Behavioural & Cognitive Neuroscience
Educational subject description sheet

Basic information

Study programme Research in Cognitive Science	**Didactic cycle** 2024/25
Speciality -	**Subject code** 23RCSS.22O.15959.24
Organizational unit Faculty of Psychology and Cognitive Science	**Lecture languages** English
Study level Second-cycle programme	**Course type** Obligatory
Study form Full-time	**Block** general subjects
Education profile General academic	

Subject coordinator	Grzegorz Króliczak

Lecturer	Grzegorz Króliczak, Maciej Raś

Period Semester 2	Activities and hours • Lecture: 30, Exam • Classes: 30, Graded credit	Number of ECTS points 5

Goals

Code	Goal
C1	• to acquaint students with key concepts related to the variety of approaches in this fascinating area of research, including neuroanatomy, research methods, and research design;
C2	• to get familiarized with the links with neurophysiology, neuropharmacology, neuropathology, and neuropsychology;
C3	• to broaden the knowledge on the main achievements of behavioral and cognitive neuroscience stemming from the clinical and neuroimaging research;
C4	• to learn to critically analyze scientific reports, and their descriptions in the popular press, including the knowledge/understanding that the obtained results are affected by the adopted methods, and a type of the approach, including its limitations;
C5	• to obtain basic knowledge on how to take care of one's health, both physical and mental, to discern dangers for one's nervous, immune, and reproductive systems, and related problems that may require specialized medical treatments.

Subject learning outcomes

Code	Outcomes in terms of	Learning outcomes	Examination methods
Knowledge – Student:			
W1	Has a firm knowledge (in English) of the studied concepts / conceptions / theories, and about the relevant structure-function links for the cerebral cortex in norm and pathology.	RCS_K2_W02, RCS_K2_W03, RCS_K2_W05, RCS_K2_W06	Test
W2	Understands the links between behavioral and cognitive neuroscience, and other closely related research disciplines, such as neurophysiology, neuropharmacology, neuroanatomy, neuropathology, and neuropsychology.	RCS_K2_W03, RCS_K2_W07	Test
W3	Knows both basic and advanced research methods and postulated mechanisms / models of cerebral and mental functions related to the control of higher-order behavior and cognition.	RCS_K2_W08	Test, Project
W4	Has advanced knowledge on the processes and mechanisms related to the control (or lack of thereof) of higher-order cognitive, tactile, linguistic, sexual, feeding, and emotional behavior.	RCS_K2_W04, RCS_K2_W05, RCS_K2_W06	Test, Multimedia presentation
W5	Knows how to interpret and combine disparate research outcomes related to the studied discipline / research topics.	RCS_K2_W01, RCS_K2_W07, RCS_K2_W08	Test, Project, Report
W6	Understands the ethical guidelines, constraints for, and advantages vs. disadvantages of non-human vs. human research, and the required extensive ethical oversight in both cases.	RCS_K2_W10	Test
W7	Knows how to take care of her/his physical and mental health, at least in the domain of the studied topics.	RCS_K2_W06, RCS_K2_W09	Test
Skills – Student:			

