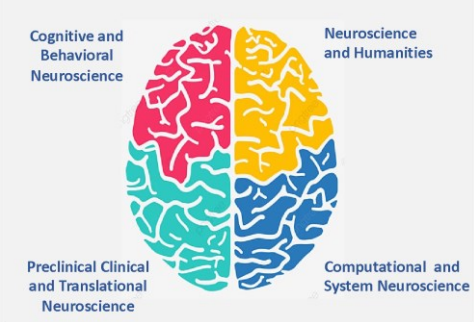
Theoretical and Applied Neuroscience

Research PhD Program



Cycle 40°

Academic year 2024-2025

List of the Research Topics

Curriculum	Research Project	Host Institution	Number of fellowships
Curriculum 1: Cognitive and Behavioral Neuroscience			
1.1	Digital solutions to promoting quality of life in chronic pain.	University of Turin/IRCCS Istituto Auxologico Italiano	1
1.2	Ideation, implementation, and validation of innovative protocols for the assessment and rehabilitation of motor and cognitive deficits in neurological patients	University of Turin	1
1.3	Advanced methods for characterizing functional correlates in cognitive and affective neuroscience	IMT School for Advanced Studies Lucca	1
1.4	Interdisciplinary study of neurophysiological correlates of cognitive and motor functions for the development of remote innovative telehealth systems.	University of Brescia	1
Curriculum 2: Neuroscience and Humanities			
2.1	Influence of gastro-intestinal system activity on complex cognitive-emotional functions	Sapienza University of Rome	1
2.2	Digital twins, artificial virtual agents (avatar) and psychophysio-neuroscience studies for improving social life in complex contexts	Sapienza University of Rome	No fellowship
2.3	Are negative biases and threat sensitivity linked with political extremism? A Psychophysiological Study.	University of Messina	1
Curriculum 3: Preclinical, Clinical and Translational Neuroscience			
3.1	To study the role of the ghrelin system in the regulation of natural reward	University of Camerino	1
3.2	The role of the orexin neuropeptide system in the disease manifestation of multiple sclerosis: exploring the therapeutic potential of pharmacological interventions in animal models	University of Camerino	1
3.3	Mapping the interplay between adolescent sleep loss and alcohol use at the molecular, circuit, and behavioral level	University of Camerino	1
3.4	Studying the effects of Virtual Reality training for the rehabilitation of social skills in neurodevelopmental disorders	Scientific Institute, IRCCS MEDEA	1

3.5	Role of stress by sex by gene interaction in the psychopathology of substance use disorder.	University of Camerino	2* * 1 reserved to the specific agreements with Chinese Universities
3.6	Integrated approach for the study of migraine and related therapies	University of Modena and Reggio Emilia	1
3.7	Investigating sleep-like dynamics and cortical connectivity in focal brain injury through invasive and non-invasive recordings in humans	University of Milan	2 ERC Grant GA 101071900 "NEurological MEchanismS of Injury, and Sleep-like cellular dynamics (NEMESIS)
3.8	The gut-liver-lung-brain axis: in vitro, ex vivo and in vivo models.	University of Palermo	1
3.9	Psycho-biological and psychometric correlates of the effects of meditative practices	University of Pisa	1
3.10	To study the neuronal basis of sporadic neurobiological, behavioral and pharmacological basis of drug addiction and related psychopathologies.	University of Camerino	2* * 1 reserved to the specific agreements with Chinese Universities
3.11	Central fatigue in mulptile sclerosis: from biomarkers to neuromodulation	University of Siena	1
3.12	Role of cannabinoids and related mechanisms in degenerative diseases of the neuromuscular system	Institute of Biomolecular Chemistry (ICB) of the CNR; University of Naples Federico II/	1
3.13	To study the molecular basis of the transition from alcohol use to abuse and addiction in rodents: Focus on social variables affecting individual vulnerability to disease development.	University of Teramo	1
3.14	Effect of gamma-hydroxybutyric acid (GHB) on the co-administration of alcohol and cocaine in rats genetically selected for alcohol preference.	University of Camerino	1
3.15	To study the neurobiological, behavioral and pharmacological basis of drug addiction and chronic pain: Focus on the opioid system	University of Camerino	1
3.16	To evaluate the neurobiological mechanisms regulating NaCl and water intake in rodent models.	University of Camerino	2
Curriculum 4: Computational and System Neuroscience			
4.1	Advanced Machine Learning methods to map brain-movement non-linear relationships	University of Ferrara	1
4.2	Functional modeling of brain dynamics: understanding reinforcement learning through the lens of dynamical systems.	Sant'Anna School of Advanced Studies	1

4.3	Development of Medical devices for e-Health and Innovative diagnostics for precision medicine	University of Camerino	1
4.4	Cross-disease and multi-modal omics approach to neurodegenerative diseases	University of Camerino	1
4.5	Computational Modeling of Reinforcement, Motivation, and Drug-Seeking Behavior in Rodents	University of Camerino	1

Note: *In compliance with Ministry Decrees, DM n.226, DM n.630, DM n.629, and the regulations of the School of Advanced Studies of the University of Camerino, PhD fellowship recipients have the obligation to spend 6 months of secondment periods in research laboratories abroad. No more than 12 months are allowed. For projects supported by fellowship PNRR, DM630, recipients have the obligation to spend 6 months of secondment periods in the partner enterprise or institution.*

Curriculum 1: Cognitive and Behavioral Neuroscience

Code 1.1

Scholarship funded under: NGEU – PNRR, DM 630/2024, M4 C2 I3.3 CUP J11J24001950006
With the contribution of IRCCS Istituto Auxologico Italiano (Milan) – VAT N° / registration n 02703120150

Project title: Digital solutions to promoting quality of life in chronic pain.

ERC Field: SH4_5 Social and clinical psychology; SH4_4 Cognitive and experimental psychology: perception, action, and higher cognitive processes

Key words: chronic pain; digital solution; body; clinical psychology; quality of life.

Host Institution: University of Turin/IRCCS Istituto Auxologico Italiano

Reference person/supervisor: Federica Scarpina **Federica.scarpina@unito.it**

Research topic description. Migraine, chronic pelvic pain, endometriosis, irritable bowel syndrome, vulvodynia, and fibromyalgia are just some examples of female chronic pain. Its knowledge of the etiopathological mechanisms, diagnosis and treatment is still poor. Pain is a complex individual experience in which psychological components (i.e., temperament, body perception, interoception, depressive and anxiety symptoms) seem to play a crucial role, especially in the efficacy of intervention for improving well-being and quality of life. This project aims to verify the role of some psychological traits in shaping the experience of pain, especially in terms of bodily sensations and perceptions, in chronic pain and to assess the applicability of digital solutions in promoting intervention for improving quality of life.

Research team and environment. This research project will be conducted in "Rita Levi Montalcini" Department of Neurosciences, University of Turin. The laboratory headed by Dr.ssa Federica Scarpina is conceived as a young multidisciplinary environment where neuropsychological and clinical approaches are integrated to investigate chronic diseases characterized by severe side effects of individual experience, with emphasis on bodily perception. Over the years, the research team explored different chronic diseases, including eating disorders, obesity, and fibromyalgia. Moreover, the role of psychological traits on the short-term efficacy of multidisciplinary treatments for quality of life and well-being was also assessed. Most of the research activities are done at the IRCCS Istituto Auxologico Italiano, Ospedale San Giuseppe (Piancavallo, VCO): it is an Italian Scientific Institute for Research, Hospitalization and Health Care, which is a well-recognized experience in biomedical research, medical assistance, treatment and training thanks to the availability of cutting-edge technologies and instrumentation and highly professional medical teams. Moreover, Istituto Auxologico Italiano has long been committed to increasing the offer of rehabilitation activities - specifically those aimed at well-being - based on telemedicine and digital solutions.

Preferred Research Skills and Competences. The doctoral candidate will receive training in the techniques most commonly used in clinical psychology, including assessment of cognitive (i.e., emotional perception; bodily input) and psychological (i.e., temperament, level of empathy) components functioning and data analysis. The doctoral candidate will experience psychological treatments for quality of life in individuals suffering from chronic diseases, including pain, through the use of digital solutions. Candidates with training backgrounds in clinical psychology and previous experience in clinical settings are preferentially considered for this position.

Special requirements, additional to "standard" ones:
The Phd Student must collaborate in the reporting activities as scheduled in the Funding Program and meet any further requirements set by the MUR in the framework of the PNRR (Italian National Plan for Recovery and Resilience) – NGEU, and in particular under the Ministerial Decree n. 630/2024:

- Semestral reports through the MUR dedicated online portal
- Respect of the DNSH principle and horizontal principles of the Program
- Respect of deadlines and guidelines set by the MUR

Curriculum 1: Cognitive and Behavioral Neuroscience

Code 1.2

Scholarship funded under: NGEU – PNRR, DM 630/2024, M4 C2 I3.3 CUP J11J24001950006
With the contribution of Cooperativa Sociale Puzzle (Turin) – VAT N° / registration n 07555280010

Project title: Ideation, Implementation, and Validation of Innovative Protocols for the Assessment and Rehabilitation of Motor and Cognitive Deficits in Neurological Patients

ERC Field: SH4_04 Neuropsychology, SH4_05 Attention, perception, action, consciousness, SH4_01 Cognitive basis of human development and education, developmental disorders; comparative cognition, SH4_6 Learning, memory; cognition in ageing, LS5_4 Sensation and perception (e.g. sensory systems, sensory processing, pain), LS5_5 Neural bases of cognitive processes (e.g. memory, learning, attention), LS5_6 Neural bases of behaviour (e.g. sleep, consciousness, addiction), LS5_9 Neurotrauma and neurovascular conditions (including injury, blood-brain barrier, stroke, neurorehabilitation)

Key words: Neuropsychological assessment, Neuropsychological rehabilitation, Brain-damaged patients, Neurological patients, Psychophysiological and Neuroimaging Techniques, Neurodevelopmental disorders, Cognitive neuroscience, Clinical and experimental neuroscience.

Host Institution: University of Turin

Reference person/supervisor: Francesca Garbarini **francesca.garbarini@unito.it**

Research topic description

The primary objective of this proposal is to develop and validate cutting-edge protocols based on innovative technologies for the assessment and rehabilitation of motor and cognitive deficits in neurological patients, with a particular focus on brain-damaged patients occurring both in adulthood and childhood. The multidisciplinary approach will be fundamental to integrating knowledge in the areas of KET (Key Enabling Technologies), primarily focusing on life-science technologies.

The PhD project involves the development of advanced tools and methodologies for the assessment of motor and cognitive deficits in neurological patients. These tools include advanced brain imaging technologies (fNIRS), movement tracking systems (eye-tracking and kinematics), equipment for psychophysiological recordings (EEG, EMG, skin conductance, and heart rate), and tools for cognitive assessment. The aim is to create personalized protocols that take into account the specific needs of each patient, facilitating early and accurate diagnosis and enabling longitudinal assessment of progress during rehabilitation.

The next phase of the project will be dedicated to the implementation of rehabilitation interventions based on personalized protocols. These interventions will include the use of cutting-edge technologies such as virtual reality, assisted robotics, and non-invasive brain stimulation, integrated with traditional approaches of physical therapy, neuropsychology, and speech therapy. The objective is to maximize the functional recovery of patients, improving their quality of life to support social integration and return to work.

Finally, the project includes the validation of the developed protocols and interventions through controlled clinical studies and collaborations with research centers and clinics specializing in the treatment of acquired brain injuries. Validation will be based on clinical, functional, psychophysiological, and quality of life criteria for patients (both adults and children), to demonstrate the efficacy and effectiveness of the proposed protocols.

The Cooperativa Sociale Puzzle, with its decade-long experience in the treatment of acquired brain injuries, and thanks to the long-lasting research collaboration with the Department of Psychology of the University of Turin, has identified the need for innovative and personalized approaches for the assessment and rehabilitation of neurological patients. This project proposal will provide companies with the technological knowledge to enable the development of innovative solutions in the field of health and neurological rehabilitation.

The technologies and protocols developed within this project will have strong potential for technology transfer to companies, particularly those interested in the health sector. Companies will directly benefit from the research results for the development of new products and services for neurological diagnosis and rehabilitation, thereby improving their market competitiveness. Additionally, the doctoral candidate involved in this project will have the opportunity to acquire high-profile skills in the areas of KET, such as cognitive and clinical neurosciences, experimental and applied neuropsychology, and psychophysiology. These skills, crucial in both the academic and business sectors, will offer the doctoral candidate extensive career opportunities after the PhD.

Research team and environment
The research project will be carried out both at the Department of Psychology (University of Turin), under the supervision of Prof. Francesca Garbarini, and at the Cooperativa Sociale Puzzle (Turin), under the supervision of prof. Marina Zettin. On the one hand, the MANIBUS Lab (i.e., Francesca Garbarini's research laboratory) is conceived as a multidisciplinary environment that focuses both on basic and applied research, employing psychophysiological techniques to measure the relationship between brain and behaviour in both normal and pathological contexts. Furthermore, the MANIBUS Lab has access to a research environment that is ideally rich in facilities. In particular, the group has access to the new research infrastructure Human Science and Technologies (HST; director and coordinator: Prof. Francesca Garbarini; website: https://www.hst.unito.it/home-page), which holds innovative techniques (e.g., VR tools, high-density electroencephalography, high-density near-infrared spectroscopy, motion capture systems) as well as multidisciplinary expertise thanks to the variety of Departments of the University of Turin collaborating in the center (e.g., Informatics, Psychology, Neuroscience, Medical Science). On the other hand, the Cooperativa Sociale Puzzle is a renowned rehabilitative center for brain-damaged patients which has conducted extensive research in the past in the field of neuropsychological rehabilitation by adopting a multidisciplinary approach (e.g., combining innovative physical therapy, neuropsychology, and speech therapy). The long-lasting collaboration between these two units will allow the candidate to develop innovative products and services to enhance the diagnosis and treatment of neurologic patients by combining the expertise in psychophysiological techniques offered by the MANIBUS Lab and the clinical expertise offered by the Cooperativa Sociale Puzzle.

