A.Y. 2022/2023
TEACHING OFFER

In line with the requests received during the PhD Retreat of May 2022, the teaching offer of Basic, Soft Skills and Advanced Courses and the format of Journal Club have been redesigned.

BASIC COURSES (in person)

PhD students are required to choose minimum 2 out of three macro topics or specific courses across the three macro topics (for a total of 68 hours). Course choices are binding. The Basic Courses will be held in person (minimum: 70% of attendance) and only PhD students who are abroad can attend the courses online.

TOPIC 1: STATISTICS (34 hours)

I module: Dr. Angela Andreella; 6 hours (1st year)
Syllabus: The first module will cover three main topics:
1. Reproducibility in Neuroscience: main concepts, when we fall into it, and how to fix it (open data, code sharing...)
2. Introduction to the programming language R, and notebooks, i.e. a solution for having reproducible results: basic R commands and basics of R markdown
3. Exploratory Data Analysis (EDA), i.e. how to start with data analysis. It can be roughly summarized in 3 parts: (a) Structure and summary of data (type of variables, location indices); (b) Exploratory plots (histograms, box-plots, correlograms, scatter-plots..); (c) Preprocessing step (transformation of variables, dealing with missing values, outliers). This part will be developed from a theoretical and practical (using R) point of view with real data applications.

II module: Dr. Federico Ferraccioli; 6 hours (1st year)
Syllabus: The second module will cover two main topics:
1. Before modeling, i.e. how to plan a good experimental design: main concepts, the difference between randomized experiments and observational studies, type of randomization, the concept of replication, and why "correlation does not imply causation".
2. Modeling: Linear regression, the concept of contrasts, the interaction between variables, analysis of confounders, how to deal with nested variation, and how to apply these elements from a theoretical and practical (using R) point of view with real data applications.

III module: Graph theory and null models, Prof. Samir Suweis; 7 hours (1st year)
Syllabus: This course covers some basic concepts of graph theory including connectivity, centralities, assortativity and clustering. Applications on some real networks are also shown. The second part of the course in-

troduces some more advanced topics, such as the use of random graphs (Erdos-Reny, Small-World and Barabasi) as null models, to actually infer biological information from data on brain networks. Upon completion of the course, students will be able to: (1) Calculate the main structural properties of graphs (2) understand the fundamental properties of some families of random graphs; (3) Use random graphs as null models to test different properties of real networks.

IV module: Repetitive measures, GLM, mixed models, Prof. Livio Finos; 8 hours (2nd year)
Syllabus: TBA

V module: Permutation and multiple testing, Prof. Livio Finos; 7 Hours (2nd year)
Syllabus: TBA

TOPIC 2: NEUROIMAGING TECHNIQUES (34 hours)

Basic course on programming in Python, Prof. Massimo Melucci; 8 hours
Syllabus: TBA

Analysis of EEG signal (theory and hands-on), Prof. Camillo Porcaro; 12 hours
Syllabus: The course will provide the basic skills to collect and analyze electroencephalographic (EEG) signals. Practical sessions will allow students to gain experience with EEG recording. If access to the laboratory is limited, the EEG recording will be addressed by showing ad hoc video tutorials. The course will also underline step-by-step EEG pre-processing for data at rest and during event-related potential (ERP) analysis. The analysis will be conducted using EEGLAB software or other open-access software based on the student's specific needs. All lessons will include theoretical and practical sessions to allow the students to familiarize themselves with the software. Direct interactions will be encouraged during the lessons.

Analysis of fMRI and PET signals (theory and hands-on), Prof. Alessandra Bertoldo and Dr. Lorenzo Pini; 14 hours
Syllabus: TBA

TOPIC 3: NEUROANATOMY, NEUROPHYSIOLOGY & NEUROPSYCHOLOGY (38 hours)

Neuroanatomy, Prof. Renzo Manara; 12 hours
Syllabus: The present Neuroimaging Course deals with the recognition of the main anatomical brain landmarks (sulci, gyri, nuclei and neural structures including cranial nerves). In addition, main intracranial vessels (arteries and venous sinuses), the anatomy of the temporal bone (inner ear, ossicle chain, VII and VIII cranial nerves) and the spine anatomy (spinal cord, nerve roots and bone structures) will be shown in routine MRI and CT exams.