Code	Outcomes in terms of	Learning outcomes	Examination methods
U1	Is capable of distinguishing between general 'ideas', specific 'scientific concepts', related evidence-based theories, and their popular press portrayals, as well as their consequences (e.g., portrayal of prefrontal lobotomy in the popular press, vs. the real consequences of its application).	RCS_K2_U02, RCS_K2_U04, RCS_K2_U15	Test, Multimedia presentation
U2	Can point to the main achievements of the behavioral and cognitive neuroscience as a separate discipline, including its ground-breaking experiments, explanatory concepts and theories, as well as their potential or real applications.	RCS_K2_U02, RCS_K2_U04, RCS_K2_U05, RCS_K2_U15	Test
U3	Can distinguish between good and bad research, ethical and (potentially) unethical research procedures, and should be capable of identifying scientific misconduct.	RCS_K2_U02, RCS_K2_U04, RCS_K2_U15	Test
U4	Is capable of differentiating between apparent and real contradictions in the studied research reports, and their consequences for general theories, and daily living.	RCS_K2_U02, RCS_K2_U03, RCS_K2_U04	Test, Multimedia presentation
U5	Following considerations of or recommendations stemming from the studied research, can take care of her/his physical and mental health.	RCS_K2_U02, RCS_K2_U12, RCS_K2_U15	Test
Social competences – Student:			
K1	Can publicly discuss advantages and disadvantages (pros and cons) of research on non-humans and humans.	RCS_K2_K01, RCS_K2_K02, RCS_K2_K08	Multimedia presentation
K2	Can argue in favour of valid (vs. dubious / questionable) research practices and their consequences for science and public health.	RCS_K2_K01, RCS_K2_K03	Multimedia presentation
K3	Should be able to comment to / advise younger students, peers, or family members on the general validity of a research approach and/or design, and its nature.	RCS_K2_K02, RCS_K2_K05, RCS_K2_K08, RCS_K2_K11	Oral colloquium, Multimedia presentation
K4	Can identify other dangers for her/his physical and mental health, and knows when and how to seek professional help (for her/his loved ones).	RCS_K2_K01, RCS_K2_K02, RCS_K2_K03, RCS_K2_K08, RCS_K2_K09, RCS_K2_K10	Multimedia presentation

Study content

No.	Course content	Subject learning outcomes	Activities
1.	Contemporary *Behavioral and Cognitive Neuroscience* (BCN) as a discipline at the crossroads of neurobiology, neuroscience, neuropsychology and experimental psychology. Achievements of BCN research, critical thinking, and scientific inference. Nonhuman and human subjects / participants, research, and its ethical oversight	W1, W2, W3, W6, U1, U2, U3, K1, K2	Lecture, Classes

No.	Course content	Subject learning outcomes	Activities
2.	Research methods in biopsychology, neurobiology, behavioral and cognitive neuroscience. Methods for visualizing, stimulating and recording psycho-physiological activity of the brain and its major functions. Advantages and disadvantages of the studied methods and research approaches	W3, W5, U3, U4, K3, K4	Lecture
3.	Functional Magnetic Resonance Imaging (fMRI), research safety, introduction to data acqusition, analyses, and visualization; MRI/fMRI research terminology/jargon	W3, W5, W6, U3, U4, K2, K3	Lecture, Classes
4.	Somatosensory system: tactile and haptic processing. Cutaneous receptors, major somatosensory pathways, and the effects of damage to the related cortices and associated neural processing streams	W3, W4, W5, U4, U5, K2, K3	Lecture
5.	Lateralization of basic behavioral and cognitive functions. Theories of the evolution of cerebral asymmetries. Left-hemisphere dominance for communication in humans and other species. Exceptions to classical accounts of interhemispheric and between hemispheric functional interrelationships	W1, W3, W4, W5, U1, U4, K2, K3	Lecture, Classes
6.	Hormones and sex, "sex" and "gender", developmental and activational effects of sex hormones. Sex determination at conception vs. sexual development; bipotential precursor for the development of external reproductive structures. Gender identity and (sexual) preference from the neurobiological perspective	W4, W5, W7, U3, U4, U5, K2, K3, K4	Lecture, Classes
7.	Hunger, eating, and related health issues. The basics of the control of eating, digestion, and energy metabolism. Hunger as a response to an energy need and an epidemic of eating disorders. Sham-eating tests and the insights on factors influencing how much we eat. The effects of diets on body weight and physiological research on hunger and satiety	W4, W5, W7, U3, U5, K1, K2, K4	Lecture, Classes
8.	Sleep, dreaming, and circadian rhythms. How much sleep do we need? Why do we sleep when we do, and how it affects stages of sleep? Dreaming, sleepwalking, and sleeptalking. The effects of sleep deprivation and sleep efficiency. Jet lag, shift work, and circadian clocks. Sleep disorders	W4, W5, W7, U4, U5, K2, K4	Lecture, Classes
9.	Emotions, stress, and related health issues. Biopsychology of emotion: Introduction to classic and contemporary case studies, damage reconstruction methods, and theories of emotion. Lie detection as an emotion detection method; studying facial expressions; fear, defense, aggression, and testosterone. Neural mechanisms of fear conditioning. Stress and its impact on health	W4, W5, U4, U5, K2, K4	Lecture
10.	Drug addiction and the brain's reward circuits. Drug abuse and addiction as goal-directed behaviors. Basic principles of drug action, administration and absorption. Drug abuse, drug tolerance, withdrawal effects and physical dependence. Addiction: risk factors for compulsive drug use. Commonly abused drugs and the effects of long-term use. Biopsychology of addiction	W4, W5, W6, W7, U3, U4, U5, K2, K3, K4	Lecture, Classes