Preferred Research Skills and Competences
The doctoral candidate will receive training in the techniques most commonly used in basic neuroscience, including neuroimaging (fNIRS), psychophysiological (EEG, EMG, skin conductance, and heart rate) and movement tracking (eye-tracking and kinematics) techniques, as well as virtual reality or real-life cognitive assessment tools. Candidates with a background in neuropsychology and previous experience in EEG and/or fNIRS are strongly encouraged to apply. Data analysis and programming competencies will be appreciated.

Special requirements, additional to "standard" ones:
The Phd Student must collaborate in the reporting activities as scheduled in the Funding Program and meet any further requirements set by the MUR in the framework of the PNRR (Italian National Plan for Recovery and Resilience) – NGEU, and in particular under the Ministerial Decree n. 630/2024:
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- Respect of deadlines and guidelines set by the MUR

Curriculum 1: Cognitive and Behavioral Neuroscience

Code 1.3

Project title: Advanced methods for characterizing functional correlates in cognitive and affective neuroscience

ERC Field: SH4 The Human Mind and its complexity: cognition, psychology, linguistics, philosophy and education

Key words: neuroimaging, cognitive and affective neuroscience, mental representation, neural correlates of mental function

Host Institution: IMT School for Advanced Studies Lucca

Reference person/supervisor: Emiliano Ricciardi emiliano.ricciardi@imtlucca.it

Research topic description

Human neuroscience has made remarkable progresses in understanding the basic aspects of brain functional organization, primarily thanks to the advent of neuroimaging that provided scientists of various disciplines with an unprecedented opportunity to investigate the neurobiological bases of mental activities, in the healthy brain or in the presence of disease (such as developmental disorders).

This project aims to provide the theoretical and methodological necessary for the study of the brain and mind, the interpretation and representation of the external world and the cognition and of human behaviors. The PhD candidate will receive intensive training on experimental design, neuroimaging (structural and functional MRI) and neurophysiological (EEG and peripheral signals) techniques and their use in humans. Different experimental paths could be developed across these macro-themes:

● Brain development and sensory experience, the complexity of neural systems and their adaptations when deprived of their typical sensory input;

● Mental representation of the external world, semantic and conceptual processing;

● Social and affective processing in humans, empathy, theory of mind and emotions and how these are represented in the brain;

● Sensory disconnection during sleep, the relationship between slow waves and conscious experience during sleep, the behavioral and neural correlates of local sleep-like episodes during wakefulness;

● Methods for integrated analysis and modeling of biosignals, (f)MRI, M/EEG; peripheral signal recordings and development of automated algorithms with clinical diagnostic and prognostic value; application of computational models for the coding of visual, acoustic and linguistic stimuli and development of multivariate approaches to study brain correlates.

Research team and environment

The Host Institution of this project is the IMT School, one of the Advanced Schools in Italy, and one of the highest-rated graduate schools in Europe (U-Multirank). The IMT School provides rigorous training and close supervision in variety of disciplines in the social, human and natural sciences, welcoming multidisciplinary and interdisciplinary approaches at their boundaries.

This research project enters the research activities of MoMiLab (https://momilab.imtlucca.it/). The MoMiLab integrates basic neuroscience methods with experimental psychophysiology, cognitive neuroscience and structural/functional brain imaging. In the thematic context of the ERC SH4 'The Human Mind and Its Complexity', the research areas of the MoMiLab include integrated and multidisciplinary aspects that focus on the study of mental activities and cognitive functions.

The PhD candidate will have access to the Multidisciplinary Lab (equipped for EEG, psychophysics and psychophysiology measures) and the Neuroscience Lab (the conjoint research lab with Innovation Center Intesa Sanpaolo) at IMT School, to the thematic laboratory for research on sleep, wakefulness and their mutual interactions (equipped for polysomnographic measures at the Fondazione Toscana 'Gabriele Monasterio' in Pisa) and to external MRI facilities (scanner from 1.5T to 7T are available in Pisa and Massa).

PhD candidates could also be involved in collaborative research programs with national and international institutions.

Within the interdisciplinary orientation of the IMT School, candidates will be exposed to seminars and conjoint research projects on different topics, ranging from molecular neurobiology of behavior to advanced computational methods for the analysis of complex systems, from social neuroscience to complex networks.

Preferred Research Skills and Competences

Candidates with a solid background in psychology, neuroscience, cognitive science, medicine, bio-engineering, physics and mathematics, computer sciences, are strongly encouraged to apply. Because of the multidisciplinary nature of this research project, applications are anyhow welcome from any area of knowledge.

Candidates with (even basic) neuroimaging data analytics experience and statistical/computer programming skills will be preferred.

Curriculum 1: Cognitive and Behavioral Neuroscience

Code 1.4

Scholarship funded under: NGEU – PNRR, DM 630/2024, M4 C2 I3.3 CUP J11J24001950006
With the contribution of Tecnobody S.p.a. (Bergamo)– VAT N° / registration n. 02323900163

Project title: Interdisciplinary study of neurophysiological correlates of cognitive and motor functions for the development of remote innovative telehealth systems.

ERC Field: LS5_5 Neural networks and plasticity; LS5_7 Sensory systems, sensation and perception, including pain; LS5_8 Neural basis of behavior (e.g. sleep, consciousness, addiction); LS5_9 Neural basis of cognition (e.g. learning, memory, attention, emotions, speech); LS5_16 Systems and computational neuroscience (e.g. modelling, simulation, brain oscillations, connectomics); LS5_18 Innovative methods and tools for neuroscience; SH4_4 Neurocognitive psychology; SH4_5 Attention, perception, action, consciousness; SH4_6 Learning, memory; cognition in ageing.

Key words: Cognition; Executive functions; Motor control; Sensorimotor integration; Cognitive training; Motor and cognitive telerehabilitation

Host University/Research Institution: University of Brescia

Reference person/supervisor:
Prof. Debora Brignani / Dr. Luca Falciati **debora.brignani@unibs.it / luca.falciati@unibs.it**

Research topic description
Aging population, rising chronicity and morbidity of neurocognitive disorders and neurological diseases challenge cognitive and behavioral neuroscience to contribute to the efforts made in the last years for integrating innovative technologies into healthcare. Cognitive and motor fragility can be found in patients with brain injuries (traumatic or vascular) and in patients with neurodegenerative pathologies (i.e., Parkinson's disease, multiple sclerosis) but also, at a lower level of severity, in physiological aging. It is well-established that individual cognitive reserve (i.e., the individual adaptability that helps explaining the different susceptibility of cognitive and functional abilities to decline due to brain aging or clinical disease) impacts on longitudinal cognitive trajectories. Therefore, interventions aimed at promoting protection of cognitive reserve are crucial to cope the effects of aging and brain injury, in part also because can be enhanced throughout the lifespan. A critical aspect of classical cognitive and motor trainings is that intervention programs require intensive in-person sessions that are unlikely to be cost-effective or feasible for large-scale implementation. Telehealth, which employ information and communication technologies to provide remote assessment and training services by connecting health professionals with utilizers, represent a promising tool to address these challenges. Our research team aims to investigate innovative approaches based on objective neurophysiological and behavioral indexes of neuroplasticity for developing advanced devices for remote assessment, monitoring, and training of cognitive and motor functions. Well-established neurophysiological techniques and state-of-the-art systems for studying cognitive and motor abilities will be combined to fulfill two primary goals: i) to promote wellbeing and healthy aging by affording advanced tools for individualized home-based trainings against cognitive and motor decline; ii) to develop innovative patient-tailored care solutions for telerehabilitation.

Research team and environment
The research project will be carried out in the Neurophysiology Laboratories (headed by Prof. Debora Brignani and Dr. Luca Falciati), Department of Clinical and Experimental Sciences, University of Brescia, Italy and in the laboratories of TecnoBody Spa. The research aims to identify physiological biomarkers to develop innovative telehealth interventions in the cognitive-motor domain and telerehabilitation protocols for the recovery of psychophysical wellbeing. The Neurophysiology Laboratories are equipped with advanced systems for the acquisition of biosignals (e.g., EEG, eye tracking, EMG, pupillometry, motion capture, skin conductance, heart rate), as well as cutting-edge methods for cognitive, cerebral, and peripheral non-invasive stimulation (e.g., TMS, NMES, tES). To enhance the ecological validity of the research protocols developed in the Neurophysiology

Laboratories, virtual reality techniques (immersive and augmented) are also employed. These techniques enable to conduct experiments in highly realistic contexts, while physiological parameters and signals are simultaneously recorded. The Neurophysiology Laboratories are part of a broader project (IN2DEPT Innovative and Integrative Department Platforms) that has recently seen the recognition of the Department of Clinical and Experimental Sciences as a Department of Excellence by the Italian Ministry of University and Research. Specifically, the Neurophysiology Laboratories are part of the Applied Neuroscience Platform within IN2DEPT project, which aims to implement, within an interdisciplinary context, an innovative interface platform between basic research and clinical practice in the field of neuroscience. The Applied Neuroscience Platform seeks to integrate resources, methods, and theoretical models used in neuroscience to develop functional assessments and rehabilitation therapies based on advanced neuro-technologies, following a multimodal and personalized approach, with the goal of achieving a high degree of generalizability of the results. Within the Applied Neuroscience Platform, the activities of the Neurophysiology Laboratories are centered on two main tasks: 1) to determine physiological biomarkers suitable for (i) characterizing the clinical profile in terms of psychomotor functional deficits, (ii) monitoring the evolutionary trajectory of the treated clinical condition, and (iii) predicting the outcome of various therapeutic interventions; 2) to develop, validate, and test individually tailored rehabilitation systems and protocols (e.g., neuromotor rehabilitation, cognitive training, non-invasive brain stimulation, immersive/augmented virtual reality, potentially supported by functional electrical stimulation techniques, etc.) that will also be made available in telehealth modalities. The doctoral candidate will receive training in the techniques most commonly used in basic neuroscience, including brain activity recording, brain stimulation, behavioral testing and data analysis.

Preferred Research Skills and Competences

• A background in cognitive neuroscience-related field;
• Skills in administering behavioral protocols;
• Hands-on experience in acquisition of neurophysiological indexes (e.g., EEG, EMG, eye movements);
• Skills in programming experiments with standard experimental software (e.g. PsychoPy; Psychtoolbox; Presentation);
• Skills in one programming language (preferably MatLab) and analyses tools (e.g. R, Jamovi, SPSS);
• Skills for teamwork in a multidisciplinary research group;
• Good command of the English language (written and oral).

Special requirements, additional to "standard" ones:

The Phd Student must collaborate in the reporting activities as scheduled in the Funding Program and meet any further requirements set by the MUR in the framework of the PNRR (Italian National Plan for Recovery and Resilience) – NGEU, and in particular under the Ministerial Decree n. 630/2024:
- Semestral reports through the MUR dedicated online portal
- Respect of the DNSH principle and horizontal principles of the Program
- Respect of deadlines and guidelines set by the MUR

Curriculum 2: Neuroscience and Humanities

Code 2.1

Project title: Influence of gastro-intestinal system activity on complex cognitive-emotional functions

ERC Field(s): *SH4 The Human Mind and Its Complexity*: SH4_2 Personality and social cognition; emotion; SH4_3 Clinical and health psychology; SH4_4 Neurocognitive psychology; SH4_5 Attention, perception, action, consciousness; SH4_6 Learning, memory; cognition in ageing; SH4_7 Reasoning, decision-making; intelligence *LS5 Neuroscience and Disorders of the Nervous System:* LS5_8 Neural basis of behavior (e.g. sleep, consciousness, addiction); LS5_9 Neural basis of cognition (e.g. learning, memory, attention, emotions, speech); LS5_18 Innovative methods and tools for neuroscience;

Key words: Body-representation, Body-related disgust, Electrogastrography -EGG-, Emotions, Embodiment

Host University/Research Institution: Sapienza University of Rome

Reference persons/supervisors:
Giuseppina Porciello: giuseppina.porciello@uniroma1.it/
Salvatore M Aglioti; salvatoremaria.aglioti@uniroma1.it

Research topic description

This project aims to provide novel evidence on (a)typical correlates of body-related disgust in normoweight and overweight people. Disgust is classified as a universal emotion mainly developed evolutionarily for protecting from dangerous situations, substances or even individuals. Indeed, at the behavioural level, disgust is characterised by the tendency to avoid disgusting stimuli even with the gaze (i.e. gaze avoidance) and recent evidence shows that gastric activity plays a crucial role in the perception of disgust and contributes to increase/decrease the avoidance of the disgusting stimuli.

