



MASTER 2 Fundamental and Clinical Neurosciences

Internship proposal 2024-2025

(internship from January to June 2025)

Host laboratory:

Institut des Sciences Cognitives Marc Jeannerod (UMR5229)

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<http://www.isc.cnrs.fr/index.rvt?language=fr&teamid=neural%5Fbases%5Fof%5Fspatial%5F cognition%5Fand%5Faction&team=research>

Host team : BASES NEURALES DE LA COGNITION ET DE L'ACTION

<https://www.benhamedlab.org/accueil/research>

Internship supervisors :

Suliann Ben Hamed principal investigator (DR) benhamed@isc.cnrs.fr

Clément M. Garin post-doctorant clement.garin@isc.cnrs.fr

Project title: Development of awake functional MRI and automatic testing of cognitive performance to characterize dogs' inter-individual differentiation

Project summary : As humans, animals possess very different “personalities” as well as cognitive performances when compared to each other. The origins and mechanisms sustaining this inter-individual differentiation are poorly understood, especially in non-human species. In order to fill this gap of knowledge, we first aim to **characterize dogs' cognitive performance inter-individual differentiation** with innovative ethological technologies based on automated tests and AI. Our second aim is to characterize how inter-individual differentiation relates to large-scale cortical network inter-individual variability. Dogs is a compelling choice for functional MRI (fMRI) studies due to their exceptional trainability and cooperative nature. Unlike many other animal species, dogs can be trained to remain still during fMRI scans without the need for sedation, allowing for the collection of high-quality imaging data. Our hypothesis is that in dogs intra- and inter-breeds cognitive differences, are characterized by cognitive characteristics that can be partially explained by their cerebral network organization. Better understanding cognitive inter-individual variability is expected to pave the way to understand the origins of dogs and human psychiatric pathologies as well as their evolutionary history. In order to develop this ambitious project, the master student will participate to the development of an automated setup to test dog cognitive performance and train dogs to remain still in an MRI machine while being scanned. The student will also be initiated to neuroimaging analysis of a dog fMRI data set. A strong interest in coding (python), neuroimaging, behavior and evolutionary theories is required. Prior experience in coding is a plus and motivation



to work with dogs is required. The master student will be supervised by Dr. Ben Hamed and Dr. Garin. This internship will be encouraged to be continued as Ph.D.

3-5 recent publications :

Berns, G. 2020. 'Decoding the Canine Mind', *Cerebrum*, 2020: cer-04-20.

Berns, G. S., A. M. Brooks, and M. Spivak. 2012. 'Functional MRI in awake unrestrained dogs', *PLoS One*, 7: e38027.

Froesel, M., M. Gacoin, S. Clavagnier, M. Hauser, Q. Goudard, and S. Ben Hamed. 2022. 'Socially meaningful visual context either enhances or inhibits vocalisation processing in the macaque brain', *Nat Commun*, 13: 4886.

Garin, C. M., Y. Hori, S. Everling, C. T. Whitlow, F. J. Calabro, B. Luna, M. Froesel, M. Gacoin, S. Ben Hamed, M. Dhenain, and C. Constantinidis. 2022. 'An evolutionary gap in primate default mode network organization', *Cell Reports*, 39: 110669.

Gordon, E. M., T. O. Laumann, B. Adeyemo, and S. E. Petersen. 2017. 'Individual Variability of the System-Level Organization of the Human Brain', *Cerebral Cortex*, 27: 386-99.

Pagani, Marco, Daniel Gutierrez-Barragan, A. Elizabeth de Guzman, Ting Xu, and Alessandro Gozzi. 2023. 'Mapping and comparing fMRI connectivity networks across species', *Communications Biology*, 6: 1238.