Edouard Duchesnay

Research Director in Statistical Machine Learning for Neuroimaging

NeuroSpin, CEA
Université Paris-Saclay, France
(+33) 6-89-35-92-72
edouard.duchesnay@cea.fr
https://duchesnay.github.io/

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 CentralSupelec**, Paris-Saclay University, head: Arthur Tenenhaus

2019-2020 Machine learning in **2nd & 3rd years of EPITA**, Kremlin-Bicètre, Image processing option, head: Elodie Puybareau 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 Hadj Selem

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)

Publications: Journals

[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

[2] C. Poiret, A. Bouyeure, S. Patil, C. Boniteau, **E. Duchesnay**, A. Grigis, F. Lemaitre, and M. Noulhiane (2024) "Attention-gated 3D CapsNet for robust hippocampal segmentation", Journal of Medical Imaging (Bellingham, Wash.), vol. 11, no. 1, pp. 014003

[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

[7] C. Poiret, A. Bouyeure, S. Patil, A. Grigis, **E. Duchesnay**, M. Faillot, M. Bottlaender, F. Lemaitre, and M. Noulhiane (2023) "A fast and robust hippocampal subfields segmentation: HSF revealing lifespan volumetric dynamics", Frontiers in Neuroinformatics, vol. 17

[8] T. Fovet, P. Yger, R. Lopes, A. de Pierrefeu, **E. Duchesnay**, J. Houenou, P. Thomas, S. Szaffarczyk, P. Domenech, and R. Jardri (2022) "Decoding Activity in Broca's Area Predicts the Occurrence of Auditory Hallucinations Across Subjects", Biological Psychiatry, vol. 91, no. 2, pp. 194-201

[9] C. Laidi, D.L. Floris, J. Tillmann, Y. Elandaloussi, M. Zabihi, T. Charman, T. Wolfers, S. Durston, C. Moessnang, F. Dell'Acqua, C. Ecker, E. Loth, D. Murphy, S. Baron-Cohen, J.K. Buitelaar, A.F. Marquand, C.F. Beckmann, V. Frouin, M. Leboyer, **E. Duchesnay**, P. Coupé, and J. Houenou (2022) "Cerebellar atypicalities in autism?", Biological Psychiatry

[10] A. Iftimovici, B. Chaumette, **E. Duchesnay**, and M.O. Krebs (2022) "Brain anomalies in early psychosis: From secondary to primary psychosis", Neuroscience & Biobehavioral Reviews, pp. 104716

[11] B. Dufumier, A. Grigis, J. Victor, C. Ambroise, V. Frouin, and **E. Duchesnay** (2022) "OpenBHB: a Large-Scale Multi-Site Brain MRI Data-set for Age Prediction and Debiasing", NeuroImage, pp. 119637

[12] F. Hozer, S. Sarrazin, C. Laidi, P. Favre, M. Pauling, D. Cannon, C. McDonald, L. Emsell, J.F. Mangin, **E. Duchesnay**, M. Bellani, P. Brambilla, M. Wessa, J. Linke, M. Polosan, A. Versace, M.L. Phillips, M. Delavest, F. Bellivier, N. Hamdani, M.A. d'Albis, M. Leboyer, and J. Houenou (2021) "Lithium prevents grey matter atrophy in patients with bipolar disorder: an international multicenter study", Psychological Medicine, vol. 51, no. 7, pp. 1201-1210

[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 Gyrification During Brain Development", Frontiers in Psychiatry, vol. 12, pp. 744419

[14] J. Stout, F. Hozer, A. Coste, F. Mauconduit, N. Djebrani-Oussedik, S. Sarrazin, J. Poupon, M. Meyrel, S. Romanzetti, B. Etain, C. Rabrait-Lerman, J. Houenou, F. Bellivier, **E. Duchesnay**, and F. Boumezbeur (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

[15] C.R.K. Ching, D.P. Hibar, T.P. Gurholt, A. Nunes, S.I. Thomopoulos, C. Abé, I. Agartz, R.M. Brouwer, D.M. Cannon, S.M.C. de Zwarte, L.T. Eyler, P. Favre, T. Hajek, U.K. Haukvik, J. Houenou, M. Landén, T.A. Lett, C. McDonald, L. Nabulsi, Y. Patel, M.E. Pauling, T. Paus, J. Radua, M.G. Soeiro-de-Souza, G. Tronchin, N.E.M. van Haren, E. Vieta, H. Walter, L.L. Zeng, M. Alda, J. Almeida, D. Alnaes, S. Alonso-Lana, C. Altimus, M. Bauer, B.T. Baune, C.E. Bearden, M. Bellani, F. Benedetti, M. Berk, A.C. Bilderbeck, H.P. Blumberg,