No.	Course content	Subject learning outcomes	Activities
11.	Psychiatric disorders, disorders of thinking and mood; mood vs. anxiety disorders; antipsychotic drugs - their history and effectiveness. Epigenetic and/or environmental factors involved in mood and anxiety disorders; primary and secondary mood disorders, recurrence risk ratios, and possible therapies	W4, W5, W7, U3, U5, K2, K3, K4	Lecture
12.	Brain damage and cerebrovascular disorders, closed-head injuries, infections of the brain, and neurotoxins. Neuropsychological diseases and their animal models. Most common diseases and damage of the nervous system, and their current / prospective treatments	W4, W5, W6, W7, U3, U5, K2, K3, K4	Lecture
13.	Recovery of brain functions: regeneration, reorganization, and neural prostheses	W2, W5, W6, U1, U2, K1, K2	Lecture

Additional information

Activities	Teaching and learning methods and activities
Lecture	Lecture with a multimedia presentation of selected issues, Problem-based lecture, Discussion, Case study, Audio and/or video demonstrations
Classes	Discussion, Work with text, Case study, Problem-based learning, Solving tasks (e.g. computational, artistic, practical), Classes method, Audio and/or video demonstrations, Activating method - "brainstorming", Work in groups

Activities	Credit conditions
Lecture	The FINAL EXAMINATION TEST consists of only one part, involving answers to 60 multiple-choice questions. In the majority of cases, but not always, only one answer (i.e., an item [e.g., A] or one of the displayed lines with [several] responses) is correct. If there are more than one correct answers, you should choose either by far the best answer, or a point/line indicating more than one correct response (if such an option is available).
	The final exam is taken in an electronic form, on your own mobile device (e.g., laptop computer, tablet, iPad, or smartphone), typically in a lecture room. The 60 questions of the exam do not have to be equally distributed across all the lectures; yet selected materials from all the lectures will be covered. The program counts / the lecturer checks / confirms the number of the obtained points. **A pass / positive grade always requires obtaining more than 50%** of – i.e., 31 correct – **answers**:
	2 (insufficient) < 51%
	3 (sufficient) from 51-59%
	3+ (sufficient plus) from 60-69%;
	4 (good) from 70-79%;
	4+ (good plus) 80-89%;
	5 (very good) > 90%
	Example questions:
	Stress can lead to negative changes in the _____, including shrinkage of its dendrites and blocking of neurogenesis (new neuron formation). Some steroid hormones, i.e., _____ are particularly implicated in these processes. Interestingly, there are clear sex differences in this respect, with females seemingly less affected by this type of stress reaction. Such a protection may be provided by _____.
	a) amygdala … hydrocortisones … testosterone
	b) fornix … dexamethasones … estriol
	c) septum … methylprednisolones … dihydrotestosterone
	d) hippocampus … glucocorticoids … estradiol
	Drug tolerance is any attenuation of a drug's effect resulting from prior exposure to the drug. There are at least two different types of tolerance effects: _____ tolerance that results from a decrease in the amount of the drug reaching the target cells, and _____ tolerance that results from a decrease in the ability of the drug to influence the target cells. Notably, tolerance to most psychoactive drugs is primarily _____.
	a) functional … metabolic … metabolic
	b) metabolic … functional … functional
	c) metabolic … functional … metabolic
	d) functional … metabolic … functional
Classes	Compulsory attendance, active participation, handing in assignments on time, and other requirements described by the person running the classes