Maladaptive disgust may become a treatment-resistant emotion disabling normal functioning. Even if scarcely investigated, maladaptive disgust does play a crucial role in the onset and maintenance of several neuropsychiatric conditions, including eating disorders. We will take advantage of the induction of the embodiment illusion with different weight avatars and of the registration of gastric activity (i.e. electrogastrogram, EGG) combined with a series of self-reports to investigate psychophysiological correlates of body-related disgust. We think that this approach will provide novel insights into unveiling the etiopathogenesis of some clinical conditions such as anorexia nervosa, will inform basic research about the role of disgust in body perception, and will extend knowledge in social psychology about the maintenance of the weight bias.

Research team and environment

The research project will be conducted at the Department of Psychology, Sapienza University of Rome, specifically at the Social and Cognitive Neuroscience Laboratory (SCNLab). The project aims to characterize the psychophysiological correlates (cardiac and gastric) of different emotions (e.g. disgust) triggered by body stimuli. The SCNLab is equipped with advanced systems for biosignal acquisition (e.g., ECG, EGG, skin conductance, respiration), state-of-the-art methods for non-invasive cerebral and peripheral stimulation (e.g., TMS, tES, taVNS), as well as head-mounted displays and various devices and software for virtual reality. These techniques allow participants to embody realistic virtual bodies that can significantly differ from their own, while simultaneously recording physiological parameters and signals.

Furthermore, thanks to a joint project (CENIMINT) with the Santa Lucia Foundation Hospital in Rome, the lab also has access to an MRI scanner dedicated to research activities. The SCNLab is part of a larger initiative that recently recognized the Department of Psychology as a Department of Excellence by the Italian Ministry of University and Research. It is a highly stimulating environment, comprising individuals at various stages of their academic careers, including Bachelor's, Master's, and PhD students, Post-Docs, Tenure-Track Assistant Professors, Associate Professors, and Full Professors. The context is international, enriched by the presence of foreign PhD and Post-Doc researchers.

The doctoral candidate will receive training in the most commonly used techniques in basic psychophysiology and neuroscience, such as ECG and EGG. Additionally, they will be trained in statistical analysis and the writing of scientific papers.

Preferred Research Skills and Competences

A background in psychology/neuroscience-related fields; Skills in administering behavioral protocols; Hands-on experience in acquisition and analyze psysicophysiological indexes (e.g. ECG) and self-reports; Skills in programming experiments with standard experimental software (e.g. PsychoPy; Psychtoolbox; E-Prime); Skills in programming virtual reality scenarios and characters (e.g. Unity); Skills in analyses tools (e.g. R, Jamovi, JASP);•Skills for teamwork in a multidisciplinary research group; Good command of the English language (written and oral).

Curriculum 2: Neuroscience and Humanities

Code 2.2

Project title: Digital twins, artificial virtual agents (avatar) and psychophysio-neuroscience studies for improving social life in complex contexts

ERC Field(s): *SH4 The Human Mind and Its Complexity*: SH4_2 Personality and social cognition; emotion; SH4_3 Clinical and health psychology; SH4_4 Neurocognitive psychology; SH4_5 Attention, perception, action, consciousness; SH4_6 Learning, memory; cognition in ageing; SH4_7 Reasoning, decision-making; intelligence *LS5 Neuroscience and Disorders of the Nervous System:* LS5_8 Neural basis of behavior (e.g. sleep, consciousness, addiction); LS5_9 Neural basis of cognition (e.g. learning, memory, attention, emotions, speech); LS5_18 Innovative methods and tools for neuroscience;

Key words: Immersive Virtual Reality – Artificial virtual agents- Body ownership and agency – Organizational Neuroscience – Psycho-physio-Neuroleadership- Social context

Host University/Research Institution: Sapienza University of Rome

Reference person/supervisor: Salvatore M Aglioti; salvatoremaria.aglioti@uniroma1.it

Research topic description Thanks to the increasing immersive properties of Virtual Reality (IVR) devices, a significant amount of our real-time multisensory social interactions are shifting toward the metaverse, a computer generated environment in which people act and communicate via embodied avatars. Thus, IVR offers unique advantages for manipulating higher-order cognitive and emotional functions in relationship to social processes. In particular, studies indicate that embodying physical agents may imply feeling their body becomes our own body and we are responsible of the actions of the virtual agent. Moreover, embodying A a given agent in immersive virtual may imply that participants tend to act according to the physical and mental features attributed to the agent, the so-called "Proteus effect". The fellowship is offered for conducting Proteus-effect related research in which not only will be tested the effect of wearing artificial virtual agents representing others but also the effect of acting in the virtual world through one's own digital twin. Generating different forms of embodiment may be used in a variety of circumstance ranging from leadership in large-scale organization (e.g. resilience to work-related stress in companies; fostering female leadership) to social contexts where positive role models may foster virtue (e.g. promoting law-abiding behaviours). The above mentioned behavioural research in virtual reality will be complemented by psychophysiological (e.g. skin conductance, hear-beating variation, thermal reactivity) and brain (e.g. time- and time-frequency EEG components) signals with the aim of understanding the link between higher-order cognitive-emotional processes with individual bodily and brain reactivity. This approach has the potential to lead to a neuroscience inspired approach to the study of social processes.

Research team and environment. The research will be conducted under the supervision of Salvatore Maria Aglioti, who heads three different laboratories, namely: the CoSAN lab at Department of Psychology Sapienza University of Rome (https://agliotilab.org/), the Neuroscience and Society Research Line (the https://www.iit.it/research/lines/neuroscience-and-society) at the Life Nano- and Neuro-Science Center **(CLN²S)**, Italian Institute of Technology and the Santa Lucia Foundation, IRCCS, Rome. The supervisor has been working for the past 25 years on a vast range of topics at the intersection between social neuroscience and humanities using a variety of theoretical approaches and state-of-the-art systems neuroscience techniques. Somewhat unique to the research environment is the close interaction between different profiles of scholars ranging from psychologists and social neuroscientists to physicists, engineers, and experts in computational modeling.

Preferred Research Skills and Competences. While there are no specific limitations in terms of the degree needed for applying for the position may attract potential PhD students coming primarily from psychology and neuroscience. Crucially applicants from diverse domains belonging into the humanities (e.g., aesthetics, art history) are encouraged to apply. Degrees in STEM or in other quant areas are very welcome. While experience in experimental psychology, cognitive, social and affective neuroscience may be expected, a strong background in computer graphics and data analysis is considered a plus.
In specific, we value: Skills in administering behavioral protocols; Hands-on experience creating Immersive virtual reality scenarios; Skills in programming experiments with standard experimental software (e.g. PsychoPy; Psychtoolbox; Presentation); Skills in one programming language (preferably MatLab) and analyses tools (e.g. R, Jamovi, SPSS); Very Good command of the English language (written and oral).

Curriculum 2: Neuroscience and Humanities

Code 2.3

Project title: Are negative biases and threat sensitivity linked with political extremism? A Psychophysiological Study.

ERC Field:

- SH4_2 Personality and social cognition; emotion
- SH4_3 Clinical and health psychology
- SH4_4 Neuropsychology; SH4_5 Attention, perception, action, consciousness; SH4_6 Learning, memory; cognition in ageing

Key words: Pavlovian fear conditioning, Personality, Consciousness, Social Cognition, Learning and memory, Metaverse, ideology, political orientation,

Host Institution: Department of Cognitive, Psychological, Educational, and Cultural studies, University of Messina.

Reference person/supervisor: Carmelo Mario Vicario (cvicario@unime.it)

Research topic description

The current literature offers conflicting results regarding the relationship between conservative political orientation and sensitivity to threat. Additionally, at least one study has linked threat sensitivity with liberal political orientation. This underscores the difficulty in clarifying whether and how political orientation is connected to the processing of fear. In this project, we aim to address these inconsistencies by studying the predictive role of political ideology and the tendency toward extremist behavior in subjective responses to Pavlovian fear conditioning, a well-established laboratory protocol for investigating the mechanisms underlying fear and response to threat.

Research team and environment

The project will be conducted at the Social-Cognitive Neuroscience Laboratory, founded in 2020 by Prof. Carmelo M. Vicario at the Department of Cognitive, Pedagogical, Psychological, and Cultural Studies at the University of Messina. The laboratory's mission is to expand knowledge of the neural bases of cognitive and affective processes through a multidisciplinary and interdisciplinary approach, utilizing non-invasive brain stimulation, electrophysiological techniques, and virtual reality.

The main research focus of the Laboratory is the study of the reward system and its impact on cognitive and affective processes. The laboratory offers various facilities, including virtual reality, non-invasive brain stimulation, and electrophysiological techniques, providing a robust environment for cutting-edge research.

Preferred Research Skills and Competences

The ideal candidate is a highly motivated psychologist (or professional from a related discipline) with a strong background in social and cognitive psychology or neuroscience. While previous experience with data collection and programming in E-prime or MATLAB is desired, it is not mandatory. Highly desirable social skills include empathy, altruism, and a strong desire to be part of a team while respecting the roles and contributions of colleagues.

Curriculum 3: Preclinical, Clinical and Translational Neuroscience

Code 3.1

Project title: To study the role of the ghrelin system in the regulation of natural reward

ERC Field: LS5 Neuroscience and Disorders of the Nervous System; LS7 Prevention, Diagnosis and Treatment of Human Diseases

Key words: Neuropharmacology, motivation, sucrose, neuropeptides

Host Institution: University of Camerino

Reference person/supervisor: Roberto Ciccocioppo roberto.ciccocioppo@unicam.it

The main objective of this research program is to study how, at a behavioral, pharmacological, neuroanatomical, and neurochemical level, the manipulation of the ghrelin (GR) system can play a role in regulating the mechanisms underlying motivation towards natural rewarding stimuli. This is in order to evaluate the basic mechanisms of reward and motivation.

The effects of peripheral as well central administration of GR on the activity of DAergic neurons that project to the shell and core of the NAc and to establish the degree of specificity of these effects will be investigated. In addition, through the manipulation of the GR system, we aim to clarify the role played by endogenous GR in the reinforcing properties of sucrose as compared to alcohol, a pharmacologically active agent that directly activate the DAergic system. The effect of selective GR receptor antagonists and of inhibitors of the catalytic enzyme that leads to GR production will be also studied. The effect of these manipulations on mesolimbic DAergic transmission will be investigated using in situ hybridization and immunohistochemistry. In vitro electrophysiological recordings of VTA DA cells will be used to further investigate the mechanisms through which the GR system modulate The DAergic activity.

Research team and environment

This research project will be carried out in the School of Pharmacy, Center for Neuroscience, University of Camerino, Italy. The laboratory headed by Prof. Roberto Ciccocioppo is conceived as a multidisciplinary environment to investigate complex questions in the field of neuroscience, advancing the understanding of the molecular basis of neuropsychiatric and neurodegenerative disorders. The team consists of several researchers, post-doctoral fellows and PhD students with different backgrounds including biology, pharmacology, philosophy, psychology and physics. Researchers have access to 1500 m2 of animal facility equipped with surgery and behavioral rooms monitored by Noldus-Ethovision tracking system. The wet lab is equipped for immunohistochemistry and wester blotting techniques. Light, confocal and scanning electron microscopes are available. One laboratory is also equipped with an Electrophysiological setup for patch-clamp recordings in slices.

Curriculum 3: Preclinical, Clinical and Translational Neuroscience

Code 3.2

Scholarship funded under: NGEU – PNRR, DM 630/2024, M4 C2 I3.3 CUP J11J24001950006
With the contribution of Idorsia Pharmaceutical (Milan)– VAT N° / registration n. 16286891003

Project title: The role of the orexin neuropeptide system in the disease manifestation of multiple sclerosis: exploring the therapeutic potential of pharmacological interventions in animal models

ERC Field: LS5_2 Glial cells and neuronal-glial communication; LS5_5 Neural networks and plasticity; LS5_8 Neural bases of behaviour; LS5_12 Mental disorders; LS5_15 Neuroimmunology, neuroinflammation;

Key words: myelin, sleep, multiple sclerosis, neuroinflammation,

Host Institution: University of Camerino

Reference person/supervisor:
Michele Bellesi michele.bellesi@unicam.it
Luisa de Vivo luisa.devivo@unicam.it

Research topic description
Multiple sclerosis (MS) affects nearly 2.5 million people globally, causing nerve damage in the brain and spinal cord and impairing the protective myelin sheath. This leads to disabilities such as fatigue, depression, and cognitive issues, significantly impacting employment and quality of life. A significant contributor to these symptoms is the lack of restorative sleep. Chronic sleep insufficiency, affecting up to 50% of people with MS, is linked to impaired myelination, increased brain inflammation, and altered immune response. MS can damage brain regions involved in regulating sleep and wakefulness, such as the orexinergic neurons in the hypothalamus, contributing to sleep disturbances.
Preclinical research using the experimental autoimmune encephalomyelitis (EAE) model suggests that orexins can mitigate inflammation and slow disease progression. Additionally, modafinil, a stimulant, is often used off-label to help MS patients manage fatigue. Therefore, the orexin system could represent a crucial pharmacological target to alleviate night-related sleep disturbances and counteract day-related fatigue and inflammation.
This project aims to explore the dual modulation of the orexin system in preclinical MS models: the cuprizone mouse model and EAE. By administering dual orexin receptor antagonists (DORAs) during sleep, we will investigate their effects on sleep improvement, remyelination, and well-being. During waking, orexin agonists will be tested for their potential to reduce inflammation, disease progression, and fatigue symptoms.
Our approach involves behavioral, electrophysiological, morphological, and molecular analyses to understand the mechanisms by which improved sleep can promote remyelination and modulate immune responses. Additionally, we will assess how stimulating the orexin system during the day can impact inflammation, disease progression, and fatigue. This research could lead to novel therapeutic strategies for MS by targeting sleep disturbances and utilizing orexin-based treatments.