E. Bøen, I. Bollettini, C. Del Mar Bonnin, P. Brambilla, E.J. Canales-Rodríguez, X. Caseras, O. Dandash, U. Dannlowski, G. Delvecchio, A.M. Díaz-Zuluaga, D. Dima, **E. Duchesnay**, T. Elvsåshagen, S.C. Fears, S. Frangou, J.M. Fullerton, D.C. Glahn, J.M. Goikolea, M.J. Green, D. Grotegerd, O. Gruber, B.C.M. Haarman, C. Henry, F.M. Howells, V. Ives-Deliperi, A. Jansen, T.T.J. Kircher, C. Knöchel, B. Kramer, B. Lafer, C. López-Jaramillo, R. Machado-Vieira, B.J. MacIntosh, E.M.T. Melloni, P.B. Mitchell, I. Nenadic, F. Nery, A.C. Nugent, V. Oertel, R.A. Ophoff, M. Ota, B.J. Overs, D.L. Pham, M.L. Phillips, J.A. Pineda-Zapata, S. Poletti, M. Polosan, E. Pomarol-Clotet, A. Pouchon, Y. Quidé, M.M. Rive, G. Roberts, H.G. Ruhe, R. Salvador, S. Sarró, T.D. Satterthwaite, A.H. Schene, K. Sim, J.C. Soares, M. Stäblein, D.J. Stein, C.K. Tamnes, G.V. Thomaidis, C.V. Upegui, D.J. Veltman, M. Wessa, L.T. Westlye, H.C. Whalley, D.H. Wolf, M.J. Wu, L.N. Yatham, C.A. Zarate, P.M. Thompson, O.A. Andreassen, and ENIGMA Bipolar Disorder Working Group (2020) "What we learn about bipolar disorder from large-scale neuroimaging: Findings and future directions from the ENIGMA Bipolar Disorder Working Group", Human Brain Mapping

[16] L.A. Claude, J. Houenou, **E. Duchesnay**, and P. Favre (2020) "Will machine learning applied to neuroimaging in bipolar disorder help the clinician? A critical review and methodological suggestions", Bipolar Disorders

[17] J.F. Mangin, D. Rivière, **E. Duchesnay**, Y. Cointepas, V. Gaura, C. Verny, P. Damier, P. Krystkowiak, A.C. Bachoud-Lévi, P. Hantraye, P. Remy, and G. Douaud (2020) "Neocortical morphometry in Huntington's disease: Indication of the coexistence of abnormal neurodevelopmental and neurodegenerative processes", NeuroImage: Clinical, vol. 26, pp. 102211

[18] P. Favre, M. Pauling, J. Stout, F. Hozer, S. Sarrazin, C. Abé, M. Alda, C. Alloza, S. Alonso-Lana, O.A. Andreassen, B.T. Baune, F. Benedetti, G.F. Busatto, E.J. Canales-Rodríguez, X. Caseras, T.M. Chaim-Avancini, C.R.K. Ching, U. Dannlowski, M. Deppe, L.T. Eyler, M. Fatjo-Vilas, S.F. Foley, D. Grotegerd, T. Hajek, U.K. Haukvik, F.M. Howells, N. Jahanshad, H. Kugel, T.V. Lagerberg, S.M. Lawrie, J.O. Linke, A. McIntosh, E.M.T. Melloni, P.B. Mitchell, M. Polosan, E. Pomarol-Clotet, J. Repple, G. Roberts, A. Roos, P.G.P. Rosa, R. Salvador, S. Sarró, P.R. Schofield, M.H. Serpa, K. Sim, D.J. Stein, J.E. Sussmann, H.S. Temmingh, P.M. Thompson, N. Verdolini, E. Vieta, M. Wessa, H.C. Whalley, M.V. Zanetti, M. Leboyer, J.F. Mangin, C. Henry, **E. Duchesnay**, and J. Houenou (2019) "Widespread white matter microstructural abnormalities in bipolar disorder: evidence from mega- and meta-analyses across 3033 individuals", Neuropsychopharmacology, pp. 1-11

[19] C. Laidi, T. Hajek, F. Spaniel, M. Kolenic, M.A. d'Albis, S. Sarrazin, J.F. Mangin, **E. Duchesnay**, P. Brambilla, M. Wessa, J. Linke, M. Polosan, P. Favre, A.L. Versace, M.L. Phillips, J.V. Manjon, J.E. Romero, F. Hozer, M. Leboyer, P. Coupe, and J. Houenou (2019) "Cerebellar parcellation in schizophrenia and bipolar disorder", Acta Psychiatrica Scandinavica, vol. 140, no. 5, pp. 468-476

[20] J. Bourgin, **E. Duchesnay**, E. Magaud, R. Gaillard, M. Kazes, and M.O. Krebs (2019) "Predicting the individual risk of psychosis conversion in at-risk mental state (ARMS): a multivariate model reveals the influence of nonpsychotic prodromal symptoms", European Child & Adolescent Psychiatry

[21] J. Scott, D. Hidalgo-Mazzei, R. Strawbridge, A. Young, M. Resche-Rigon, B. Etain, O.A. Andreassen, M. Bauer, D. Bennabi, A.M. Blamire, F. Boumezbeur, P. Brambilla, N. Cattane, A. Cattaneo, M. Chupin, K. Coello, Y. Cointepas, F. Colom, D.A. Cousins, C. Dubertret, **E. Duchesnay**, A. Ferro, A. Garcia-Estela, J. Goikolea, A. Grigis, E. Haffen, M.C. Høegh, P. Jakobsen, J.L. Kalman, L.V. Kessing, F. Klohn-Saghatolislam, T.V. Lagerberg, M. Landén, U. Lewitzka, A. Lutticke, N. Mazer, M. Mazzelli, C. Mora, T. Muller, E. Mur-Mila, K.J. Oedegaard, L. Oltedal, E. Pålsson, D. Papadopoulos Orfanos, S. Papiol, V. Perez-Sola, A. Reif, P. Ritter, R. Rossi, T. Schulze, F. Senner, F.E. Smith, L. Squarcina, N.E. Steen, P.E. Thelwall, C. Varo, E. Vieta, M. Vinberg, M. Wessa, L.T. Westlye, and F. Bellivier (2019) "Prospective cohort study of early biosignatures of response to lithium in bipolar-I-disorders: overview of the H2020-funded R-LiNK initiative", International Journal of Bipolar Disorders, vol. 7, no. 1

