



MASTER 2 Fundamental and Clinical Neurosciences

Internship proposal 2024-2025

(internship from January to June 2025)

Host laboratory: *Name + address*

Institut des Sciences Cognitives, 67 bd Pinel, 69675 BRON

Host team : *team name + website*

Team Jean-Claude Dreher

<https://dreherteam.wixsite.com/neuroeconomics>

Internship supervisors : *name + position + email*

Jean-Claude Dreher : dreher@isc.cnrs.fr

Project title : Impacts of stress and sex hormones on the adolescent brain

Project summary : *approx 10 lines*

Adolescence heralds critical changes in the hypothalamic-pituitary-adrenal (HPA) and hypothalamic-pituitary-gonadal (HPG) axes, which regulate stress responses and sexual maturation, respectively. These changes are associated with alterations in the secretion patterns of key hormones like cortisol, testosterone, and estradiol, which in turn influence brain function and structure. For instance, cortisol, a primary stress hormone, has widespread effects on various brain regions, including the prefrontal cortex and amygdala, areas crucial for social cognition and emotional regulation. Furthermore, social hierarchy learning, an essential aspect of adolescent social development, is thought to be particularly susceptible to the effects of stress. This learning process is fundamental for navigating social environments and is intricately linked to reinforcement learning mechanisms that are sensitive to neuroendocrine modulation. Acute social stress has been shown to affect these learning processes, potentially altering the trajectory of social and cognitive development in adolescents. This internship project aims to explore these complex neuroendocrine dynamics, focusing on how acute social stress influences social hierarchy learning among adolescents. By integrating approaches from model-based fMRI and neuroendocrinology, the project seeks to elucidate the underlying mechanisms of stress susceptibility during this critical developmental window. Understanding these mechanisms is crucial for identifying potential intervention targets to mitigate the adverse effects of stress on adolescent development.



****Research Aims and Methodologies:****

The project aims to investigate the impact of social stress on the neural circuits and hormonal pathways involved in social hierarchy learning. Through the use of fMRI, we will examine changes in brain activation patterns in response to stress, focusing on areas involved in social cognition and emotional processing. Hormonal analyses will provide insights into how fluctuations in cortisol and sex hormones contribute to individual differences in stress responses and learning outcomes.

Students will have the opportunity to engage in a comprehensive research program, acquiring skills in neuroimaging, hormonal assay techniques, and computational modeling. This hands-on experience will offer invaluable insights into the interdisciplinary approach required to tackle complex questions in modern neuroscience.

****Invitation to Prospective master students:****

We invite motivated students who are intrigued by the intersection of neurobiology, psychology, and endocrinology to apply for this enriching internship. This is an opportunity to contribute to cutting-edge research that has the potential to inform interventions aimed at supporting adolescent resilience in the face of social stress.

3-5 publications :

- Dreher JC, Dunne S, Pazderska A, Frodl T, Nolan J.J, O'Doherty J.P, Testosterone Causes Both Prosocial and Antisocial Status-enhancing Behaviours in Human Males, **Proceedings of the National Academy of Sciences USA**, Oct 11, Vol 113, 41, 2016
- J-C Dreher*, P.J. Schmidt, P. Kohn, D. Furman, D. Rubinow, K.F. Berman. Menstrual cycle phase modulates reward-related neural function in women, **Proceedings of the National Academy of Sciences USA**, 104 (7), 2465-2470, 2007
- J. Thomas, E. Metereau, H Déchaud, M Pugeat, JC Dreher, Sequential 17 β -Estradiol Plus Oral Progesterone Increases the Response of the Reward System in Perimenopausal Women, **Psychoneuroendocrinology**, Vol. 50, December 2014, Pages 167–180
- J-C Dreher*, P. Kohn, B. Kolachana, D.R. Weinberger and K.F. Berman. Variation in dopamine genes influences responsivity of the human reward system, **Proceedings of the National Academy of Sciences USA**, vol 106 no. 2, 617-622, 2009