Neuropsychiatric cognitive symptoms by defective synaptic plasticity in recurrent neural networks performing complex working memory tasks.

Principal Investigator
Albert Compte

Keywords
Working memory, computational neuroscience, simulations, computational psychiatry, prefrontal cortex.

Our research

We study cognition in neuropsychiatric patients based on behavioural testing, computational modeling, EEG and fMRI. These tests on humans are combined with the analysis of electrophysiological data recorded in the cerebral cortex of animals while they perform working memory tasks. The ultimate objective is to formulate computational models that link neural activity with the human cognitive function and provide a mechanistic framework with predictive power to understand brain diseases. A recent example of our approach was published in Nature Neuroscience and Nature Communications in 2020.

What we are looking for

We are looking for a motivated and dedicated PhD student with strong interest in cognitive computational neuroscience, a strong background in math, physics or computer science (or equivalent) and good programming skills (Python). The successful candidate will investigate the role of synaptic potentiation in neural circuits supporting complex working memory tasks, and their dysfunction, using computational modeling and mathematical analysis of neurophysiological data in behaving animals. S/he will be embedded in the Brain Circuits and Behavior lab at IDIBAPS, with long-standing expertise in the investigation of brain circuits underlying cognition.

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Lipid droplets as innate immunity hubs.

Principal Investigator
Albert Pol

Keywords
Lipid droplets, innate immunity, bacteria, fatty acids, defensive proteins.

Our research

To date, approximately 1400 species of human pathogens have been identified. These pathogens cause 16 million deaths each year and this situation is predicted to worsen in the future. It is therefore imperative that countermeasures to face this global threat are identified and implemented as soon as possible. A distinctive premise of our research is that countermeasures could be learnt from the sophisticated defence mechanisms that eukaryotes have developed over millions of years to cope with the pervasive presence of microbes. As major lipid storage organelles of eukaryotes, lipid droplets (LDs) are an attractive source of nutrients for invaders. Pathogens induce and physically interact with LDs, and the current view is that they 'hijack' LDs to draw on substrates for host colonisation. We recently challenged this dogma by demonstrating that LDs are endowed with a regulated protein-mediated antibiotic activity. Our work introduced the new concept that dependence on host nutrients is a generic 'Achilles' heel' of intracellular pathogens and LDs a chokepoint harnessed by innate immunity to organise a front-line defence. The Lipid Droplet-Innate Immunity Group is an ERC-funded international and multidisciplinary consortium that combine complementary knowledge and transdisciplinary expertise to investigate the hypothesis that LDs are innate immunity hubs sensing infection and directly confronting invaders. Using state-of-the-art technology, we will characterise how LDs efficiently coordinate and precisely execute a plethora of immune responses. Characterisation of these novel innate immune systems will be paradigm-shifting in immunology, physiology and cell biology. In the age of antimicrobial resistance and viral pandemics, unravelling how eukaryotic LDs fight and defeat dangerous microorganisms will inspire new anti-infective therapies.

What we are looking for

Candidates must have a degree in Biology, Medicine, or similar. Profiles with experience in Immunology, Cell Biology, or Bioinformatics will be especially considered. Previous experience in the design and development of research projects will be valued positively. Experience in the following areas/techniques will be positively valued: Microbiology and innate immunity mechanisms; Immunology, purification, handling and study of blood cells including macrophages; Bioinformatic analysis and big data management of RNA seq and high throughput screening; Experience in experimentation with animals including organelle purification; Cell Biology techniques including cell culture, electrophoresis, DNA transfection, RNA interference, RT-PCR, kinase assays, immunoprecipitation and western-blot; Molecular Biology, design and production of plasmids and DNA vectors, CRISPR screening; Flow cytometry, cell viability and proliferation, detection of lipid content, oxidative stress, and cell separation; Microscopy, Immunofluorescence techniques, immunocytochemistry, and confocal microscopy; Lipid analysis, affinity chromatography, and HPLC.

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Inflammatory bowel disease.

Principal Investigator
Azucena Salas

Our research

The Inflammatory Bowel Disease group, led by Dr. Azucena Salas, is at the forefront of investigating Crohn's disease and ulcerative colitis. We study the molecular and cellular mechanisms of intestinal inflammation, exploring the roles of immune, epithelial, and stromal cells. Our research is highly translational, aiming to uncover why certain patients do not respond to treatment and identifying predictive markers for treatment outcomes. We employ cutting-edge techniques such as single-cell RNA sequencing (scRNAseq) and Spatial Transcriptomics to advance our understanding in this field.

What we are looking for

We are looking for a highly motivated and creative individual with a Master's degree in biomedicine, translational medicine, bioinformatics, immunology or related fields. She or He should have an intermediate to proficient level of English and be able to communicate and discuss ideas and results with others. The candidate should be able to work both in group and independently depending on the specific tasks and projects. Previous knowledge on immunology, cell biology and data analysis will be valued. No specific accreditations are required.

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Autobiographical memory.

Principal Investigator
Mariana Babo-Rebelo

Keywords
Memory, body, electrophysiology, consciousness.

Our research

Episodic autobiographical memory refers to memories of events from one's life that constitute one's personal history. Life episodes are experienced from within the body, so bodily signals may contribute to memory encoding and retrieval. In this project, we will investigate how the body contributes to the ability to relive memories. We will develop experiments in virtual reality to create new lab-based, controlled memories, and test bodily reactivations during recall. We will use electrophysiological techniques (EEG) and TMS to probe the causal role of bodily signals in memory recall.