[22] C. Laidi, J. Boisgontier, A. de Pierrefeu, **E. Duchesnay**, S. Hotier, M.A. d'Albis, R. Delorme, F. Bolognani, C. Czech, C. Bouquet, A. Amestoy, J. Petit, Š. Holiga, J. Dukart, A. Gaman, E. Toledano, M. Ly-Le Moal, I. Scheid, M. Leboyer, and J. Houenou (2019) "Decreased Cortical Thickness in the Anterior Cingulate Cortex in Adults with Autism", Journal of Autism and Developmental Disorders, vol. 49, no. 4, pp. 1402-1409

[23] A. de Pierrefeu, T. Lofstedt, F. Hadj-Selem, M. Dubois, R. Jardri, T. Fovet, P. Ciuciu, V. Frouin, and **E. Duchesnay** (2018) "Structured Sparse Principal Components Analysis With the TV-Elastic Net Penalty", IEEE transactions on medical imaging, vol. 37, no. 2, pp. 396-407

[24] A. de Pierrefeu, T. Löfstedt, C. Laidi, F. Hadj-Selem, J. Bourgin, T. Hajek, F. Spaniel, M. Kolenic, P. Ciuciu, N. Hamdani, M. Leboyer, T. Fovet, R. Jardri, J. Houenou, and **E. Duchesnay** (2018) "Identifying a

neuroanatomical signature of schizophrenia, reproducible across sites and stages, using machine learning with structured sparsity", Acta Psychiatrica Scandinavica, vol. 138, no. 6, pp. 571-580

[25] A. de Pierrefeu, T. Fovet, F. Hadj-Selem, T. Löfstedt, P. Ciuciu, S. Lefebvre, P. Thomas, R. Lopes, R. Jardri, and **E. Duchesnay** (2018) "Prediction of activation patterns preceding hallucinations in patients with schizophrenia using machine learning with structured sparsity", Human Brain Mapping, vol. 39, no. 4, pp. 1777-1788

[26] F. Hadj-Selem, T. Lofstedt, E. Dohmatob, V. Frouin, M. Dubois, V. Guillemot, and **E. Duchesnay** (2018) "Continuation of Nesterov's Smoothing for Regression With Structured Sparsity in High-Dimensional Neuroimaging", IEEE transactions on medical imaging, vol. 37, no. 11, pp. 2403-2413

[27] A. Nunes, H.G. Schnack, C.R.K. Ching, I. Agartz, T.N. Akudjedu, M. Alda, D. Alnæs, S. Alonso-Lana, J. Bauer, B.T. Baune, E. Bøen, C.D.M. Bonnin, G.F. Busatto, E.J. Canales-Rodríguez, D.M. Cannon, X. Caseras, T.M. Chaim-Avancini, U. Dannlowski, A.M. Díaz-Zuluaga, B. Dietsche, N.T. Doan, **E. Duchesnay**, T. Elvsåshagen, D. Emden, L.T. Eyler, M. Fatjó-Vilas, P. Favre, S.F. Foley, J.M. Fullerton, D.C. Glahn, J.M. Goikolea, D. Grotegerd, T. Hahn, C. Henry, D.P. Hibar, J. Houenou, F.M. Howells, N. Jahanshad, T. Kaufmann, J. Kenney, T.T.J. Kircher, A. Krug, T.V. Lagerberg, R.K. Lenroot, C. López-Jaramillo, R. Machado-Vieira, U.F. Malt, C. McDonald, P.B. Mitchell, B. Mwangi, L. Nabulsi, N. Opel, B.J. Overs, J.A. Pineda-Zapata, E. Pomarol-Clotet, R. Redlich, G. Roberts, P.G. Rosa, R. Salvador, T.D. Satterthwaite, J.C. Soares, D.J. Stein, H.S. Temmingh, T. Trappenberg, A. Uhlmann, N.E.M. van Haren, E. Vieta, L.T. Westlye, D.H. Wolf, D. Yüksel, M.V. Zanetti, O.A. Andreassen, P.M. Thompson, T. Hajek, and ENIGMA Bipolar Disorders Working Group (2018) "Using structural MRI to identify bipolar disorders - 13 site machine learning study in 3020 individuals from the ENIGMA Bipolar Disorders Working Group", Molecular Psychiatry

