CLÉMENT MOULIN-FRIER, PHD

Address:	Sant Antoni Maria Claret, 22 08037 Barcelona, Spain	**Date of Birth:**	27th of May 1981 36 year old
Email:	clement.moulinfrier@gmail.com	**Nationality:**	French
Web:	clement-moulin-frier.github.io	**Phone:**	(+34) 692.190.686

CURRENT POSITION

Since October 2017

RESEARCH SCIENTIST

Cogitai, Inc., Orange County, USA (working remotely from Barcelona, Spain)

Research: Cogitai, Inc. is dedicated to building artificial intelligences (AIs) that learn continually from interaction with the real world. Our goal is to build the brains, i.e., the continual-learning AI software, that will let everyday things that sense and act get smarter with experience. This experience will be shared across devices and domains to allow the rapid scaling-up of learning.
Website: https://www.cogitai.com

PREVIOUS POSITIONS

January 2015 – October 2017

POST-DOCTORAL RESEARCHER

SPECS research group, Universitat Pompeu Fabra, Barcelona, Spain

Research: *Adaptive cognitive architectures for robotics and the emergence of social behaviors*
Supervision: Paul Verschure
Funding: ▪ *What You Say Is What You Did,* WYSIWYD project (FP7 ICT 612139)
▪ *Socialising Sensori-Motor Contingencies,* socSMC project (641321-H2020FETPROACT-2014).
▪ *Role of Consciousness in Adaptive Behavior* ERC's CDAC project (ERC-2013ADG 341196)

January 2012 – November 2014

RESEARCHER

FLOWERS research group, Inria, Bordeaux, France.

Research: *Curiosity-driven learning applied to robotics*
Supervision: Pierre-Yves Oudeyer
Funding: ERC Starting Grant EXPLORERS 240 007, then Inria institute

September 2011 – December 2011

POST-DOCTORAL RESEARCHER

LPPA (Physiology of Perception and Action), Collège de France CNRS, Paris, France.

Research: *Bayesian models of decision making for bipedal walking control*
Supervision: Jacques Droulez
Funding: French government

January 2009 – July 2009

VISITING SCHOLAR

University of Southern California, Los Angeles, USA.

Research: *Recognizing speech in a novel accent: The motor theory of speech perception reframed*
Supervision: Michael A. Arbib
Funding: Explora-Doc French scholarship

ACADEMIC EDUCATION

September 2007 – June 2011

PhD STUDENT

Gipsa-Lab, Speech and Cognition department, Grenoble University

Research: *Emergence of communication systems in Bayesian vocal agent populations*
Supervision: Jean-Luc Schwartz, Pierre Bessière, and Julien Diard
Research stay: 6 months with M.A. Arbib at University of Southern California, Los Angeles, USA.
Funding: French ministry research scholarship

September 2006 – July 2007

MASTER DEGREE IN COGNITIVE SCIENCE

Grenoble Institute of Technology, France

With honors
Grenoble Institute of Technology

September 2005 – July 2006

MASTER DEGREE IN COMPUTER SCIENCE

With honors
University Joseph Fourier, Grenoble, France

SCIENTIFIC RESPONSIBILITIES

2017

ASSOCIATE EDITOR

International Conference on Development and Learning, ICDL/Epirob, Lisbon, Portugal

www.icdl-epirob.org

2015

PROGRAM CHAIR

International Conference on Development and Learning, ICDL/Epirob, Providence, RI, USA

www.icdl-epirob.org

2015-present

CHAIR OF THE LANGUAGE AND COGNITION TASK FORCE

IEEE Technical Committee on Autonomous Mental Development

https://openlab-flowers.inria.fr/t/cds-tc-task-force-on-language-and-cognition

2014 – 2015

CO-EDITOR OF THE SPECIAL ISSUE "ON THE COGNITIVE NATURE OF SPEECH SOUND SYSTEMS"

Journal of Phonetics

> First author of the target article, see *Publications*

2015

MEMBER OF THE PROGRAM COMMITTEE

Workshop "Sensorimotor Contingencies for Robotics" at IROS 2015, Hamburg, Germany

