Proposal of Master Research Project (MRP) for the Academic Year 2026-27

Group Name: Neural Circuits of Alcohol Control
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Title of the MRP: Chemogenetic Manipulation of Microglia During Binge Alcohol Drinking

Summary of the MRP: Binge alcohol drinking is a major risk factor for the development of alcohol use disorder. Although neuronal mechanisms underlying alcohol consumption have been extensively studied, the role of microglia in regulating alcohol-related neuronal activity remains poorly understood. Recent work from our laboratory identified a neuronal ensemble in the medial orbitofrontal cortex (mOFC) that becomes activated during binge alcohol drinking and limits excessive alcohol intake (Gimenez-Gomez et al., Nature Neuroscience, 2025). Preliminary data further suggest that microglia contribute to the reactivation of this ensemble during subsequent drinking episodes. The aim of this MRP is to determine whether chemogenetic manipulation of microglia alters the reactivation of alcohol-induced neuronal ensembles in the mOFC and modifies alcohol consumption.

The student will:

1. Use the Drinking-in-the-Dark (DID) mouse model of binge alcohol drinking.
2. Manipulate microglial activity using DREADD-based chemogenetics.
3. Characterize alcohol-induced neuronal ensembles using activity-dependent neuronal tagging.
4. Quantify microglia–ensemble interactions using immunohistochemistry and confocal microscopy.
5. Perform image and statistical analysis of neuronal and microglial changes.

The project is designed to be feasible within the duration of the Master's programme and will provide training in modern systems neuroscience, viral approaches, microscopy, and quantitative image analysis. The expected outcome of the project is to establish whether chemogenetic manipulation of microglia is sufficient to modulate alcohol-related neuronal ensembles in the mOFC stablishing that microglia is key to limit binge alcohol drinking.

We strongly encourage applications from highly motivated students interested in neuroscience, neuroimmunology, and behavior. Our laboratory is committed to supporting the scientific development of Master's students, and outstanding candidates will be strongly considered for future research opportunities and potential recruitment within the group.

Methods and technology involved in the MRP:
Drinking-in-the-Dark (DID) model of binge alcohol drinking.
TRAP2/Ai14 mice for activity-dependent neuronal labeling.
Stereotaxic viral injections.
DREADD-based chemogenetic manipulation of microglia.
Immunohistochemistry and immunofluorescence.
Confocal microscopy.
Image analysis using FIJI/ImageJ and IMARIS.
Basic statistical analysis and data visualization.

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