[28] J. Lebenberg, M. Labit, G. Auzias, H. Mohlberg, C. Fischer, D. Rivière, **E. Duchesnay**, C. Kabdebon, F. Leroy, N. Labra, F. Poupon, T. Dickscheid, L. Hertz-Pannier, C. Poupon, G. Dehaene-Lambertz, P. Hüppi, K. Amunts, J. Dubois, and J.F. Mangin (2018) "A framework based on sulcal constraints to align preterm, infant and adult human brain images acquired in vivo and post mortem", Brain Structure and Function, vol. 223, no. 9, pp. 4153-4168

[29] Y. Le Guen, G. Auzias, F. Leroy, M. Noulhiane, G. Dehaene-Lambertz, **E. Duchesnay**, J.F. Mangin, O. Coulon, and V. Frouin (2018) "Genetic Influence on the Sulcal Pits: On the Origin of the First Cortical Folds", Cerebral Cortex, vol. 28, no. 6, pp. 1922-1933

[30] **E. Duchesnay**, F. Hadj Selem, F. De Guio, M. Dubois, J.F. Mangin, M. Duering, S. Ropele, R. Schmidt, M. Dichgans, H. Chabriat, and E. Jouvent (2018) "Different Types of White Matter Hyperintensities in CADASIL", Frontiers in Neurology, vol. 9, pp. 526

[31] R. Magalhães, J. Bourgin, F. Boumezbeur, P. Marques, M. Bottlaender, C. Poupon, B. Djemaï, **E. Duchesnay**, S. Mériaux, N. Sousa, T.M. Jay, and A. Cachia (2017) "White matter changes in microstructure associated with a maladaptive response to stress in rats", Translational Psychiatry, vol. 7, no. 1, pp. e1009

[32] E. Jouvent, Z.Y. Sun, F. De Guio, **E. Duchesnay**, M. Duering, S. Ropele, M. Dichgans, J.F. Mangin, and H. Chabriat (2016) "Shape of the Central Sulcus and Disability After Subcortical Stroke: A Motor Reserve Hypothesis", Stroke, vol. 47, no. 4, pp. 1023-1029

[33] E. Jouvent, **E. Duchesnay**, F. Hadj-Selem, F. De Guio, J.F. Mangin, D. Hervé, M. Duering, S. Ropele, R. Schmidt, M. Dichgans, and H. Chabriat (2016) "Prediction of 3-year clinical course in CADASIL", Neurology, vol. 87, no. 17, pp. 1787-1795

[34] B. Gesierich, **E. Duchesnay**, E. Jouvent, H. Chabriat, R. Schmidt, J.F. Mangin, M. Duering, and M. Dichgans (2016) "Features and Determinants of Lacune Shape: Relationship With Fiber Tracts and Perforating Arteries", Stroke, vol. 47, no. 5, pp. 1258-1264

[35] L. Pirpamer, E. Hofer, B. Gesierich, F. De Guio, P. Freudenberger, S. Seiler, M. Duering, E. Jouvent, **E. Duchesnay**, M. Dichgans, S. Ropele, and R. Schmidt (2016) "Determinants of iron accumulation in the normal aging brain", Neurobiology of Aging, vol. 43, pp. 149-155

[36] **E. Duchesnay**, J. Bourgin, F. Hadj-Selem, and V. Frouin (2015) "Méthodes de prédiction multivariées basées sur la neuroimagerie : application aux maladies psychiatriques", Annales Médico-psychologiques, revue psychiatrique

[37] **E. Duchesnay**, J. Bourgin, F. Hadj-Selem, and V. Frouin (2015) "Méthodes de prédiction multivariées basées sur la neuroimagerie : application aux maladies psychiatriques", Annales Médico-psychologiques, revue psychiatrique

[38] J. Bourgin, A. Cachia, F. Boumezbeur, B. Djemaï, M. Bottlaender, **E. Duchesnay**, S. Mériaux, and T.M. Jay (2015) "Hyper-responsivity to stress in rats is associated with a large increase in amygdala volume. A 7T MRI study", European Neuropsychopharmacology: The Journal of the European College of Neuropsychopharmacology, vol. 25, no. 6, pp. 828-835

[39] F. De Guio, S. Reyes, A. Vignaud, M. Duering, S. Ropele, **E. Duchesnay**, H. Chabriat, and E. Jouvent (2014) "In Vivo High-Resolution 7 Tesla MRI Shows Early and Diffuse Cortical Alterations in CADASIL", PloS One, vol. 9, no. 8, pp. e106311

[40] F. De Guio, A. Vignaud, S. Ropele, M. Duering, **E. Duchesnay**, H. Chabriat, and E. Jouvent (2014) "Loss of Venous Integrity in Cerebral Small Vessel Disease: A 7-T MRI Study in Cerebral Autosomal-Dominant Arteriopathy With Subcortical Infarcts and Leukoencephalopathy (CADASIL)", Stroke; a Journal of Cerebral Circulation, vol. 45, no. 7, pp. 2124-2126

[41] S. Sarrazin, C. Poupon, J. Linke, M. Wessa, M. Phillips, M. Delavest, A. Versace, J. Almeida, P. Guevara, D. Duclap, **E. Duchesnay**, J.F. Mangin, K. Le Dudal, C. Daban, N. Hamdani, M.A. D'Albis, M. Leboyer, and J. Houenou (2014) "A multicenter tractography study of deep white matter tracts in bipolar I disorder: psychotic features and interhemispheric disconnectivity", JAMA psychiatry, vol. 71, no. 4, pp. 388-396