Research team and environment
This research project will be carried out in collaboration with Idorsia Pharmaceuticals Ltd (Basel, Switzerland) where the PhD student will have the opportunity to spend 12 months to carry out part of the project. The remaining time will be spent at the Brain and Sleep Research Laboratory of the University of Camerino (Italy). The sleep team, led by Luisa de Vivo and Michele Bellesi, aims at understanding the functions and mechanisms of sleep in health and disease. Our research combines morphological and functional methods of analysis in both animals and humans to investigate why sleep is beneficial for the brain at the molecular, circuit and behavioral level. On one hand, we are focused on mapping the consequences of sleep impairment across the lifecycle and to characterize the interaction between sleep disruption and other environmental and genetic factors. On the other hand, we are interested in the therapeutic potential of sleep enhancement to improve health and cognition at different levels.

To this aim, we are studying pharmacological and non-pharmacological approaches to mitigate neuropsychiatric and neurodegenerative conditions by targeting sleep.
The lab explores also scientific questions linking sleep to glial cells, gut microbiome, cellular metabolism, adipose tissue, torpor, etc., thanks to the collaboration with other research groups within the University of Camerino and outside. Relevant publications and key interests of the research group can be found at https://www.bsr-laboratory.org/. The team consists of several post-doctoral fellows and PhD students with different backgrounds including biology, pharmacology, informatics, and physics. Researchers have access to 1500 m^2 of animal facility equipped with systems for EEG/EMG and LFP recordings, in vivo calcium imaging in freely behaving rodents, automatic motion detection, apparata for behavioral tests, and a new human sleep laboratory. Fully equipped labs for immunohistochemistry, light, confocal, and electron microscopy, cell culture, and molecular biology are available.

Preferred Research Skills and Competences
The ideal candidate has a genuine passion for neuroscience and sleep research, a proactive attitude in studying relevant literature, formulate plausible hypothesis and experiments to test them. Self-motivation, curiosity, and ability to work both alone and in team are essential characteristics. Background in neurophysiology, interest in learning microscopy techniques, basic knowledge of Python or Matlab, and a propensity to care for details are desirable.

The doctoral candidate will receive training in histology, *in vivo* and *ex vivo* imaging (light and electron microscopy), electrophysiology in vivo, behavioural testing, molecular biology, and data analysis. Pharmacological, chemogenetic and optogenetic approaches will be also experienced.

Special requirements, additional to "standard" ones:
The Phd Student must collaborate in the reporting activities as scheduled in the Funding Program and meet any further requirements set by the MUR in the framework of the PNRR (Italian National Plan for Recovery and Resilience) – NGEU, and in particular under the Ministerial Decree n. 630/2024:
- Semestral reports through the MUR dedicated online portal
- Respect of the DNSH principle and horizontal principles of the Program
- Respect of deadlines and guidelines set by the MUR

Curriculum 3: Preclinical, Clinical and Translational Neuroscience

Code 3.3

Project title: Mapping the interplay between adolescent sleep loss and alcohol use at the molecular, circuit, and behavioral level

ERC Field: LS5_2 Glial cells and neuronal-glial communication; LS5_5 Neural networks and plasticity; LS5_8 Neural bases of behaviour; LS5_12 Mental disorders; LS5_15 Neuroimmunology, neuroinflammation;

Key words: microglia, synapses, electron microscopy, calcium imaging, scRNA-seq

Host Institution: University of Camerino

Reference person/supervisor: Luisa de Vivo luisa.devivo@unicam.it

Research topic description

The research project seeks to understand the intricate relationship between chronic sleep restriction (CSR), alcohol consumption, and synaptic connectivity in the adolescent brain, particularly focusing on the medial prefrontal cortex (mPFC) and connected brain regions. Epidemiological evidence suggests a bidirectional link between sleep problems and alcohol use disorders (AUD), yet the underlying molecular mechanisms remain unclear. Utilizing a preclinical model, the project aims to elucidate the impact of adolescent CSR and alcohol drinking on synaptic connectivity, mPFC circuit function, and behavior. Through advanced techniques such as in vivo calcium imaging, optogenetic modulation, 3d electron microscopy and single nuclei transcriptomics, the study will investigate the effects of CSR and alcohol consumption on mPFC connectivity and synaptic refinement. Additionally, the project aims to explore novel therapeutic strategies to reverse the morphological, functional, and behavioral alterations associated with adolescent CSR and alcohol drinking. The research offers a unique opportunity for a PhD student to contribute to cutting-edge neuroscience research and advance our understanding of the neurobiological mechanisms underlying AUD. Candidates with a background in neuroscience, biology, pharmacy, physics are encouraged to apply. The position promises to provide valuable insights into addiction and sleep research while offering a collaborative and dynamic research environment.

Research team and environment

This research project will be carried out in the School of Pharmacy, Center for Neuroscience, University of Camerino, Italy. The laboratory led by Luisa de Vivo and Michele Bellesi aims at understanding the functions and mechanisms of sleep in health and disease. Our research combines morphological and functional methods of analysis in both animals and humans to investigate why sleep is beneficial for the brain at the molecular, circuit and behavioral level. On one hand, we are focused on mapping the consequences of sleep impairment across the lifecycle and to characterize the interaction between sleep disruption and other environmental and genetic factors. On the other hand, we are interested in the therapeutic potential of sleep enhancement to improve health and cognition at different levels. To this aim, we are studying pharmacological and non-pharmacological approaches to mitigate neuropsychiatric and neurodegenerative conditions by targeting sleep.

The lab explores also scientific questions linking sleep to glial cells, gut microbiome, cellular metabolism, adipose tissue, torpor, etc., thanks to the collaboration with other research groups within the University of Camerino and outside. Relevant publications and key interests of the research group can be found at https://www.bsr-laboratory.org/. The team consists of several post-doctoral fellows and PhD students with different backgrounds including biology, pharmacology, informatics, and physics. Researchers have access to 1500 m^2 of animal facility equipped with systems for EEG/EMG and LFP recordings, in vivo calcium imaging in freely behaving rodents, automatic motion detection, apparata for behavioral tests, and a new human sleep laboratory. Fully equipped labs for immunohistochemistry, light, confocal, and electron microscopy, cell culture, and molecular biology are available.

Preferred Research Skills and Competences

The ideal candidate has a genuine passion for neuroscience and sleep research, a proactive attitude in studying relevant literature, formulate plausible hypothesis and experiments to test them. Self-motivation, curiosity, and ability to work both alone and in team are essential characteristics. Background in neurophysiology, interest in

learning microscopy techniques, basic knowledge of Python or Matlab, and a propensity to care for details are desirable.

The doctoral candidate will receive training in histology, *in vivo* and *ex vivo* imaging (light and electron microscopy), electrophysiology in vivo, behavioural testing, molecular biology, and data analysis. Pharmacological, chemogenetic and optogenetic approaches will be also experienced.

Curriculum 3: Preclinical, Clinical and Translational Neuroscience

Code 3.4

Project title: Studying the effects of Virtual Reality training for the rehabilitation of social skills in neurodevelopmental disorders

ERC Field: SH4_1 Cognitive basis of human development and education, developmental disorders; comparative cognition; SH4_2 Personality and social cognition; emotion; SH4_4 Neuropsychology; SH4_5 Attention, perception, action, consciousness

Key words: neurodevelopmental disorders; neuromodulation; virtual reality; neurorehabilitation; neuropsychology; electroencephalography.

Host Institution: Scientific Institute, IRCCS E. Medea

Reference person/supervisor: Cosimo Urgesi cosimo.urgesi@uniud.it
Alessandra Finisguerra alessandra.finisguerra@lanostrafamiglia.it

Research topic description

Recent studies suggested a close relationship between motor representations and high-level cognitive and social functions. Understanding the motor, sensory, emotional and cognitive states of people we interact with seems to be, at least partially, linked to embodiment of their mental states into our own internal states (embodied cognition). This association between motor, cognitive and social representations is relevant in developmental age, where more complex cognitive and social functions can emerge from basic sensory and motor functions. Predictive coding accounts of social cognition suggests that we anticipate others' actions based on context and past experiences. Various neurodevelopmental disorders present social deficits linked to dysfunctions in predictive mechanisms and basic cognitive skills. The present research aims to study the use of novel methodologies for boosting the effects of rehabilitation in neurodevelopmental disorders by using noninvasive brain stimulation techniques, particularly transcranial direct current stimulation (tDCS), transcranial alternating current stimulation (tACS) and transcutaneous vagal nerve stimulation (tVNS), combined with new technologies, such as Virtual or Augmented Reality, to promote neuroplasticity. It is hypothesized that training that promotes the creation of predictive models, integrating sensory information and expectations about daily events, can enhance social skills. Specifically, near and far-transfer effects on social competencies assessed outside the virtual reality context with standardized neuropsychological tests and ad-hoc behavioral paradigms and electroencephalographic measures will be measured.

Research team and environment

The IRCCS Eugenio Medea is a scientific institute specialized in research, treatment and training in the field of neurological and neuropsychic pathologies in the developmental age. It has obtained the IRCCS recognition from the Ministry of Health in different regions. Through the network of rehabilitation centers of the Associazione La Nostra Famiglia, the IRCCS Eugenio Medea has access to the widest range of cases in Italy in the field of neurological and neuropsychological disabilities in the age of development. The research facilities are equipped with:

- Bioinformatics Laboratory, for genetic analysis for clinical and research purposes;
- Bioengineering laboratory, with virtual reality systems and movement analysis, for the development of new technologies applied to neurorehabilitation;
- Neuroimaging laboratory, with a 3T scanner in place and access to a 7T scanner, for the study of the anatomical and functional correlates of neurodevelopmental disorders and the effects of neurorehabilitation;
- EEG Lab (with EEG and eye-tracking system) for the early diagnosis of neurodevelopmental disorders and measurements of the outcome of rehabilitation programs;
- Laboratory of Neuromodulation, with transcranial magnetic stimulation systems, transcranial electrical stimulation and transcutaneous vagus nerve stimulation, for the facilitation of cerebral plasticity during neurorehabilitation.

Preferred Research Skills and Competences

The ideal candidate has previous experience and/or interests in neurorehabilitation, neuropsychology, electroencephalography and/or neuromodulation studies in developmental age. He/she has strong background in cognitive neuroscience, cognitive psychology, neuropsychology and aims to foster his/her knowledge in neuropsychology, neurorehabilitation, and neuromodulation of neurodevelopmental disorders.

Curriculum 3: Preclinical, Clinical and Translational Neuroscience

Code 3.5

1 Scholarship co-funded under PRIN-PNRR project n° P2022E4MLS - Italian Ministry of University and Research - CUP J53D23017960001 (CUP master G53D23007600001) NIH/NIAAA/Sanford Burnham Prebys Medical Discovery

Project title: Role of stress by sex by gene interaction in the psychopathology of substance use disorder.

ERC Field: LS5_3 Neurochemistry and neuropharmacology; LS7_3 Pharmacology, pharmacogenomics, drug discovery and design, drug therapy; LS5_12 Psychiatric disorders

Key words: Reward and Motivation, Stress, Sex, Neurocircuitry, Pharmacology, Electrophysiology,

Host Institution: University of Camerino

Reference person/supervisor: Nazzareno Cannella **nazzareno.cannella@unicam.it**

Research topic description
Substance Use Disorder (SUD) is a psychiatric condition causing major social and health burden at global level. The development of SUD is characterized by a shift from recreational to compulsive use of drugs as described in the DSM-5. Long-term consumption of substances of abuse induces neuroadaptations that are associated with loss of control, compulsive drug taking and negative emotional states (i.e. anxiety, depression). The trajectory toward SUD is influenced by genetically predisposing factors and stressful life events. In addition, men and women diagnosed with SUD tend to use drugs for different reasons, men to alleviate dysphoric state and women as a stress-coping strategy; sex is therefore another factor influencing the trajectory to SUD. These three factors interact with each other increasing individual risk to develop the disease. The goal of our laboratory is to investigate the neurobiological and neuropharmacological background through which these three factors influence the development of SUD, with the ultimate objective to identifying novel molecular targets and therapies to treat SUD. To pursue our goals, we combine behavioral models of SUD with classical pharmacological manipulations, in vivo optogenetic, chemogenetic and neurophysiological approaches. Viral mediated upregulation and downregulation of specific receptors in selected brain areas are also used to determine the role of specific neurocircuitry in SUD. Histological, biomolecular and electrophysiology techniques will be also used to support the study.

