behavior Analysis**, Chattanooga, TN, USA. October 2018.

11. *HIV-1 Tat transgenic mice show inhibitory control deficits in the Go/No-Go task.* S. Fitting, I.R. Jacobs, D.J. Hermes, A.G. Antonucci, A.B. Ferguson, K.L. Leggette, N.R. Miseo, **A.M. Proca**, C.B. Russell, C. Manjarres, C. Xu, K. Mackie, A.H. Lichtman, B. Ignatowska-Jankowska. **Federation of European Neuroscience Societies**, Berlin, Germany, July 2018.

12. *Changes of the endocannabinoid system in HIV-1 Tat transgenic mice.* I.R. Jacobs, C. Xu, D.J. Hermes, A.G. Antonucci, A.B. Ferguson, K.L. Leggette, N.R. Miseo, **A.M. Proca**, C.B. Russell, C. Manjarres, C. Xu, M.J. Niphakis, B.F. Cravatt, K. Mackie, A.H. Lichtman, B. Ignatowska-Jankowska, S. Fitting. **International Cannabinoid Research Society**, Leiden, Netherlands, June 2018.

Supervision

Pratyaksh Sharma: MEng Computing thesis on *Analyzing the computational role of complex representations in RNNs*

Nicolas Anguita: MEng Joint Maths & Computing thesis on *Learning dynamics of linear neural networks*

Teaching

Graduate Teaching Assistant — Oct. 2024 – Dec 2024
Computational Neurodynamics — *London, UK*

Undergraduate Teaching Assistant — Jan. 2019 – May 2019
Introduction to Research in Network Data Science — *Chapel Hill, USA*

Training and Workshops

Junior Scientists Workshop on Recent Advances in Theoretical Neuroscience — June 2024
Trieste, IT

Gatsby Unit Analytical Connectionism Summer School — August 2023
London, UK

Mathematical Consciousness Science: Modelling Consciousness Workshop — August 2022
Dorfgastein, AUT

Sinergia Meeting 2022 — July 2022
Bern, CH

UCL & PSL Summer School on Consciousness and Metacognition — June 2021
London, UK

MIT Brains, Minds, and Machines Summer Course — Aug. 2020
Cambridge, USA

University of Nicosia Summer Pre-Med Program — June 2017 – July 2017
Nicosia, CY

Leadership and Service

Member — Sept. 2024 – Present
Mechanistic Interpretability Journal Club — *London, UK*

Executive Officer — Feb. 2022 – Jan. 2023
Qualiaheads Consciousness Science Journal Club — *Zürich, CH*

Treasurer — March 2018 – May 2019
Psi Chi Psychology Honor Society — *Chapel Hill, USA*

Executive Officer — Jan. 2018 – May 2020
Carolina Neuroscience Club — *Chapel Hill, USA*

Piano Instructor — Sept. 2017 – May 2020
Musical Empowerment — *Chapel Hill, USA*

Member — Sept. 2017 – May 2020
Women in Computer Science — *Chapel Hill, USA*

Boston Qualifying Team — Sept. 2016 – May 2020
UNC Marathon Team — *Chapel Hill, USA*

Swim Coach — Sept. 2014 – Aug. 2016
Worthington Special Olympics — *Columbus, USA*

Skills

Python, Pytorch, JAX, Java, Latex, C/C++

Languages

English: Native
Romanian: Conversational
French: Elementary
Spanish: Elementary