> http://www.iri.upc.edu/groups/perception/sensorimotorIROS15/

AWARDS, HONORS, GRANTS AND COMPETITIONS

2017 – 2019

PLAN NACIONAL (SPANISH RESEARCH GRANT)

INSOCO project (DPI2016-80116-P)

> Social interactions based on sensorimotor contingencies
> In collaboration with Marti Sanchez-Fibla.
> http://specs.upf.edu/projects/3159

April 2013

COMPETITIVE EXAM FOR CNRS (FRENCH NATIONAL RESEARCH COUNCIL)

> Second place among 53 international researchers.
> Category: Associate scientist in Computer Science

November 2012

BEST PAPER AWARD

International Conference on Development and Learning, ICDL/Epirob, San Diego, USA.

> Category: Computational models of development
> Paper: Curiosity-driven phonetic learning, see *Publications*

2012

QUALIFICATION AS ASSOCIATE PROFESSOR

French ministry of research

> Domain: Computer Science

2009

BEST TEACHING PROJECT

Grenoble CIES (French center for university-level teaching)

2008

EXPLORA-DOC SCHOLARSHIP

French Rhone-Alpes region

> Funding for a 6-months visit at the University of Southern California, Los Angeles, USA

2006

MASTER DEGREE FELLOWSHIP

French government

INVITED TALKS

June 2017

"COGNITION, EMBODIMENT AND SELF-ORGANIZATION: AN INTEGRATED VIEW TO ARTIFICIAL INTELLIGENCE"

Machine Learning group at Universitat Pompeu Fabra

Invitation from Hector Geffner, head of the group

March 2017

"COGNITIVE ARCHITECTURES FOR SOCIAL ROBOTICS"

European Robotics Forum, Edinburgh, Scotland

Empathic Human-Robot Interaction Workshop
Invitation from Kerstin Dautenhahn, organizer of the workshop

August 2015

"EVOLUTION AND DEVELOPMENT OF VOCAL COMMUNICATION STRUCTURES"

Princeton University, Developmental Neuromechanics & Communication Lab, USA

Invitation from Asif Ghazanfar, head of the group

November 2014

"EXPLORATION STRATEGIES IN DEVELOPMENTAL ROBOTICS"

Humanoids conference, Madrid, Spain. Workshop

Workshop "Active Learning in Robotics: Exploration Strategies in Complex Environments"
Organisers: Johannes Kulick, Herke van Hoof, Marc Toussaint, and Jan Peters

October 2014

"POPPY: A ROBOTIC PLATFORM FOR CODERS, MAKERS, ARTISTS AND RESEARCHERS"

Pycon conference, Lyon, France

Invitation by Françoise Conil, co-organizer of the conference

August 2013

"EXPLORATION STRATEGIES IN DEVELOPMENTAL ROBOTICS"

Honda Research Institute, Tokyo, Japan

Invitation by Angelica Lim, visiting scholar and now researcher at Softbank Robotics

TEACHING ACTIVITIES

2015-2017

RESPONSIBLE PROFESSOR (37.5 HOURS)

Universitat Pompeu Fabra, Barcelona, Spain

Course "Real-time Interaction in Cognitive and Social Systems"
Cognitive Systems and Interactive Media (CSIM) Master

2010--2011

TEACHING ASSISTANT IN COMPUTER SCIENCE (92 HOURS)

UFR IMAG, University Joseph Fourier, Grenoble, France

Computer Science and Applied Mathematics

Bachelor and Master degrees

2007--2010

TEACHING ASSISTANT IN COMPUTER SCIENCE (192 HOURS)

Université Stendhal, Grenoble, France

3 years of teacher training

STUDENT SUPERVISION

2015-present

PHD THESIS CO-SUPERVISION

SPECS group, Universitat Pompeu Fabra, Spain

Student: Jordi-Ysard Puigbo
Value modulation in cortical visual processing and application to robotic control

2016 – 2017

MASTER PROJECT SUPERVISION

SPECS group, Universitat Pompeu Fabra, Spain

Student: Ismael Tito Freire González, CSIM Master, UPF, Spain
Modeling the formation of social conventions in agent populations