Research team and environment
This research project will be carried out in the School of Pharmacy, Center for Neuroscience, University of Camerino, Italy. The laboratory headed by Prof. Nazzareno Cannella is part of the Neuropsychopharmacology Joint Research Team, which also includes Prof Ciccocioppo's, Prof Domi's and Prof Ubaldi's labs. The aim of this multi-PI consortium is to create a multidisciplinary, heterogeneous, and interactive environment in which complex questions in neuroscience are addressed integrating the views of multiple scholars, of which students can benefit in the pursue of a high-quality scientific training. The main research interest of the laboratory is the study of the neurobiological basis and brain functions relevant to motivated behaviors and human psychopathology of substance use disorder with emphasis on reward seeking, motivation, and impulsivity. The ultimate goal of the lab is the understanding of the neurobiological mechanisms responsible for these aberrant behaviours to promote the development of innovative treatments. With regard to psychopharmacology, the lab is also interested in precision medicine, specifically in studying the endophenotypes of treatment response. The research team consists of the four PIs, their post-doctoral fellows, PhD students and undergrads. Lab members derive from different backgrounds, including biology, pharmacology, philosophy, psychology and physics. The lab has access to a 1500 m^2 animal facility equipped with operant self-administration chambers, EPM equipments, Porsolt swimming tubes, open field arenas for social interaction, Noldus Etovision system for behavioral monitoring, etc. Fully equipped lab for immunohistochemistry, light, confocal and scanning electron microscopes are available. One laboratory is equipped an Electrophysiological setup for patch-clamp recordings in slices. Finally, equipment for molecular and cellular studies is available.

Preferred Research Skills and Competences
The doctoral candidate will receive training in the techniques most commonly used in basic neuroscience, including brain activity recording, imaging, electrophysiology, proteomics, behavioural testing, molecular

biology, histology and data analysis. Pharmacological, chemogenetic and optogenetic approaches will be also experienced. Candidates with training backgrounds in life sciences, behavioral pharmacology, electrophysiology, pharmaceutical sciences, molecular genetics, and medicine are preferentially considered for this position.

Curriculum 3: Preclinical, Clinical and Translational Neuroscience

Code 3.6

Scholarship funded under: NGEU – PNRR, DM 630/2024, M4 C2 I3.3 CUP J11J24001950006
With the contribution of Azienda ospedaliero-universitaria di Modena – VAT N° / registration n. 02241740360

Project title: Integrated approach for the study of migraine and related therapies

ERC Field: LS5_7 Neurological disorders (e.g. neurodegenerative diseases, seizures), LS5_3 Neurochemistry and neuropharmacology; LS7_3 Pharmacology, pharmacogenomics, drug discovery and design, drug therapy;

Key words: migraine, Pharmacology , Pharmacogenetics

Host Institution: University of Modena

Reference person/supervisor: Fabio Tascedda **fabio.tascedda@unimore.it**

Research topic description
Migraine is a complex neurological disorder characterized by recurrent episodes of severe and debilitating pain. Current therapies range from pain management with analgesic medications to the prevention of attacks with prophylactic treatments, yet many questions remain regarding the underlying causes and optimal treatment methods. An integrated approach involving multiple disciplines may provide new perspectives for better understanding this condition and developing more effective therapies.

Project Objectives:
1. To analyze the pathophysiological mechanisms of migraine through the integration of neurological, genetic, environmental, and pharmacological data.
2. To evaluate the efficacy and safety of current migraine therapies, including medications, non-pharmacological treatments, and lifestyle interventions.
3. To explore new potential therapies based on scientific evidence, including innovative pharmacological approaches, complementary and alternative therapies, and interventions based on neuroplasticity.
4. To identify risk factors and predictors of treatment response to personalize the therapeutic approach.
5. To examine the impact of migraine on quality of life, mental health, and cognitive functions, and to develop integrated management strategies.

Methodology:
The project will employ a multidisciplinary approach, involving neurologists, pharmacologists, neuroscience researchers, and experts in integrative medicine. Controlled clinical trials, observational studies, genetic analyses, brain imaging studies, neuropsychological assessments, and qualitative surveys on patient perceptions of therapies will be conducted. Collaborations with research institutes and clinical centers specialized in migraine treatment will facilitate data collection and participant involvement.

Research team and environment
This research project will be carried out in the Headache Center and Drug Abuse-Laboratory of Clinical Pharmacology and Pharmacogenomics at university of Modena. The laboratory headed by Prof. Fabio Tascedda is conceived as a multidisciplinary environment to investigate complex questions in neuropharmacology. The main research focus of the laboratory is on the study of the neurobiological basis of brain functions relevant to human psychopathology with emphasis on how adverse event impact on the developing brain and influence the

present and future disease burden, with a special focus on migraine. The full collaboration of the "Centro Cefalee", University Hospital "Azienda Ospedaliero-Universitario Policlinico di Modena, will allow to study the role of crucial biological risk factors, such as serotonergic tone and inflammatory mediators, along with gender (hormonal background), age of disease onset and age at assessment, disease characteristics, the intensity of treatment, and psychosocial factors in determining outcomes. Then, a set of peripheral as well as central markers will be evaluated in specific animal models to identify a standard set of risk processes, which may help to specify when in development and for whom a specific therapeutic intervention could be most effective.
The team consists of several researchers, post-doctoral fellows and PhD students with different backgrounds including biology, pharmacology, medicine, and psychology. Researchers have full access to Center for Cefalee for the clinical part of the project, while preclinical studies will be carried out in an animal facility equipped with mazes, arenas for anxiety-related behaviours, social interactions, Noldus Etovision system for behavioral monitoring, etc.
Molecular analysis will be performed in a fully equipped lab for gene expression and protein analysis, In the campus facilities with confocal and scanning electron microscopes, HPLC MS/MS GC-MS are available.

Preferred Research Skills and Competences
The doctoral candidate will receive training in the techniques most commonly used in basic and clinical neuroscience, including brain activity recording, imaging, proteomics, behavioural testing, molecular biology, histology and data analysis. Candidates with training backgrounds in clinical pharmacology, are preferentially considered for this position.

Special requirements, additional to "standard" ones:
The Phd Student must collaborate in the reporting activities as scheduled in the Funding Program and meet any further requirements set by the MUR in the framework of the PNRR (Italian National Plan for Recovery and Resilience) – NGEU, and in particular under the Ministerial Decree n. 630/2024:
- Semestral reports through the MUR dedicated online portal
- Respect of the DNSH principle and horizontal principles of the Program
- Respect of deadlines and guidelines set by the MUR

Curriculum 3: Preclinical, Clinical and Translational Neuroscience

2 Scholarship Funded under the project **ERC Synergy Grant "NEurological MEchanismS of Injury, and Sleep-like cellular dynamics (NEMESIS)" C93C23004980007 GA 101071900**

Code 3.7

ERC Field: LS5_2 Systems neuroscience and computational neuroscience

Project title: Investigating sleep-like dynamics and cortical connectivity in focal brain injury through invasive and non-invasive recordings in humans.

Key words: intracranial recording, intracranial stimulation, TMS, EEG, stroke, focal brain lesion

Host Institution: University of Milan (UNIMI)

Reference person/supervisor: Andrea Pigorini **email: andrea.pigorini@unimi.it**
Marcello Massimini **email: marcello.massimini@unimi.it**
Simone Sarasso **email: simone.sarasso@unimi.it**
Ezequiel Mikulan **email:ezequiel.mikulan@unimi.it**

Research topic description
In the context of the project NEMESIS (NEurological MEchanisms of Injury and Sleep-like cellular dynamics), funded by European Research Council (ERC) with a synergy grant, UNIMI will create datasets, analysis pipelines and experimental set-ups to explore human cortical circuits from a causal perspective, whereby cortical perturbations and recordings are performed both intracranially and extracranially. Specifically, UNIMI will collect two large curated and standardized datasets. The first one comprises Stereo-electroencephalographic (SEEG) intracranial recordings in humans performed before and after localized cortical lesions (delivered for epilepsy treatment) both at rest and during intracerebral stimulation, which constitute the gold-standard for estimating effective connectivity. And the second one combines transcranial magnetic stimulation and electroencephalography (TMS-EEG) in healthy subjects as well as in pathological stroke patients. All this data will be used to study the mechanistic underpinning of loss and recovery of brain functions in physiological conditions (wake and sleep) as well as in stroke. The PhD student will be involved mainly in data collection, data preprocessing, data storage and analysis.

Research team and environment
The team in which the PhD will work is a large lab of around 15-20 PhD students (5 on this project) and post-docs researchers in the fields of neurophysiology, bioengineering and system neuroscience with the supervision of experimental neurologists, bioengineers and neuroscientists.
The research will be developed in University of Milan and partner institutions (Niguarda Hospital, IRCCS Fondazione Don Gnocchi, IRCCS Fondazione Maugeri and IN-CNR, University of Padova, Universitat Pompeu Fabra, IDIBAPS Barcellona), and will foresee international mobility (active collaborations with Harvard University, Stanford University, Universitat Pompeu Fabra, IDIBAPS Barcellona).

Preferred Research Skills and Competences
The ideal candidate has experience in intracerebral and/or scalp EEG data collection and brain stimulation. The ideal candidate has a background of neurophysiology/neurology and should be willing to work not only in a laboratory but also in clinical environments such as stroke unit and epilepsy surgery unit, interacting with clinicians, physicians and patients. The ideal candidate must be able to carry out his/her work in a diligent, independent and highly collaborative manner.

Curriculum 3: Preclinical, Clinical and Translational Neuroscience

Code 3.8

Project title: The gut-liver-lung-brain axis: in vitro, ex vivo and in vivo models.

ERC Field: LS3_1 Morphology and functional imaging of cells and tissues; LS3_4 Cell junctions, cell adhesion, cell communication and the extracellular matrix; LS9_1 Applied biotechnology (including transgenic organisms, applied genetics and genomics, biosensors, bioreactors, microbiology, bioactive compounds); LS9_2 Applied bioengineering, synthetic biology, chemical biology, nanobiotechnology, metabolic engineering, protein and glyco-engineering, tissue engineering, biocatalysis, biomimetics

Key words: Human Anatomy, Histology, Cell differentiation, Tissue homeostasis, Organ remodelling,

Host Institution: University of Palermo

Reference person/supervisor: Fabio Bucchieri **fabio.bucchieri@unipa.it**

Research topic description
There has long been proposed a gut-brain axis mediated by the autonomic nervous system, including the visceral sensory innervation. More recently, our group has proposed another tool for interaction between the intestine and the brain, mediated by extracellular vesicles and in particular nanovesicles (exosomes), produced both by human cells and by microorganisms of the saprophytic intestinal flora (microbiota), capable of crossing bidirectionally the blood-brain barrier (10.3390/biology13050296).
However, the nanovesicles produced by the intestine to reach the brain through the bloodstream, in humans, must pass through two "filters", one in the large circulation (the liver) and the other in the small circulation (the lung). During this step the nanovesicles can transit through, or come into contact with, different cytotypes and be reworked/remodeled. This remodeling also depends on the physiological and/or pathophysiological conditions of these organs.
To the best of our knowledge, this is a very innovative field of research and there are many experimental models, also using totally new biotechnology and bioengineering systems (including microfluidics) for delving deeper into these chapters of functional anatomy and pathophysiology.

Research team and environment
This project will be developed mainly within the laboratories of the Institute of Human Anatomy and Histology of the University of Palermo (UNIPA). Among the laboratories potentially available to the PhD student there will also be those of the ATEN Center (Advanced Technologies Network Center) of UNIPA. The extensive national and international inter-university collaborations will allow the PhD student to also be able to train in further laboratories chosen and selected together with the tutor. The research environment is international as PhD students of the international research doctorate in Biomedicine, Neuroscience and Advanced Diagnostics, of which the tutor is Coordinator, coexist in the same spaces.

Preferred Research Skills and Competences
There are several experimental models that can be used, including in vivo, ex vivo and in vitro models. The use of cytology, histology, histochemistry, immunohistochemistry, confocal microscopy, electron microscopy, flow cytometry, biochemistry, molecular biology, biophysics, etc. techniques is therefore envisaged. It is therefore desirable that the candidate has basic knowledge of all or many of these techniques.

Curriculum 3: Preclinical, Clinical and Translational Neuroscience

Code 3.9

Scholarship funded under: NGEU – PNRR, DM 630/2024, M4 C2 I3.3 CUP J11J24001950006
With the contribution of GUNA Spa (Milan) – VAT N° / registration n. 06891420157

Project title: The Psycho-Biological and Psychological Effects of Meditative Practices

ERC Field: SH4_3, SH4_5

Key words Slow Breathing, Mindfulness, Sensory Processing, Perception, Attention, Emotional Regulation, Meditative Practices, Cognitive Neuroscience

Host Institution: University of Pisa

Reference person/supervisor: Angelo Gemignani angelo.gemignani@unipi.it

Research topic description

Recent approaches that incorporate meditative practices have demonstrated significant influence in the psychological treatment of various psychopathological conditions. Scientific evidence suggests that some of the beneficial effects of these practices may be attributed to the synchronizing effect of slow breathing on brain rhythms and activities mediated by the olfactory bulb. Building on this foundation, the project aims to explore the impact of meditative practices on a range of behaviors, from basic sensory and perceptual processes to complex functions such as decision making, emotional processing, and regulation. Additionally, the project will investigate the psychophysiological correlates that underlie these potential behavioral changes.

Research team and environment

The research team will comprise psychologists, psychiatrists and bioengineering experts, fostering a multidisciplinary approach to the investigation. The PhD student involved in the project will benefit from the advanced facilities available at the University of Pisa for psychophysiological research in humans. These facilities include high-density EEG and high-field MRI for detailed brain imaging and monitoring. Furthermore, the project may implement perturbational approaches such as TMS (Transcranial Magnetic Stimulation) and tDCS (Transcranial Direct Current Stimulation) protocols to further investigate the neural mechanisms underlying the observed effects of meditative practices.

