Course syllabus

Course title	Advanced topics in cognitive science
Instructor(s)	prof. Maciej Haman, prof. Marcin Miłkowski
Contact details	Maciej Haman. E-mail: maciej.haman@psych.uw.edu.pl, room 202, Tuesdays, 12.00-14.00 Marcin Miłkowski
Affiliation	Maciej Haman – Faculty of Psychology, University of Warsaw
Course format	seminar
Number of hours	30 hours
Number of ECTS credits	**4 ECTS credits** 1 ECTS credit stands for 25-30 hours of work, including time spent in class, preparation for classes, exams and any other course related activity. Please specify here the estimated workload (in hours) for the different components of the course.
Brief course description	The course is aimed to familiarize participants with the current trends in research and controversies in cognitive science at the advanced level. The course will help students (1) broaden their knowledge of cognitive processes, their cerebral foundations, and computational models, (2) understand the main debates within contemporary cognitive science, (3) clarify their own research interests, chose their educational pathway and master's seminar. Course begins with an outline of current controversies around the architecture of cognition, methods, and aims of cognitive science. Further, the issues of elementary representations and cognitive processes which enable the orientation in the physical and social environments will be taken up, ending with the big issue of consciousness. Then, some methodological issues concerning current experimental methodology (especially replicability issue), main approaches in computational modeling (deep learning, Bayesian, predictive learning, formal modeling of brain connectivity), and neuroimaging will be discussed. Debate on the radical alternatives for the mainstream cognitive science („4E": embodied, embedded, extended and enacted cognition) is planned as summing-up theoretical issues of cognitive science. The final classes will be devoted to the application of cognitive science (human/brain-computer interfaces, education, design, etc.)
Full course description	
Learning outcomes	Please ensure that learning outcomes are compatible with the format, learning activities and teaching methods of the course you propose, e.g. lectures would not match with transfer of skills as a learning outcome. Also, please ensure that each learning outcome of your course relates to at least one of the learning outcomes of the CogSci programme (attached).

	Formulate learning outcomes in a way the allows them to be assessed. Avoid vague terminology (e.g. "understanding", "be aware of" , "know about", etc.); use precise wording instead ("describe x", "compare x and y", "identify …", etc.) For a short overview of organization and formulation of learning outcomes see this page from the Uni of Illinois; examples are here at a page of Carnegie Mellon For more detailed information, including on Blooms taxonomy of learning objectives and its application, see this page from Carnegie Mellon
Learning activities and teaching methods	Each main topic (and some sub-topics) will consist of (1) an entry test of 3-6 questions based on the obligatory reading for the class, (2) a short introductory lecture, (3) student presentations (approximately 20-30 min including questions/discussion each) based on advanced readings listed in the topic's description and the student's selection of additional papers, (4) the final discussion with an introductory student presentation. Readings and entry tests: For each topic a list of obligatory introductory readings will be provided. Classes will start with an entry test (up to 6 questions) assessing student's understanding of the obligatory topic's reading (one or two papers/chapters). Main presentation: Each student is expected to deliver a presentation based on advanced readings for the topic (selected from the list and supplemented with 1-3 papers independently found by the student). The presentation will be assessed on several criteria: (1) the clarity of the form and content, (2) validity of the content selection; (3) validity of auxiliary reading included in presentation, (4) conforming to time limits (5), quality of supplementary materials (handouts). The supplementary reading must be accepted by the lecturer and the handout of the presentation must be presented to the lecturer at least 2 days in advance. Auxiliary presentation: Each student is expected to deliver an additional presentation based on a short discussion paper on a different topic than main presentation, or with the presentation on applied cognitive science during the last two classes. Contribution to discussion: Student are expected to ask actively the questions and comment on the issues presented during the classes. Contribution to discussion should keep the rules of the good debate, including relevance and the time discipline. Additional activities (not listed above) may be considered to prior agreement with the lecturer.
List of topics/classes and bibliography	**Class 1**: ***What is modern cognitive science?*** Open discussion based on the entry survey (no marks): What are the main object and methods of research in cognitive science? Introductory lecture: History and paradigms of cognitive science

Classes 2-4: ***Core knowledge and cognitive development.***
(1) Object concept and perceptual ontology (2) Space (3) Numbers (4) How biological and artificial systems become cognitive agents?
Introductory papers:

- Spelke, E. S. (2016). Core knowledge and conceptual change. *Core knowledge and conceptual change*, *279*, 279-300.
- Vallortigara, G. (2012). Aristotle and the chicken: Animacy and the origins of beliefs. In *The theory of evolution and its impact* (pp. 189-199). Springer, Milano.