Neurophysiology (theory and laboratory), Prof. Aram Megighian; 10 hours (6 + 4)

Syllabus: Visuomotor responses; navigation; basal ganglia.

Psychophysiology, Prof. Chiara Spironelli and Prof. Simone Messerotti Benvenuti; 6 hours (3 + 3)

Syllabus: The Psychophysiology course provides a brief review of the main psychophysiological models along with the basic techniques and methods used in this field during a psychophysiological assessment. The association between body and mind is scientifically analyzed not only by introducing the characteristics of every approach, but also with a practical/supervised training session.

1. First module (3 hours) – Prof. Spironelli: (1) The key concepts of the psychophysiological approach; dependent and independent variables. (2) Electroencephalography (EEG), electromyography (EMG) and eye movement/blinks: basic information and practical/supervised training on EEG.
2. Second module (3 hours) – Prof. Messerotti Benvenuti: Emotion, attention and the startle reflex. Autonomic psychophysiology: models and basic techniques, including examples of clinical applications and practical activity.

Neuropsychology, Dr. Andrea Zangrossi; 8 hours

Syllabus: The Neuropsychology course will give a theoretical and practical introduction to the brain-behavior link. We will focus on a selection of cognitive functions (e.g., memory, attention and visuospatial functions, executive functions) and related deficits, quantitative assessment (i.e., tests) and neural correlates.

Lab in Neuroanatomy, Prof. Raffaele De Caro; 2 hours

Syllabus: The Neuroanatomy Lab will consist in a practical session focusing on brain cutting and dissection. The aim of the laboratory is to allow PhD students to evaluate neuroanatomical structures first-hand by employing human specimens deriving from the body donation program of the University of Padua. A personal lab coat is recommended.

SOFT SKILLS (mandatory for all)

Presentation skills and public outreach, Dr. Giorgia Cona; 4 hours

Syllabus: This course illustrates the basic guidelines to make an effective talk and includes practical exercises. In the first part of the course, theoretical lessons will deal with: (a) how to prepare slides; (b) communicative aspects; (c) emotional aspects; (d) content of the talk. In the second part of the course PhD students will be challenged with theatrical and public speaking exercises.

Academic writing: How to write a scientific paper, Prof. Judit Gervain; 4 hours (1st semester of the 2nd year)

Syllabus: This course is a hands-on, practical course introducing students to the basic principles of writing academic texts in English. Students will be familiarized with basic guidelines and best practices, will carry out exercises and small assignments and will then be working on an individual writing project for which they will get personalized feedback.

1h: How to write an efficient sentence
1h: How to write an efficient paragraph
1h: How to write an efficient text
1h: Project discussion and individual feedback

Practical lesson on how to write scientific papers, Dr. Elena Becker Barroso; 1 hour

Syllabus: TBA

Grant Writing Workshop, prof. Nazareno Paolocci; 6 hours (?) (2nd semester of 2nd year and also for PhD students in their 3rd year)

Syllabus: TBA

Open Science: Toward a change in the scientific paradigm, Prof. Massimo Grassi; 1 hour

Syllabus: TBA

ADVANCED COURSES

PhD students are required to choose the modules that they find more useful and interesting for their research training to complete the required number of hours (minimum: 16 hours). PhD students are also allowed to choose courses from other Institutions or curricula (the classification in curricula is only meant to better cluster methodological skills and knowledge), as they are strongly encouraged to broaden their horizon to the different aspects of Neurosciences.

