Gecia **Bravo-Hermsdorff**

Research Fellow · Department of Statistics @ University College London

(+44)778.088.1912 | gecia.bravo@gmail.com | gecia.github.io

Interests

Statistical analysis of interactions, information dynamics, computations, causality, privacy and fairness, with the goal of distilling principled theories of learning (both *in silico* and *in the flesh*).

Education

Princeton University *Princeton, NJ, USA*

PhD in Quantitative & Computational Neuroscience *(link)* *2020*

- *Dissertation*: "Quantifying human priors over abstract relational structures"
- *Selected courses (hyperlinked):* Random graphs and networks, Mathematical physics, Theory of deep learning, Complex analysis, Natural algorithms, Statistical learning and nonparametric estimation, Machine learning & pattern recognition, Interacting with data, Optimal learning, Abstract algebra, Computational complexity, Statistical optimization and reinforcement learning, High-dimensional probability, Stochastic processes on graphs

École Normale Supérieure (ENS Ulm) *Paris, France*

Research Master in Cognitive Sciences and Neuroscience *(link)* *2011*

- *Dissertation*: "Neural basis of self-contingency detection in 5-month-old babies"

Diplôme de l'ENS *(link)* *2011*

- Admitted via the "International Selection in Science" *(link)*
- Three-year multidisciplinary program, coursework included: Computational neuroscience, Cognitive science, Decision theory, Biophysics, Logics, Mathematics, Modeling, Ecology and evolutionary biology, Philosophy of science, Theoretical chemistry, Statistics, Philosophy of Mind

Bachelor of Science *(link)* *2009*

Publications

Private and Communication-Efficient Algorithms for Entropy Estimation. *(link)*
G Bravo-Hermsdorff, R Busa-Fekete, M Ghavamzadeh, A Muños Medina & U Syed. *NeurIPS, 2022*

Statistical Anonymity: Quantifying Reidentification Risks Without Reidentifying Users. *(link)*
G Bravo-Hermsdorff, R Busa-Fekete, LM Gunderson, A Muños Medina & U Syed. *arXiv, 2022*

A Principled (and Practical) Test for Network Comparison. *(link)*
G Bravo-Hermsdorff*, LM Gunderson*, PA Maugis & CE Priebe. *arXiv, 2021*

Introducing Graph Cumulants: What is the Variance of your Social Network? *(link, video, code)*
LM Gunderson* & G Bravo-Hermsdorff*. *arXiv, 2020*

Quantifying Human Priors over Abstract Relational Structures. *(link, slides, demos)*
G Bravo-Hermsdorff. *Ph.D. dissertation, Princeton University, 2020*

A Unifying Framework for Spectrum-Preserving Graph Sparsification and Coarsening. *(link, video, demos, code, poster)*
G Bravo-Hermsdorff* & LM Gunderson*. *NeurIPS, 2019*

Gender and Collaboration Patterns in a Temporal Scientific Authorship Network. *(link, dataset)*
G Bravo-Hermsdorff, V Felso, E Ray, LM Gunderson, ME Helander, J Maria & Y Niv. *Applied Network Science, 4(1), 2019*

Modeling the Hemodynamic Response Function for Prediction Errors in the Ventral Striatum. *(link)*
G Bravo-Hermsdorff & Y Niv. *bioRxiv, Cold Spring Harbor Laboratory, 2019*

Quantifying Humans' Priors over Graphical Representations of Tasks. *(link)*
G Bravo-Hermsdorff, TD Pereira & Y Niv. *Unifying Themes in Complex Systems IX. ICCS, Springer Proceedings in Complexity, 281–290, 2018*