Advanced readings:

- Mascalzoni, E., Regolin, L., Vallortigara, G., & Simion, F. (2013). The cradle of causal reasoning: newborns' preference for physical causality. *Developmental science*, *16*(3), 327-335 i do tej samej prezentacji Di Giorgio, E., Lunghi, M., Simion, F., & Vallortigara, G. (2017). Visual cues of motion that trigger animacy perception at birth: the case of self-propulsion. *Developmental science*, *20*(4), e12394.
- Meristo, M., & Surian, L. (2014). Infants distinguish antisocial actions directed towards fair and unfair agents. *PloS one*, *9*(10), e110553.
- Surian, L., & Caldi, S. (2010). Infants' individuation of agents and inert objects. *Developmental Science*, *13*(1), 143-150.
- Vallortigara, G., Regolin, L., & Marconato, F. (2005). Visually inexperienced chicks exhibit spontaneous preference for biological motion patterns. *PLoS biology*, *3*(7), e208, or for the same presentation: Simion, F., Regolin, L., & Bulf, H. (2008). A predisposition for biological motion in the newborn baby. *Proceedings of the National Academy of Sciences*, *105*(2), 809-813.
- Nieder, A. (2016). The neuronal code for number. *Nature Reviews Neuroscience*, *17*(6), 366.
- XXXX
- XXXX
- XXXX

Classes 5-6: ***Social cognition***
(1) What's specific for people, but not animals and robots? (2) Understanding mental states of other people (3) Cognitive science of moral intuitions and moral decisions in animals, human and robots
Introductory readings:

- Moll, H., & Tomasello, M. (2007). Cooperation and human cognition: the Vygotskian intelligence hypothesis. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *362*(1480), 639-648.
- Bermudez J. L. (2014), Cognitive Science. The introduction to the science of the mind. Cambridge: Cambridge Un iversity Press, Chpt. 12., pp. 352-399.
- Haidt, J. (2013). Moral psychology for the twenty-first century. *Journal of Moral Education*, *42*(3), 281-297.

Advanced readings

- Herrmann, E., Call, J., Hernández-Lloreda, M. V., Hare, B.,

& Tomasello, M. (2007). Humans have evolved specialized skills of social cognition: The cultural intelligence hypothesis. *science*, *317*(5843), 1360-1366.
- Gergely, G., & Csibra, G. (2005). The social construction of the cultural mind: Imitative learning as a mechanism of human pedagogy. *Interaction Studies*, *6*(3), 463-481.
- Krupenye, C., Kano, F., Hirata, S., Call, J., & Tomasello, M. (2016). Great apes anticipate that other individuals will act according to false beliefs. *Science*, *354*(6308), 110-114.
- Kovács, Á. M., Téglás, E., & Endress, A. D. (2010). The social sense: Susceptibility to others' beliefs in human infants and adults. *Science*, *330*(6012), 1830-1834.
- Richardson, H., Lisandrelli, G., Riobueno-Naylor, A., & Saxe, R. (2018). Development of the social brain from age three to twelve years. *Nature communications*, *9*(1), 1027.
- Ruffman, T. (2014). To belief or not belief: Children's theory of mind. *Developmental review*, *34*(3), 265-293.
- Scott, R. M., & Baillargeon, R. (2017). Early false-belief understanding. *Trends in Cognitive Sciences*, *21*(4), 237-249.
- Sachdeva, S., Singh, P., & Medin, D. (2011). Culture and the quest for universal principles in moral reasoning. *International journal of psychology*, *46*(3), 161-176.
- Haidt, J. (2013). Moral psychology for the twenty-first century. *Journal of Moral Education*, *42*(3), 281-297.
- Koenig, M. A., Tiberius, V., & Hamlin, J. K. (2019). Children's Judgments of Epistemic and Moral Agents: From Situations to Intentions. *Perspectives on Psychological Science*, *14*(3), 344-360.
- Shenhav, A., & Greene, J. D. (2014). Integrative moral judgment: dissociating the roles of the amygdala and ventromedial prefrontal cortex. *Journal of Neuroscience*, *34*(13), 4741-4749.
- Haidt, J., & Joseph, C. (2007). The moral mind: How five sets of innate intuitions guide the development of many culture-specific virtues, and perhaps even modules. *The innate mind*, *3*, 367-391.
- Bloom, P. (2012). Religion, morality, evolution. *Annual review of psychology*, *63*, 179-199.
- Bloom, P. (2004). *Descartes' baby*. London: William Heinemann.

