Polyphony J. Bruna

PhD Student · Cognitive and Information Sciences

University of California, Merced

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Education

Research Interests: Computational Modeling, Complex & Dynamical Systems, Coordination, Alignment, Philosophy

University of California, Merced — *Merced, CA*

PhD Cognitive and Information Sciences — *Expected 2027*

- Committee: Christopher T. Kello (chair), Michael J. Spivey, and Jeff Yoshimi
- Master's thesis (*en route*): "Synergetic Mechanisms Underlying the Emergence of Alignment in Human Dyadic Interaction"

University of California, Los Angeles — *Los Angeles, CA*

Graduate Fellow, Institute for Pure and Applied Mathematics — *Fall 2024*

- Program: Mathematics of Intelligences

Vassar College — *Poughkeepsie, NY*

BA Cognitive Science and Philosophy (Minor: Japanese) — *2018 - 2022*

- Overall GPA: 3.99/4.00
- Honors: *Phi Beta Kappa, Sigma Xi, Psi Chi, cum laude generali et cum laude in materia subiecta*
- Thesis: "Leveraging Surprise in a Recurrent Neural Network to (de)Construct Morphological Complexity in Japanese" (Advisors: Jan Andrews and Josh de Leeuw)

Professional Experience

2024	**Humane Studies Fellow**, Institute for Humane Studies, George Mason University
2022-2023	**Adolph Sutro Fellow**, Vassar College
2021-2022	**Intern**, Cognitive Science, Vassar College
2021	**Senior Researcher**, Undergraduate Research Summer Institute, Vassar College
2019, 2020	**Research Fellow**, Undergraduate Research Summer Institute, Vassar College
2018-2021	**Research Assistant**, Cognitive Science, Vassar College

Publications

** Denotes co-principal authorship*

In Prep

Kello, C., **Bruna, P.**, & Thao, K. (2025). *Contextual Assembly of Lexical Functions in Large Language Models*. (Under review at *Cognitive Science*)

Bruna, P. & Gyllingberg, L. (2025). *Cognition without neurons: modelling anticipation in a basal reservoir computer*. https://arxiv.org/abs/2505.02114

Published

Bruna, P. and Kello, C. (2025). Least Effort and Alignment in Task-Oriented Communication. *Cognitive Science, 49*, Article e70062. https://doi.org/10.1111/cogs.70062

Abbas, M., Alharthi, D., Balbas, J., Beckelhymer, D., Beylkin, G., **Bruna, P.**, Cartmill, E., Chormai, P., Corea, F., Dai, X., Das, P., Dipoppa, M., Eberle, O., El Hady, A., Evans, J., Feghhi, E., Flack, J., Flores, C., Foster, J., … Zhu, Y. (2021). White Paper: "Mathematics of Intelligences." *Institute for Pure and Applied Mathematics*. https://www.ipam.ucla.edu/reports

de Leeuw, J. R., Andrews, J., Barney, L., Bigler, M., **Bruna, P.**, Chen, Y., Cherry, R., Dowie, D. R., Forbes, E., Haffey, B., Hu, X., Jaklitsch, M., Leopold, N., Lewis, C., MacDonald, D., McShaffrey, C., Nakayama, K., Olstad, W., Peng, R., … Zhang, L. (2021). Words May Jump-Start Meaning More Than Vision: A Non-Replication of Early ERP Effects in Boutonnet and Lupyan (2015). *Collabra: Psychology, 7*(1). https://doi.org/10.1525/collabra.29763

Proceedings

Kello, C. & **Bruna, P.** (2024). Emergent Mental Lexicon Functions in ChatGPT. *Proceedings of the Annual Meeting of the Cognitive Science Society, 46.* https://escholarship.org/uc/item/5m9098b5

*Rane, S., ***Bruna, P.**, Sucholutsky, I., Kello, C., & Griffiths, T. (2023). Concept alignment. *1st NeurIPS Workshop on AI meets Moral Philosophy and Moral Psychology (MP2).* https://arxiv.org/abs/2401.08672

Misc.

Yoshimi, J., Beckmann, P., **Bruna, P.** and Meyer, T. (2025). Transformer Architectures and LLMs. In J. Yoshimi (Ed.), Neural Networks in Cognitive Science. https://downloads.jeffyoshimi.net/NeuralNetworksCogsci.pdf

Bruna, P. (2019). A Review of Bryan W. Van Norden, Taking Back Philosophy. *Vassar College Journal of Philosophy, 6.* https://www.vassar.edu/sites/default/files/2021-08/philosophy-journal-spring-2019.pdf

Presentations

** Presenting author(s); [+] Mentored undergraduate*

Contributed Talks

***Bruna, P.** 2025. *Collective Information Processing in Loosely Coupled Echo State Networks*. Graduate Workshop in Computational Social Science, Santa Fe Institute, New Mexico.

***Bruna, P.** & Gyllingberg, L. 2025. *Basal Reservoir Computing*. Philosophy and Cognitive Science Working Group, University of California, Merced.

