Daniel Herrera-Esposito, PhD

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Academic Positions

Postdoctoral Researcher, Department of Psychology, University of Pennsylvania   2022–Ongoing

Research and Teaching Associate, Interdisciplinary Center for Data Science and Machine Learning,   2021–2022
Universidad de la República (UdelaR), Uruguay

Research and Teaching Associate, Neuroscience Laboratory, School of Sciences, UdelaR, Uruguay   2017–2022

Research and Teaching Assistant, Biochemistry Department, School of Medicine, UdelaR, Uruguay   2013–2017

Education

PhD, Computational Neuroscience, UdelaR, Uruguay   2015–2021
Thesis: *Contextual modulation and segmentation of naturalistic textures in peripheral vision*.
Supervisors: Leonel Gomez-Sena, Ruben Coen-Cagli (Albert Einstein College of Medicine, NY, USA).

BSc, Biochemistry, UdelaR, Uruguay. (summa cum laude)   2010–2015

Publications and Presentations

= corresponding author

I published 8 peer-reviewed journal articles and 2 preprints (under review). I am first author in 6, co-author in 3, and last author in 1. I am also corresponding author in 7 of these publications.

Journal Articles and Preprints

Preprints under review: Statistics

- "Projected Normal Distribution: Moment Approximations and Generalizations". *arXiv* (2025)
  Daniel Herrera-Esposito[#], Johannes Burge

- "Supervised Quadratic Feature Analysis: Information Geometry for Dimensionality Reduction". *arXiv* (2025)
  Daniel Herrera-Esposito[#], Johannes Burge

Journal Articles: Neuroscience

- "Optimal Estimation of Local Motion-in-Depth with Naturalistic Stimuli". *Journal of Neuroscience* (2024)
  Daniel Herrera-Esposito[#], Johannes Burge

- "Redundancy between spectral and higher-order texture statistics for natural image segmentation".
  Vision Research (2021)
  Daniel Herrera-Esposito[#], Leonel Gómez-Sena, Ruben Coen-Cagli

- "Flexible contextual modulation of naturalistic texture perception in peripheral vision". *Journal of Vision* (2021)
  Daniel Herrera-Esposito[#], Ruben Coen-Cagli, Leonel Gómez-Sena

Journal Articles: Epidemiology

- "Dynamics of SARS-CoV-2 seroassay sensitivity: a systematic review and modeling study". *Eurosurveillance* (2023)
  Nana Owusu-Boaitey, Timothy W Russell, Gideon Meyerowitz-Katz, Andrew T Levin, **Daniel Herrera-Esposito**[#]

- "Age-specific rate of severe and critical SARS-CoV-2 infections estimated with multi-country seroprevalence studies".
  BMC Infectious Diseases (2022)
  Daniel Herrera-Esposito[#], Gustavo de los Campos

- "Assessing the burden of COVID-19 in developing countries: systematic review, meta-analysis and public policy implications". *BMJ Global Health* (2022)
  Andrew T Levin, Nana Owusu-Boaitey, Sierra Pugh, Bailey K Fosdick, Anthony B Zwi, Anup Malani, Satej Soman, Lonni Besançon, Ilya Kashnitsky, Sachin Ganesh, Aloysius McLaughlin, Gayeong Song, Rine Uhm, **Daniel Herrera-Esposito**, Gustavo de Los Campos, Ana Carolina Pecanha Peçanha Antonio, Enyew Birru Tadese, Gideon Meyerowitz-Katz

- "Contact tracing-induced Allee effect in disease dynamics". *Journal of Theoretical Biology* (2022)
  Matías Arim, **Daniel Herrera-Esposito**, Paola Bermolen, Álvaro Cabana, María Inés Fariello, Mauricio Lima, Héctor Romero

Journal Articles: Biochemistry

- "Tyrosine oxidation and nitration in transmembrane peptides is connected to lipid peroxidation". *Archives of Biochemistry and Biophysics* (2017)
  Bartesaghi, S., **Herrera, D.**, Martinez, D.M., Petruk, A., Demicheli, V., Trujillo, M., Martí, M.A., Estrín, D.A., Radi, R.

