

Design of machine learning and statistical models to discover brain predictive signatures of psychiatric disorders
As a leader of the team “Signatures of brain disorders” at NeuroSpin, CEA, Paris-Saclay University, France, I supervise the design of machine learning and statistical models to uncover neural signatures predictive of clinical trajectories in psychiatric disorders. To unlock the access to data required by learning algorithms, I oversee the data management, calculation, and regulation (GDPR) of large-scale national and European initiatives.

Keywords: Machine/Deep Learning – AI – Statistics – Neuroimaging – Scientific computing – Data management

Positions

- 2024–now **Head of Laboratory**, GAIA, NeuroSpin CEA, Paris-Saclay University, France, Genetic, brain Architecture, AI
- 2021–now **Research Director**, NeuroSpin, CEA, Paris-Saclay University, France, Machine Learning (ML) & Neuroimaging
- 2018–2023 **Leader of the team**, “Signature” in GAIA lab., NeuroSpin CEA, Paris-Saclay University, France, ML, Neuroimaging applied to Psychiatry
- 2008–2021 **Research Scientist**, NeuroSpin, CEA, Paris-Saclay University, France, ML & Neuroimaging
- 2005–2008 **R&D Engineer**, INSERM Unit “Neuroimaging and Psychiatry”, Orsay, France, ML & Neuroimaging
- 2003–2004 **Postdoc**, CEA, Orsay, France, ML & Neuroimaging
- 2002 **Software Engineer**, MBD.A (Matra BAe Dynamics) Velizy, France, Object-oriented prog., C++
- 2001–2002 **Teaching and Research Assistant**, Rennes 1 University, France, Signal & Image processing, Object-oriented programming, Java

Education

- 2020 **Habilitation (for full professorship)**, Paris-Saclay University, France, ML & Neuroimaging
- 1999–2001 **Ph.D.**, LTSI (lab. of signal and image processing). Rennes 1 University, France, AI in medical imaging
- 1997–1998 **Master’s degree**, Rennes 1 University, France, Signal & Image Processing
- 1994–1997 **Master’s degree**, EPITA, France, Software Engineering

Projects

- 2024–2029 **Work Package (WP) leader of data analysis, computing and data management**, IHU ICE: Institut Hospitalo-Universitaire-Institut du Cerveau de l’Enfant Robert, Leaders: R Delorme, G Dehaene, T Bourgeron, Team budget: 2M€
- 2023–2028 **WP leader of data analysis, large-scale computing and datamanagement**, PEPR Santé Mentale PROPSY: PROgram-project in Precision pSYchiatry, Leader: M Leboyer, Team budget: 4.6M€
- 2022–2026 **WP leader of data analysis**, RHU FAME: Improving FAMily members’ Experience in the ICU, Leader: E Azoulay, Team budget: 547k€
- 2020–2024 **Leader of Artificial Intelligence (AI) Chair**, ANR Big2Small, Transfer Learning from Big Data to Small Data: Leveraging Psychiatric Neuroimaging Biomarkers Discovery, Budget: 543k€
- 2019–2026 **WP leader of data analysis**, RHU PsyCARE. Preventing psychosis through personalized care, Leader: MO Krebs, Team budget: 715k€
- 2018–2023 **WP leader of data analysis, computing and management**, Horizon Europe R-LiNK. Optimizing response to Li treatment through personalized evaluation of individuals with bipolar I disorder, Leader: F Bellivier, Team budget: 800k€
- 2014–2018 ANR BIP-Li7 (ANR-14-CE15-0003) Therapeutic Lithium response in Bipolar Disorders and brain Lithium-7 NMR Spectroscopy Imaging at 7 Tesla, Leader: F Bellivier, WP leader: F Boumezbeur, Team budget: 280k€
- 2011–2015 **WP leader of data analysis**, EU FP6-ERA-NET-NEURON MESCOG: Mechanisms of Small Vessel-Related Brain Damage and Cognitive Impairment: Integrating Imaging Findings from Genetic and Sporadic Disease, Leader: M Dichgans, Team budget: 195k€
- 2012–2016 **WP leader of image analysis**, BRAINOMICS (ANR-10-BINF-04) Methodological and software solutions for the integration of neuroimaging and genomic data, Leader: V Frouin, 800k€
- 2010–2013 **Leader (with A Roche)**, ANR Karamétria (ANR-09-BLAN-0332): A unified framework for feature-based morphometry of the brain, Team budget: 200k€

- 2007–2010 **WP Leader of data analysis, ANR AGIR (ANR-07-NEUR-0001): Autism: Genetic and Imaging Research**, Leader: M. Zilbovicius, Team budget: 150k€
- 2007–now Contribution to the CATI platform, *a national platform created by the French Alzheimer plan in 2011 to support multicenter neuroimaging studies* (9M€ grant), sLeader: JF Mangin

Teaching

I wrote a course on Statistics and Machine Learning in Python, github: Jupyter notebooks and python sources and . I deliver lectures on machine learning/statistics in:

- 2019–now *Introduction to AI: main algorithms of machine learning* in **Master 2** radiophysique médicale Paris-Saclay University
- 2015–now Machine learning in **Master 2** Innovation, marché et science des données IMSD, Paris-Saclay University, head: Ekaterina Kalugina
- 2018–now: Machine learning in **Master 2** Modelisations Statistiques Economique & Financières MoSeF, Panthéon Sorbonne Paris 1 University, head: Rania Hentati Kaffel
- 2017–2020 Biostatistics **3rd year of CentralSupélec**, Paris-Saclay University, head: Arthur Tenenhaus
- 2019–2020 Machine learning in **2nd & 3rd years of EPITA**, Kremlin-Bicêtre, Image processing option, head: Elodie Puybureau and Guillaume Tochon
- 2016–2017 Data analysis in **Master 1** Mathématiques et applications, option “Ingénierie mathématique pour les sciences du vivant”, Paris Descartes University, head: Etienne Birmele

