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2026 Topic-Specific Grants and Descriptions – FIRST CALL

1. Investigating the effect of naturalistic hierarchical context on neural prediction using MEG-based dynamic RSA (I. De Vries - 1 position)

FIS 3 DE VRIES: Codice Progetto FIS-2024-01366 - CUP E53C25002550001 – “Naturalistic Predictions: How our brain anticipates the future in a dynamic world”

Adaptive behaviour (e.g., in traffic or sports) requires our brain to continuously predict unfolding external events. Contemporary theories posit that our brain combines an internal hierarchical model of the spatio-temporal structure of our world with new sensory input to continuously generate those predictions (e.g., [1,2,3]). This model is hierarchical in the sense that higher-level representations exert top-down influence / constraints on lower-level representations. A key example is biological motion perception. The motion of a hand is biomechanically constrained by the arm it belongs to, which in turn is constrained by the body, which is constrained by the environment (and objects) it may interact with, and at even higher levels by the actor's intentions. Our hierarchical internal model should constrain future outcomes, and therefore facilitate neural prediction.

However, while hierarchical prediction theories of brain function are gaining traction, empirical support mostly comes from highly controlled artificial paradigms that use simple, discrete and often static stimuli. While these conventional paradigms show that the brain can predict, they lack the naturalistic hierarchical structure of our everyday world, and therefore do not allow testing if and how hierarchically higher levels constrain and facilitate predictions at lower levels in naturalistic dynamic input.

We recently developed a new approach in the lab that combines MEG recordings of participants observing naturalistic dynamic input (e.g., movies), with dynamic representational similarity analysis (dRSA) to quantify both the strength and the millisecond-precision latency of neural representations of naturalistic dynamic input, across hierarchical levels of stimulus complexity (from perceptual-to-conceptual). In this project the PhD student will use this approach to systematically investigate if and how naturalistic hierarchical structure in the input facilitates predictive processing in the brain. See [4,5] for relevant previous research from the lab on which this project will build.

The ideal candidate should have a background in cognitive neuroscience and neuroimaging (preferably M/EEG or fMRI, MVPA/RSA) and strong programming skills (preferably Matlab or Python). Candidates with a neighbouring background with strong computational skills (computer science/engineering, math, etc.) are also encouraged to apply. Please do get in touch with the PI for further details (ingmar.devries@unitn.it).

References

- Clark, A. (2013) Whatever next? Predictive brains, situated agents, and the future of cognitive science. *Behavioral and Brain Sciences* 36, 181–204.
- De Lange, F. P., Heilbron, M. & Kok, P. (2018) How Do Expectations Shape Perception? *Trends Cogn Sci* 22.
- Friston (2010) The free-energy principle: a unified brain theory? *Nat Rev Neurosci* 11, 127–138



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De Vries, I.E.J., Wurm, M.F. (2023) Predictive neural representations of naturalistic dynamic input. Nat Commun 14, 3858

De Vries, I.E.J., De Lange, F.P., Wurm, M.F. (2025) Hierarchical priors enable neural prediction of perceived biological motion. <https://doi.org/10.1101/2025.10.09.681210>



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2. Beyond object recognition in biological and artificial object vision (S. Bracci - 1 position)

FIS 2 BRACCI: Codice Progetto FIS-2023-02203 - CUP E53C25001830001 - "HIAP - Human-Inspired Artificial Perception"

In object vision, current AI models are trained to recognise objects, based on the premise that perceiving objects represents the ultimate computational goal of our visual system. Yet, human object vision is far from being solved and accumulating evidence suggests that to understand object vision we need to move beyond the object recognition framework. Through an integrated cognitive-computational approach this PhD project will investigate the role of behavioural goals neural is shaping representational content and spatial organization of object representations in the human visual system.

A series of functional neuroimaging (fMRI) experiments will map how different behavioural goals influence neural representations of objects and their semantic structure. These data will be analysed using multivariate techniques, including Representational Similarity Analysis (RSA), to characterise the representational geometry underlying visual and semantic object processing. In addition, state-of-the-art AI models will be used to model and quantify the structure of visual representations, enabling direct comparisons between neural, behavioural, and computational representational spaces.

