

PSY546 Selected topics in contemporary neuroscience

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Extent and Intensity

4 blocks per 4 lectures (á 60 min)

4 credits

Type of completion: z (credit)

Course objectives

The aim of this course is to introduce students to selected topics and latest advances in social neurosciences. As a part of the course, students will visit Multimodal and Functional Imaging Laboratory (MAFIL) at Central European Institute of Technology, where various neuroimaging techniques will be demonstrated.

At the end of the course, students will understand the basics of neuroimaging techniques and the practical aspects of research in neuroscience. They will have knowledge about recent advances in selected areas of social neuroscience research.

Schedule & Syllabus:

- 5.10. at 8.00;
 - Introduction to Contemporary Neuroscience

Will discuss basic principles of the nervous system functioning and the recent advances and findings from human brain mapping.
Zimmer, C., & Clark, R. (2014). Secrets of the brain. Nat. Geogr, 28-58.
 - Biomarkers and underlying mechanisms of psychiatric diseases

Will discuss the DSM vs. RDoC approach to study mental health disorders and the related biomarkers and include examples from my research.
Cuthbert, B. N., & Insel, T. R. (2013). Toward the future of psychiatric diagnosis: the seven pillars of RDoC. BMC medicine, 11(1), 126.
 - Impulsivity

Impulsivity can be defined as acting without thinking about possible alternatives and consequences. In fact, it is very heterogenous term which can manifest in personality traits, cognitive and emotional processes and behaviour control. Neural correlates of impulsivity as well as cooccurrence with various mental disorders will be discussed.
 - Inhibition

Inhibition can be observed in all levels of organization in the nervous system, from neurons inhibiting one another to our social behaviour, where we must forego our egocentric tendencies in favour of the rules of conviviality. We will describe the important role inhibition has in shaping our minds and we will place in the context of three psychiatric conditions: Major Depressive Disorder, Obsessive Compulsive Disorder, and Tourette's syndrome.
Monnart, A., Kornreich, C., Verbanck, P., & Campanella, S. (2016). Just Swap Out of Negative Vibes? Rumination and Inhibition Deficits in Major Depressive Disorder: Data from Event-Related Potentials Studies. Frontiers in Psychology, 7(1019). <http://doi.org/10.3389/fpsyg.2016.01019>

- 26.10. at 8.00 (at CEITEC at University Campus at Bohunice; further instructions will be given at first lecture);
 - Research methods in neuroscience

What they can reveal about human brain structure and functions? How they are often misinterpreted? We will cover types of research design, behavioural methods and overview the most popular imaging methods with focus on electrophysiology (e.g. EEG), which is not as sexy as fMRI, but stays the backbone of functional neuroscience.
Carter, M., & Shieh, J. C. (2015). Chapter 1 - Whole Brain Imaging. Guide to research techniques in neuroscience. Academic Press.
 - Magnetic resonance imaging

Magnetic resonance imaging (MRI) is a non-invasive imaging method used routinely in the clinic and in research. In this lecture, the theoretical basis, examples of methods and applications of structural MRI and functional magnetic resonance imaging (fMRI) will be presented. In this lecture we will also visit Multimodal and Functional Imaging Laboratory at CEITEC MU, in order to show you how an actual fMRI experiment looks like.
Logothetis, N. K. (2008). What we can do and what we cannot do with fMRI. Nature, 453(7197), 869.
 - Repetitive transcranial magnetic stimulation & fMRI biofeedback

The lesson will go over principles and mechanisms of both repetitive transcranial magnetic stimulation (rTMS) and real-time fMRI neurofeedback techniques. Further, possible areas of both research and clinical of the methods will be explained, with focus on research and treatment of emotion regulation impairment.

- EEG, TMS & MRI demonstrations
- 16.11. at 8.00;
 - Social cognition in schizophrenia

Schizophrenia is a neurodevelopmental disorder with severe difficulties in social functioning. Various approaches to studying neural substrate of social cognition deficits will be discussed.

Green, M. F., Horan, W. P., & Lee, J. (2015). Social cognition in schizophrenia. Nature Reviews Neuroscience, 16(10), 620

- Ambiguity in social cognition

Inherent ambiguity of social cues makes effective functioning in our social world relatively challenging. The more ambiguous the situation, the higher the risk of misinterpretation and reliance upon cognitive bias. Here we will discuss the mechanisms and neural correlates of social cognitive bias in healthy population, as well as in mental disorders where cognitive bias plays crucial role in the development and maintenance of the disease (e.g., anxiety disorder, major depression, eating disorders).

Todorov, A., Harris, L. T., & Fiske, S. T. (2006). Toward socially inspired social neuroscience. Brain research, 1079(1), 76-85.

- Connectivity and network neuroscience

There is a growing tendency in neuroscience to focus on networks and connectivity instead on discrete brain areas. We will introduce concepts of functional and effective connectivity, basics of graph theory and show their applications in network research in neuroscience. We will attend several well research networks in human brain, including resting state network, salience network and attention networks.