Literature

Obligatory

1. Pinel, J.P.J.; Barnes, S., Biopsychology, Global Edition. Pearson. Kindle Edition. • Or Pinel, J.P.J. [the latest edition]. Biopsychology. Pearson Education, Limited. (This is a primary background for all discussed topics.)
2. Kandel, E.R.; Schwartz, J.H.; Jessell, T.M.; Siegelbaum, S.A.; Hudspeth, A.J.; Principles of Neural Science, Fifth Edition. McGraw Hill LLC. Kindle Edition. • Or Kandel, E.R., Schwartz, J.H., Jessell, T.M., Siegelbaum, S.A., Hudspeth, A.J., (2013). Principles of Neural Science, Fifth Edition. McGraw-Hill Companies, USA. (Only selected and most relevant chapters/sections from this textbook will be referred to or discussed.)

Optional

1. Lecture related readings: Anafi, R.C., Kayser, M.S., Raizen, D.M., 2019. Exploring phylogeny to find the function of sleep. Nature Reviews Neuroscience 20, 109-116.
2. Anderlini, D., Wallis, G., Marinovic, W., 2019. Language as a Predictor of Motor Recovery: The Case for a More Global Approach to Stroke Rehabilitation. Neurorehabil Neural Repair, 1545968319829454.
3. Berenbaum, S.A., Beltz, A.M., 2016. How Early Hormones Shape Gender Development. Curr Opin Behav Sci 7, 53-60.
4. Boly, M., Gosseries, O., Massimini, M., Rosanova, M., 2016. Functional Neuroimaging Techniques. In: Laureys, S.,

Gosseries, O., Tononi, G. (Eds.), The Neurology of Consciousness (Second Edition). Academic Press.

5. Cabrera, F.F., Gamarra, E.R., Garcia, T.E., Littlejohn, A.D., Chinga, P.A., Pinentel-Morillo, L.D., Tirado, J.R., Chung, D.Y., Pande, L.J., McCall, K.L., Nichols, S.D., Piper, B.J., 2019. Opioid distribution trends (2006-2017) in the US Territories. PeerJ 7, e6272.

6. Cheignon, C., Tomas, M., Bonnefont-Rousselot, D., Faller, P., Hureau, C., Collin, F., 2018. Oxidative stress and the amyloid beta peptide in Alzheimer's disease. Redox Biology 14, 450-464.

7. Corballis, M., 2017. The Evolution of Lateralized Brain Circuits. Frontiers in Psychology 8:1021.

8. Dauvilliers, Y., Schenck, C.H., Postuma, R.B., Iranzo, A., Luppi, P.H., Plazzi, G., Montplaisir, J., Boeve, B., 2018. REM sleep behaviour disorder. Nat Rev Dis Primers 4, 19.

9. Endendijk, J.J., Beltz, A.M., McHale, S.M., Bryk, K., Berenbaum, S.A., 2016. Linking Prenatal Androgens to Gender-Related Attitudes, Identity, and Activities: Evidence From Girls With Congenital Adrenal Hyperplasia. Arch Sex Behav 45, 1807-1815.

10. Filmer, H.L., Dux, P.E., Mattingley, J.B., 2014. Applications of transcranial direct current stimulation for understanding brain function. Trends in Neurosciences 37, 742-753.

11. Gahagan, S., 2012. Development of eating behavior: biology and context. J Dev Behav Pediatr 33, 261-271.

12. Gurtubay-Antolin, A., Leon-Cabrera, P., Rodriguez-Fornells, A., 2018. Neural evidence of hierarchical cognitive control during haptic processing: An fMRI study. eNeuro 5.

13. Huang, R.S., Chen, C.F., Sereno, M.I., 2017. Mapping the complex topological organization of the human parietal face area. Neuroimage 163, 459-470.

14. Petrides, K.V., Mikolajczak, M., Mavroveli, S., Sanchez-Ruiz, M.J., Furnham, A., Perez-Gonzalez, J.C., 2016. Developments in Trait Emotional Intelligence Research. Emotion Review 8, 335-341.

15. Siegel, E.H., Sands, M.K., Van den Noortgate, W., Condon, P., Chang, Y.L., Dy, J., Quigley, K.S., Barrett, L.F., 2018. Emotion Fingerprints or Emotion Populations? A Meta-Analytic Investigation of Autonomic Features of Emotion Categories. Psychological Bulletin 144, 343-393.