The selected candidate will be responsible for carrying out the project, including the acquisition of neuroimaging data and the implementation of the planned computational and multivariate data analyses.

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3. Comparative visual information processing mechanisms and brain asymmetry, with particular reference to the comparison between vertebrates and invertebrates (G. Vallortigara / G. Stancher - 1 position)

This is a co-funded PhD scholarship between Prof. Giorgio Vallortigara and the [Fondazione Museo Civico di Rovereto](#). The asymmetry of function is a foundational mechanism for all nervous systems, both vertebrates and invertebrates, with special reference to vision that will be investigated here mainly with behavioural



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methods. The ideal candidate should possess a Master degree in Natural Sciences, Psychology, Biology, Neuroscience or related disciplines and experience with behavioural and ethological methods in both invertebrates and vertebrates. The dissemination at the Museum aims to equip young scholars with solid communication skills to convey their findings and scientific knowledge to audiences of diverse backgrounds and ages, as well as employing multiple methods of communication in events such as science festivals, exhibitions, and conferences.

The doctoral student will have the opportunity to immerse himself or herself in a dynamic, stimulating environment, characterized by a strong multidisciplinary approach and multiple institutional objectives. He/she will have access to the Museum's exhibition rooms, laboratories and deposit and will be supported by staff experts in the fields of research, or in communication, teaching, and dissemination. It will be offered to him/her individual mentoring in exploring the institution's resources and network. The student will have the opportunity to experiment with different communication methods, as well as to explore how his/her project (and, more generally, his/her knowledge) fits within a broader conceptual framework, possibly multidisciplinary, which will facilitate its dissemination to a non-expert audience.

Supervisor: [Giorgio Vallortigara](#)

4. Integrated Multimodal Connectomics for Predicting Progression and Outcomes in Neurological Disorders (L. Coletta - FBK - 1 position)

Neurological disorders are increasingly understood as network-level pathologies, yet current clinical tools struggle to integrate heterogeneous sources of biological and clinical data into reliable prognostic models. This PhD project aims to develop an integrated multimodal connectomics framework combining structural and functional neuroimaging, clinical and behavioral measures, and advanced data science approaches to characterize individualized patterns of brain connectivity. Leveraging diffusion MRI tractography, functional connectivity analyses, and harmonized clinical datasets, the project will implement machine learning and artificial intelligence methods to model disease trajectories and predict functional outcomes at the patient-specific level.

The PhD scholarship will be hosted at The Neuroinformatics Laboratory (<https://nilab.fbk.eu/research/>), directed by Dr. Paolo Avesani. The lab is embedded within the Center for Augmented Intelligence at the Fondazione Bruno Kessler (Trento). The supervisor will be Dr. Ludovico Coletta.

The successful candidate is expected to develop from scratch point cloud and graph neural networks using python based solutions (PyTorch). Knowledge in neuroimaging – and especially of preprocessing softwares using the command line (FSL, AFNI, ANTs, and the Python ecosystem) – is a strong plus. For further information, candidates are strongly encouraged to get in contact with Paolo Avesani and Ludovico Coletta.

5. Neuroimaging and electrophysiological biomarkers behind autisms distinguished by disability versus difference over development (M. Lombardo - IIT - 1 position)

The Laboratory of Autism and Neurodevelopmental Disorders at IIT (IIT-LAND), directed by Dr. Michael Lombardo, at the Center for Neuroscience and Cognitive Systems, Istituto Italiano di Tecnologia, Rovereto,



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invites applications for 2 PhD scholarships to investigate early biomarkers behind autism subtypes. Our research aims to understand how autism may be split into distinctive types of autisms, characterized by distinctive phenotypic presentation, underlying neurobiological mechanisms, and differential responses to treatment. To answer these types of questions, we use a combination of approaches from neuroimaging (EEG, MRI), cognitive and computational neuroscience, and data science. Our work is primarily focused on human patients (i.e. autistic children), but we also collaborate with other groups on larger cross-cutting translational work focused on elucidating biological mechanisms in model systems. For more info, see: <https://land.iit.it>.