2015 – 2016

MASTER PROJECT SUPERVISION

SPECS group, Universitat Pompeu Fabra, Spain

Student: Yasin Can Akmehmet, CSIM Master, UPF, Spain
Autonomous development of turn-taking behaviors in robot populations

2014 – 2015

MASTER PROJECT, THEN PHD THESIS CO-SUPERVISION

Flowers group, Inria, France

Student: Sébastien Forestier, Ecole Normale Supérieur, Paris, France
Active learning strategies for the modelling of infant vocal development

2014 – 2013

MASTER PROJECT SUPERVISION

Flowers group, Inria, France

Student: Marie-Morgane Paumard, Ecole Normale Supérieur de Cachan, France
Learning the manipulation of flexible tools in developmental robotics: a fishing robot

2013 – 2014

MASTER PROJECT SUPERVISION

Flowers group, Inria, France

Student: Jules Brochard, Ecole Normale Supérieur de Cachan, France
Emergent maturations in early vocal development. Journal article, see *Publications*

2010 – 2011

MASTER PROJECT SUPERVISION

GIPSA-Lab, Grenoble Institute of Technology, France

Student: Raphaël Laurent, Master MoSIG, ENSIMAG, Grenoble, France

A computational model to study quantitatively motor, sensory, and sensorimotor model responses in Speech Recognition. <u>3 co-authored publications, including a journal paper</u>

OUTREACH ACTIVITIES & INNOVATION

September 2017

CO-ORGANIZER OF THE RE-FLUX PERFORMANCE

Barcelona Cognition Brain and Technology summer school (BCBT 2016)

Multimodal Performance with AI, Robots, VR and Humans
http://bcbt.upf.edu/bcbt16/node/330

2013 – 2017

INITIATOR AND MAIN CONTRIBUTOR OF THE OPEN-SOURCE *EXPLAUTO* LIBRARY

A library to study, model and simulate intrinsically motivated multitask learning and exploration in virtual and robotic agents
https://github.com/flowersteam/explauto

October 2014

ORGANISATION OF A 3-DAY HACKATHON

Universciences, Paris, France

Conception and programming of the Poppy robot. 25 participants
Video of the event: https://vimeo.com/109145300

September 2014

INTERVIEW FOR THE FRENCH JOURNAL BIOFUTUR

On robotic approaches to language evolution modelling

2013 – 2015

MEMBER OF THE POPPY-PROJECT

Open-source robotics for teacher, makers, artists and researchers
Realisation of a various robotic demonstrations, workshops and dissemination events
https://www.poppy-project.org

LANGUAGES

English (C1), French (native), Spanish (B1)

PUBLICATIONS

JOURNAL ARTICLE IN PREPARATION

Arsiwalla, X.D., <u>Moulin-Frier, C.</u>, Herreros, I., Sanchez-Fibla, M., Verschure, P.F.M.J (2017). The Morphospace of Consciousness. *arXiv preprint arXiv:1705.11190*

JOURNAL ARTICLES

<u>Moulin-Frier, C.</u>, Fischer, T., Petit, M. Pointeau, G., Puigbo, J.-Y., Pattacini, U., Low, S.C., Camilleri, D., Nguyen, P. Hoffmann, M. Chang, H.J., Zambelli, M., Mealier, A.-L., Damianou, A., Metta, G.

Prescott, T., Demiris, Y., Dominey, P.-F. and. Verschure, P. (2017). DAC-h3: A Proactive Robot Cognitive Architecture to Acquire and Express Knowledge About the World and the Self. *IEEE Transactions on Cognitive and Developmental Systems*. In press

Moulin-Frier, C., Brochard, J., Stulp, F., & Oudeyer, P.-Y. (2017). Emergent Jaw Predominance in Vocal Development through Stochastic Optimization. *IEEE Transactions On Cognitive and Developmental Systems*. In press

Acevedo Valle, J. M., Angulo, C., & Moulin-Frier, C. (2017). Autonomous Discovery of Motor Constraints in an Intrinsically-Motivated Vocal Learner. *IEEE Transactions On Cognitive and Developmental Systems*. In press.

