UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

# SYLLABUS DEL CORSO

# Metodi Neuro-funzionali in Neuropsicologia e Psicologia Clinica

**2122-1-F5104P011**

## Learning area

Psychological functioning: models and methods for assessment

## Learning objectives

*Knowledge and understanding*

· Neurophysiological basis of methods and techniques of transcranial non-invasive brain stimulation (NIBS)

· Neurostimulation (Transcranial Magnetic Stimulation, TMS); neuromodulation (transcranial Electric Stimulation, tES)

· Specific structural (CT & MRI) and functional (PET & fMRI) neuroimaging techniques.

· Technological and neurobiological foundations of neuroscientific inference with neurostimulation and neuroimaging techniques.

· Main applications in neuropsychology, cognitive neuroscience and clinical psychology of the aforementioned techniques

*Applying knowledge and understanding*

· To promote the ability to use NIBS in neuropsychological and psychological clinical settings.

· To promote the ability to use neuroimaging techniques in neuropsychological and psychological clinical settings.

To promote the ability for an integrated use of NIBS and neuroimaging techniques in neuropsychological and psychological clinical settings.

## Contents

Methods and techniques of neural non-invasive stimulation and modulation: TMS, tES. Methods and techniques of neuroimaging: CT, MRI, PET and, mainly, fMRI. Applications in cognitive neuroscience, neuropsychology and clinical psychology.

## Detailed program

· Transcranial non-invasive brain stimulation (NIBS)

· Historical background about NIBS

· Methodological foundations of NIBS

· Transcranial Magnetic Stimulation (TMS): spTMS (single pulse), ppTMS (paired pulse), rTMS (repetitive), pattern stimulation.

· transcranial Electric Stimulation (tES): tDCS (transcranial Direct Current Stimulation), tACS (transcranial Alternate Current Stimulation), tRNS (transcranial Random Noise Stimulation).

· NIBS and brain plasticity

· NIBS in cognitive neuroscience.

· NIBS in motor and neuropsychological rehabilitation.

· NIBS in the treatment of psychiatric disorders.

· In the neuroimaging module the student will learn the technical foundations of the main imaging techniques (CT, MRI, PET) and their application in clinical neuropsychology, cognitive neuropsychology and cognitive neuroscience.

· The student will learn the experimental design principles of anatomo-clinical correlation studies and activation studies and the relevant statistical techniques. Finally, the student will become familiar with modern functional connectivity techniques and meta-analytical techniques.

In particular, the use of the imaging techniques will be presented in the context of concrete case studies: learning disorders, mood disorders and pre-surgical assessments of the representation of linguistic functions. In addition, illustrations on the use of (functional)anatomical correlation studies will be presented for classical neuropsychological syndromes like aphasia, spatial neglect, amnesia and so forth.

· Ultimately, the student should become capable of designing his own –simple- experiments with the aforementioned techniques and to critically assess the relevant literature in both the areas of NIBS and neuroimaging.

## Prerequisites

It is strongly advised that the CV includes having passed the following exams: Biology and Genetics, Anatomo-physiological Foundations of Psychic Activity and Physiological Psychology, Neuropsychology of the Adult and the Elderly.

## Teaching methods

Room lessons, audio-visual material.

*Lessons will be held in presence, unless further COVID-19 related restrictions are imposed.*

*Although this course is held in Italian, for Erasmus students, course material can also be available in English, and students can take the exam in English if they wish to do so.*

## Assessment methods

1) *A written assessment* includes multiple choice-questions, and two open questions on the topics of the course.

a) 30 multiple choice 4-alternative questions, with 1 correct choice (15 questions about neurostimulation and 15 about neuroimaging). One point is assigned for each correct answer, with no penalty. The minimum score for a successful assessment is 18 out of 30 correct answers. Example: “A brain stimulation is invasive: 1: if no incision of the skull and insertion of objects in the brain are made; 2: if it decreases heart rate; 3: if incision of the skull and insertion of objects in the brain are made (correct choice); 4: if it increases body temperature.

b) Two open questions to which a complete and concise response is to be provided. Example: (1) “Briefly summarize the main physiological features of 1 Hz rTMS”. (2) “Describe the anatomo-behavioural correlation methods for acquired lesions in populations of patients with neuropsychological deficits”. Based on the assessment made by the teacher, the score assigned to each open question ranges from -3 to +3 points, to be added to the score obtained by the student in the multiple-choice questions.

**2) Oral assessment (optional)**, including one or more open questions, to which concise and complete responses are to be provided. Example: “What is a *coil*?” “Please discuss the biophysical and physiological foundations of the BOLD contrast in fMRI”. The evaluation of the oral assessment may result in a modification of the final score of the exam with a positive or negative sign, or in no change.

The students’ knowledge of the two topics of the course (non-invasive brain stimulation, neuroimaging methods) is also evaluated by written (see above #1) *in itinere* assessments, at the end of the two sections of the course.

*During the Covid-19 emergency, exams will be conducted according to the University's regulations regarding the COVID-19 emergency situation.*

## Textbooks and Reading Materials

- Bolognini, N., & Vallar, G. (a cura di) [2015], *Stimolare il cervello*. Bologna, Il Mulino.
- Slides e articoli scientifici indicati durante il corso.
- Sacco, K. (a cura di) [2020]. Neuroimaging. Per lo studio del cervello umano.. Napoli: Idelson Gnocchi.
- Poldrack R. A., Mumford, J. A. & Nichols, T. E. (a cura di) [2011] *Handbook of Functional MRI Data Analysis*. Cambridge University Press. (FACOLTATIVO /OPTIONAL)