We have 2 PhD positions focused on identifying biomarkers for different clinically and behaviorally distinctive subtypes of autism. The work heavily focuses on methodologies such as eye tracking, EEG, and MRI/fMRI. The datasets we work with are a combination of large publicly available datasets, datasets from international collaborators, as well as data coming from ongoing experiments run within IIT-LAND. The work will heavily rely on new or past stratification models of neural and phenotypically distinctive autism subtypes. The two positions are fully-funded off of an ERC Consolidator Grant to Dr. Michael Lombardo.

We are looking for talented and highly motivated individuals that can build on prior skill sets or knowledge within the core areas of our research - EEG, eye tracking, neuroimaging (MRI, fMRI), data science, and autism. Advanced understanding and conceptual thinking with regards to statistics and big data analysis is a plus, as is requisite computational and programming skills (e.g., R, Python, MATLAB) to implement such ideas. Ability to speak both Italian and English is highly prioritized. Good communication skills and ability to work within larger groups is also emphasized. Strong passion/desire to pursue an academic career focusing on neurodevelopmental disorders like autism is also a key characteristic we are looking for, as is an existing strong grasp of the literature on autism and neurodevelopmental disorders.

Successful candidates will join a growing diverse, multidisciplinary and collegial group, and will be offered direct training, supervision and mentorship from the principal investigator and other senior members of the lab. The work also offers up the possibility of working within a larger international context, as nearly all of the work we do on this topic is done with collaborations from colleagues in Europe and the USA. The position is a four-year scholarship in the international doctoral school in Cognitive and Brain Sciences (CIMEC) at the University of Trento. Candidates will join a diverse cohort of PhD students and receive multi-disciplinary training at the interface of computational, experimental and cognitive neuroscience across humans and animal models.

The IIT-CNCS in Rovereto is actively expanding its infrastructure for systems level neuroscience research. Our center is located in Trentino, a region of Northern Italy nested within the Dolomite mountains, offering easy access to spectacular natural beauty and mountaineering, vibrant culture and exceptional quality of life (<https://www.iit.it/it-IT/cncs-unitn/>).

Candidates can informally contact Dr Michael Lombardo (michael.lombardo@iit.it) to gather more information about the position, the project, the application procedure and the selection process.

7. Whole brain modelling of mouse brain functional activity (A. Gozzi - IIT - 1 position)

The doctoral student will develop and apply whole-brain network models of mouse brain activity (including modelling frameworks such as neural mass models), to investigate the principles governing large-scale



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functional brain dynamics. By integrating computational approaches with experimental neuroimaging data, the project will examine how interactions between distributed brain regions give rise to coherent patterns of activity across the mouse brain. A central goal will be to understand how structural and functional network organization constrain spontaneous and evoked activity, and how these large-scale dynamics responds to targeted perturbation. The project will provide a quantitative and mechanistic framework to link local circuit processes with global brain dynamics. Contact alessandro.gozzi@iit.it

8. Functional ultrasound imaging of large-scale mouse brain network (A. Gozzi - IIT - 1 position)

The doctoral student will use functional ultrasound imaging (fUSI) to investigate the organization and dynamics of large-scale brain networks in the mouse. fUSI offers a powerful approach for mapping brain-wide activity and functional connectivity with high spatial and temporal resolution, enabling the non invasive mapping of distributed neural dynamics in the mouse brain (see Pepe et al., biorXiv, 2026). The project will apply this methodology to characterize patterns of spontaneous and task-related activity in the awake mouse. The overall goal is to understand how distributed brain circuits coordinate activity during cognition and how network-level organization emerges in the mammalian brain. Contact alessandro.gozzi@iit.it

9. Synaptic mechanisms of visual computation and visuo-motor learning (F. Rossi - IIT - 1 position)

The [Rossi Lab](#) invites applications for a PhD scholarship at the Center for Neuroscience and Cognitive Systems (CNCS), Istituto Italiano di Tecnologia (IIT), Rovereto (Italy), to investigate the synaptic mechanisms of visual computation and learning in visual and motor cortex, by combining two-photon imaging and optogenetic connectivity mapping.