***Bruna, P.** & *Gyllingberg, L. 2024. *Non-neural Pattern Completion in an Adaptive Reservoir Computer*. Mathematics of Intelligences Culminating Workshop at Lake Arrowhead, Institute for Pure and Applied Mathematics, University of California, Los Angeles.

***Bruna, P.** & Kello, C. 2024. *Least Effort and Alignment in Task-Oriented Communication*. Mathematics of Intelligences Seminar Series, Institute for Pure and Applied Mathematics, University of California, Los Angeles.

Rane, S., ***Bruna, P.**, Sucholutsky, I., Kello, C., & Griffiths, T. 2024. *Concept Alignment*. Mathematics of Intelligences Working Group on Architecture and Evaluation of Generative AI, Institute for Pure and Applied Mathematics, University of California, Los Angeles.

***Bruna, P.** 2024. *Falandays-style Reservoir Networks*. Mathematics of Intelligences Working Group on Ecological and Homeostatic Intelligence, Institute for Pure and Applied Mathematics, University of California, Los Angeles.

Rane, S., ***Bruna, P.**, Sucholutsky, I., Kello, C., & Griffiths, T. 2024. *Concept Alignment*. Philosophy and Cognitive Science Working Group, University of California, Merced.

***Bruna, P.**, Ryskin, R., & Spivey, M. J. 2023. *Semantics and Syntax Co-emerge in Adaptive Reservoir Network Dynamics*. Diverse Intelligences Summit, University of St. Andrews, Scotland.

***Bruna, P.** 2020. *Hearing That It Is Silent: How to Hallucinate a Non-Perception*. 10th Annual Mid-Hudson Valley Undergraduate Philosophy Conference, Marist College, Poughkeepsie, NY. (Canceled due to COVID-19)

Contributed Posters

***Bruna, P.**, Dale, R., Spivey, M., & Kello, C. 2025. *Coupled Echo State Networks as a Model of Task-Oriented Alignment*. 47th Annual Conference of the Cognitive Science Society, San Francisco, CA.

*Gyllingberg, L., Tian, Y., Sumpter, D., & **Bruna, P.** 2025. *Oscillations and Adaptation: Mathematical Models of Non-Neural Cognition*. Biological Systems that Learn, National Institute for Theory and Mathematics in Biology, Chicago, IL.

***Bruna, P.** & *Kello, C. 2024. *Alignment Through Dyadic Least Effort in Task-Oriented Conversations*. 65th Annual Meeting of the Psychonomic Society, New York City, NY.

***Bruna, P.** & Kello, C. 2024. *Alignment Through Dyadic Least Effort in Task-Oriented Conversations*. Modeling Multi-Scale Collective Intelligences, Institute for Pure and Applied Mathematics, University of California, Los Angeles.

*Kello, C. & ***Bruna, P.** 2024. *Emergent Mental Lexicon Functions in ChatGPT*. 46th Annual Conference of the Cognitive Science Society, Rotterdam, Netherlands.

*+Thao, K., **Bruna, P.**, & Kello, C. 2024. *Exploring Emergent Embodied Intelligence in Large Language Models: Insights from ChatGPT-4*. 15th Annual California Cognitive Science Conference, Berkeley, CA.

*Rane, S. & ***Bruna, P.** 2023. *Concept alignment*. 1st NeurIPS Workshop on AI meets Moral Philosophy and Moral Psychology (MP2), New Orleans, LA.

*+Leshock, E., *+Pena, Y., **Bruna, P.**, & Andrews, J. 2021. *Learned Categorical Perception with Artificially Generated Faces*. 36th Annual URSI Symposium, Vassar College, Poughkeepsie, NY.

*Bigler, M. & ***Bruna, P.** 2020. *Probing the Methodology and Interpretation of Learned Categorical Perception Research*. 35th Annual URSI Symposium, Vassar College, Poughkeepsie, NY.

***Bruna, P.** & *Marks, P. 2019. *Psychophysical Adaptive Procedure: Developing a New, Generalizable Method*. 34th Annual URSI Symposium, Vassar College, Poughkeepsie, NY.

Invited Talks

Fall 2024. *Least Effort and Alignment in Task-Oriented Communication*. Dept. of Cognitive Science, Vassar College, Poughkeepsie, NY.

Honors

2025 **Graduate Student Highlight ("Rising Star: How Life's Journey Shaped a Cognitive Scientist's Path to Discovery")**, `https://graduatedivision.ucmerced.edu/Polyphony-J-Bruna`

2022 **Best Technical Write-Up**, *Mid-Hudson IEEE Undergraduate Capstone Project Awards*