[42] J. Bourgin, and **E. Duchesnay** (2014) "Phénotypes cliniques précoces et recherche de biomarqueurs stratégiques : les fondements d'une psychiatrie personnalisée", L'information psychiatrique, vol. 89, no. 10, pp. 781-789

[43] M. Duering, B. Gesierich, S. Seiler, L. Pirpamer, M. Gonik, E. Hofer, E. Jouvent, **E. Duchesnay**, H. Chabriat, S. Ropele, R. Schmidt, and M. Dichgans (2014) "Strategic white matter tracts for processing speed deficits in age-related small vessel disease", Neurology, vol. 82, no. 22, pp. 1946-1950

[44] E. Le Floch, V. Guillemot, V. Frouin, P. Pinel, C. Lalanne, L. Trinchera, A. Tenenhaus, A. Moreno, M. Zilbovicius, T. Bourgeron, S. Dehaene, B. Thirion, J.B. Poline, and **E. Duchesnay** (2012) "Significant correlation between a set of genetic polymorphisms and a functional brain network revealed by feature selection and sparse Partial Least Squares", NeuroImage, vol. 63, no. 1, pp. 11-24

[45] P. Reiner, E. Jouvent, **E. Duchesnay**, R. Cuingnet, J.F. Mangin, H. Chabriat, and Alzheimer's Disease Neuroimaging Initiative (2012) "Sulcal span in Azheimer's disease, amnestic mild cognitive impairment, and healthy controls", Journal of Alzheimer's disease: JAD, vol. 29, no. 3, pp. 605-613

[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

[47] F. Pedregosa, G. Varoquaux, A. Gramfort, V. Michel, B. Thirion, O. Grisel, M. Blondel, P. Prettenhofer, R. Weiss, V. Dubourg, J. Vanderplas, A. Passos, D. Cournapeau, M. Brucher, M. Perrot, and **E. Duchesnay** (2012) "Scikit-learn: Machine Learning in Python", Journal of Machine Learning Research, vol. 12, no. Oct, pp. 2825-2830

[48] E. Jouvent, J.F. Mangin, **E. Duchesnay**, R. Porcher, M. Düring, Y. Mewald, J.P. Guichard, D. Hervé, S. Reyes, N. Zieren, M. Dichgans, and H. Chabriat (2012) "Longitudinal changes of cortical morphology in CADASIL", Neurobiology of Aging, vol. 33, no. 5, pp. 1002.e29-36

[49] **E. Duchesnay**, A. Cachia, N. Boddaert, N. Chabane, J.F. Mangin, J.L. Martinot, F. Brunelle, and M. Zilbovicius (2011) "Feature selection and classification of imbalanced datasets: Application to PET images of children with autistic spectrum disorders", NeuroImage, vol. 57, no. 3, pp. 1003-1014

[50] J. Penttilä, A. Cachia, J.L. Martinot, D. Ringuenet, M. Wessa, J. Houenou, A. Galinowski, F. Bellivier, T. Gallarda, **E. Duchesnay**, E. Artiges, M. Leboyer, J.P. Olié, J.F. Mangin, and M.L. Paillère-Martinot (2009) "Cortical folding difference between patients with early-onset and patients with intermediate-onset bipolar disorder", Bipolar Disorders, vol. 11, no. 4, pp. 361-370

[51] M. Fouquet, B. Desgranges, B. Landeau, **E. Duchesnay**, F. Mézenge, V. de la Sayette, F. Viader, J.C. Baron, F. Eustache, and G. Chételat (2009) "Longitudinal brain metabolic changes from amnestic mild cognitive impairment to Alzheimer's disease", Brain: A Journal of Neurology, vol. 132, no. Pt 8, pp. 2058-2067

[52] J. Penttilä, M.L. Paillère-Martinot, J.L. Martinot, D. Ringuenet, M. Wessa, J. Houenou, T. Gallarda, F. Bellivier, A. Galinowski, P. Bruguière, F. Pinabel, M. Leboyer, J.P. Olié, **E. Duchesnay**, E. Artiges, J.F. Mangin, and A. Cachia (2009) "Cortical folding in patients with bipolar disorder or unipolar depression", Journal of psychiatry & neuroscience: JPN, vol. 34, no. 2, pp. 127-135

[53] R. Maroy, R. Boisgard, C. Comtat, V. Frouin, P. Cathier, **E. Duchesnay**, F. Dollé, P.E. Nielsen, R. Trébossen, and B. Tavitian (2008) "Segmentation of rodent whole-body dynamic PET images: an unsupervised method based on voxel dynamics", IEEE transactions on medical imaging, vol. 27, no. 3, pp. 342-354

[54] A. Cachia, M.L. Paillère-Martinot, A. Galinowski, D. Januel, R. de Beaurepaire, F. Bellivier, E. Artiges, J. Andoh, D. Bartrés-Faz, **E. Duchesnay**, D. Rivière, M. Plaze, J.F. Mangin, and J.L. Martinot (2008) "Cortical folding abnormalities in schizophrenia patients with resistant auditory hallucinations", NeuroImage, vol. 39, no. 3, pp. 927-935