1. PROGRAMMING AND COMPUTATIONAL NEUROSCIENCE

Basic introduction to Bayesian reasoning, Prof. Giovanni Zanzotto; 8 hours
Syllabus: TBA

Data reduction for neuroimaging data, Dr. Michele Allegra and Prof. Samir Suweis; 12 hours
Syllabus: TBA

Programming in Python—Advanced, Dr. Emanuele Di Buccio; 10 hours
PhD students can choose whether to do only the Basic Course or the Advanced Course, too.
Syllabus: TBA

Deep learning in Biomedical Imaging, Dr. Marco Castellaro; 16 hours
Syllabus: TBA

2. COGNITIVE AND BEHAVIORAL NEUROSCIENCE

Practical course for EEG recording and analysis—Advanced, Prof. Camillo Porcaro; 8 hours
Syllabus: TBA

Practical course for transcranial magnetic stimulation, Dr. Giorgia Cona; 4 hours
Syllabus: The course will address theoretical, methodological and practical issues of transcranial magnetic stimulation including: 1) Basic TMS principles, 2) TMS parameters; 3) safety issues; 4) possible applications. The course includes also a practical part in which students will familiarize with coil position, selection of motor threshold, change of frequency and paradigm (single-pulse vs. repetitive TMS).

Systematic review meta-analysis and study quality in neuroimaging, Prof. Claudio Gentili; 8 hours
Syllabus: TBA

Practical course for Functional Near-Infrared Spectroscopy (fNIRS) and infant brain imaging, Prof. Judit Gervain; 4 hours
Syllabus: TBA

3. CELLULAR AND MOLECULAR NEUROSCIENCE

Light-based methods for brain circuit analysis, Prof. Marco Dal Maschio and Prof. Mario Bortolozzi; 8 hours
Syllabus: TBA

Invertebrate nervous system: a way to study higher brain function and their evolution in a simpler (not so simple) nervous system, Prof. Aram Megighian, Dr. Nicola Cellini and Prof. Mauro Zordan; 4 hours
Syllabus: TBA

Inhibitory interneurons in the neocortex: from cellular properties to circuits, Prof. Daniela Pietrobon; 4 hours
Syllabus: TBA

Electrophysiological recordings in animals, Prof. Stefano Vassanelli; 4 hours
Syllabus: TBA

4. TRANSLATIONAL AND CLINICAL NEUROSCIENCE

Translating neuroscience into clinical practice, Prof. Angelo Antonini; 4 hours
Syllabus: TBA

Motor recovery and neuroplasticity after central nervous system injury, Prof. Alessandra Del Felice; 4 hours
Syllabus: TBA

Neurodegenerative disorders, Prof. Annachiara Cagnin; 4 hours
Syllabus: TBA

Multiple sclerosis, Prof. Paolo Gallo; 2 hours
Syllabus: TBA

Brain-body interactions in psychopathology and the bio-neurofeedback, Prof. Daniela Palomba and Dr. Elisabetta Patron; 6 hours
Syllabus: TBA

The second part of the scheme includes advanced short classes of 2-8 hours, among which the student will choose some: they focus on the individual research subject of the proposing faculty and have been clustered on the different platforms of the PNC. The courses are conceived to provide, in addition to the theoretical background, the skills to use the concepts/tools in the students' research project and should also be considered as an opportunity to explore areas not directly related to the student background or research project.

JOURNAL CLUB (online)

Journal Clubs will take place weekly and they will last 1 hour in total.
PhD students in their 1st, 2nd and 3rd year will be presenting in pairs and each presentation should last 20 minutes. Presentations should either be presenting conflicting or converging points of views, so to create more interactive presentations and to stimulate a real debate (20 minutes) with the audience, i.e. the other PhD students.

For example, PhD students could present:

- Two conflicting theories, accounts or models of a phenomenon or construct (e.g. a single G-factor or multiple intelligence; innate or learn linguistic knowledge; distributed or modular representations etc.);
- Two (or more) papers/studies/models that provide conflicting results or positions;
- Two (or more) papers/studies/models that provide converging evidence for a phenomenon from different points of view or using different methods (e.g. animal and human models of the same ability, data from neuroimaging and behavioral studies, computational models and clinical approaches of the same pathology etc.).

The format can be switched also to more interactive and original formats (e.g. speaker 1 presents point 1 in 5 minutes then speaker 2 responds/presents their point of view, then there is an open discussion etc.).

PhD students should aim at proposing a high quality presentation and being able to engage the public and generate a lively discussion, but they should use their creativity, too.