Moulin-Frier, C., Diard, J., Schwartz, J.-L., and Bessière, P. (2015). COSMO ("Communicating about Objects using Sensory-Motor Operations"): a Bayesian modeling framework for studying speech communication and the emergence of phonological systems. *Journal of Phonetics*. 53: 5–41 **Target paper of a special issue**.

Moulin-Frier, C., Nguyen, S. M., and Oudeyer, P.-Y. (2013). Self-organization of early vocal development in infants and machines: The role of intrinsic motivation. *Frontiers in Psychology (Cognitive Science)*, 4(1006).

Moulin-Frier, C. and Arbib, M. A. (2013). Recognizing speech in a novel accent: The motor theory of speech perception reframed. *Biological Cybernetics*, 107 (4):421–447.

N'Guyen, S., Moulin-Frier, C., and Droulez, J. (2013). Decision Making under Uncertainty: A Quasimetric Approach. *PLoS ONE*, 8(12).

Moulin-Frier, C., Laurent, R., Bessière, P., Schwartz, J.-L., and Diard, J. (2012). Adverse conditions improve distinguishability of auditory, motor and perceptuo-motor theories of speech perception: an exploratory Bayesian modeling study. *Language and Cognitive Processes*. 27(7-8): 1240–1263. Special Issue: Speech Recognition in Adverse Conditions.

INVITED COMMENTARIES IN INTERNATIONAL JOURNALS

Moulin-Frier, C., & Verschure, P. (2016). Two possible driving forces supporting the evolution of animal communication: Comment on "Towards a Computational Comparative Neuroprimatology: Framing the language-ready brain" by Michael A. Arbib. *Physics Of Life Reviews*, 16, 88–90.

Schwartz, J.-L., Barnaud, M.-L., Bessière, P., Diard, J., & Moulin-Frier, C. (2016). Phonology in the mirror: Comment on "Towards a Computational Comparative Neuroprimatology: Framing the language-ready brain" by Michael A. Arbib . *Physics Of Life Reviews*, 16, 93–95.

Laurent, R., Moulin-Frier, C., Bessière, P., Schwartz, J.-L., & Diard, J. (2013). Integrate yes, but what and how? A computational approach of sensorimotor fusion in speech. Commentary In *Behavioral and Brain Sciences*, 36(4):36–37.

BOOK CHAPTER

Moulin-Frier, C., Schwartz, J., Diard, J., and Bessière, P. (2011b). Emergence of articulatory-acoustic systems from deictic interaction games in a "Vocalize to Localize" framework. Chapter in Primate communication and human language: Vocalisations, gestures, imitation and deixis in humans and non-humans. *Advances in Interaction Studies'* series by John Benjamins Pub. Co.

INTERNATIONAL CONFERENCES – FULL PAPERS

Moulin-Frier, C., Puigbò, J. Y., Arsiwalla, X. D., Sanchez-Fibla, M., & Verschure, P. F. (2017). Embodied Artificial Intelligence through Distributed Adaptive Control: An Integrated Framework. *International Conference on Development and Learning, ICDL/Epirob, Lisbon, Portugal*.

Arsiwalla, X.D., Herreros, I., Moulin-Frier, C., Verschure, P.F.M.J (2017). Consciousness as an Evolutionary Game-Theoretic Strategy. In *Conference on Biomimetic and Biohybrid Systems*, 509-514

Moulin-Frier, C., Arsiwalla, X. D., Puigbò, J.-Y., Sánchez-Fibla, M., Duff, A., and Verschure, P. F. M. J. (2016). Top-Down and Bottom-Up Interactions between Low-Level Reactive Control and Symbolic Rule Learning in Embodied Agents. In *Proceedings of the Workshop on Cognitive Computation: Integrating neural and symbolic approaches. 30th Annual Conference on Neural Information Processing Systems (NIPS 2016)*.