Class 7: *Consciousness*

Introductory papers:

- Boly, M., Seth, A. K., Wilke, M., Ingmundson, P., Baars, B. J., Laureys, S., et al. (2013). Consciousness in humans and non-human animals: Recent advances and future directions. *Frontiers in Psychology*, *4*. doi:10.3389/fpsyg.2013.00625
- Dehaene, S., Lau, H., & Kouider, S. (2017). What is consciousness, and could machines have it? *Science*, *358*(6362), 486–492. doi:10.1126/science.aan8871

Advanced readings:

- Thagard, P., & Stewart, T. C. (2014). Two theories of consciousness: Semantic pointer competition vs. information integration. *Consciousness and Cognition*, *30*, 73–90. doi:10.1016/j.concog.2014.07.001
- Lau, H. C. (2007). A higher order Bayesian decision theory of consciousness. In R. Banerjee & B. K. Chakrabarti (Eds.), *Progress in Brain Research* (pp. 35–48). https://doi.org/10.1016/S0079-6123(07)68004-2

Classes 8-9: *Main modern trends in modelling cognitive systems* (1) neural networks and deep learning (2) Bayesian modelling (3) predictive learning (4) formal models of brain connectivity

- Schmidhuber, J. (2015). Deep learning in neural networks: An overview. *Neural Networks*, *61*, 85–117. doi:10.1016/j.neunet.2014.09.003
- Marblestone, A. H., Wayne, G., & Kording, K. P. (2016). Toward an Integration of Deep Learning and Neuroscience. *Frontiers in Computational Neuroscience*, *10*. doi:10.3389/fncom.2016.00094
- Tenenbaum, J. B., Kemp, C., Griffiths, T. L., & Goodman, N. D. (2011). How to grow a mind: Statistics, structure, and abstraction. *science*, *331*(6022), 1279-1285. (Note: required at admission)
- Rubinov, M., & Sporns, O. (2010). Complex network measures of brain connectivity: uses and interpretations. *Neuroimage*, *52*(3), 1059-1069
- Friston, K. J. (2010). The free-energy principle: a unified brain theory? *Nature reviews. Neuroscience*, *11*(2), 127–38. doi:10.1038/nrn2787
- Zorzi, M., & Testolin, A. (2018). An emergentist perspective on the origin of number sense. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *373*(1740), 20170043.
- Small-world formalism and its application:
- Liao, X., Vasilakos, A. V., & He, Y. (2017). Small-world human brain networks: perspectives and challenges. *Neuroscience & Biobehavioral Reviews*, *77*, 286-300.
- Betzel, R. F., Avena-Koenigsberger, A., Goñi, J., He, Y., De Reus, M. A., Griffa, A., ... & Van Den Heuvel, M. (2016). Generative models of the human connectome. *Neuroimage*, *124*, 1054-1064.
- Marcus, G. F., & Davis, E. (2013). How robust are probabilistic models of higher-level cognition?. *Psychological science*, *24*(12), 2351-2360. https://journals.sagepub.com/doi/pdf/10.1177/0956797613495418?casa_token=4J0EZzzeKO4AAAAA:qx7LBDy59_53e19G-Axx_WIfEqRe1YZIxWnxiR44mkyhOtXgENbtpYVhAmZ84Eb5aagDjm6a2F0a
- Lee, M. D., & Wagenmakers, E. J. (2014). *Bayesian cognitive modeling: A practical course*. Cambridge university press.http://faculty.sites.uci.edu/mdlee/files/2011/03/BB_Fre

e.pdf

- Zorzi, M., Testolin, A., & Stoianov, I. P. (2013). Modeling language and cognition with deep unsupervised learning: a tutorial overview. *Frontiers in psychology*, *4*, 515.