What we are looking for

Our ideal candidate should have a background in cognitive neuroscience, psychology, biology, medicine or other relevant fields. He/she should have research experience (preferentially with human electrophysiology or TMS), and the strong motivation to carry out research that involves developing new ideas in psychology and rigorous methods for data analyses. Programming skills (Matlab, Python, R) are a strong plus. Organisation, adaptation and rigor are essential skills. English is required, Spanish is a plus.

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Microenvironment in lymphoma.

Principal Investigator
Patricia Pérez Galán

Keywords
Non-Hodgkin lymphoma, microenvironment immunotherapy, cell therapy, patient-derived models.

Our research

The group studies lymphoma microenvironment (LME) using both transcriptomic (bulk / scRNA seq, spatial transcriptomics) and proteomic approaches (secretome, confocal immunofluorescence) in samples from lymphoma patients diagnosed at Hospital Clínic of Barcelona (HCB), to identify prognosis biomarkers and novel potential therapeutic targets. For this purpose, we have generated patient derived lymphoma 3D models including tumor cells and LME, using different methods (spheroids, tumoroids, lymphoma-on chip). These systems constitute robust lymphoma models to test novel immunotherapies (ie BiTE) and cell therapies (ie CAR-T) developed in house or obtained through agreements with pharmaceutical companies.

What we are looking for

The ideal candidate should be a highly motivated, research-driven, enthusiastic, and efficient researcher, with creativity, initiative, endurance, good communication skills (Spanish and English) and a proactive approach to solving problems and developing new ideas. The candidate should be able to work independently as well as part of a team, as most group projects have common grounds. Previous experience in cancer research, 3D culture and primary cell culture, generation of cell therapy along with flow cytometry and bioinformatics will be a value. Title of animal experimentation will be needed.
Join our team to contribute to cutting-edge research in immunometabolism and cancer immunology and gain valuable experience in a highly dynamic scientific environment.

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Uncovering the contribution of ABI3 to Alzheimer's disease and human microglia using novel humanized models.

Principal Investigator
Anna Martinez-Muriana

Keywords
Microglia, neurodegeneration, alzheimer's disease, humanized models, iPSCs.

Our research

Our research will apply functional genomics to unravel how genetic risk factors for Alzheimer's disease (AD) shape microglial function and drive neurodegeneration. By combining advanced humanized microglia models (Fattorelli and Martinez-Muriana, Nat. Prot. 2021; Mancuso, Fattorelli and Martinez-Muriana, Nat. Neurosci. 2024) with genome editing, iPSCs, transcriptomics, and disease-relevant assays, we aim to dissect causal pathways linking risk alleles to altered microglial responses. This pioneering approach will provide critical insights into the role of human microglia in neurodegeneration, paving the way for targeted therapeutic strategies to mitigate AD progression.

What we are looking for

We are seeking an enthusiastic candidate with a master or equivalent degree in neuroscience, bioinformatics, or a related area of life sciences with a strong academic record. Hands-on experience in molecular biology (e.g., gene editing, cloning) and expertise in transcriptomics analysis using R or Python are highly desirable. Holding an animal handling license is considered an asset. The ideal applicant is curious, well-organized, an excellent communicator in written and spoken English, and thrives in a collaborative team environment.

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Neural mechanisms of decision making and working memory.

Principal Investigator
Jaime de la Rocha

Keywords
Mouse behaviour, neural circuits, optogenetics, electrophysiology, computational modelling, working memory.

Our research

In the Brain Circuits and Behavior Lab we use a combination of experimental and computational methods including finely controlled behavioral tasks in both rodents and humans and use mathematical models to characterize behavior and to interpret manipulation experiments (i.e. optogenetics) and neural recordings obtained electrophysiological recordings in animals. We are currently developing a 24/7 animals training platform (the Training Village) to train mice in new working memory behavioral paradigms that allow us to characterize the neural representations of prospective and retrospective working memory in mice. We will use new Calcium and light-gated labeling methods to manipulate functionally defined neural engrams during these working memory tasks.
Our laboratory is also an active node of the Barcelona Computational Cognitive and Systems Neuroscience (BARCCSYN) community, which integrates around twenty laboratories scattered across multiple local institutions.

What we are looking for

We look for international students interested in deciphering the brain circuit mechanisms of some fundamental cognitive abilities such as perceptual decision making or working memory. Students should be motivated to learn and use modern labeling methods to manipulate functionally defined neural engrams in mice during decision making tasks. The experimental work will be strongly motivated and ideally combined by mathematical neural network models. The work will be fundamentally interdisciplinary as it will involve combining both animal experiments and computational modeling/analysis. The candidate should have some experience in quantitative data analysis using Python or R (or be very eager to learn). Experience performing behavioral experiments, optogenetics or electrophysiology in rodents will also be a plus. Having a certificate to work with laboratory animals will also be highly valued.

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Molecular pathology of lymphoid neoplasms.

Principal Investigator
Elías Campo

Our research

The Molecular Pathology of Lymphoid Neoplasms Group, led by Elías Campo, is a strong interdisciplinary research team focused on the study of lymphoid neoplasms. The group is interested in understanding the genetic, epigenetic, and molecular mechanisms underlying the biological diversity of these tumors and how they may influence the different clinical evolution of the patients. The group has contributed significantly to the knowledge of these tumor entities and it is an international reference for these diseases.

What we are looking for

The Group is looking for a highly motivated predoctoral researcher with wide experience in molecular and cell biology and genomic data analysis. The selected candidate will work on a project aimed at decoding the biological heterogeneity of lymphoid neoplasms, particularly mantle cell lymphoma (MCL), through an unprecedented integrative multilayer analysis of tumor cells and their microenvironment in samples from fully annotated cohorts of patients. It will perform whole genome/transcriptome, single cell and spatial transcriptomics analysis of tumor samples and functional studies using primary tumor samples from patients and cell lines.

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