Preferred Research Skills and Competences

Ideal candidates for the project should possess expertise in psychology, cognitive neuroscience, complemented by a strong foundation in biological signal analysis and modeling.

Special requirements, additional to "standard" ones:
The Phd Student must collaborate in the reporting activities as scheduled in the Funding Program and meet any further requirements set by the MUR in the framework of the PNRR (Italian National Plan for Recovery and Resilience) – NGEU, and in particular under the Ministerial Decree n. 630/2024:
- Semestral reports through the MUR dedicated online portal
- Respect of the DNSH principle and horizontal principles of the Program
- Respect of deadlines and guidelines set by the MUR

Curriculum 3: Preclinical, Clinical and Translational Neuroscience

Code 3.10

Scholarship co-funded under PRIN project n. 2022B5RMW9- Italian Ministry of University and Research - CUP J53D23012110 006 (CUP MASTER F53D2300662 0001)

Project title: To study the neuronal basis of sporadic neurobiological, behavioral and pharmacological basis of drug addiction and related psychopathologies.

ERC Field: LS7_7 Pharmacology and toxicology; LS5_10 Ageing of the nervous system, LS5_11 Neurological and neurodegenerative disorders

Key words: Alzheimer's disease model, Autophagy, Pharmacology

Host Institution: University of Camerino

Reference person/supervisor: Esi Domi esi.domi@unicam.it

Alzheimer's disease (AD) is the most common form of dementia, which nowadays affects 55 million people worldwide. In spite of huge research efforts, AD therapy is still a major unmet medical need. The animal models available recapitulate some of the features characterizing AD and contributed to a better understanding of the disease. However, the efficacy of treatment options developed using the current preclinical models failed the expectations when tested in humans. One possible reason for this translational failure may be that the available AD models mimic only genetic alterations found in familial cases, which represent 5% of the AD affected patients. On the contrary, nearly 95% of AD cases are sporadic, pointing to an urgent need to develop aetiology-based models of sporadic AD to identify novel therapeutic mechanisms with a translational utility. The interaction of genetic and environmental factors that increase the risk of developing sporadic AD are still unknown. One of the most relevant genetic alleles associated with the development of late-onset AD is the E4 variant of the APOE lipoprotein. On the environmental side, recent evidence suggests that neurotropic viral infections may contribute to AD pathogenesis.
Our laboratory aims to investigate the interactions between common genetic risk factors and environmental trigger by generating novel in vitro and in vivo mouse models that more closely simulate the pathogenic cascades of sporadic AD. To accomplish this research project, different transgenic mouse lines will be used (i.e., APOE4 knock-in mice a) in combination with viral infection (i.e.,Herpes Simplex virus-1). The sporadic AD models will be validated for the presence of classical hallmarks of AD and will be compared with the canonical AD models that are based on the central infusion of the oligomeric species of amyloid-beta. This project aims to identify new t argeting strategies that could be beneficial in the treatment of sporadic AD, such as the potential of autophagy promoting drugs (e.g. Tat–beclin). Ex vivo brain slice electrophysiology will be also used to assess the hippocampal alterations in the sporadic AD model.

Research team and environment
This research project will be carried out in the School of Pharmacy, Center for Neuroscience, University of Camerino, Italy. The laboratory is conceived as a multidisciplinary environment to investigate complex questions in the field of neuroscience, advancing the understanding of the molecular basis of neuropsychiatric and neurodegenerative disorders. The team consists of several researchers, post-doctoral fellows and PhD students with different backgrounds including biology, pharmacology, philosophy, psychology and physics. Researchers have access to 1500 m2 of animal facility equipped with surgery and behavioral rooms monitored by Noldus-Ethovision tracking system. The wet lab is equipped for immunohistochemistry and wester blotting techniques. Light, confocal and scanning electron microscopes are available. One laboratory is also equipped with an Electrophysiological setup for patch-clamp recordings in slices.

Preferred Research Skills and Competences
We are seeking a highly motivated and passionate candidate to study the complexities of sporadic neurobiological disorders. A strong background in molecular biology and microscopy is essential. The successful candidate will receive comprehensive training in behavioral testing, brain surgeries, and molecular techniques including immunohistochemistry, fluorescent in situ hybridization, chemogenetics, as well as training in data analysis.

Curriculum 3: Preclinical, Clinical and Translational Neuroscience

Code 3.11

Scholarship funded under: NGEU – PNRR, DM 630/2024, M4 C2 I3.3 CUP J11J24001950006
With the contribution of Medel – Elektromedizinische Geräte GmbH (Innsbruck)

Project title: Neuromodulation of acquired language and speech perception disturbances

ERC Field: LS5_5 Neural bases of cognitive processes (e.g. memory, learning, attention); LS5_7 Neurological disorders (e.g. neurodegenerative diseases, seizures)

Key words: Language disorders; cochlear implants; primary progressive aphasia; neurophysiology; neuromodulation

Host Institution: University of Siena

Reference person/supervisor: Simone Rossi simone.rossi@unisi.it

Research topic ìdescription
Acquired language and speech perception disorders include a variety of conditions spanning from degenerative processes (as Primary Progressive Aphasia, PPA) to hearing impairments, often so severe to require a cochlear implant.
As a common feature, these disorders require intensive speech therapy that, however, as stand-alone support is not sufficient for satisfactory reacquisition of speech perception or language production.
The aim of the project is to provide additional support based on non-invasive neuromodulatory strategies with repetitive transcranial magnetic stimulation (rTMS) of language network. Indeed, rTMS may promote plastic changes in stimulated regions that may boost the effects of speech therapy.
We will develop rTMS interventions protocols coupled with speech therapy in patients with PPA aimed to slow down the unavoidable degenerative process of language networks. Effects will be monitored with clinical tests, neuroimaging and neurophysiological investigations.
In parallel, we will develop neuromodulatory interventions with rTMS of auditory cortex in patients undergoing to cochlear implants for severe hearing loss. In this case, the rTMS coupled with speech therapy will serve to shorten the time necessary for reacquisition of speech perception.

Research team and environment
The team is located at the Siena Brain Investigation and Neuromodulation Lab, Department of Medicine, Surgery and Neuroscience, University of Siena, Policlinico Le Scotte, Siena.
The project will be carried out in strict collaboration with the clinical team of Otolaringology. All necessary equipments are already available, either for MRI, neurophysiological recordings and blood sample analyses..

Preferred Research Skills and Competences
The doctoral candidate will receive training in the neurophysiological techniques most commonly used including brain activity recording, imaging, noninvasive neuromodulation and data analysis. Candidates with training backgrounds in life sciences, neuroscience, psychology, Speech therapy; Neurology are preferentially considered for this position.

Special requirements, additional to "standard" ones:
The Phd Student must collaborate in the reporting activities as scheduled in the Funding Program and meet any further requirements set by the MUR in the framework of the PNRR (Italian National Plan for Recovery and Resilience) – NGEU, and in particular under the Ministerial Decree n. 630/2024:

- Semestral reports through the MUR dedicated online portal
- Respect of the DNSH principle and horizontal principles of the Program
- Respect of deadlines and guidelines set by the MUR

Curriculum 3: Preclinical, Clinical and Translational Neuroscience

Code 3.12

Scholarship funded under: NGEU – PNRR, DM 630/2024, M4 C2 I3.3 CUP J11J24001950006
With the contribution of Institute of Biomolecular Chemistry (ICB) – National Research Council (CNR) Pozzuoli (NA)

Project title: Role of cannabinoids and related mechanisms in degenerative diseases of the neuromuscular system

ERC Field: LS5_5 Neural bases of cognitive processes (e.g. memory, learning, attention); LS5_7 Neurological disorders (e.g. cognitive impairment and behavioural abnormalities)

Keywords: cannabinoids; ion channels; neuromuscular diseases

Host Institution: University Federico II of Naples/Institute of Biomolecular Chemistry (ICB) – National Research Council (CNR) Pozzuoli (NA)

Reference person/supervisor: Maurizio Taglialatela/Fabio A. Iannotti mtaglial@unina.it
fabio.iannotti@icb.cnr.it

Research topic description
Neuromuscular disorders (NMDs) include a diverse array of inherited or acquired conditions characterized by complex and often poorly understood pathological mechanisms affecting both central and peripheral components of the neuromuscular system. One of the main challenges in understanding these mechanisms is the heterogeneity of symptoms and the multifaceted nature of the diseases.
In diseases like Amyotrophic Lateral Sclerosis (ALS), which is characterized by the progressive degeneration of nerve cells in the spinal cord and brain, the discovery of TDP-43 as the main constituent of pathological cytoplasmic aggregates was a significant breakthrough. However, many aspects of how these aggregates contribute to disease progression remain unclear. Cognitive and behavioral impairments in ALS include deficits in executive function, attention, verbal fluency, language, social cognition, apathy, and stereotyped behaviors. Duchenne muscular dystrophy (DMD), the most frequent and detrimental form of hereditary myopathy, causes a similarly complex spectrum of neurocognitive and behavioral problems. Research has shown that boys with DMD exhibit non-progressing cognitive dysfunction, particularly in areas such as verbal, short-term, and working memory. Epileptic seizures can also occur in about 7% of DMD patients. These problems have been linked to mutations in the dystrophin gene affecting different brain dystrophin isoforms. Nonetheless, cognitive and behavioral functions in boys with DMD are highly variable, complicating the identification of the exact causes. For this reason, understanding the neurocognitive aspects of NMDs is crucial for comprehensive patient care and support, highlighting the need for ongoing research and tailored therapeutic strategies.
The primary goal of the participants in this call will be to search for potential dysfunctions in ion channels (particularly K+ and TRP channels) and specific classes of metabotropic receptors associated with the activity of endocannabinoids in the brains of ALS and DMD animal models employed in our laboratories. Specifically, changes in the expression and function of ion channels and receptors will be investigated in brain regions such as the cortex, hippocampus, and cerebrum, which are predominantly affected by both ALS and DMD pathology. This investigation will be conducted using molecular biology and electrophysiology techniques, including patch-clamp and multi-electrode array (MEA). Subsequently, selective pharmacological (agonists/antagonists) and genetic (siRNA, CRISPR/CAS9) tools will be employed to evaluate the involvement of identified targets in the development and progression of cognitive and behavioral symptoms. Additionally, since it is known that the activity of certain K+ channels, including members of the voltage-gated Kv7 subfamily, and TRP channels are regulated by plant cannabinoids (e.g., Cannabidiol – CBD) as well as lipid mediators and receptors belonging to

the endocannabinoid system, another key objective will be to understand if and how the severity of these diseases can be mitigated through the modulation of identified targets by cannabinoids and endocannabinoids.

Research team and environment
For the execution of the project, the PhD candidate will be supported by the research team located at the Institute of Biomolecular Chemistry (ICB)/National Research Council (CNR) supervised by Dr. Fabio Arturo Iannotti, and by the research group led by Prof. Maurizio Taglialatela at the Department of Neuroscience, Reproductive Sciences and Dentistry Federico II University of Naples.

The Institute of Biomolecular Chemistry (ICB) is located in the upper town quarters of Pozzuoli, at the "Comprensorio Olivetti", an ex-factory built in 1954. The "Comprensorio Olivetti" is a unique example of the intelligent insertion of an industrial structure in an environment of great natural beauty. 5000 square meters converted into laboratories, office and research services: 25 "open space" laboratories, 2 meeting rooms, 1 library, over 40 offices for researchers and administrative staff, dedicated spaces to microscopy, cell culture and bioinformatics. Research approaches available to the Institute of Biomolecular Chemistry (ICB) include molecular genetics, cell biology, protein biochemistry, analytical core, and structurally oriented molecular database (StOrMoDB) service. To sustain the breadth of research approaches offered to ICB scientists, the Institute has invested in the establishment of five core facilities that provide state-of-the-art technology as well as "housekeeping" assistance (http://www.icb.cnr.it). Each core is supervised by at least one ICB investigator and is composed of specialized technical staff. Five cores (Liquid Chromatography Mass Spectrometry (LC-MS/MS) core, Nuclear Magnetic Resonance (NMR) spectroscopy core, Microscopy and Imaging Core, Cell Culture Core, and Molecular Biology Core) offer high-quality and rapid scientific and technical services that help to improve and speed up the work of ICB investigators and PhD students. Finally, the Informatics Core and the General Services Core provide maintenance for the Institute's general activities and resources.
The core facilities available at ICB fully respond to the requirements set by the execution of the project.
Moreover, the ICB counts on a long-standing collaboration with the Department of Neuroscience, Reproductive Sciences and Dentistry (NRSD) at the University Federico II of Naples. Facilities available at NRSD include neurophysiological techniques most commonly used including electrophysiology, neuro-imaging, multiphoton microscope systems, and equipment for molecular and cellular biology analysis

Preferred Research Skills and Competences
The doctoral candidate will be trained to manage animal models of NMD diseases, neuroanatomical and neurophysiological analysis including brain activity recording, imaging, noninvasive neuromodulation, and data analysis. Preference is given to candidates with backgrounds in life sciences, neuroscience, pharmacology and biochemistry.

