UNIVERSITY OF WARSAW

UNIVERSITY'S INTEGRATED DEVELOPMENT PROGRAMME

Course syllabus

Course title	Modern topics in cognitive neuroscience
Instructor(s)	prof. Łukasz Okruszek + invited lecturers
Contact details	lukasz.okruszek@psych.uw.edu.pl
Affiliation	Faculty of Psychology, University of Warsaw Social Neuroscience Lab, Institute of Psychology, Polish Academy of Sciences
Course format	lecture + class
Number of hours	30 hours + 30 hours
Number of ECTS credits	**5 ECTS credits** 60 hours of class activities 90 hours of students own work
Brief course description	The aim of the course is to introduce participants to a range of techniques and methodological advancements which can be used to create complex models human behavior and its neural underpinnings than standard mass univariate approaches, which have been traditionally applied throughout cognitive neuroscience research.
Full course description	Cognitive neuroscience is a multidisciplinary field which main focuses on exploring neurobiological underpinnings of behavior by the means of neuroimaging methods. Recently, it has been emphasized that complex models of the human behavior cannot be created without developing methods which integrate data from various neuroimaging methods and synthesizing large scale data which are already publicly available. The course will cover a range of methodological advancements which are believed to be necessary for further progressing the cognitive neuroscience field. The list of topics will include among others: advanced EEG data analysis, multimodal neuroimaging, open (neuro)science and online repositories, functional connectivity analysis. Furthermore, methods which extend the ecological validity of cognitive neuroscience research (e.g. via virtual reality techniques) will be introduced.
Learning outcomes	- discuss the use of advanced fMRI and EEG analysis in neuroscience as well as the design of studies and hypothesis testing (K_W01; K_W02; K_W03; K_W05; K_W06; K_W07; K_U01; K_K01)

	- develop some of the technical skills required to process and analyze neuroimaging and neurophysiological data (K_U03, K_U04) - understand the process of EEG and fMRI data collection for advanced analyses (K_K02) - is able to use open repositories for own research (K_U08) - discuss safety issues related to VR, MRI and ethical issues of using pre-existing data (K_W09) - is able to critically evaluate methodology of research using VR, EEG, and fMRI techniques (K_U01; K_U07; K_K06; K_K01; K_K02) - present and discuss avanced neuroimaging and neurophysiological analyses in a written format (K_U03, K_U06; K_U07)
Learning activities and teaching methods	Each issue will be introduced via the theoretical lectures, which will be interspersed with group discussions. All of the students will be invited to contribute to the group discussion, which will be based on the assigned readings. Upon completion of the theoretical introductions, students will perform practical exercises to familiarize themselves with practical aspects of using each of the presented techniques.
List of topics/classes and bibliography	Main blocks: 14 h – EEG time-frequecy analysiss 8 h – multimodal fusion of EEG and fMRI data 14 h - EEG time-frequency analysis: 1. Advantages and limitations of time-frequency domain analyses 2. Time-frequency decomposition methods 3. Time-frequency power and baseline normalisations 4. The basic connectivity analyses 5. Interpretation of time-frequency results 6. Reporting results of time-frequency analyses Bibliography: Mike X Cohen (2014). *Analyzing Neural Time Series Data: Theory and Practice.* The MIT Press. Mike X Cohen (2014). *Fundamentals of Time-Frequency Analyses in Matlab/Octave.* sinc(x) Press. 8 h – Multimodal neuroimaging: 1. Pros and cons of multimodal neuroimaging (2 x 45)

	2. How to integrate EEG and fMRI data? (2 x 45) 3. EEG-informed fMRI Analysis (2 x 45) 4. Fusion of EEG and fMRI data by ICA (2 x 45) Bibliography: Ullsperger M., Debener, S. (2010) Simultaneous EEG and fMRI. Recording, Analysis and Application: - Snyder, A.Z., Raichle, M.E. (2010). Studies of the Human Brain Combining Functional Neuroimaging and Electrophysiological Methods (ch. 1.3) - Ullsperger M. (2010) EEG-informed fMRI Analysis (ch. 3.3.) - Caloun, V.D., Eichele, T. (2010) Fusion of EEG and fMRI by Parallel Group ICA (ch. 3.4) Mijovic B. et al. (2012). The “why” and “how” of JointICA: Results from a visual detection task. Neuroimage, 60, 1171-1185. Wynn J. et al. (2016). Impaired target detection in schizophrenia and the ventral attentional network: Findings from a joint event-related potential–functional MRI analysis. Neuroimage: Clinical, 9, 95-102.
Assessment methods and criteria	For each part of the course students will be obliged to: 1/ preprocess and analyze the data provided throughout each block of the course 2/ prepare short presentation of the results of the analysis
Attendance rules	Max. 8 hours of unexcused absences are allowed throughout the course, missing more than 15 hours of the course is equivalent to the course failure.
Prerequisites	Methods in neuroscience Research methods and experimental design in neuroscience
Academic honesty	Students must respect the principles of academic integrity. Cheating and plagiarism (including copying work from other students, internet or other sources) are serious violations that are punishable and instructors are required to report all cases to the administration.
Remarks	The specific list of issues discussed throughout the course depends on the availalbility of the invited lecturers.