Puigbò, J.-Y., Moulin-Frier, C., and Verschure, P. F. M. J. (2016). Towards Self-controlled Robots Through Distributed Adaptive Control. In *Conference on Biomimetic and Biohybrid Systems* (pp. 490–497). Springer.

Arsiwalla, X. D., Herreros-Alonso, I., Moulin-Frier, C., Sánchez-Fibla, M., and Verschure, P. F. M. J. (2016). Is Consciousness a Control Process? In *Proceedings of the 19th International Conference of the Catalan Association for Artificial Intelligence*.

Acevedo Valle, J. M., Angulo Bahón, C., Moulin-Frier, C., Trejo Ramírez, K. A. (2016). The role of somatosensory models in vocal autonomous exploration. In *Revista Internacional de Investigación e Innovación Tecnológica* 4 (23), 1-11

Moulin-Frier, C., Sanchez-Fibla, M., and Verschure, P. F.M.J (2015b). Autonomous development of turn-taking behaviors in agent populations: a computational study. In *International Conference on Development and Learning, ICDL/Epirob, Providence (RI), USA*.

Puigbò, J.-Y., Moulin-Frier, C., Vouloutsi, V., Sanchez-Fibla, M., Herreros, I., and Verschure, P. F. M. J. (2015). Skill refinement through cerebellar learning and human haptic feedback: an iCub learning to paint experiment. In *IEEE-RAS Conference on Humanoids Robots (Humanoids 2015)*, Seoul, Korea.

Puigbò, J.-Y., Herreros, I., Moulin-Frier, C., and Verschure, P. F. M. J. (2015). Towards a two-phase model of sensor and motor learning. In *Conference on Biomimetic and Biohybrid Systems* (pp. 453–460). Springer.

Acevedo Valle, J. M., Angulo, C., Agell, N., and Moulin-Frier, C. (2015). Proprioceptive Feedback and Intrinsic Motivations in Early-Vocal Development. In *Proceedings of the 18th International Conference of the Catalan Association for Artificial Intelligence*. Armengol, E., Boixader, D., Grimaldo, F.

Moulin-Frier, C. and Oudeyer, P.-Y. (2013a). Exploration strategies in developmental robotics: A unified probabilistic framework. In *International Conference on Development and Learning, ICDL/Epirob, Osaka, Japan*.

Moulin-Frier, C. and Oudeyer, P.-Y. (2013b). Learning how to reach various goals by autonomous interaction with the environment: unification and comparison of exploration strategies. In *1st Multidisciplinary Conference on Reinforcement Learning and Decision Making (RLDM2013), Princeton University, New Jersey*.

Moulin-Frier, C. and Oudeyer, P.-Y. (2013c). The role of intrinsic motivations in learning sensorimotor vocal mappings: a developmental robotics study. In *Proceedings of Interspeech, Lyon, France*, Lyon, France.

Moulin-Frier, C. and Oudeyer, P.-Y. (2012). Curiosity-driven phonetic learning. In *International Conference on Development and Learning, Epirob, San Diego, USA*. **Best paper award.**

Moulin-Frier, C., Laurent, R., Bessière, P., Schwartz, J., and Diard, J. (2011a). Noise and inter-speaker variability improve distinguishability of auditory, motor and perceptuo-motor theories of speech perception : An exploratory bayesian modeling study. In *9th International Seminar on Speech Production, ISSP'11*, Montreal, Canada.

Moulin-Frier, C., Schwartz, J., Diard, J., and Bessière, P. (2010). A unified theoretical bayesian model of speech communication. In *1st conference on Applied Digital Human Modeling, Miami, USA*.

Moulin-Frier, C., Schwartz, J., Diard, J., and Bessière, P. (2008c). Emergence of a language through deictic games within a society of sensori-motor agents in interaction. In *International Workshop on "Speech and Face to Face Communication"*, Grenoble France.

Moulin-Frier, C., Schwartz, J., Diard, J., and Bessière, P. (2008b). Emergence of a language through deictic games within a society of sensori-motor agents in interaction. In *8th International Seminar on Speech Production, ISSP'08*, Strasbourg, France.