[55] A. Dubois, A.S. Hérard, G. Flandin, **E. Duchesnay**, L. Besret, V. Frouin, P. Hantraye, G. Bonvento, and T. Delzescaux (2008) "Quantitative validation of voxel-wise statistical analyses of autoradiographic rat brain volumes: application to unilateral visual stimulation", NeuroImage, vol. 40, no. 2, pp. 482-494

[56] J. Dubois, G. Dehaene-Lambertz, M. Perrin, J.F. Mangin, Y. Cointepas, **E. Duchesnay**, D. Le Bihan, and L. Hertz-Pannier (2008) "Asynchrony of the early maturation of white matter bundles in healthy infants: quantitative landmarks revealed noninvasively by diffusion tensor imaging", Human Brain Mapping, vol. 29, no. 1, pp. 14-27

[57] **E. Duchesnay**, A. Cachia, A. Roche, D. Rivière, Y. Cointepas, D. Papadopoulos-Orfanos, M. Zilbovicius, J.L. Martinot, J. Régis, and J.F. Mangin (2007) "Classification based on cortical folding patterns", IEEE transactions on medical imaging, vol. 26, no. 4, pp. 553-565

[58] A. Dubois, J. Dauguet, A.S. Herard, L. Besret, **E. Duchesnay**, V. Frouin, P. Hantraye, G. Bonvento, and T. Delzescaux (2007) "Automated three-dimensional analysis of histological and autoradiographic rat brain sections: application to an activation study", Journal of Cerebral Blood Flow and Metabolism: Official Journal of the International Society of Cerebral Blood Flow and Metabolism, vol. 27, no. 10, pp. 1742-1755

[59] B. Thirion, **E. Duchesnay**, E. Hubbard, J. Dubois, J.B. Poline, D. Lebihan, and S. Dehaene (2006) "Inverse retinotopy: inferring the visual content of images from brain activation patterns", NeuroImage, vol. 33, no. 4, pp. 1104-1116

[60] J.F. Mangin, D. Rivière, A. Cachia, **E. Duchesnay**, Y. Cointepas, D. Papadopoulos-Orfanos, P. Scifo, T. Ochiai, F. Brunelle, and J. Régis (2004) "A framework to study the cortical folding patterns", NeuroImage, vol. 23 Suppl 1, pp. S129-138

[61] J.F. Mangin, F. Poupon, **E. Duchesnay**, D. Rivière, A. Cachia, D.L. Collins, A.C. Evans, and J. Régis (2004) "Brain morphometry using 3D moment invariants", Medical Image Analysis, vol. 8, no. 3, pp. 187-196

[62] J.F. Mangin, D. Rivière, A. Cachia, **E. Duchesnay**, Y. Cointepas, D. Papadopoulos-Orfanos, D.L. Collins, A.C. Evans, and J. Régis (2004) "Object-based morphometry of the cerebral cortex", IEEE transactions on medical imaging, vol. 23, no. 8, pp. 968–982

[63] **E. Duchesnay**, J.J. Montois, and Y. Jacquelet (2003) "Cooperative agents society organized as an irregular pyramid: A mammography segmentation application", Pattern Recognition Letters, vol. 24, no. 14, pp. 2435–2445

Publications: Conferences (sample)

[1] P. Auriau, A. Grigis, B. Dufumier, R. Louiset, P. Gori, J.F. Mangin, and **E. Duchesnay** (2024) "Supervised Diagnosis Prediction from Cortical Sulci: Toward the Discovery of Eurodevelopmental Biomarkers in Mental Disorders", 21st IEEE International Symposium on Biomedical Imaging (ISBI 2024)

[2] R. Louiset, **E. Duchesnay**, G. Antoine, B. Dufumier, and P. Gori (2024) "SepVAE: a contrastive VAE to separate pathological patterns from healthy ones", Medical Imaging with Deep Learning (MIDL) 2024

[3] R. Louiset, **E. Duchesnay**, B. Dufumier, A. Grigis, and P. Gori (2024) "SepCLR: Separating common from salient patterns with Contrastive Representation Learning", The Twelfth International Conference on Learning Representations (ICLR) 2024

[4] B. Dufumier, C.A. Barbano, R. Louiset, **E. Duchesnay**, and P. Gori (2023) "Integrating Prior Knowledge in Contrastive Learning with Kernel", 40th International Conference on Machine Learning (ICML) 2023

[5] C. Ambroise, A. Grigis, **E. Duchesnay**, and V. Frouin (2023) "Multi-View Variational Autoencoders Allow for Interpretability Leveraging Digital Avatars: Application to the HBN Cohort", IEEE 20th International Symposium on Biomedical Imaging (ISBI) 2023

[6] C.A. Barbano, B. Dufumier, **E. Duchesnay**, M. Grangetto, and P. Gori (2023) "Contrastive learning for regression in multi-site brain age prediction", IEEE 20th International Symposium on Biomedical Imaging (ISBI) 2023

[7] B. Dufumier, P. Gori, J. Victor, A. Grigis, M. Wessa, P. Brambilla, P. Favre, M. Polosan, C. McDonald, C.M. Piguet, and **E. Duchesnay** (2021) "Contrastive Learning with Continuous Proxy Meta-Data for 3D MRI Classification", 24th International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI) 2021

