

# Matthew Ricci

Data Science Initiative  
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## Current position

### *Postdoctoral Associate*

Data Science Initiative  
Brown University  
Advisor: Stuart Geman

## Areas of interest

Machine learning for network dynamics  
Systems of coupled oscillators  
The representation of syntactic structures in neural networks

## Education

2020

### *Ph.D. in Computational Neuroscience*

Brown University  
Specialization: Computer vision, neural dynamics  
Advisor: Thomas Serre  
Dissertation: “Towards Systematic Vision: Limitations of Convolutional Neural Networks and Future Directions in Oscillatory Coding”

2012

### *MA/BA in Mathematics*

University of Pennsylvania  
Specialization: Signal processing  
Advisor: Philip Gressman

2012

### *BA in Musicology*

University of Pennsylvania  
Specialization: American modernism and performance practice  
Advisors: Arman Schwartz, Emily Dolan

## Appointments held

Aug. 2018 -  
Dec. 2018

### ***Visiting Doctoral Researcher***

Département d'informatique  
École normale supérieure, Paris  
Principal Investigator: Stéphane Mallat

2013-2014

### ***Research Assistant***

Rutgers University Center for Cognitive Science  
Principal Investigator: Randy Gallistel

## Grants, honors & awards

Sep. 1, 2017-  
July 1, 2019

NSF Graduate Research Fellowship  
Award no. 1644760  
Principal Investigator: Thomas Serre

2018

Brown University Graduate School Travel Grant

2017

CCN Travel Grant

Jan. 1, 2015-  
Jan. 1, 2017

NIH Vision Training Grant  
Award no. 5T32EY018080-08  
Principal Investigator: Michael Paradiso

2012

Admitted to Phi Beta Kappa

2012

Phi Beta Kappa Outstanding Thesis Award, University of Pennsylvania

2012

Rose Award for Outstanding Thesis, University of Pennsylvania

2011

Submatriculated into graduate program, Department of Mathematics, University of Pennsylvania

## Peer-Reviewed Publications

### PUBLISHED

Alamia, A., Luo, C., Ricci, M.G., Kim, J., Serre, T. and VanRullen, R. (forthcoming) Differential involvement of EEG oscillatory components in identity vs. spatial-relation reasoning tasks. *eNeuro*

Ricci, M., Cadène, R., Serre, T. (2021). Same-different conceptualization : A machine vision perspective. *Current Opinion in Behavioral Sciences*, 37, 47-55. <https://doi.org/10.1016/j.cobeha.2020.08.008>

Ricci, M., and Serre, T. (2020). Hierarchical Models of the Visual System. Encyclopedia of Computational Neuroscience, 1–14. [https://doi.org/10.1007/978-1-4614-7320-6\\_345](https://doi.org/10.1007/978-1-4614-7320-6_345) – 2

Kim, J., Ricci, M.G., and Serre, T. (2018) Not-so-CLEVR: Learning same-different relations strains feedforward neural networks, Journal of the Royal Society Interface, 8(4), <https://doi.org/10.1038/35073582>

Ricci, M.G, Kim, J. and Serre, T. (2018) Same-Different Problems Strain Convolutional Neural Networks, Proceedings of the 40th Annual Conference of the Cognitive Science Society.

Ricci, M.G., and Gallistel, R. (2017). Accurate Step-Hold Tracking of Smoothly Varying Periodic and Aperiodic Probability. Atten. Percept. Psychophys., 1–32. <https://doi.org/10.3758/s13414-017-1310-0>

#### SUBMITTED

Chalvidal, M., Ricci, M.G., Serre, T., VanRullen, R. Go With the Flow: Adaptive Control for Neural ODEs

Gallistel, C.R., Johansson, F., Jirenhed, D.-A., Rasmussen, A., Ricci, M.G., Hesslow, G. Quantitative Properties of the Learned Pause in the Spontaneous Firing of the Cerebellar Purkinje Cell