Presentations (Selected)

- Invited talk at NeuroStatsLab lab meeting, Flatiron Institute (2024).
  "A Geometric Analysis of Task-Specific Natural Image Statistics"

- Poster at Symmetry and Geometry in Neural Representations Workshop @ NeurIPS (2024).
  "Supervised Quadratic Feature Analysis: An Information Geometry Approach to Dimensionality Reduction"

- Invited talk at Congress of the Uruguayan Society for Neuroscience (2024).
  "Noise and Divisive Normalization: Neuroscience in Online Math Forums"

- Poster at Computational Systems Neuroscience conference (2024).
  "Analytic model of response statistics in noisy neural populations with divisive normalization"

- Talk at Vision Sciences Society Annual Meeting (2022).
  "Task-dependent contribution of higher-order statistics to natural texture processing"

- Talk at 7th International Conference on Time Series and Forecasting 2021 (ITISE).
  "Age-stratified hospitalisation rates to estimate COVID-19 under-reporting"

Technical reports (not peer reviewed)

During COVID-19 I joined a collaboration at UdelaR, for producing statistical analyses to inform the public and policy makers. I authored the following reports, which are hosted at the university's website.

- "Report 2: Subexponential growth of reported cases" (03/2020) ☑
  Matías Arim, **Daniel Herrera-Esposito**, Juan Ignacio Sanguinetti, Javier Pintos, Alicia Alemán, Héctor Romero, María Inés Fariello, Horacio Botti

- "Report 3: Estimation of the under-ascertainment of COVID-19 cases in Uruguay" (04/2020) ☑
  Daniel Herrera-Esposito, Paola Bermolen, María Inés Fariello

- "Report 9: COVID-19 dynamics at low numbers: alternative states and policy implications" (09/2020) ☑
  Paola Bermolen, **Daniel Herrera-Esposito**; Álvaro Cabana, María Inés Fariello, Matías Arim, Héctor Romero

- "Report 10: Age-stratified severe, critical and fatal SARS-CoV-2 infections" (12/2020) ☑
  Daniel Herrera-Esposito

Software (not peer reviewed)

I have published the following open-source Python packages, implementing statistical methods developed in my work:

- **sqfa** ☑: Package implementing Supervised Quadratic Feature Analysis, a supervised dimensionality reduction method.

- **projnormal** ☑: Package to work with and fit the Projected Normal distribution and its generalizations.

Teaching

My teaching experience is at UdelaR, Uruguay, a large public university with students from many different socioeconomic backgrounds. Most of my teaching materials are available at my personal website.

Graduate courses and workshops

Basic Machine Learning for Scientists. For the first edition of this course, I designed and taught 7 hands-on workshops in Python, which are still used in new editions of the course.	2021
Computational and Cognitive Neuroscience. I TA'd the practical classes and updated the hands-on Python notebooks.	2021
Systems Neuroscience. I taught a 2h workshop of advanced statistical methods in R.	2021
Psychophysics programming workshop. I designed and taught a workshop on programming perceptual experiments for an international graduate course.	2016

Undergraduate courses

Molecular and Cellular Neuroscience. I taught 5 lectures each year, several discussion seminars, and designed a 3-class computational simulation laboratory. I participated in grading and exam preparation.	2017–2022
Systems and Behavioral Neuroscience. I taught 5 lectures each year, several discussion seminars, and a perceptual experiment laboratory. I participated in grading and exam preparation.	2017–2022
Milestones and Myths of the Brain. I teach a yearly lecture plus a discussion seminar. I wrote a chapter for the course book, titled *Is the world as we see it?*	2017–Ongoing
Introduction to Biology. I led weekly discussion seminars.	2016
Biochemistry for pre-med. I led twice-per-week problem-based seminars and laboratory classes for both small and large groups. I was responsible for preparing the laboratory materials.	2013–2017

Mentoring

I twice mentored groups of undergraduate students in year-long research projects. These projects obtained small grants from a student research program at UdelaR. Students presented their results at the end-of-program symposiums.

Deep Convolutional Neural Networks as Models of the Visual System. Group of 3 biology and psychology undergraduates, using deep learning to model selectivity and invariance in the visual system. It was their first exposure to machine learning.	2023
Neural Networks and Face Masks: Face Perception During COVID-19. Group of 3 biology undergraduates, using deep learning to model face perception with facemasks. It was the students' first exposure to programming and machine learning.	2021

Awards and recognitions

Project Grants

Grant for COVID-19 research in Uruguay. Principal Investigator in grant awarded by Comisión Sectorial de Investigación Científica (CSIC), UdelaR. Grant proposal "Estimation of under-ascertainment of COVID-19 cases in Uruguay." (USD 3000).	2020
Doctoral Scholarship, Comisión Académica de Posgrados, UdelaR. Competitive monthly stipend award while doing PhD.	2018–2021
Master's Scholarship, Comisión Académica de Posgrados, UdelaR. Competitive monthly stipend award while doing Masters in Science.	2016–2017

