UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Practical Class: Methods in Cognitive Neurosciences

2526-2-F5108P024

Learning area

Psychological functioning: models and methods for assessment.
Intervention and rehabilitation models and techniques.
Methods, techniques, and tools of psychology.
Statistics and quantitative methods.

Learning objectives

Structural and functional neuroimaging methods provide fundamental support to cognitive neuroscience research and in the neuropsychological practice. In relation to these methods, the course will promote the following knowledge and skills:

- Knowledge and understanding of the processing and analysis procedures meeting the current consensus in the neuroimaging community.
- Applying knowledge and understanding will be acquired in the form of a set of basic tools and routines, useful for the design and analysis of experiments with neuroimaging techniques (structural and functional MRI) in the fields of cognitive neuroscience and neuropsychology.
- Making judgements: judgment and critical skills will be promoted by a specific focus on aspects of replicability and reproducibility and sharing of science, through the individual performance of processing and analysis tasks of neuroimaging data, and the delivery of short reports of the activity carried out.
- Communication skills will be stimulated by direct and constant interaction with the teacher in carrying out laboratory activities, promoting the acquisition of technical-specialist language in the field of neuroimaging research.
- Learning ability will be stimulated by in-depth exploration of how to use advanced computer technology for neuroimaging analysis, in line with the most up-to-date practices in this branch of scientific research.

Contents

Design and analysis of studies with structural MRI techniques.
Design and analysis of studies with functional MRI techniques.
Large-scale open science resources for inferential analysis and meta-analysis.

Detailed program

• Structural MRI: segmentation techniques and quantitative morphometric analysis
• Structural MRI: analysis by regions of interest
• Structural MRI: quantitative statistical analysis of lesion data
• Diffusion-weighted structural MRI: tensor indices and tractographic analysis
• Functional MRI (fMRI): planning and efficiency of experimental designs
• Functional MRI (fMRI): data processing and univariate statistical analysis
• Functional MRI (fMRI): multivariate statistical analysis
• Functional MRI (fMRI): functional connectivity analysis
• Meta-analysis of neuroimaging data

Prerequisites

Good knowledge of the foundations of cognitive neuroscience is required, as well as of the basic principles and applications of neurofunctional methods.

Teaching methods

The course will mainly consist of:

- 7 interactive exercise lessons of 4 hours each, in presence.
  Teaching will be in Italian, with audio-visual materials in either Italian or English.
  The laboratory activity will include practical exercises using the personal laptop as a hardware component.
  The students willing to install and use the software component on their personal laptop computer are advised to equip themselves with the following applications before the start of the course:
- Matlab (Mathworks): any versions between 2007a and 2024a, inclusive of “Image Processing Toolbox” and “Statistics and Machine Learning Toolbox” (https://it.mathworks.com/academia/tah-portal/universita-degli-studi-di-milano-bicocca-30566431.html).
- GingerALE, Sleuth, Scribe (http://brainmap.org/software.html)
- Trackvis (http://trackvis.org)
  As an alternative, for the software component, the students may use the Unimib’s LIBaaS VMware environment, which is already endowed with these applications.

Assessment methods

The evaluation of the course (passed / failed) will be based on timely delivery of the practical exercises included in

the program and of the reports of the activity carried out.
Erasmus students can contact the teacher to agree on the possibility of carrying out the project work and taking the exam in English.

Textbooks and Reading Materials

The lecture handouts and other relevant teaching materials will be made available online on the e-Learning website of the course. The recommended textbook for the course is:

- Huettel SA, Song AW, McCarthy G. Functional Magnetic Resonance Imaging. Sinauer Associates, 3rd edition 2014, pp. 573, ISBN: 9780878936274. (optional)

Sustainable Development Goals

GOOD HEALTH AND WELL-BEING