16. Speth, J., Speth, C., 2016. Motor imagery in REM sleep is increased by transcranial direct current stimulation of the left motor cortex (C3). Neuropsychologia 86, 57-65.

17. Weinstein, A., Lejoyeux, M., 2015. New developments on the neurobiological and pharmaco-genetic mechanisms underlying internet and videogame addiction. Am J Addict 24, 117-125.

18. Zhang, H.Y., Wang, Z.G., Lu, X.H., Kong, X.X., Wu, F.Z., Lin, L., Tan, X., Ye, L.B., Xiao, J., 2015. Endoplasmic reticulum stress: relevance and therapeutics in central nervous system diseases. Mol Neurobiol 51, 1343-1352.

19. Classes related readings: Lester, G. L., & Gorzalka, B. B. (1988). Effect of novel and familiar mating partners on the duration of sexual receptivity in the female hamster. Behavioral and Neural Biology, 49(3), 398-405.

20. Bartels, A., & Zeki, S. (2004). The neural correlates of maternal and romantic love. Neuroimage, 21(3).

21. Morris, R. G., Garrud, P., Rawlins, J. A., & O'Keefe, J. (1982). Place navigation impaired in rats with hippocampal lesions. Nature, 297(5868), 681-683.

22. Avena, N. M., Rada, P., Moise, N., & Hoebel, B. G. (2006). Sucrose sham feeding on a binge schedule releases accumbens dopamine repeatedly and eliminates the acetylcholine satiety response. Neuroscience, 139(3), 813-820.

23. Deroche-Gamonet, V., Belin, D., & Piazza, P. V. (2004). Evidence for addiction-like behavior in the rat. Science, 305(5686), 1014-1017

24. Holmes, A. J., & Pizzagalli, D. A. (2008). Spatiotemporal dynamics of error processing dysfunctions in major depressive disorder. Archives of General Psychiatry, 65(2), 179-188.

25. Anguera, J. A., Boccanfuso, J., Rintoul, J. L., Al-Hashimi, O., Faraji, F., Janowich, J., Kong, E.,Larraburo, Y., Rolle, C., Johnston, E., & Gazzaley, A. (2013). Video game training enhances cognitive control in older adults. Nature, 501(7465)

26. Aeschbach, D., Cutler, A. J., & Ronda, J. M. (2008). A role for non-rapid-eye-movement sleep homeostasis in perceptual learning. The Journal of Neuroscience, 28(11), 2766-2772.

27. Siuda-Krzywicka, K., Bola, Ł., Paplińska, M., Sumera, E., Jednoróg, K., Marchewka, A., Śliwińska, M., Amedi, A., Szwed, M. (2016) Massive cortical reorganization in sighted Braille readers. eLife, 5, e10762

28. Kroliczak, G., Buchwald, M., Kleka, P., Klichowski, M., Potok, W., Nowik, A. M., ... & Piper, B. J. (2021). Manual praxis and language-production networks, and their links to handedness. cortex, 140, 110-127.

29. Verma, A., Van der Haegen, L., & Brysbaert, M. (2013). Symmetry detection in typically and atypically speech lateralized individuals: A visual half-field study. Neuropsychologia, 51(13), 2611-2619

30. Króliczak, G., McAdam, T. D., Quinlan, D. J., & Culham, J. C. (2008). The human dorsal stream adapts to real actions and 3D shape processing: a functional magnetic resonance imaging study. Journal of neurophysiology, 100(5), 2627-2639.