Travel Grants

Presenter's Travel Grant, Uruguayan Society for Neuroscience. Travel grant to give invited talk (USD 1000).	2024
Presenter's Travel Grant, COSYNE 2022. Travel grant to attend COSYNE (USD 1000).	2022
Research Travel Grant. Travel grant to do research at Albert Einstein College of Medicine, NY, USA (USD 3000). Awarded by Programa de Desarrollo de las Ciencias Básicas, Uruguay.	2019
Research Travel Grant. Travel grant to do research for 3 months at Albert Einstein College of Medicine, NY, USA (USD 3000). Awarded by CSIC, UdelaR.	2018

Other Recognitions

Cited in U.S. House of Representatives ↗. The preprint of my BMC 2022 paper was cited in hearings about COVID-19 and school openings.	2021
Cited in Time magazine ↗. My BMC 2022 paper was cited in Time magazine.	2023
Research highlight by UdelaR ↗. My COVID-19 research was highlighted in UdelaR's report of contributions against COVID-19 in Uruguay.	2021
Cover at Journal of Vision. My paper was on the cover of the January 2021 Issue.	2021
Reviewing distinction. Exceptional reviewer distinction by Journal of Vision in 2023 and 2024.	2023 & 2024

Service and Outreach

Science Communication and Outreach

COVID-19 related outreach

During the COVID-19 pandemic I had dozens of interviews in TV, radio and newspapers. Some selected interviews are:

Nature News ↗. Interviewed and quoted in the piece *COVID was twice as deadly in poorer countries*.	06/28/2022
Stuff.co.nz ↗. Interviewed by one of the largest newspaper in New Zealand for the piece *COVID-19: Just how deadly is the virus?*.	08/10/2021
Telenoche ↗. 20 minute interview about COVID-19 in one of the main TV News shows in Uruguay.	12/19/2020
El País ↗. Interviewed for Sunday cover story of largest newspaper in Uruguay, featuring my research about COVID-19 under-reporting.	12/27/2020
La Diaria ↗. Contributed piece about the end of the COVID-19 pandemic, to the science section of large Uruguay newspaper	08/10/2021

I also co-authored an official infographic ↗ about COVID-19 prevention, used by the Uruguay government. The infographic was partly based on research that I participated in (my Journal of Theoretical Biology 2022 paper).

Other

CrossValidated contributor. Since 2023 I have been an active contributor to the CrossValidated statistics forum, with over 50 answers to questions about statistics and machine learning, under the username dherrera ↗.	2023–Ongoing
Opinion piece about reproducibility ↗. I wrote an invited opinion piece for a Uruguay online news outlet, about the reproducibility crisis in science.	02/05/2019
Neuroscience talk for teachers. I gave a neuroscience talk to Uruguay high-school teachers about visual perception, as part of a lecture series at the high-school.	11/01/2017
TV interview about memory. I was a guest expert in the sciente TV show "Todo tiene un porqué", in TV Ciudad, Uruguay, where I explained the neuroscience of memory to a general audience.	03/02/2020

Reviewing

Journals: Journal of Vision; Neurons, Behavior, Data Analysis and Theory; Scientific Reports; Emerging Infectious Diseases.

Conferences: Computational Systems Neuroscience (COSYNE); Shared Visual Representations in Humans and Machines (SVRHM) Workshop @ NeurIPS; Geometry and Symmetry in Neural Representations (NeurReps) Workshop @ NeurIPS.

Open Source Software Contributions

I have contributed to the following open-source Python packages:

- **geomstats** ⬈: Package for statistics in Riemannian manifolds, developed at UC Santa Barbara. I improved the computation of distances between positive definite matrices.

- **plenoptic** ⬈: Package for model-based image synthesis, developed at the Flatiron Institute, NYC. I improved the characterization of texture statistics, and added regularized image synthesis.

- **scikit-learn** ⬈: Most popular Python package for classical machine learning. I submitted an enhancement of Quadratic Discriminant Analysis to support use of robust and shrinkage covariance estimators, and a fix to the bias of the Minimum Covariance Determinant estimator due to a lack of appropriate correction. Both are pending approval from the maintainers.

Institutional Service

Ruben Budelli Annual talk ⬈. I started, and co-organize, this annual talk at UdelaR which invites an international speaker to give a (virtual) talk to the Uruguay neuroscience community. It is supported by the Federation of Latin American and Caribbean Neuroscience Societies (FALAN).   2023–Ongoing

Founding member of GUIAD-COVID-19. ⬈. I was a founding member of the Uruguay Interdisciplinary Group for Data Analysis of COVID-19 (GUIAD-COVID-19), a collaboration of over 50 researchers at UdelaR, elaborating technical reports and doing science communication during the pandemic.   2020–2021

Collaborator to Uruguay Government COVID-19 advisory group. I was an official collaborator to the Uruguay government's COVID-19 scientific advisory group. I participated in meetings with the advisory group, and my research was used to inform their recommendations.   2020–2021