[8] R. Louiset, P. Gori, B. Dufumier, J. Houenou, A. Grigis, and **E. Duchesnay** (2021) "UCSL : A Machine Learning Expectation-Maximization framework for Unsupervised Clustering driven by Supervised Learning", Joint European Conference on Machine Learning and Knowledge Discovery in Databases (ECML/PKDD) 2021

[9] A. de Pierrefeu, T. Lofstedt, C. Laidi, F. Hadj-Selem, M. Leboyer, P. Ciuciu, J. Houenou, and **E. Duchesnay** (2018) "Interpretable and stable prediction of schizophrenia on a large multisite dataset using machine learning with structured sparsity", 2018 International Workshop on Pattern Recognition in Neuroimaging (PRNI)

[10] M. Pauling, C. Henry, S. Sarrazin, **E. Duchesnay**, J. Stout, D. Hibar, N. Jahanshad, O. Andreassen, P. Thompson, and J. Houenou (2017) "Bipolar disorder and white matter microstructure: ENIGMA bipolar disorder fractional anisotropy DTI results", European Neuropsychopharmacology

[11] Y.L. Guen, G. Auzias, G. Dehaene-Lambertz, F. Leroy, J.F. Mangin, **E. Duchesnay**, O. Coulon, and V. Frouin (2017) "Regional study of the genetic influence on the sulcal pits", 14th IEEE International Symposium on Biomedical Imaging, ISBI 2017, Melbourne, Australia, April 18-21, 2017

[12] A. Teillac, S. Lefrance, **E. Duchesnay**, F. Poupon, M.A.R. Fuster, D.L. Bihan, J.F. Mangin, and C. Poupon (2016) "Colocalization of Functional Activity and Neurite Density Within Cortical Areas", Computational Diffusion MRI

[13] B. Da Mota, J. LI, M. Cadenne, V. Ducrot, S. Monnot, and V. Frouin (2014) "Permuted Voxelwise Genome-Wide Association", Human Brain Mapping

[14] T. Lofstedt, F. Hadj-Selem, V. Guillemot, C. Philippe, **E. Duchesnay**, A. Tenenhaus, and V. Frouin (2014) "Analysis, Structured variable selection for generalized canonical correlation", International Conference on Partial Least Squares and Related Methods

[15] V. Guillemot, A. Tenenhaus, **E. Duchesnay**, J.B. Poline, and V. Frouin (2013) "A multi-block approach in imaging genetics", 9th International Imaging Genetics Conference

[16] E. Le Floch, L. Trinchera, V. Guillemot, A. Tenenhaus, J.B. Poline, V. Frouin, and **E. Duchesnay** (2013) "Dimension Reduction and Regularization Combined with Partial Least Squares in High Dimensional Imaging Genetics Studies", New Perspectives in Partial Least Squares and Related Methods

[17] A.L. Fouque, C. Fischer, V. Frouin, P. Ciuciu, and **E. Duchesnay** (2013) "Comparison of Features for Voxel-Based Analysis and Classification of Anatomical Neuroimaging Data", 2013 International Workshop on Pattern Recognition in Neuroimaging

[18] E. Le Floch, L. Trinchera, A. Tenenhaus, J.B. Poline, V. Frouin, and **E. Duchesnay** (2012) "Dimension reduction and regularisation combined with Partial Least Squares in high dimensional imaging-genetics studies", Partial Least Squares

[19] E. Le Floch, P. Pinel, A. Tenenhaus, L. Trinchera, J.B. Poline, V. Frouin, and **E. Duchesnay** (2012) "Discovering associations in high dimensional imaging-genetics data: A comparison study of dimension reduction and regularisation strategies combined with partial least squares", International Symposium on Biomedical Imaging (ISBI)

[20] A.L. Fouque, P. Fillard, A. Bargiacchi, A. Cachia, M. Zilbovicius, B. Thyreau, E. Le Floch, P. Ciuciu, and **E. Duchesnay** (2011) "Voxelwise multivariate statistics and brain-wide machine learning using the full diffusion tensor", MICCAI

[21] C. Damon, **E. Duchesnay**, and M. Depecker (2011) "Structured Multivariate Pattern Classification to Detect MRI Markers for an Early Diagnosis of Alzheimer's Disease", 2011 10th International Conference on Machine Learning and Applications and Workshops

[22] E. Le Floch, C. Lalanne, P. Pinel, A. Moreno, L. Trinchera, A. Tenenhaus, B. Thirion, J.B. Poline, V. Frouin, and **E. Duchesnay** (2011) "Bridging the gap between imaging and genetics : a multivariate statistical investigation", Human brain mapping

[23] J.B. Poline, C. Lalanne, A. Tenenhaus, **E. Duchesnay**, B. Thirion, and V. Frouin (2010) "Imaging Genetics: Bio-Informatics and Bio-Statistics Challenges", compstat

[24] E. Le Floch, M. Keller, V. Frouin, C. Lalanne, P. Pinel, J.B. Poline, and **E. Duchesnay** (2010) "Cluster-level Inference and Resampling-Based Multiple Testing applied to Imaging Genetics Studies", Human brain mapping