Calculation of ECTS points

Activities	Activity hours*
Lecture	30
Classes	30
Preparation for classes	5
Reading the indicated literature	10
Preparation of a multimedia presentation	2
Report preparation	1
Preparation of a demonstration	2
Preparation for the exam	60
Preparation for the assessment	10
Student workload	**Hours** 150
Number of ECTS points	**ECTS** 5

* academic hour = 45 minutes

Efekty uczenia się dla kierunku

Kod	Treść
RCS_K2_K01	The graduate is ready to undertake an in-depth critical analysis of one's ideas, positions, and opinions and is prepared to change them in the light of data and arguments, knows the limitations of one's knowledge
RCS_K2_K02	The graduate is ready to demonstrate an active approach in problem-solving based on the analysis and evaluation of available data, their own research experience, and, when necessary, expert opinions
RCS_K2_K03	The graduate is ready to demonstrate sensitivity to issues of intellectual honesty in one's own and other people's actions; ensuring the reliability of conducted research (taking into account the role of the team leader)
RCS_K2_K05	The graduate is ready to collaborate with representatives from various disciplines, aimed at fostering a shared professional environment
RCS_K2_K08	The graduate is ready to initiate the application of knowledge in cognitive science (by selecting appropriate means and considering their own research experience) to actions aimed at benefiting the social environment
RCS_K2_K09	The graduate is ready to actively and independently deepen and synthesize knowledge in selected fields of science
RCS_K2_K10	The graduate is ready to promote the principles of caring for mental and physical health and recognizing potential threats to health, especially the brain
RCS_K2_K11	The graduate is ready to notice the existence of theoretical and methodological pluralism in scientific research and to recognize the consequences of this pluralism in one's own and others' research work
RCS_K2_U02	The graduate can integrate information from various sources, interpret them creatively and critically, as well as draw conclusions and formulate and fully justify opinions (including author's opinions)
RCS_K2_U03	The graduate can independently design, prepare and conduct empirical research, as well as perform statistical analysis and interpretation of results; select (or create) an appropriate research method for a given problem and an appropriate statistical method for a given problem and type of analyzed data
RCS_K2_U04	The graduate can recognize and critically evaluate the course of research reasoning conducted in the paradigms of the basic sciences of cognitive science and its subdisciplines
RCS_K2_U05	The graduate can present their own ideas, hypotheses and concepts, as well as doubts and suggestions, referring to constructs and theoretical models, as well as relying on research results (including their own)
RCS_K2_U12	The graduate can integrate acquired knowledge and skills by solving applications and utility problems and propose innovative solutions in these areas
RCS_K2_U15	The graduate can communicate his own and other people's research reports, created in the context of the scientific research process or professional practice, precisely and coherently formulating oral and written statements
RCS_K2_W01	The graduate knows and understands in an in-depth way the multidisciplinary nature of cognitive science and its sources, the position of cognitive science within the system of sciences, its subject-specific and methodological characteristics, as well as the main trends in its development
RCS_K2_W02	The graduate knows and understands fluently professional cognitive science terminology in English (to the extent that allows participation in classes conducted entirely in English)
RCS_K2_W03	The graduate knows and understands various approaches to the study of the mind (e.g. computational, neuroscientific, philosophical, evolutionary), as well as the limitations and advantages of individual approaches
RCS_K2_W04	The graduate knows and understands relevant theories or research results (including his own), based on which he formulates in-depth opinions on complex cognitive science issues
RCS_K2_W05	The graduate knows and understands in an in-depth way the cognitive processes that cognitive science studies and explains: perception, consciousness, representations, emotions, memory, speech, communication, social cognition

Kod	Treść
RCS_K2_W06	The graduate knows and understands in-depth the types of disorders of processes, structures and cognitive mechanisms and the factors determining the development of these disorders
RCS_K2_W07	The graduate knows and understands in a structured and in-depth manner, advanced issues in the field of disciplines basic to cognitive science and subdisciplines of cognitive science (including their characteristic research methods)
RCS_K2_W08	The graduate knows and understands in a well-established practical way the principles of designing and conducting scientific research, with particular emphasis on formulating research problems, formulating hypotheses, as well as research methods, techniques and tools (including the principles of their design and testing)
RCS_K2_W09	The graduate knows and understands the applications of cognitive science in addressing civilizational challenges such as new technologies, health, education, marketing and management, economics, spatial design, rehabilitation, social relations, human-computer communication, and also proposes new forms and fields of cognitive science applications
RCS_K2_W10	The graduate knows and understands in-depth the ethical and legal conditions of research in the field of knowledge about the functioning of the mind/brain