Special requirements, additional to "standard" ones:
The Phd Student must collaborate in the reporting activities as scheduled in the Funding Program and meet any further requirements set by the MUR in the framework of the PNRR (Italian National Plan for Recovery and Resilience) – NGEU, and in particular under the Ministerial Decree n. 630/2024:
- Semestral reports through the MUR dedicated online portal
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- Respect of deadlines and guidelines set by the MUR

Curriculum 3: Preclinical, Clinical and Translational Neuroscience

Code 3.13

Scholarship funded under: NGEU – PNRR, DM 630/2024, M4 C2 I3.3 CUP J11J24001950006
With the contribution of AM Microsystems (Urbisaglia) VAT N° / registration n. 01835980432

Project title: To study the molecular basis of the transition from alcohol use to abuse and addiction in rodents: Focus on social variables affecting individual vulnerability to disease development.

ERC Field: LS5_3 Neurochemistry and neuropharmacology; LS7_3 Pharmacology, pharmacogenomics, drug discovery and design, drug therapy;LS5_12 Psychiatric disorders

Key words: Reward and Motivation, Environment, Neurocircuitry, Pharmacology

Host Institution: University of Teramo

Reference person/supervisor: Claudio D'addario cdaddario@unite.it
Roberto Ciccocioppo roberto.ciccocioppo@unicam.it

Alcoholism is an etiologically and clinically heterogeneous disorder in which compulsive alcohol seeking and use represent core symptoms. Environment and heritability factors can play a dramatic role in controlling individual vulnerability to developing alcohol abuse. Initially alcohol is taken for recreational use, however a certain subgroup of social drinkers progressively develop excessive use progressively leading to abuse and addiction. Understanding this transition is of fundamental importance to develop preventive strategies in vulnerable individuals. In preclinical research this type of work has been hampered by the possibility to investigate individual drinking behaviors under social context. Recently, in collaboration with AM-microsystem, a company expert in the development of electronic devices, we have developed a prototype to study rodents behaviors in their homecage. This device consists of an operant wall that can be positioned in the animal's homecage allowing the possibility to monitor their drug taking behavior 24 hours a day in group housed rats. RFID technology is used to identify individual rats. This project is aimed at twofold. First to optimize the use of this modified operant self-administration device. Secondly to study the transition from drug use to abuse under social context. Molecular, genetic, epigenetic and biochemical techniques will be used to characterize the basic mechanisms subserving this transition in vulnerable individuals. To accomplish the objectives of this project a collaboration between the University of Teramo, the University of Camerino and AM-microsystem is established.

Research team and environment
This research project will be carried out in collaboration between the University of Teramo, The University of Camerino and AM-Microsystem. The laboratories involved in the project offer a multidisciplinary environment to investigate complex questions in neuroscience. The main research focus of this team of researchers is on the study of the neurobiological basis of substance use disorder. Attention to the study of neurocircuitry and molecular mechanisms controlling animals behavior under social context is central in this project. Researchers have access to multiple laboratories, animal facility equipped with operant self-administration chambers, EPM equipments, Porsolt swimming tubes, open field arenas for social interaction, Noldus Etovision system for behavioral monitoring, etc. Fully equipped lab for immunohistochemistry, light, confocal and scanning electron microscopes are available. Finally, equipment for molecular and cellular studies is available.

Preferred Research Skills and Competences
The doctoral candidate will receive training in the techniques most commonly used in basic neuroscience, including brain activity recording, imaging, proteomics, behavioural testing, molecular biology, histology and data analysis. Candidates with training backgrounds in life sciences, behavioral pharmacology, pharmaceutical sciences, molecular genetics, are preferentially considered for this position.

Special requirements, additional to "standard" ones:
The Phd Student must collaborate in the reporting activities as scheduled in the Funding Program and meet any further requirements set by the MUR in the framework of the PNRR (Italian National Plan for Recovery and Resilience) – NGEU, and in particular under the Ministerial Decree n. 630/2024:
- Semestral reports through the MUR dedicated online portal
- Respect of the DNSH principle and horizontal principles of the Program
- Respect of deadlines and guidelines set by the MUR

Curriculum 3: Preclinical, Clinical and Translational Neuroscience

Code 3.14

Scholarship funded under: NGEU – PNRR, DM 630/2024, M4 C2 I3.3 CUP J11J24001950006
With the contribution of Laboratorio Farmaceutico CT (Sanremo) VAT N° / registration n. 00071020085

Project Title: Effect of gamma-hydroxybutyric acid (GHB) on the co-administration of alcohol and cocaine in rats genetically selected for alcohol preference.

ERC Field: LS5_3 Neurochemistry and neuropharmacology; LS7_3 Pharmacology, pharmacogenomics, drug discovery and design, drug therapy; LS5_12 Psychiatric disorders

Key words: Reward and Motivation, Cocaine, Neurocircuitry, Pharmacology

Host Institution: University of Camerino

Reference person/supervisor: Massimo Ubaldi massimo.ubaldi@unicam.it

The proposed project aims to test the potential of gamma-hydroxybutyric acid (GHB) as a therapeutic option for individuals who simultaneously abuse alcohol and cocaine. Among the approved drugs for treating alcohol abuse is GHB, while pharmacological therapies for cocaine abuse are still in development, and no specific pharmacological treatment for cocaine dependence has been approved yet. In humans, the simultaneous use of multiple substances of abuse is very common. For example, it is widely reported that individuals who use cocaine often do so in conjunction with alcohol. Clinical studies have shown promising results in limiting alcohol abuse with GHB, with significantly increased abstinence rates compared to placebo. Additionally, GHB decreases the self-administration of cocaine. GHB exerts its effects by acting on GABA B receptors and extrasynaptic GABA A receptors and has a favorable safety profile and a good risk-benefit ratio in the treatment of alcohol dependence. With over 25 years of clinical use in Austria and Italy, GHB has shown acceptable adverse effects and few cases of abuse. Studies indicate that the efficacy of GHB in maintaining abstinence surpasses that of naltrexone, another drug used to prevent alcohol relapse.
In this project, an animal model of alcoholism will be used: msP rats (genetically selected for alcohol preference) that will be placed in conditions to self-administer both cocaine and alcohol to study the effect of GHB on their simultaneous self-administration. The efficacy of the drug in reducing both substances would provide evidence supporting its use in cases of polydrug dependence on alcohol and cocaine.

Research team and environment
The laboratories involved in the project offer a multidisciplinary environment to investigate complex questions in neuroscience. The main research focus of this team of researchers is on the study of the neurobiological basis of substance use disorder. Researchers have access to multiple laboratories, animal facility equipped with operant self-administration chambers, EPM equipments, Porsolt swimming tubes, open field arenas for social interaction, Noldus Etovision system for behavioral monitoring, etc. Fully equipped lab for immunohistochemistry, light, confocal and scanning electron microscopes are available. Finally, equipment for molecular and cellular studies is available.

Preferred Research Skills and Competences
The doctoral candidate will receive training in the techniques most commonly used in basic neuroscience, including pharmacology, proteomics, behavioural testing, molecular biology, histology and data analysis. Candidates with training backgrounds in life sciences, behavioral pharmacology, pharmaceutical sciences, molecular genetics, are preferentially considered for this position.

Special requirements, additional to "standard" ones:
The Phd Student must collaborate in the reporting activities as scheduled in the Funding Program and meet any further requirements set by the MUR in the framework of the PNRR (Italian National Plan for Recovery and Resilience) – NGEU, and in particular under the Ministerial Decree n. 630/2024:
- Semestral reports through the MUR dedicated online portal
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- Respect of deadlines and guidelines set by the MUR

Curriculum 3: Preclinical Clinical and Translational Neuroscience

Code 3.15

Scholarship co-funded with the contribution of TRIS PHARMA Inc.(USA)

Project title: To study the neurobiological, behavioral and pharmacological basis of drug addiction and chronic pain: Focus on the opioid system.

ERC Field: LS5_3 Neurochemistry and neuropharmacology; LS7_3 Pharmacology, pharmacogenomics, drug discovery and design, drug therapy;LS5_12 Psychiatric disorders

Key words: opioid use disorders, pain, opioid agonists, drug abuse, reward and motivation

Host Institution: University of Camerino

Reference person/supervisor: Roberto Ciccocioppo roberto.ciccocioppo@unicam.it

Research topic description

Opioid abuse is a serious global problem that affects the health, social and economic welfare of all societies.Opioid use disorder (OUD) is a medical condition characterized by the compulsive use of opioids despite adverse consequences from continued use and the development of a withdrawal syndrome when opioid use ends. Animal models provide a rigorous, convenient means to precisely control environmental context and drug exposure, and assess behavioral, molecular and cognitive changes associated with opioid use. Effective utilization of such models can be used to identify more efficacious pharamacotreatments for pain based on opioid agonism while simultaneously limiting their abuse potential. The aim of this PhD project is to study at behavioral, cellular and molecular levels the mechanisms through which is possible to treat pain and addiction by targeting the opioid receptor system.

Research team and environment

This research project will be carried out in the Laboratory of Neuropsychopharmacology, School of Pharmacy, University of Camerino, Italy. The laboratory, headed by Roberto Ciccocioppo, is conceived as a multidisciplinary environment to investigate complex questions in neuroscience. The main research focus of the laboratory is on the study of the neurobiological basis of abnormal behavior and brain functions relevant to human psychopathology with emphasis on motivation and reward-related disorders. The majority of this work is directed at the understanding the neurological mechanisms responsible for these aberrant behaviours and at identifying innovative pharmacological targets to aid the development of new more effective treatments. Attention to the study of neurocircuitry and molecular mechanisms controlling emotional and cognitive disturbances associated with protracted exposure to drugs of abuse or chronic stress is also an important area of research. Over the years this research team contributed to the preclinical development of at least 3 compounds that reached various clinical development stages. The team consists of several researchers, post-doctoral fellows and PhD students with different backgrounds including biology, pharmacology, philosophy, psychology and physics. Researchers have access to 1500 m2 of animal facility equipped with 50 operant self-administration chambers, EPM equipments, Porsolt swimming tubes, open field arenas for social interaction, Noldus Etovision system for behavioral monitoring, and areas dedicated to surgical procedures etc. Fully equipped lab for immunohistochemistry, light, confocal and scanning electron microscopes are also available. One laboratory is equipped an Electrophysiological setup for patch-clamp recordings in slices. Finally, equipment for molecular and cellular studies is available.

Preferred Research Skills and Competences

The doctoral candidate will receive training in the techniques most commonly used in basic neuroscience, including brain activity recording, imaging, electrophysiology, proteomics, behavioural testing, molecular biology, histology and data analysis. Pharmacological, chemogenetic and optogenetic approaches will be also experienced. Candidates with training backgrounds in life sciences, behavioral pharmacology, neurophysiology, pharmaceutical sciences, are preferentially considered for this position.

Curriculum 3: Preclinical Clinical and Translational Neuroscience

Code 3.16

Project title: To evaluate the neurobiological mechanisms regulating NaCl and water intake in rodent models.

ERC Field: LS5_3 Neurochemistry and neuropharmacology; LS7_3 Pharmacology, pharmacogenomics, drug discovery and design, drug therapy

Key words: Salt intake, thirst, motivation, neuronal damage, mineralocorticoids, hormones

Host Institution: University of Camerino

Reference person/supervisor: Carlo Polidori carlo.polidori@unicam.it

Research topic description. This research aims to explore the physiology and regulation of sodium chloride (NaCl) and water intake, focusing on the neurobiological mechanisms controlling their consumption and their health impacts. The study investigates the role of the hypothalamus and the renin-angiotensin-aldosterone system (RAAS) in regulating NaCl appetite and intake through a combination of animal studies using rodent models of excessive NaCl consumption and polydipsia. Through manipulation of dietary NaCl levels, or through pharmacological stimulation of its intake we aim to modify the neural and hormonal pathways, responsible for the motivation to its consumption. The expected outcomes include a detailed understanding of the neural circuits and hormonal influences on NaCl regulation, as well as the relationship between high NaCl intake and neurological damages possibly associated with hypertension. The findings aim to inform public health strategies and therapeutic approaches to manage salt consumption and mitigate associated health risks.

Research team and environment
This research project will be carried out in the Laboratory of Behvaioral Pharmacology, School of Pharmacy, University of Camerino, Italy. The team has established experience in rodent models of ingestive behavior. Reseacher will have access to 1500 m2 of animal facility equipped with metabolic cages, EPM equipments, Porsolt swimming tubes, open field arenas for social interaction, Noldus Etovision system for behavioral monitoring, Equipments for immunohistochemistry, western blot and gine expression analysis are also available.

Preferred Research Skills and Competences
The doctoral candidate will receive training in behavioral pharmacology technique commonly used in basic neuroscience. Candidates with training backgrounds in life sciences, behavioral pharmacologyphysiology, pharmaceutical sciences, are preferentially considered for this position.

Curriculum 4: Computational and System Neuroscience

Code 4.1

Scholarship funded under: NGEU – PNRR, DM 629/2024, M4 C1 I 4.1 "Ricerca PNRR" CUP J11J24001940006

Project title: Advanced Machine Learning methods to map brain-movement non-linear relationships.

ERC Field: SH4_5 Attention, perception, action, consciousness; LS5_2 Systems neuroscience and computational neuroscience (e.g. neural networks, neural modelling); LS5_5 Neural bases of cognitive processes (e.g. memory, learning, attention)

Key words: motor control, movement analysis, MoCap, EEG, machine learning, deep neural networks

Host Institution: University of Ferrara

Reference person/supervisor: Alessandro D'Ausilio **alessandro.dausilio@unife.it**

Research topic description

The study of how the activity of the nervous system controls human movements has been a central goal of neuroscience since the historical beginnings of this discipline (Fritsch, Hitzig, 1870). In more recent times, modelling the neural dynamics underlying movement coordination has become central to the construction of brain-machine interfaces. An application that in recent years has seen virtually all technological giants (e.g. Google, Facebook, Neuralink, etc.) enter the field.