## Technical Reports and Preprints

Chalvidal, M., Ricci, M.G., Serre, T., VanRullen, R. Go With the Flow: Adaptive Control for Neural ODEs. [arXiv:2006.09545](https://arxiv.org/abs/2006.09545) [cs.LG]

Alamia, A., Luo, C., Ricci, M.G., Kim, J., Serre, T., VanRullen, R. Differential involvement of EEG oscillatory components in sameness vs. spatial-relation visual reasoning tasks [bioRxiv 2019.12.16.877829](https://arxiv.org/abs/2019.12.16.877829)

Ricci, M.G., Kim, J and Johansson, F. A Passage-of-time Model of the Cerebellar Purkinje Cell, 2016, [arXiv:1605.03060v2](https://arxiv.org/abs/1605.03060v2) [q-bio.NC]

## Works in Progress

Ricci, M.G., Zhang, Y., Soni, A., Chalvidal, M., Jung, M., Serre, T. Neural optimal control of the Kuramoto model for phase-based data clustering (In preparation)

Ricci, M.G., Linsley, D., Govindarajan, L., Chalvidal, M., Serre, T., Network reconstruction from neural observables (In preparation)

Ricci, M.G., Linsley, D., Govindarajan, L., Serre, T., Generalized Adversariality: Parameterized data set optimization to evaluate the limits of neural models and mechanisms (In preparation)

Ricci, M.G., Windolf, C., Zhang, Y., Harrison, M., Serre, T., Energy-based models for unsupervised learning using phase coding (In preparation)

## Articles Reviewed

Sims, C. R. (2016). Rate-distortion theory and human perception. *Cognition*, 152, 181–198. <https://doi.org/10.1016/j.cognition.2016.03.020>

## Conferences, Talks and Workshops

### AS CONFERENCE PRESENTER

- |           |                                                                                                                                                                                                                |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| June 2020 | Ricci, M.G., “N’Sync: Learning to Synchronize in Complex Networks” Brown Unconference. June 29-30, 2020.                                                                                                       |
| Feb. 2020 | Ricci, M.G., Zhang, Y., Soni, A., Jung, M., Serre, T. “Kura-Net: Exploring systems of coupled oscillators using deep learning” Poster, COSYNE 2020. Denver, USA. February 27-March 2, 2020.                    |
| Feb. 2019 | Ricci, M.G., Windolf, C., Serre, T. “A Formal Model of Neural Synchrony for Unsupervised Image Grouping”. Poster, COSYNE 2019. Lisbon, Portugal. February 28-March 3, 2019.                                    |
| July 2018 | “Not-So-CLEVR: Same-different problems strain feedforward neural networks”. 40th Annual Meeting of the Cognitive Science Society”, July 25, 2018. Monona Terrace Community and Convention Center, Madison, WI. |
| Sep. 2017 | “A Dichotomy of Visual Relations, Or the Limits of Convolutional Neural Networks”, Conference on Cognitive Computational Neuroscience (CCN), September 6-8, 2017. Columbia University, NYC.                    |
| Aug. 2017 | “Deep RL Bootcamp”, August 26-27, 2017, University of California, Berkeley. (Accepted)                                                                                                                         |
| June 2015 | “Cell autonomous metabotropic signaling”, Kavli Futures Symposium – The Synapse Hypothesis: To be or not to be. June 25-26, 2015. University of California, Santa Barbara                                      |