<https://theconversation.com/the-brain-a-radical-rethink-is-needed-to-understand-it-74460>

- Meta-analysis in neuroscience

Meta-analysis is an important tool for quantitatively summarizing results from studies. Advantages include higher statistical power but are prone to biases. Various methods in context of neuroscience will be discussed.

- 7.12. at 8.00;

- Altruism, cooperation & competition

We will discuss neural mechanisms of prosocial behaviour, empathy, cooperation & competition. Results from recent hyperscanning research on competition and cooperation will be presented.

- Consciousness

The hard problem: how does biological brain activity give rise to subjective experience? We will give a little philosophical background (fun thought experiments), overview main theories of consciousness and discuss their shortcomings, reveal (the little we know about) neural correlates of consciousness, study methods and their flaws and cover most interesting case studies.

Koch, C., Massimini, M., Boly, M., & Tononi, G. (2016). Neural correlates of consciousness: progress and problems. Nature Reviews Neuroscience, 17(6), 395–395. <https://doi.org/10.1038/nrn.2016.61>

- Presentations & Discussions

Literature

- Green, M. F., Horan, W. P., & Lee, J. (2015). Social cognition in schizophrenia. *Nature Reviews Neuroscience*, 16(10), 620.
- Logothetis, N. K. (2008). What we can do and what we cannot do with fMRI. *Nature*, 453(7197), 869.
- Zimmer, C., & Clark, R. (2014). Secrets of the brain. *Nat. Geogr*, 28-58.
- Cuthbert, B. N., & Insel, T. R. (2013). Toward the future of psychiatric diagnosis: the seven pillars of RDoC. *BMC medicine*, 11(1), 126.
- Todorov, A., Harris, L. T., & Fiske, S. T. (2006). Toward socially inspired social neuroscience. *Brain research*, 1079(1), 76-85
- Monnard, A., Kornreich, C., Verbanck, P., & Campanella, S. (2016). Just Swap Out of Negative Vibes? Rumination and Inhibition Deficits in Major Depressive Disorder: Data from Event-Related Potentials Studies. *Frontiers in Psychology*, 7(1019). <http://doi.org/10.3389/fpsyg.2016.01019>
- Koch, C., Massimini, M., Boly, M., & Tononi, G. (2016). Neural correlates of consciousness: progress and problems. *Nature Reviews Neuroscience*, 17(6), 395–395. <https://doi.org/10.1038/nrn.2016.61>
- Carter, M., & Shieh, J. C. (2015). Chapter 1 - Whole Brain Imaging. *Guide to research techniques in neuroscience*. Academic Press.

Assignments

- Reading: 1-3 papers prior to each block; fill in an online questionnaire on each paper (see section above)
- Writing: a neuroscience research proposal OR presentation of a neuroscientific topic
- Attendance: absence on 1 lecture (60 minutes) is allowed, if you need to skip an entire block, you will be asked to write an additional assignment:
read this paper
<http://news.nationalgeographic.com/news/2013/12/131219-brain-bioethics-neuroscience-greely-science/>
pick one of the topics mentioned and write an essay discussing your opinion on this topic. This essay should be no shorter than 3 standard pages (but no longer than 5) and should include at least 3 sources.

Neuroscience research proposal

Select any topic (can be ideas for your diploma thesis, old assignments of other courses, current interests in psychology) and propose a way to do neuroscientific research based on it.

These sections are expected to be covered:

Introduction

- Motivation for the research
(what new and interesting discoveries could come about if we implement your proposal?)
- Brief overview of the literature
(what has been done in the field so far, what did you base your hypotheses on)
- Hypotheses

Methods

- Participants
- Methods, tasks
- Physiological/ neuroimaging/ behavioural/ or computational modelling techniques used

Discussion

- Expected results & their interpretation.
- Significance of the results, possible applications

Literature

3-5 standard pages (5400-9000 characters, literature not included)

Presentation on a neuroscientific topic

Introduce a neuroscientific topic that wasn't covered on the lectures (we can help you come up with an idea)

10-minute presentation (+ 5 minutes for discussion)

Short handout with the take-home messages of the presentation

Interact with your audience, prepare some questions.

Make a nice story of it

Both assignments are due to 4.11., you will get feedback by 25.11. and you will have a chance to resubmit by 5.12.

Assessment methods

Students will be given their credits based on attendance and writing assignments.

Assignments will be evaluated based on these criteria:

1. State of the art: ability to grasp the selected topic, find relevant articles, communicate the current knowledge of the issue and identify the scientific gap
2. Methodology: understanding of general scientific research principles, methodologies used, basic understanding of neuroscientific tools
3. Impact and applications: the ability to reflect, what implications can the topic have in real life, (e.g. clinical practice, education etc.) AND/OR the potential to bring new knowledge or inspire further research
4. Format: segmentation, intelligibility,

Opinion essay:

1. Understanding of the topic
2. Ability to communicate different angles of the issue
3. Personal opinion