Given the complexity of the issue, the problem has always been investigated according to a reductionist approach, especially on the behavioural side. In short, behaviour has always been reduced to the execution of rather simple and short movements, repeated hundreds of times. The evidence accumulated so far, however, makes it clear that this approach may have serious limitations, to the point of even producing artefactual results. Indeed, the nervous system does not control human movement in a fragmented fashion (Bernstein, 1967).

In fact, this methodological choice was fundamentally determined by the lack of adequate statistical tools. Recently, techniques capable of solving this problem have been proposed using the latest artificial intelligence methods. More specifically, techniques based on deep neural networks would be able to reveal the latent representations shared between the neural and behavioural data space (joint neural and behavioural latent embeddings; Schneider et al., Nature 2023; Safaie et al., Nature 2023). One of the strength of this family of methods is that they are not constrained by the dimensionality of neural and behavioural data.

The PhD student will be trained in these techniques and apply them to electroencephalographic and motion capture data of healthy participants during solo and dyadic motor interaction tasks. The aim is to explore latent individual and shared neuro-behavioural representations in a range of tasks designed to explore how two brains change because of a socio-motor interaction.

Research team and environment

The PhD student will have access to state-of-the-art laboratories for human movement and non-invasive electrophysiological recordings and will be part of a group already working on these AI technologies (2 post-docs and 2 more PhD students). The candidate will also benefit from participating in the research and training activities promoted by the Translational Neurophysiology Centre of the Italian Institute of Technology, hosted by the University of Ferrara, and by the network of experts participating in the EU PRIMI project.

Preferred Research Skills and Competences

The ideal candidate has a degree in engineering, computer science, physics or neuroscience and has a particular interest in working with non-invasive human neurophysiological signals and motion capture data. Advanced programming skills and a general knowledge of common machine learning techniques are required.

Special requirements, additional to "standard" ones:
The Phd Student must collaborate in the reporting activities as scheduled in the Funding Program and meet any further requirements set by the MUR in the framework of the PNRR (Italian National Plan for Recovery and Resilience) – NGEU, and in particular under the Ministerial Decree n. 629/2024:
- Semestral reports through the MUR dedicated online portal
- Respect of the DNSH principle and horizontal principles of the Program
- Respect of deadlines and guidelines set by the MUR

Curriculum 4: Computational and System Neuroscience

Code 4.2

Scholarship funded under: NGEU – PNRR, DM 630/2024, M4 C2 I3.3 CUP
With the contribution of Institute of Universitätsmedizin der Johannes Gutenberg-Universität Mainz, Germany

Project title: Functional modeling of brain dynamics: understanding reinforcement learning through the lens of dynamical systems.

ERC Field: PE6_11 Machine learning, statistical data processing and applications using signal processing; PE6_12 Scientific computing, simulation and modelling tools; LS5_9 Neural basis of cognition; LS5_16 Systems and computational neuroscience; LS5_18 Innovative methods and tools for neuroscience.

Key words: neural coding, neuronal manifolds, modelling, dynamical system reconstruction, RNN, statistical mechanics, machine learning, reinforcement learning, dopamine.

Host Institution: Sant'Anna School of Advanced Studies, BioRobotics Institute

Reference person/supervisor: Russo Eleonora eleonora.russo@santannapisa.it

Research topic description
Understanding the dynamical systems governing neuronal activity is crucial for unraveling how the brain performs cognitive functions. Historically, various forms of recurrent neural networks (RNNs) have been proposed as simplified models of the cortex. Recently, due to remarkable advancements in machine learning, RNNs' ability to capture temporal dependencies has been used to develop tools for approximating unknown dynamical systems by training them on observed time-series data. This approach allows us to use time series of electrophysiological multi-single unit recordings as well as whole brain ultra-high field functional imaging (fMRI) to parametrize neuronal population dynamics and build functional models of cognitive functions. The objective of this research project is to investigate the neuronal mechanisms underlying the reinforcement and depreciation of perceived stimuli in the extended network of the mouse forebrain regions.

Research team and environment
The PhD student will carry out his/her/their studies primarily at the BioRobotics Institute of Sant'Anna School of Advanced Studies. The project will expose the student to a highly international and interdisciplinary context, in tight collaboration with theoretical and experimental neuroscientists in Italy and abroad. At the BioRobotics Institute, the research groups involved will be the Brain Dynamics Lab, the Computational Neuroengineering Lab, and the Bioelectronics and Bioengineering Area. Moreover, the project will be carried out in tight collaboration with the experimental group of Prof. Wolfgang Kelsch, Johannes Gutenberg University, Mainz, Germany. During the PhD, the student will have the opportunity to spend a period abroad.

Preferred Research Skills and Competences
The ideal candidate has a strong interest in neuroscience and a background in physics / math / biomedical engineering with computational and programming skills (ideally, knowledge of Matlab and/or Python). The ideal candidate carries out his/her/their work in a diligent, independent, and highly collaborative manner. The project will not require any experimental work.

Special requirements, additional to "standard" ones:
The Phd Student must collaborate in the reporting activities as scheduled in the Funding Program and meet any further requirements set by the MUR in the framework of the PNRR (Italian National Plan for Recovery and Resilience) – NGEU, and in particular under the Ministerial Decree n. 630/2024:
- Semestral reports through the MUR dedicated online portal
- Respect of the DNSH principle and horizontal principles of the Program
- Respect of deadlines and guidelines set by the MUR

Curriculum 4: Computational and System Neuroscience

Code 4.3

Project Title: Development of Medical devices for e-Health and Innovative diagnostics for precision medicine.

ERC Field: PE6_11 Machine learning, statistical data processing and applications using signal processing; PE6_12 Scientific computing, simulation and modelling tools; LS5_2 Systems neuroscience and computational neuroscience.

Key words: Diagnostics for brain disorders; electronics, machine learning, coding.

Host Institution: University of Camerino

Reference person/supervisor: Massimo Ubaldi massimo.ubaldi@unicam.it

Research topic description
The main goal of this project is to develop innovative, contactless, and non-invasive diagnostic sensors for use in healthcare with focus on brain disorders. A secondary objective is to enhance community healthcare by equipping it with advanced tools that improve the management of healthcare services. The development of sensor systems for remote diagnostics would enhance home health monitoring capabilities, thereby reducing pressure on hospital and outpatient services. Contactless, non-invasive sensors enable the acquisition of information related to the subject under examination without requiring them to perform particularly complex actions. The operating principle of these sensors is based on the processing of both radar (radio frequency) and three-dimensional video signals. The application of appropriate artificial intelligence algorithms allows the extraction of characteristics of interest of the individual under examination, both from a physiological and behavioral or movement-related perspective. Information can be deduced regarding the subject's ability to walk, any falls or tremors, as well as information related to simple daily gestures that can monitor the state of health, both physical and mental.
The prototype sensor will be developed by testing its capacity in laboratory animals and then tested in humans. The project will be conducted in close collaboration with AM-Microsystem and Tech4care, two companies involved in the development of electronic devices for healthcare.

Research team and environment
The University of Camerino will provide the research laboratories of the School of Pharmaceutical and Health Products Sciences, which feature cutting-edge diagnostic and analytical equipment. AM-Microsystem will provide the technology for sensor development whereas, Tech4care, will provide the PhD student with access to the ICT Laboratory of the Faculty of Engineering, Department of Information Engineering at the University of Ancona. This laboratory has electronic equipment for signal generation, analysis, and processing, radar and environmental sensors (commonly used for ongoing research activities), and an IT infrastructure for data acquisition, storage, and processing.

Preferred Research Skills and Competences
The ideal candidate has a strong interest in neuroscience and non-invasive neurophysiological signals and motion capture data. A background in engineering, computer science, physics with computational and programming skills (ideally, knowledge of Matlab and/or Python) are evaluated favorably. The ideal candidate is expected to show ability to work independently in a highly collaborative environment.

Curriculum 4: Computational and System Neuroscience

Code 4.4

Project title: Cross-disease and multi-modal omics approach to neurodegenerative diseases

ERC Field: LS2_4 Genetic epidemiology; LS2_8 Transcriptomics; LS2_12 Bioinformatics

Key words: Alzheimer's; Genomics; Neurodegenerative disorders; Parkinson's; Transcriptomics

Host Institution: University of Camerino

Reference person/supervisor: Valerio Napolioni valerio.napolioni@unicam.it

Research topic description

Neurodegenerative diseases, including Alzheimer's disease (AD), Parkinson's disease (PD), and Amyotrophic Lateral Sclerosis (ALS), impose a major global health burden. Despite their distinct clinical features, these conditions share common pathological mechanisms such as protein misfolding, oxidative stress, and neuroinflammation. This project aims to elucidate the molecular underpinnings of these diseases through a cross-disease, multi-modal omics approach. By integrating genomics, transcriptomics, proteomics, metabolomics, and epigenomics data from AD, PD, and ALS patients, a comprehensive dataset will be generated. Advanced bioinformatics and machine learning techniques will be employed to identify biomarkers, pathways, and therapeutic targets. Objectives include creating a detailed multi-omics dataset, integrating, and analyzing these datasets to identify key regulatory nodes, and discovering and validating biomarkers for diagnostic and therapeutic purposes. Cross-disease comparisons will highlight common and distinct molecular pathways, with functional validation conducted in vitro and in vivo. This approach promises to enhance the understanding of neurodegenerative diseases, improve diagnostic and prognostic capabilities, and facilitate personalized therapeutic strategies. The resulting multi-modal dataset will be a valuable resource for future research, potentially leading to broad-spectrum therapeutic advancements.

Research team and environment

This research project will be carried out in the Genomic And Molecular Epidemiology (GAME) laboratory, School of Biosciences and Veterinary Medicine, University of Camerino, Italy. The laboratory, headed by Prof. Valerio Napolioni, is conceived as a multidisciplinary environment to investigate complex questions in both human and animal genomics. The PhD fellow will work under the main supervision of Prof. Napolioni, along with the collaboration of his two post-doc fellows, both expert in bioinformatics and analysis of big-genomic data. The laboratory consists of both computational and wet-lab areas, in a total of 4 rooms; the wet-lab is organized in four areas to avoid contamination during the different steps in the molecular assay: storage room (samples storage), sample preparation area (DNA/RNA extraction), PCR area (amplification) and a post-PCR area (Detection or quantization of amplified product). The following laboratory machinery are available: MJ Mini - Personal Thermal Cycler (BIO-RAD), Real Time PCR machine (BIO-RAD), Centrifuge 5418 (Eppendorf), Shaking water bath - ST 402 (Nuve), Vortex ZX3 (VELP Scientifica), Incubator MABEL, Ultra-Turrax homogenizer, Stove Thermostabil K, Spectrophotometer UV-1600 PC (VWR), Transiluminator Uvitec Cambridge, laboratory hood for microbiology and chemistry. For the storage of the biological samples a cold room for storage +4 C, a Freezer -80 C, two Freezers -20 C and two Refrigerators +4 C are available. Computational resources: 2 x (256 Gigabytes RAM server) + 300 Terabytes of data storage.

Preferred Research Skills and Competences

Candidates with training backgrounds in life sciences, genomics and transcriptomics are preferentially considered for this position. Knowledge of Linux OS and R programming is mandatory.

Curriculum 4: Computational and System Neuroscience

Code 4.5

Project title: Computational Modeling of Reinforcement, Motivation, and Drug-Seeking Behavior in Rodents

ERC Field: LS5: Neurosciences and Neural Disorders: Neurobiology, neuroanatomy, neurophysiology, neurochemistry, neuropharmacology, neuroimaging, systems neuroscience, neurological and psychiatric disorders

Key words: Reward, modelling, neurocircuits, reinforcement, rodent

Host Institution: University of Camerino

Reference person/supervisor: Roberto Ciccocioppo roberto.ciccocioppo@unicam.it

Project decsription: We aim to develop and utilize computational models to simulate and analyze the reinforcing, motivational, and drug-seeking effects of drugs of abuse. By integrating data from molecular biology and immunohistochemical techniques, as well as Designer Receptors Exclusively Activated by Designer Drugs (DREADD) experiments, we will explore the neurocircuitry-level consequences of prolonged drug exposure. Our goal is to understand how the manipulation of neural circuits involved in the regulation of motivated behavior and emotion modulates seeking and taking responses for drugs of abuse compared to natural reinforcers. By structuring this project into a neurocomputational framework, we aim to leverage the power of computational models to gain deeper insights into the complex dynamics of drug-seeking behavior and its underlying neural mechanisms.

Research team and environment: This research project will be carried out in the School of Pharmacy, Center for Neuroscience, University of Camerino, Italy. The laboratory headed by Prof. Roberto Ciccocioppo is conceived as a multidisciplinary environment to investigate complex questions in the field of neuroscience, advancing the understanding of the molecular basis of neuropsychiatric and neurodegenerative disorders.

Preferred Research Skills and Competences
Candidates with training backgrounds in life sciences, with experience in computational neuroscience While experience in in vitro electrophysiology is not required, it is highly appreciated.