**denotes equal contribution*

Research positions

AI resident at Google research *US (remote) now London, UK, 2020 – now*

- **Privacy:** Leading author on a paper describing a class of protocols that offer anonymity to users without the need for a fully-trusted central entity *(link).*
- **Symmetry:** Developing a neural network architecture for analyzing images of cells from drug discovery experiments. Specifically, the aim is to identify compounds that are likely to be effective against the "dormant" phase of the parasite responsible for Malaria. I've implemented a permutation-equivariant layer, as the order of the images is unimportant *(link to my short and fun explanation)*. Also, as the orientation of a cell is unimportant, I've also implemented a rotation-equivariant layer.
- **Graphs:** Implementing a method for scalable computation of graph cumulants [G&B-H 2020 *(link)*], with an aim to detect atypical patterns of information propagation in social networks.
- **Entropy:** Developed and analyzed private and "communication efficient" algorithms for computing entropies, work published at NeurIPS, 2022. Implemented the algorithm from [Jian et al 2015 *(link)*] for computing entropy in the sparse data regime.

PhD candidate at the Niv lab *(link)* *Princeton University, 2014 – 2019*

- Developed methods to efficiently quantify human priors over relational data by exploiting the relevant underlying symmetry *(link).*

PhD research rotation at the Botvinick lab *Princeton University, 2013 – 2014*

Research scholar in neuroeconomics at the Montague lab *(link)* *Virginia Tech Carilion Research Institute (VTCRI), 2011–2013*

- Worked on computational modelling of behavioral data from neuroeconomic experiments, e.g., multi-armed bandit problems, repeated ultimatum game, and gambling tasks.

Master's student at the Cognitive Science and Psycholinguistic lab *(link)* *ENS Ulm, Paris, 2011*

- Studied the neural substrates of self-contingency detection in babies using functional near-infrared spectroscopy (fNIRS). Designed, built, and coded the experimental apparatus, recorded and analyzed the data from 61 babies. *Advisor*: Emmanuel Dupoux

Research internship at the Emotion and Social Cognition lab *(link)* *California Institute of Technology (Caltech), Spring 2010*

- Designed and carried out behavioral experiments to analyze whether humans express values learned via Pavlovian conditioning in an unrelated task without their conscious awareness. *Advisors*: Naotsugu Tsuchiya and Ralph Adolphs

Research internship at the Development and Neuropharmacology lab *(link)* *Collège de France, Paris, 2009*

- Studied the molecular mechanisms involved in the emergence of cellular territories during the morphogenesis of the neural tube. *Advisors*: Elizabeth Di Lullo and Alain Prochiantz

Undergraduate student at the Physiology of Cognition lab *(link)* *UFRJ, Brazil, 2007-2008*

- Studied the physiology of the visual system in monkeys (using intracranial recordings) and humans (using EEG). *Advisor*: Mário Fiorani

Research internship at the Institute of Neurobiology Alfred Fessard *(link)* *CNRS, Gif-sur-Yvette, France, Summer 2007*

- Studied the development of the neural crest by grafting quail and chick embryos *in ovo*. *Advisors*: Sophie Creuzet and Nicole Le Douarin

Awards

- **Google AI residency NYC (Algorithm and theory branch):** Competitive position for exploring research at Google *2020—2022*
- **Independent research grant:** Graduate student research funding ($5,000), Princeton Cognitive Science Department *2019*
- **Scholarship for Lake Como School of Advanced Studies in Complex Networks** *May, 2016*
- **Cognitive Science Graduate Fellowship** *2016—2017*
- **Scholarship for Brains, Minds and Machines summer school** *August, 2015*
- **Scholarship for SAMSI Bayesian Nonparametrics workshop** *July, 2015*
- **Princeton PhD Fellowship** *2013—2019*
- **École Normale Supérieure (ENS Ulm) "International Selection in Science"** *2008*
- **Scholarship for studying French literature in France, Lions Club** *Summer, 2006*
- **Brazilian CNPq "scientific initiation" scholarship** *2006—2008*
- **Entrance exam for the Biomedical Sciences program at the Universidade Federal do Rio de Janeiro (UFRJ):** Top Brazilian undergraduate program in biomedical sciences, completed two of four years before moving to France *2006—2008*
- **99th percentile at the Exame Nacional de Ensino Médio (ENEM):** Nationwide exam for Brazilian students after high school *2005*
- **Travel awards for presenting at conferences:**