Moulin-Frier, C., Schwartz, J., Diard, J., and Bessière, P. (2008a). Emergence du langage par jeux déictiques dans une société d'agents sensori-moteurs en interaction. In *27e Journées d'Etudes sur la Parole, JEP'2008*, Avignon France.

INTERNATIONAL CONFERENCES – ABSTRACTS

Puigbò, J.-Y., Vouloutsi, V., Moulin-Frier, C., & Verschure, P. F. M. J. (2015). Reactive and adaptive control loops for social learning in human--robot interaction. Workshop "Mechanisms of learning in social contexts", *IEEE International Conference on Development and Learning, ICDL/Epirob*, Providence (RI), USA.

Moulin-Frier, C., Rouanet, P., and Oudeyer, P.-Y. (2014). Explauto: an open-source Python library to study autonomous exploration in developmental robotics. In *International Conference on Development and Learning, ICDL/Epirob, Genova, Italy*.

Arbib, M. A. and Moulin-Frier, C. (2010). Recognizing speech in a novel accent: The motor theory of speech perception reframed. In *Neurobiology of Language Conference, San Diego, USA*.

Schwartz, J., Rochet-Capellan, A., and Moulin-Frier, C. (2007). Speech at reach of hand and mouth: Theoretical arguments, experimental facts and computational advances. In *Workshop " Vocoid – Vocalization, COmmmunication, Imitation and Deixis in adult and infant human and non human primates "*, Grenoble France.

THESES

Moulin-Frier, C. (2011). Rôle des relations perception-action dans la communication parlée et l'émergence des systèmes phonologiques : étude, modélisation computationnelle et simulations. PhD thesis, Université de Grenoble.

Moulin-Frier, C. (2007). Jeux déictiques dans une société d'agents sensori-moteurs en interaction. Master's thesis, Grenoble-INP.

Moulin-Frier, C. (2006). Objets communicants : la traçabilité. Master's thesis, Université Joseph Fourier, Grenoble.

RECOMMENDATIONS

PIERRE-YVES OUDEYER

INRIA Research Director, Head of the Flowers research group, Bordeaux, France
PhD thesis reviewer and post-doc advisor (2012-2014)
Specialized in developmental robotics.
pierre-yves.oudeyer@inria.fr

PIERRE BESSIÈRE

CNRS Research Director, Sorbonne Universités – UPMC -ISIR, Paris, France
PhD thesis advisor
Specialized in computer and cognitive sciences
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YIANNIS DEMIRIS

Head of the Personal Robotics Laboratory, Imperial College, London, UK
Collaborator in the WYSIWYD European project (2015-2017)
Specialized in human-robot interaction and machine learning
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PAUL VERSCHURE

Head of the SPECS research group, Universitat Pompeu Fabra, Barcelona, Spain
Post-doc advisor (2015-present)
Specialized in computational neuroscience, psychology and robotics
paul.verschure@upf.edu

MICHAEL A. ARBIB

Professor, USC Brain Project, University of Southern California, Los Angeles, USA
Collaborator and PhD thesis reviewer
Specialized in computational neuroscience and language evolution
arbib@usc.edu

MATTHIEU LAPEYRE

CEO and co-founder of Pollen Robotics, Bordeaux, France. http://pollen-robotics.com/en
Designer of the *Poppy* humanoid robot for which I have realized a number of applications
Specialized in open-source robotics
matthieu.lapeyre@pollen-robotics.com

JEAN-LUC SCHWARTZ

CNRS Research Director, GIPSA-Lab, Speech and Cognition Dpt, Grenoble, France
PhD thesis advisor
Specialized in speech science
jean-luc.schwartz@gipsa-lab.grenoble-inp.fr

JACQUES DROULEZ

CNRS Research Director, Sorbonne Universités – UPMC -ISIR, Paris, France
Post-doc advisor
Specialized in computer and cognitive sciences
jacques.droulez@isir.upmc.fr

ANNE WARLAUMONT

Head of the Emergence of Communication Lab, UC Merced, USA
Collaborator and co-chair of the 2015 ICDL-Epirob conference
Specialized in computational models of speech acquisition.
awarlaumont2@ucmerced.edu