Awards, Fellowships, & Grants

** Awarded but declined*

2025	**Summer Research Fellowship**, *University of California, Merced*	*$ 5,400*
	Hayek Fund, *Institute for Humane Studies*	*$ 3,475*
	Graduate Workshop in Computational Social Science Scholarship, *Santa Fe Institute*	*$ 1,000*
	Hayek Fund, *Institute for Humane Studies*	*$ 2,400*
2024	**Humane Studies Fellowship**, *Institute for Humane Studies*	*$ 5,000*
	Fall Research Fellowship, *University of California, Merced*	*$ 6,000*
	MacKenzie Scott Graduate Student Travel Award, *University of California, Merced*	*$ 1,000*
	Travel Award, *University of California, Merced*	*$ 1,800*
	Summer Research Fellowship, *University of California, Merced*	*$ 5,475*
2023	**Alumni Research Award**, *Diverse Intelligences Summer Institute*	*$ 750*
	Fall Research Fellowship, *University of California, Merced*	*$ 22,500*
	Travel Award, *University of California, Merced*	*$ 800*
	Summer Research Fellowship, *University of California, Merced*	*$ 1,600*
2022	**Chancellor's Recruitment Fellowship**, *University of California, Merced*	*$ 45,000*
	***Foreign Language and Area Studies (FLAS) Fellowship**, *U.S. Department of Education*	*$ 22,500*
	Adolph Sutro Fellowship, *Vassar College*	*$ 10,000*
	The Jamie Nisse Greenberg Philosophy Prize, *Vassar College*	*$ 900*
	Critical Language Scholarship for advanced Japanese, alternate, *U.S. Department of State; American Councils for International Education*	
2021	**Frances Lehman Loeb 1928 Scholarship**, *Vassar College*	*$ 44,000*
	Summer Research Fellowship, *Vassar College*	*$ 4,000*

2020	**Frances Lehman Loeb 1928 Scholarship**, *Vassar College*	*$ 44,000*
	Undergraduate Research Summer Institute Fellowship, *Vassar College*	*$ 5,000*
2019	**Frances Lehman Loeb 1928 Scholarship**, *Vassar College*	*$ 42,500*
	Undergraduate Research Summer Institute Fellowship, *Vassar College*	*$ 5,000*
2018	**1956 Memorial Scholarship**, *Vassar College*	*$ 42,000*

Teaching Experience

Fall 2025	**Mind, Brain, and Computation,** Teaching Assistant, *Cognitive Science, University of California, Merced*
Spr. 2025	**Critical Reasoning,** Teaching Assistant, *Philosophy, University of California, Merced*
Spr. 2024	**Contemporary Moral Problems,** Teaching Assistant, *Philosophy, University of California, Merced*
Spr. 2022	**Introduction to Cognitive Science,** Teaching Assistant, *Cognitive Science, Vassar College*
Fall 2021	**Introduction to Cognitive Science,** Teaching Assistant, *Cognitive Science, Vassar College*

Outreach & Professional Development

Workshops & Training

2025 **Santa Fe Institute,** Graduate Workshop in Computational Social Science, *Santa Fe, New Mexico*
Complexity Science Hub, Winter School on Complex Systems in Our Changing World, *Vienna, Austria*

2024 **Institute for Pure and Applied Mathematics,** Mathematics of Intelligences Culminating Retreat, *UCLA Lake Arrowhead Lodge*
Institute for Pure and Applied Mathematics, Modeling Multi-Scale Collective Intelligences, *University of California, Los Angeles*
Berggruen Institute, Future Humans Workshop on Computational Consciousness, *Beverly Hills, California*
Institute for Pure and Applied Mathematics, Naturalistic Approaches to Artificial Intelligence, *University of California, Los Angeles*
Institute for Humane Studies, Aristotle and Human-Centered AI, *Webinar*
Institute for Pure and Applied Mathematics, Theory and Practice of Deep Learning, *University of California, Los Angeles*
Dynamic Interactions and Methodologies Symposium, *University of California, Los Angeles*
Institute for Pure and Applied Mathematics, Analyzing High-dimensional Traces of Intelligent Behavior, *University of California, Los Angeles*

2023 **Sante Fe Institute,** Complexity-GAINs International Summer School on Intelligence and Representation, *Isaac Newton Institute for Mathematical Sciences, University of Cambridge*
Diverse Intelligences Summer Institute, *University of St. Andrews*

2022 **Phi Beta Kappa,** Key Connections, *Webinar*

2020 **Center for Philosophy of Science,** Pittsburgh Summer Program in Philosophy of Science and Specialized Sciences, *University of Pittsburgh and Carnegie Mellon University*

Service Positions

2025-cont. **Book Club President,** Cognitive and Information Sciences, *University of California, Merced*

2025 **Brownbag Organizer,** Cognitive and Information Sciences, *University of California, Merced*

2023-2024 **Graduate Student Chair,** Cognitive and Information Sciences, *University of California, Merced*
Research Mentor, Learning Aligned Employment Program, *University of California, Merced*

2021 **Research Mentor,** Undergraduate Research Summer Institute, *Vassar College*

2018-2019 **Editor,** Vassar College Journal of Philosophy, *Vassar College*

Peer Review

Cognitive Science
Minds and Machines
Journal of Experimental Psychology: General

Professional Memberships

Phi Beta Kappa, Academic Honor Society
Sigma Xi, The Scientific Research Honor Society
Psi Chi, International Honor Society in Psychology
Cognitive Science Society
MetaSTEM, Research Group on the Philosophy and Science of Science
Merced Complexity Lab

Skills

Languages: English (native), Japanese (conversational)
Programming: Python, R, JavaScript, HPC parallel computing
Technical: Neural networks, Complex and dynamical systems, Information theory, Bayesian statistics, Data visualization