Role summary

The successful candidate will study the rules of functional connectivity and plasticity of direction selective neurons and circuits in visual and motor cortical areas. The project combines:

- two-photon imaging, including dendritic and synaptic imaging
- connectivity mapping with viral tracing and optogenetics
- rodent behavior in VR
- analysis of resulting data

The student will join an international, diverse and multidisciplinary team at IIT, and will be affiliated to the PhD program in Cognitive and Brain Sciences in partnership with the University of Trento.

Scholarship details:

The position is a four-years scholarship, offered in partnership between IIT and the international doctoral school in Cognitive and Brain Sciences ([CIMEC](#)) at the University of Trento. The scholarship amounts to €1,650 net per month, which exceeds the standard level of most Italian PhD programs. Candidates will join a diverse cohort of PhD students and receive multi-disciplinary training at the interface of computational, experimental and cognitive neuroscience across humans and animal models.



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Host lab and training offered:

The [Rossi Lab](https://rossilab.iit.it/lab-culture) aims to understand the neural architectures underlying adaptive visual processing and visually guided behavior in mice, combining two-photon functional imaging, optogenetics, viral tracing and spatial transcriptomics to link function, connectivity, and gene expression across scales. The Rossi lab is a co-founder and supporter of the SAFE Labs network: for more details on the lab culture and policies can be found at this link: <https://rossilab.iit.it/lab-culture>

In the lab, the student will be offered direct training, supervision and mentorship from the principal investigator. They will be also sponsored to attend top international workshops and courses, as well as training provided within IIT and our partners at University of Trento. Additional training computational modelling of neural circuits and neural networks will be offered via our collaboration with the Sanzeni lab (Università Bocconi).

The [IIT-CNCS](#) in Rovereto centre is located in Trentino, a region of Northern Italy nested in the Dolomite mountains, offering easy access to spectacular natural beauty and mountaineering, vibrant culture and exceptional quality of life.

Candidate profile:

We are looking for MSc graduates (or equivalent) across STEM and engineering backgrounds, who wonder at the marvels of experimental observation, enjoy crafting new tools to investigate neurophysiology and animal behaviour, and are eager to challenge their expertise.

Besides their track record and interest for the lab research programme, candidates will be assessed on: critical thinking; hands-on training in experimental physiology or computational modelling; data analysis and programming skills in Python or Matlab; science communication skills in English; expertise in designing and controlling experimental and behavioural setups.

10. Psychophysical models of the modular visual system of jumping spiders (P. Neri - IIT - 1 position)

Hierarchical models have become ubiquitous in describing the nervous processes that govern visual perception in the brain, as well as computer vision algorithms. This holds across the whole tree of life, from humans to insects. In fact, even brains without common structures seem to follow the same functional organization, and are even subject to the same perceptual errors, and visual illusions. In the end, the rules described by psychophysics hold true throughout. Recently however, a novel model of visual perception has challenged this notion: the jumping spiders. With a modular visual system distributed across 8 different eyes, the computation of the visual scene is split into distinct functional units that interact only partially. In such an architecture, generally accepted psychophysical principles may not hold true. Indeed, there is already available evidence suggesting that jumping spiders are immune to common visual illusions, like the peripheral drift. The subject of your PhD will be the identification of the rules governing this unique visual system.

This PhD project will be carried out in collaboration between Professor Peter Neri, PI of the Sensory Process and Computation lab of IIT, and Dr Massimo De Agrò, Assistant Professor at CIMeC. You will be implementing highly controlled experiments using automated stimuli presentation procedures, to be programmed from scratch. You will collect spiders from nature, learn how to maintain their population and prepare specimens for testing. You will also learn how to design and implement computational models describing their perception. Lastly, you will have the opportunity to use neurophysiological techniques.



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You should be comfortable with quantitative subjects, and ideally have at least some experiences with computer programming. It is essential that you enjoy coding, because this PhD project involves a lot of it, potentially spanning different languages (e.g., Python, C#, javascript) and platforms (e.g., Pytorch, Unity3D).

Contact: peter.neri@iit.it or massimo.deagro@unitn.it