  Neural Information Processing Systems (NeurIPS) Scholar Award, *2022* and *2019*; NeurIPS Women in Machine Learning, *2018*; International Conference on Complex Systems (ICCS), *2018*; Society for Industrial and Applied Mathematics (SIAM) Annual Meeting, *2018*; NIPS Women in Machine Learning, *2017*; Multidisciplinary Conference in Reinforcement Learning and Decision Making (RLDM), *2017*; International Conference on Mathematical Neuroscience (ICMNS), *2017*; Multidisciplinary Conference in Reinforcement Learning and Decision Making (RLDM), *2015*; Austin Memory & Learning Conference, *2015*

Summer schools

Machine Learning Summer School (MLSS) *(link, 9m21s video)* — *Tübingen (virtual event), Germany, Summer 2020*

Complex networks: theory, methods, and applications *(link)* — *Lake Como School, Italy, May 2016*

Bayesian nonparametrics: synergies in statistics, probability and math *(link)* — *SAMSI, NC, USA, June 2015*

Brains, minds and machines summer school *(link)* — *Woods Hole, MA, USA, August 2015*

Computational and cognitive neuroscience summer school *(link)* — *Suzhou, China, August 2010*

Selected talks

- Cumulants for Networks *Algebraic and Combinatorial Perspectives in the Mathematical Sciences (ACPMS), 2022 (link)*
- What is the variance of your social network? — Graph cumulants *Learning with Graphs Summit (Google), 2022*
- Graph cumulants: What is the variance of your social network? *Graph Mining Meeting (Google), 2021*
- Statistical anonymity: quantifying reidentification risk without reidentifying users. *Chrome Privacy Budget Meeting, 2021*
- Using graph cumulants to detect atypical patterns of information spread in social networks. *MML Eng Meeting (Google), 2021*
- Entropy estimation of high-dimensional sparse datasets. *Chrome Privacy Budget Meeting, 2021*
- Graph reduction by edge deletion and edge contraction. *International Conference on Complex Systems (ICCS), 2018*
- Quantifying people's priors over graphical representations of tasks. *ICCS, 2018*
- Graph reduction by edge deletion and edge contraction. *SIAM workshop on network science (SIAMNS18), 2018*
- Characterizing people's priors over navigation task structure. *Princeton Cognitive Science Lunchtime Talk, 2017*
- Assessing decision-making deficits in patients with insula lesion using various neuroeconomic tasks. *Regional conference in neuroeconomics at the Duke center for interdisciplinary decision sciences, 2016*

Teaching

BioMath Bootcamp (Princeton University) *(link)* — *Summer 2016*

- Month-long training in mathematical and computational tools for incoming PhD students in neuroscience and biology, organized by Carlos Brody
- Lectured for the probability module, and held afternoon sessions for exercises in: linear algebra, ODEs, programming, probability, and signal processing

Introduction to cognitive neuroscience (Princeton University) *(link)* — *Spring 2015*

- Held weekly sessions discussing relevant journal publications, constructed and graded the exams

Lab course for introduction to psychology (Princeton University) *(link)* — *Fall 2014*

- Held weekly 3 hours lab sessions with introductory lectures and exercises in:
  statistical analysis, MRI, EGG, psychophysics, experimental design, programming, computational modeling, and game theory

Voluntary work

Mentoring (Princeton University)

- Daniel J Wilson (intern during 2015, now a PhD student at the University of Toronto)
- Caitlyn Cap and Olamilekan Sule (interns during 2014 summer)

Reviewer

- *Journals:* Trends in Cognitive Sciences, Socio-Economic Planning Sciences
- *Conferences:* NeurIPS Women in Machine Learning (2017, 2018), WHMD 2021 NeurIPS workshop, ICML 2022

Languages

- **Human:** Portuguese *(native),* English & French *(fluent),* Spanish & Italian *(basic)*
- **Computer:** Python & MATLAB *(fluent),* Mathematica, C++ & R *(functional),* Javascript & HTML *(basic)*