[25] C. Damon, P. Pinel, M. Perrot, V. Michel, **E. Duchesnay**, J.B. Poline, and B. Thirion (2008) "Discriminating between populations of subjects based on FMRI data using sparse features selection and SRDA classifier", MICCAI Analysis of Functional Medical Images Workshop

[26] Z.Y. Sun, D. Riviere, **E. Duchesnay**, B. Thirion, F. Poupon, and J.F. Mangin (2008) "Defining cortical sulcus patterns using partial clustering based on bootstrap and bagging", 2008 5th IEEE International Symposium on Biomedical Imaging: From Nano to Macro

[27] B. Thirion, **E. Duchesnay**, E. Hubbard, J. Dubois, J.B. Poline, and S. Dehaene (2006) "Reading the brain visual system as an inverse problem", International Symposium on Biomedical Imaging (ISBI)

[28] B. Thirion, **E. Duchesnay**, J. Dubois, J.B. Poline, and D. Le Bihan (2005) "Reading in the subject's mind: the case of low-level vision", Proc. 11th HBM CD-Rom Neuroimage vol 26 (1)

[29] A. Cachia, **E. Duchesnay**, M. Plaze, M.L. Paillère-Martinot, D. Januel, F. Bellivier, A. Galinowski, J. Andoh, D. Bartrés-Faz, R. De Beaurepaire, E. Artiges, D. Rivière, J.F. Mangin, and J.L. Martinot (2005) "Sulcus-based morphometry of heteromodal cortex in schizophrenia patients with resistant auditory hallucinations.", Proc. 11th HBM CD-Rom Neuroimage vol 26 (1)

[30] J.L. Martinot, T. Kircher, M.L. Paillère-Martinot, M. Plaze, D. Januel, F. Bellivier, J. Andoh, R. De Beaurepaire, S. Chanraud, E. Artiges, **E. Duchesnay**, J.F. Mangin, T. Kellermann, D. Leube, D. Bartrés-Faz, and A. Cachia (2005) "Brain folding in schizophrenia", Proc. 8th World congress of biological psychiatry. The world journal of biological psychiatry vol 6 (1)

[31] J.L. Martinot, T. Kircher, M.L. Paillère-Martinot, M. Plaze, D. Januel, F. Bellivier, J. Andoh, R. De Beaurepaire, S. Chanraud, E. Artiges, **E. Duchesnay**, J.F. Mangin, T. Kellermann, D. Leube, D. Bartrés-Faz, and A. Cachia (2005) "Brain folding in schizophrenia", Proc. 8th World congress of biological psychiatry. The world journal of biological psychiatry vol 6 (1)

[32] **E. Duchesnay**, A. Roche, D. Rivière, D. Papadopoulos-Orfanos, Y. Cointepas, and J.F. Mangin (2004) "Population Classification Based on Structural Morphometry of Cortical Sulci", International Symposium on Biomedical Imaging (ISBI)

[33] **E. Duchesnay**, A. Roche, D. Rivière, D. Papadopoulos-Orfanos, Y. Cointepas, and J.F. Mangin (2004) "Guessing the Sex from the Shapes of Cortical Folds", HBM, Budapest

[34] Y. Jacquelet, J. Montois, **E. Duchesnay**, and A. Kinic (2002) "Combinatorial pyramid transposed to behavioural space for object recognition process", Systems, Man and Cybernetics, 2002 IEEE International Conference on

[35] **E. Duchesnay**, J.J. Montois, Y. Jacquelet, and A. Kinie (2001) "An agent-based implementation of irregular pyramid for distributed image segmentation", Emerging Technologies and Factory Automation, 2001. Proceedings. 2001 8th IEEE International Conference on

[36] Y. Jacquelet, J.J. Montois, **E. Duchesnay**, M. GARREAU, and A. KINIE (2001) "Architecture pyramidale agent pour la segmentation d'image: Application à l'extraction d'une zone lobulaire issue d'une mammographie", 18° Colloque sur le traitement du signal et des images, FRA, 2001

[37] A. Kinie, **E. Duchesnay**, F. Wendling, J.J. Montois, and Y. Jacquelet (2001) "Segmentation vectorielle des signaux épileptiques une approche expérimentale multi-agents", 18° Colloque sur le traitement du signal et des images, FRA, 2001

[38] **E. Duchesnay**, J.J. Montois, and Y. Jacquelet (2000) "A Multiagent System for a Cooperative and Distributed Vision System", Advances in Concurrent Engineering: CE2000 Proceedings

[39] **E. Duchesnay**, J.J. Montois, Y. Jacquelet, and A. Kinie (2000) "Irregular adaptative pyramid of agents for segmentation to interpretation of image", 2000 IEEE International Conference on Systems, Man, and Cybernetics

[40] **E. Duchesnay**, J.J. Montois, and Y. Jacquelet (2000) "Résolution distribuée de conflits dans un réseau d'agents", 10ème Journées Neurosciences et Sciences de l'Ingénieur

Patents

PCT/FR2010/050431. Inventors: Duchesnay, Edouard; Paillere, Marie-Laure; Cachia, Arnaud; Martinot, Jean-Luc; Artiges, Eric. "Method for Developing an Information Prediction Device, Use Thereof, and Corresponding Storage Medium and Apparatus".