Supervision experience

Ph.D.s

- 2022–now Thibault Dupont together with Elie Azoulay
- 2022–now Sara Petiton together with Antoine Grigis
- 2022–now Pierre Auriau together with Pietro Gori, Antoine Grigis, and Jean-François Mangin
- 2020–now Robin Louiset together with Pietro Gori and Antoine Grigis
- 2019–2022 Benoit Dufumier, together with Arthur Tenenhaus, Pietro Gori and Antoine Grigis
- 2019–2021 Anton Iftimovici, together with Marie-Odile Krebs
- 2016–2019 Amicie de Pierrefeu, together with Philippe Ciuciu
- 2008–2012 Edith Lefloch together with V Frouin
- 2009–2011 Cecilia Damon together with JB Poline

Post-docs

- 2017–2019 Pauline Favre, Post-doc, together with JF Mangin and J. Houenou
- 2016 Pietro Gori, Post-doc together with JF Mangin and J. Houenou
- 2013–2015 Fouad Hady Salem
- 2013–2015 Tommy Lofstedt

Engineers

- 2023–now Raphael Vock together with Antoine Grigis
- 2022–now Bérangère Dollé together with Antoine Grigis
- 2021–now Loic Dorval together with Antoine Grigis
- 2019–2022 Julie Victor together with Antoine Grigis
- 2013–2014 Mathieu Dubois
- 2014 Clémence Pinaud
- 2013–2014 Jinpeng Li

Bibliometry

Publications	94(a), 131(b). (a) Web of Science, (b) Google scholar
Citations	42,237(a), 95,150(b)
H-Index	26(a), 36(b)

- [1] T. Dupont, N. Kentish-Barnes, F. Pochard, **E. Duchesnay**, and E. Azoulay (2024) "Prediction of post-traumatic stress disorder in family members of ICU patients: a machine learning approach", *Intensive Care Medicine*, vol. 50, no. 1, pp. 114-124
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- [3] J. Fraize, C. Fischer, M. Elmaleh-Bergès, E. Kerdreux, A. Beggiato, A. Ntorkou, **E. Duchesnay**, D. Bekha, O. Boespflug-Tanguy, R. Delorme, L. Hertz-Pannier, and D. Germanaud (2023) "Enhancing fetal alcohol spectrum disorders diagnosis with a classifier based on the intracerebellar gradient of volumetric undersizing", *Human Brain Mapping*, vol. 44, no. 11, pp. 4321-4336
- [4] A. Iftimovici, J. Bourgin, J. Houenou, O. Gay, A. Grigis, J. Victor, B. Chaumette, M.O. Krebs, **E. Duchesnay**, and ICAAR-plus Study Group. (2023) "Asynchronous neural maturation predicts transition to psychosis", *Psychiatry and Clinical Neurosciences*
- [5] A. Iftimovici, Q. He, C. Jiao, **E. Duchesnay**, M.O. Krebs, O. Kebir, and B. Chaumette (2023) "Longitudinal MicroRNA Signature of Conversion to Psychosis", *Schizophrenia Bulletin*, pp. sbad080
- [6] Y. Elandaloussi, D.L. Floris, P. Coupé, **E. Duchesnay**, A. Mihailov, A. Grigis, I. Bègue, J. Victor, V. Frouin, M. Leboyer, J. Houenou, and C. Laidi (2023) "Understanding the relationship between cerebellar structure and social abilities", *Molecular Autism*, vol. 14, no. 1, pp. 18
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- [13] C. Piguet, A. Mihailov, A. Grigis, C. Laidi, **E. Duchesnay**, and J. Houenou (2021) "Irritability Is Associated With Decreased Cortical Surface Area and Anxiety With Decreased Gyrfication During Brain Development", *Frontiers in Psychiatry*, vol. 12, pp. 744419
- [14] J. Stout, F. Hozer, A. Coste, F. Mauconduit, N. Djibrani-Oussedik, S. Sarrazin, J. Poupon, M. Meyrel, S. Romanzetti, B. Etain, C. Rabrait-Lerman, J. Houenou, F. Bellivier, **E. Duchesnay**, and F. Boumezbaur (2020) "Accumulation of Lithium in the Hippocampus of Patients With Bipolar Disorder: A Lithium-7 Magnetic Resonance Imaging Study at 7 Tesla", *Biological Psychiatry*, vol. 88, no. 5, pp. 426-433
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- [46] C. Leroy, L. Karila, J.L. Martinot, M. Lukasiewicz, **E. Duchesnay**, C. Comtat, F. Dollé, A. Benyamina, E. Artiges, M.J. Ribeiro, M. Reynaud, and C. Trichard (2012) "Striatal and extrastriatal dopamine transporter in cannabis and tobacco addiction: a high-resolution PET study", *Addiction Biology*, vol. 17, no. 6, pp. 981-990
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Patents

PCT/FR2010/050431. Inventors: **E. Duchesnay**, M.L. Paillere, A. Cachia, J.L. Martinot, E. Artiges "Method for Developing an Information Prediction Device, Use Thereof, and Corresponding Storage Medium and Apparatus".