#### AS GUEST SPEAKER

June 2020	“The Kuramoto Model Meets Machine Learning: Some Early Results in the Statistical Modeling of Oscillatory Systems”. University of Ghent. PI: Tom Verguts. June 19, 2020
Nov. 2019	“The Serre Lab: From machine learning to biology and back again”, Information Theory (APMA 1710). Instructor: Govind Menon. November 11, 2019.
Oct. 2019	“Coupled Oscillators for Data Science: A Research Program”, Serre Lab-ANITI Joint Meeting, PIs: Thomas Serre, Rufin VanRullen. October 24, 2019.
Sep. 2019	“Review: Coupled Oscillators for Perceptual Grouping”, Carney Institute for Brain Science. September 5, 2019.
April 2019	“Systems of coupled neural oscillators: Results and applications based on Slotine, Izhikevich, Kuramoto”, Carney Institute for Brain Science. April 30, 2019.
Aug. 2019	“Kosterlitz Machines”, Carney Institute for Brain Science. August 7, 2019.
Oct. 2018	“Get Rhythm: Object Multiplexing in Phase Neural Networks”. Centre de Recherche Cerveau et Cognition, Toulouse, France. October 2., 2018
March 2018	“Reinforcement Learning 101”, Computational Cognitive Science (CLPS 1291). Instructor: Thomas Serre. March 22, 2018.
Dec. 2017	“Visual Relations and Convolutional Networks”, Perception & Action Seminar, Brown University, Department of Cognitive, Linguistic and Psychological Sciences. December 7, 2017
Oct. 2015	“Contemporary Problems in Vision”, Brown University, Department of Cognitive, Linguistic and Psychological Sciences. October 9, 2015.
June 2015	“Contemporary Problems in Vision”, UCL Gatsby Computational Neuroscience Unit. June 26, 2015.
June 2015	“Challenges to Hebbianism: A Case from Cerebellar Learning”, UCL Gatsby Computational Neuroscience Unit, June 25, 2015.
June 2015	“Challenges to Hebbianism: A Case from Cerebellar Learning”, University of Geneva. June 3, 2015.
June 2015	

“Challenges to Hebbianism: A Case from Cerebellar Learning”, Neurospin.  
June 5, 2015.

March 2014 “Non-stationary Bernoulli Processes: Ideal Observers’ Predictions and Surprisals”, Rutgers University Center for Cognitive Science. March 28, 2014.

#### AS ORGANIZER

April 2018 “Beyond Deep Learning Workshop: Session 2”, Brown University, April 6, 2018

Speakers: David Heeger (NYU), Dima Amso (Brown University), Tom Griffiths (UC Berkeley)

Jan. 2018 “Beyond Deep Learning Workshop: Session 1”, Brown University, January 18-19, 2018

Speakers: Matthias Bethge (Universität Tübingen), Randy Gallistel (Rutgers University), Gary Marcus (NYU), Samuel Gershman (Harvard)

## Teaching

#### BROWN UNIVERSITY

2019-present

##### ***Mentor***

Visiting undergraduate researcher, Yuwei Zhang  
Nankai University

Project: An end-to-end differentiable clustering algorithm using the Kuramoto Model

2019

##### ***Teaching Assistant***

Human Cognition (CLPS 0200)  
Instructor: Katheryn Spoehr

2018

##### ***Teaching Assistant***

Deep Learning in Brains, Minds and Machines (CLPS 1950)  
Instructor: Thomas Serre

2017

##### ***Teaching Assistant***

Introduction to Programming for Mind, Brain and Behavior (CLPS 1292)  
Instructor: Thomas Serre

2016-2018

##### ***Mentor***

Masters student, Charles Windolf  
Department of Applied Mathematics, Brown University  
Project: Angular Gibbs random fields for image processing

UNIVERSITY OF PENNSYLVANIA

2012-2013

***Tutor***

Multivariable calculus, linear algebra (MATH 103, MATH 104)  
Department of Mathematics

PRINCETON REVIEW

2013

***SAT Instructor***

2013

***MCAT Instructor***

## References

### **Thomas Serre**

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Brown University  
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### **Charles Randy Gallistel**

Distinguished Professor Emeritus of Behavioral and Systems Neuroscience  
Rutgers University  
152 Frelinghuysen Road  
Piscataway, NJ 08854  
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### **Matthew Harrison**

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