Module Number **3c**	**Title:** **Cognitive Neuroscience: Methods**		
Module type: compulsory elective	**Language:** English	**Group Size:** 12 students	
Study semester: 1	**Availability:** winter semester	**Study semester:** 1	
Workload: 420 hrs	**Credits:** 14CP	**Workload:** 420 hrs	**Credits:** 14CP

1 Courses

a) Lectures: 4 PPW
b) Practical Course: 5 PPW
c) Seminar 2 PPW

2 Intended learning outcomes

Upon completion of this module the students are able to explain and interpret modern imaging methods for representing the structures and functions of the human brain as well as methods for brain stimulation. These include structural and functional magnetic resonance imaging (MRI), neuroinformatic tools and models, magnetoencephalography (MEG), and electroencephalography (EEG) as well as transcranial magnetic stimulation (TMS), transcranial direct and alternating current stimulation (tDCS/tACS), and deep brain stimulation (DBS). This is complemented by an introduction to statistics, computational modelling, neuroimaging meta-analysis, and lesion-based neuropsychological approaches. The students will be able to plan and develop investigations employing these methods (including first knowledge in applying them), to evaluate and interpret the data thus gathered and to coherently present the results verbally and in writing.

3 Content

Lecture: *Methods in cognitive neuroscience: from brain to behaviour*
Methods of brain imaging and brain stimulation, neural rhythms and oscillatory networks, neuropsychology, statistical analysis approaches including a hands-on intro to Matlab
***Recommended reading*:**

- Baer, MF, Connors, BW, Paradiso MA: Neuroscience – Exploring the Brain. Lippincott Williams and Wilkins, USA 2007
- Squire LR, Berg D, Bloom FE, DuLac S, Ghosh A, Spitzer NC: Fundamental Neuroscience. Elsevier, Amsterdam 2008

Practical course: *Measurement and modulation of human brain activity*
1) *Theoretical exercises on imaging techniques and neurophysiological methods:* MEG or EEG (including planning, execution and evaluation of MEG or EEG examinations, derivation of eye movements and muscle activity, time frequency analyses, co-registration of MRT and MEG, source reconstruction); structural and functional MRI (including morphometry, connectivity analyses, or coordinate-based meta-analysis).
2) *Experimental neurophysiological and functional imaging applications for the examination of brain functions as well as their non-invasive modulation:* Students will perform any of the following methods in the practical course: electroencephalography (EEG), transcranial magnetic stimulation (TMS), magnetoencephalography (MEG), transcranial electric stimulation (tDCS, tACS) as well as the analysis of structural or functional magnetic resonance imaging data.
***3) Short presentation of experimental results at the end of the course*.**

Seminar: *Application of neuroscientific methods to the study of cognitive systems*
Functional neuroanatomy, brain network analysis, connectivity, event-related potentials, coherence analysis, neuropsychology, etc. applied to investigate motor and somatosensory systems, perception and attention, language, memory, emotion and motivation, social cognition.
Students will present and critically discuss with the audience a paper exemplifying one of the above approaches and topics.

4	**Teaching methods** Lecture, seminar and practical course with accompanying lessons
5	**Prerequisites** **Formal:** Successful completion of module 1. Proficiency in English level B2 of Common European Framework of Reference for Languages (CEFR); Bachelor degree in biology, psychology or a related field **With regards to content:** Basic knowledge of neuroanatomy, neurophysiology and neurobiology are a prerequisite.
6	**Examination type:** **Cumulative Examination:** 1. Poster presentation of experimental results at the end of the practical course (15 minutes including questions, 33.3% of total grade). 2. Oral presentation and moderation of a discussion in the seminar (45 min, 33.3% of total grade) 3. Written exam (multiple-choice format) on lecture content (90 minutes, 33.3% of total grade).
7	**Requirements for award of credit points** Regular and active participation in the lecture, practical course and seminar, including oral presentations in the latter. Drafting of experimental designs. Successful presentation of the project at the end of the practical course. Written exam.
8	**Module applicability** The module is closely related to module 4c.
9	**Assessment** The mark given will contribute to the final grade in proper relation to its credits.
10	**Module convenor and main lecturers** Prof. Dr. Simon Eickhoff, Prof. Dr. Esther Florin, PD Dr. Markus Butz, Dr. Robert Langner
11	**Further information** The regular attendance at the lectures is strongly recommended. The content of the lectures (material presented both via voice and on slides) is prerequisite for the practical course and the seminar, and will be examined in a written exam at the end of the module.