Center for Neuroscience

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School of Pharmacy
School of Biosciences and Veterinary Medicine
School of Science and Technology

CNS
CENTER for NEUROSCIENCE
University of Camerino

Rapporto strutturati/non strutturati: 4 PO, 9 PA, 4 RTD-B/ 1 RTD-A, 8 PostDoc, 1 CoCoCo, 25 PhD

Research Day UNICAM
Camerino 12 dicembre 2024

BRAIN AND SLEEP RESEARCH LABORATORY

Michele Bellesi, Luisa de Vivo

Characterizing studies
- Biological mechanisms regulating sleep functions
- The cellular effects of sleep loss and enhancement

National and International Impact
The Brain and Sleep Research Laboratory (BSRLab), led by Professor Michele Bellesi and Professor Luisa de Vivo at the University of Camerino, has a significant impact on both national and international levels. By combining expertise in neuroscience, computer science, and engineering, the lab focuses on understanding the mechanisms regulating sleep and its implications for health and disease. The lab's work is recognized globally through collaborations and publications in prestigious journals, contributing to the understanding of sleep's role in brain plasticity, mental health, and neurodegenerative diseases. Supported by important organizations such as Harvard-Armenise Foundation, the Wellcome Trust, Bial Foundation, and Alzheimer's Research UK, the lab's work bridges basic science and applied solutions, shaping therapeutic approaches to sleep-related health challenges.

Relations with SME
BSRLab has contributed to a research project in collaboration with Philips Research and Respironics aimed at developing an innovative technology for brain stimulation to improve sleep quality. This collaboration has led to eight patents and the manufacturing of a commercialized product.
Morevover, BSRLab is leading a research project developing a complex wheel for rodents to test motor deficits in collaboration with Ugo Basile, a world leading manufacturer of instruments for Behavioral Research.

Sources of fundings
Giovanni Armenise Harvard Foundation career development award, Wellcome Trust, PRIN, Alzheimer's research UK, BIAL foundation, Above & Beyond Charity, Fondazione Carima

International Collaborations
University of Oxford, UK; University of Bristol, UK; Institute of Neuroscience - Alicante, Spain; Cardiff University, UK

Roles in scientific societies/Networks/Research centers
The BSRLab is part of an international network aimed at creating an open repository of sleep and dreams data (DREAM: A Dream EEG and Mentation database. PsyArXiv, 16 May 2023).
The BSRLab is recognized by the European Sleep Research Society as a leading laboratory in basic sleep research.

NEUROPSYCHOPHARMACOLOGY

Roberto Ciccocioppo, Carlo Polidori, Pierluigi Pompei, Massimo Ubaldi, Laura Soverchia, Nazzareno Cannella, Esi Domi

Characterizing studies
- Pharmacotherapeutic candidates for the treatment of addiction-related disorders
- Neurobiological mechanisms linked to human psychopathologies associated with stress
- Neurobiological mechanisms associated with chronic pain

National and International Impact
The Neuropsychopharmacology research group of the University of Camerino investigates the neurobiological mechanisms involved in addiction to discover potential pharmacotherapeutic candidates for its treatment. The research is based on preclinical models that aim to reproduce the human condition and which allow to analyse many of the behaviors associated with addiction, such as motivation, withdrawal syndrome and relapse. They also allow for the study of behaviors that often show co-morbidity with addiction, such as heightened sensitivity to stress, anxiety, and depressive symptoms. To elucidate the neurobiological mechanisms underlying genetic vulnerability, the study of behavior is supported by other approaches that allow to uncover the neurobiology of the disorders. Altogether, these strategies have made it possible to study the role of numerous neurotransmitters involved in the phenomenon of abuse, the discovery of new therapeutic targets. To date, preclinical data generated in our laboratories contributed to the initiation of of 4 clinical programs that are ongoing in collaboration with pharmaceutical industries.

Relations with SME
The Neuropsychopharmacology group collaborate with different SMEs including Mitsubishi Pharmaceuticals, CT Sanremo, Omeros Corp., TRIS Pharma, Molteni, AM Microelectronics.

Sources of fundings
NIAAA-NIH, NIDA-NIH, PRIN, Partenariato Esteso Mnesys, Eva-Maria and Rutger Hetzler Foundation, ERAB.

International Collaborations
University of Linkoping (Svezia), University of California San Diego (USA), Queen's University Belfast (UK), Medical University of South Carolina (USA), The Scripps Research Institute (USA), Brown University (USA), Sanford Burnham Prebys (USA).

Roles in scientific societies/Networks/Research centers
Società Italiana di Farmacologia, Società Italiana di Neuroscienze; Society for Neuroscience, Mediterranean Neuroscience Society

GUT BRAIN AXIS IN AGING AND NEURODEGENERATIVE DISORDERS

Anna Maria Eleuteri, Mauro Angeletti, Valentina Cecarini, Laura Bonfili, Massimiliano Cuccioloni

Characterizing studies
- Gut-brain axis in aging and neurodegenerative disorder
- Role of microglia in Alzheimer's disease

National and international Impact:
Dementia is a global public health priority. In Italy, an increase in all age-related chronic diseases, including dementia has been observed, with Alzheimer disease being the most frequent. The research contributes to identify alternative strategies, including probiotic supplementation and the design of tailored functional food, to counteract age-related cognitive decline and the onset of neurodegenerative disorders exploiting the gut brain axis modulation. Another project is focused on the dysregulation of proteolytic mechanisms in Alzheimer's disease hippocampal astrocytes in order to identify promising druggable therapeutic target in Alzheimer's disease, specifically for the normalization of cellular protein homeostasis. Managing the substantial increase in the prevalence of patients with dementia and reducing disease burden are among the main priorities of the European Commission research programs (see Horizon Europe Program, cluster 1, point 3). This research supports the hypothesis of multitarget preventative and therapeutic approach based on gut microbiota metabolites, prebiotics and probiotics inducing beneficial effects able to delay the gut mediated neuroinflammation and cognitive disorders for a good health and high-quality accessible healthcare in our rapidly changing society.

