David Benacom, Ph.D.

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Education

2020 – 2023, **Collège de France**, PSL University
Ph.D**.** Neuroscience - Directed by Ariel Di Nardo & Alain Prochiantz with "Félicitations du jury".

2017 – 2021, **École Normale Supérieure** de Paris (Ulm)
Normalien - Neurosciences and interdisciplinary degree. Development, physiology, ethology, evolution and epigenetics of the nervous system. Introduction to artificial intelligence, Computational cognition, Mathematics for biology, Egyptology, Writing masterclass, English rhetoric, Economy.

2014 –2027, **Sorbonne**
MD - Top 0.01% admission test. On going, with 4-month hospital rotations.

Professional positions

2024 –, **Stanford University**, Stanford.
Postdoctoral/consultant position in Emmanuel Mignot laboratory in Machine Learning

2015 – 2018, 2024 –, **Hôpital de la Pitié Salpêtrière**, Paris.
4-month internships in: Internal Medicine (Pr. Benveniste), Neurology (Pr. Samson), Cardiology (Pr.Bonnevie), Cardio-Surgery (Pr. Leprince), Urgences (Pr. Hausfater)

2019 – 2024, **Collège de France**, Paris.
Master 2, AI, PhD, Postdoctoral position in Alain Prochiantz lab with Nathalie Rouach collaboration in post-doc.

2018, **Institut Pasteur**, Paris.
Master student in Germano Cecere lab on the mechanisms of epigenetic inheritance.

Competences

- Quantitative analysis of multi-omics, microscopy, and behavioral data in R, Python, C and Java. I used scikit, pytorch, and DeepLabCut for artificial intelligence methods. I have also used Nengo for Spiking neural network modelling.
- Animal surgery, design, engineering and conduction of behavioral tests, histology, vector design including CRISPR-Cas9, advanced biomolecular techniques and sequencing libraries preparation.
- Collaborative work, writing proficiency, student management, associative involvement.

Professional summary

After the first cycle of medical studies, I integrated the selective MD-PhD program of the Ecole Normale Superieure to study neurosciences and bioinformatics. For my PhD, I joined Alain Prochiantz's lab to work on the molecular mechanisms involved in brain meta-plasticity. The initial intuition I had was that modulating adult plasticity could allow the brain to re-wire in later life stages, providing therapeutic opportunities. Therefore, my work was focused on critical periods in post-natal development and on molecular methods to enhance adult brain plasticity.

We first provided evidence that PV cells, which are responsible for critical periods development in the brain, lack specific transcriptomics pathways in different types of enhanced plasticity paradigms, which suggest that multiple genetic pathways can lead to the same functional plasticity. We then developed two models of neurological disorders, one of Parkinson's disease and one of psychiatric disorders, and studied the effect of adult brain plasticity modulation as a potential therapeutic strategy, with promising results. I developed new techniques in the lab, including CUT&RUN, ATAC-Seq, TRAP, image analysis, and their respective data analysis pipelines. I also implemented new behavioral tests and associated video analysis using automated tracking and machine learning that are still used by the lab's students. I pursued this work with a short post-doc in bioinformatics on astrocytes transcriptomic data in collaboration with Nathalie Rouach.

I then joined the lab of Emmanuel Mignot in Stanford to work in machine learning for medical data. The aim of that project is to investigate circadian rythms using blood proteins. My individual contribution is on the extrapolation of organ-related circadian signal, based solely on blood markers. I am currently pursuing this project while finishing my medical degree. My long-term goal and personal project is to work at the interface of medicine, neurosciences, and artificial intelligence and to include principles of brain metaplasticity and connectomics in AI algorithms.

Publications

- Chataing, C*., **Benacom, D*.,** Prochiantz, A., Di Nardo A. A. (2024). Choroid plexus alterations following early-life stress are reversed with Otx2 loss of function. *In preparation*.

- **Benacom, D*.,** Chataing, C*., Prochiantz, A., Di Nardo A. A. (2024). Perineuronal net removal in the motor cortex impedes motor function in unchallenged animals but provides motor recovery in a Parkinson disease model. *In revision*.

- **Benacom, D.,** Chataing, C., Apulei, J., Queguiner, I., Prochiantz, A., Di Nardo A. A. (2023). Plasticity state-dependent changes in visual cortex parvalbumin interneuron mRNA translation and chromatin**.** *BioRxiv.* https://doi.org/10.1101/2023.09.11.557035

- **Benacom, D**., Gibel-Russo, R., & Di Nardo, A. A. (2022). Non-Cell-Autonomous Factors Implicated in Parvalbumin Interneuron Maturation and Critical Periods. *Frontiers in Neural Circuits*, *16*. https://doi.org/10.3389/FNCIR.2022.875873

- Planques, A., Moreira, V. O., **Benacom, D**., Bernard, C., Jourdren, L., Blugeon, C., Dingli, F., Masson, V., Loew, D., Prochiantz, A., & Di Nardo, A. A. (2021). OTX2 Homeoprotein Functions in Adult Choroid Plexus. *International Journal of Molecular Sciences*, *22*(16). https://doi.org/10.3390/IJMS22168951

Conferences

TERAIS (2024, Bratislava)
Cognitive modeling (2024, Groningen)
ENCODS (2022, Paris- 2023, Faro),
Israel Society of Neurosciences (2019, 2020, Eilat),
Curie Institute,Epigenetics Course (2019, Paris).

Teaching and supervision

2020 – 2023, **Université de Paris-Cité**, Paris.
Teaching assistant in Biochemistry. Subjects covered: Molecular biology, Proteomics, Thermodynamics.

2016 – 2019, **Sorbonne**, Paris.
Tutor for pre-med student. Subjects covered: Biology, Chemistry, Anatomy, Physics and Biophysics.

2019 – 2024, **Collège de France**, Paris.
Supervision of Camille Chataing (M2 Sorbonne), Sofia El-hanafi (M2 Sorbonne), Pierre-Alexandre Curty (M1 EPHE), Uma Mani (Pre-med UChicago), Marion Binet (L2 psychology).

Associative

Organization of the 2022 edition of ENCODS meeting (FENS satellite event)
Member of ANDC (for MD-PhD), Gali'ENS, Israel Society for Neurosciences, Pasteur Institute former students, A-Ulm
Participation to the MIT Grand Hack Paris 2020

Personal interests

Writing (Novels, poems).
Climbing, swimming, cycling.
Programming, robotics.
Linguistics.

References

Alain Prochiantz: alain.prochiantz@college-de-france.fr
Ariel Di Nardo: ariel.dinardo@college-de-france.fr
Alain Bessis: alain.bessis@bio.ens.psl.eu