Relations with SME
Mendes S.A (Lugano, Switzerland); Ormendes SA

Sources of Fundings
Ministerial (PRIN, NextGenerationEU-program; Private donations

International Collaborations
University of California San Diego - School of Medicine; Louisiana State University - Pennington Biomedical Research Center; TEXAS A&M University - Department of Small Animal Clinical Sciences,

Roles in scientific societies/Networks/Research centers
- Member of the International Natural products Sciences Taskforce (INPST)
- Member of SiBioC (Italian Society of Clinical Biochemistry and Clinical Molecular Biology)
- Member of the European Federation of Clinical Chemistry and Laboratory Medicine (EFLM)

NEUROPSYCHIATRIC GENOMICS

Valerio Napolioni

Characterizing studies
- Exploring the dark genome of neurodegenerative disorders
- Cross-disease and multi-modal omics approach to neurodegenerative diseases

National and International Impact
The Genomic and Molecular Epidemiology (GAME) lab, led by Prof. Valerio Napolioni, is at the forefront of neuropsychiatric genomics, unraveling the genetic foundations of disorders such as Alzheimer's, autism, and Parkinson's. By leveraging large-scale genomic datasets (>100,000 genomes) and exploring key sources of missing heritability—including the X chromosome, dark genome components (STRs, VNTRs, SVs), and multi-omics approaches—the lab is driving significant advancements in precision medicine.
The lab's work is distinguished by its collaborative publications in top-tier journals, including *JAMA*, *Nature Medicine*, *Nature Genetics*, *Nature Aging*, *Nature Communications*, and *JAMA Neurology*.

Relations with SME
The GAME lab's research activities are bolstered by active collaborations with national private companies, including the Genome Research Center for Health (CRGS) in Salerno, Clinica Montevergine (Gruppo GVM S.p.A) in Avellino, and Polo Genomics, Genetics & Biology (GGB) in Siena. These partnerships aim to facilitate the integration of genomic data into clinical practice and enhance disease prediction.

Sources of Fundings
PRIN, private companies' contractor.

International Collaborations
Stanford University, USA
Yale University, USA
Albert Einstein College of Medicine, USA
Peking University, China

Roles in scientific societies/Networks/Research centers
The GAME lab is an active member of the European Alzheimer Disease DNA Biobank (EADB), contributing to subject recruitment, DNA sampling, and sequencing efforts.

BRAIN AND COMPLEXITY

Emanuela Merelli

Characterizing studies
- Data analysis beyond complex networks
- Deciphering neural languages and coding artificial models

National and International Impact
The Bioshape and Data Science research group at the University of Camerino embodies a multidisciplinary network of diverse expertise formed through participation in national projects (e.g., IT-FIRB, PRIN) and international initiatives (e.g., EU-FET). The group adopts a fully interdisciplinary approach with the unique objective of deciphering the language underlying various biological processes, ranging from the molecular to the cellular level. The research addresses challenges in mining data collections to develop a novel concept of data space designed to associate human behaviours—whether healthy or pathological. The group investigates complex networks and explores phenomena beyond their traditional boundaries through data analysis, machine learning, agent-based modelling, and simulation. Recent findings have uncovered the presence of semantic contexts in dreams that deviate significantly from everyday experiences. These alterations are hypothesised to result from changes in neurobiological mechanisms, particularly in the context of therapeutic interventions. The Lab's motto is "It is facts that characterize the world, not things".

Relations with SME
The Bioshape and Data Science group collaborates with several SMEs, including Diatech Pharmacogenetics.

Sources of fundings
EU, FIRB, PRIN, Diatech Pharmacogenetics

International Collaborations
BCAM and Center of Neuroscience in Bilbao, Centre de Physique Théorique, Aix-Marseille University

Roles in scientific societies/Networks/Research centers
Member of the Italian Society of Bioinformatics
Board member of the European Association of Theoretical Computer Science
Member of the Italian Society of Artificial Intelligence
Member of the National Group of Scientific Computing of the National Institute for High Mathematics

DEEP LEARNING FOR NEUROSCIENCE

Andrea Della Valle, Sebastiano Pilati, Andrea Perali

Characterizing studies
- Deep Learning the behaviour of rodents
- Machine-learning analysis of spectra of volatile organic compounds

National and International Impact
Deep-learning techniques are emerging worldwide as powerful numerical tools to analyse complex data. They promise to allow scientists to accelerate and/or deepen the extraction of useful information. Physicists of the Complex Quantum Matter group (https://cqm.unicam.it) are collaborating with neuroscientists of the CNS to expand the utilization of deep-learning techniques in different sectors of neurosciences, such as, e.g., the assessment of antidepressant efficacy based on automatic rodent-behaviour recognition.

Relations with SME
The Complex Quantum Matter group has engaged in various fruitful collaborations with private companies, focusing on the usage of advanced machine-learning methods borrowed from physics research. Examples include the B-Green project (automatic texture recognition, with Benetton), the collaboration with 6Tour S.r.l. (ML for booking engines), and MadeLab (analysis of e-commerce data).

Sources of fundings
PRIN, NQSTI, Centro Nazionale per HPC, Big Data e Quantum Computing (NEXTGENERATIONEU)

International Collaborations
University of Antwerp (Belgium)
University of Zurich (Switzerland)
University of Barcelona (Spain)

Roles in scientific societies/Networks/Research centers
Multisuper Network
National Quantum Science and Technology Institute