Classes 10-11: *Methodological challenges in contemporary cognitive science*

(1) Reliability of neuroimaging

- Carp, J. (2012). The secret lives of experiments: methods reporting in the fMRI literature. *NeuroImage*, *63*(1), 289–300. doi:10.1016/j.neuroimage.2012.07.004
- Bennett, C., Miller, M., & Wolford, G. (2009). Neural correlates of interspecies perspective taking in the post-mortem Atlantic Salmon: an argument for multiple comparisons correction. *NeuroImage*, *47*, S125. doi:10.1016/S1053-8119(09)71202-9
- Maier-Hein, K. H., Neher, P. F., Houde, J. C., Côté, M. A., Garyfallidis, E., Zhong, J., ... & Reddick, W. E. (2017). The challenge of mapping the human connectome based on diffusion tractography. *Nature communications*, *8*(1), 1349.

(2) Rreplication crisis in psychology

Introductory reading

- Open Science Collaboration. (2015). Estimating the reproducibility of psychological science. *Science*, *349*(6251), aac4716.

Advanced readings

- Zwaan, R. A., Etz, A., Lucas, R. E., & Donnellan, M. B. (2017). Making Replication Mainstream. *Behavioral and Brain Sciences*, 1–50. doi:10.1017/S0140525X17001972
- Wagenmakers, E.-J., Beek, T., Dijkhoff, L., Gronau, Q. F., Acosta, A., Adams, R. B., et al. (2016). Registered Replication Report: Strack, Martin, & Stepper (1988). *Perspectives on Psychological Science*, *11*(6), 917–928. doi:10.1177/1745691616674458
- Maxwell, S. E., Lau, M. Y., & Howard, G. S. (2015). Is psychology suffering from a replication crisis? What does “failure to replicate” really mean? *American Psychologist*, *70*(6), 487–498. doi:10.1037/a0039400

Class 12: *Radical alternatives to mainstream cognitive science: 4E (embodied, embedded, extended and enacted cognition)*

Introductory reading

- Chemero, A. (2013). Radical embodied cognitive science. *Review of General Psychology*, *17*(2), 145-150.

Advanced readings

- Miłkowski, M., Clowes, R. W., Rucińska, Z., Przegalińska, A., Zawidzki, T., Gies, A., et al. (2018). From Wide Cognition to Mechanisms: A Silent Revolution. *Frontiers in Psychology*, *9*. doi:10.3389/fpsyg.2018.02393
- Hutchins, E. (2010). Cognitive Ecology. *Topics in Cognitive Science*, *2*(4), 705–715. doi:10.1111/j.1756-8765.2010.01089.x
- Goldinger, S. D., Papesh, M. H., Barnhart, A. S., Hansen, W.

	A., & Hout, M. C. (2016). The poverty of embodied cognition. *Psychonomic Bulletin & Review*, *23*(4), 959–978. doi:10.3758/s13423-015-0860-1 • Núñez, R., Allen, M., Gao, R., Rigoli, C. M., Relaford-Doyle, J., & Semenuks, A. (2019). What happened to cognitive science? *Nature Human Behaviour*, 1. doi:10.1038/s41562-019-0626-2 • Clark, A. (2013). Whatever next? Predictive brains, situated agents, and the future of cognitive science. *Behavioral and brain sciences*, *36*(3), 181-204. **Classes 13-14: Applied cognitive science: stock exchange of ideas** No intgroductory reading. Suggested readings: Norman, D. A. (2002). *The Design of Everyday Things*. New York: Basic Books.
Assessment methods and criteria	Student is expected to gain at least 60% total score to complete the course. The following activities contribute to the score: Entry tests: 30% Main presentation 30% Auxiliary presentation 15% Contribution to discussion 20% Additional activities 5% Entry tests (up to 6 questions) will assess student's understanding of the obligatory topic's reading (one or two papers/chapters). Tests will be weighted depending on the topic's scope. Extended version of the test will be used in the case of absence compensation. No more than 2 entry tests during the term may be scored below 50%. Main presentation: Each student is expected to deliver a presentation based on advanced readings for the the topic (predetermined and independently found by the student). The presentation will be assessed on several criteria: (1) the clarity of the form and content, (2) validity of the content selection; (3) validity of auxiliary reading included in presentation, (4) conforming to time limits (5), quality of supplementary materials (handouts). Auxiliary presentation: Presentation will be assessed on several criteria: (1) the clarity of the form and content, (2) validity of content selection, (3) conforming to time limits. Contribution to discussion: Student contributions to discussion will be scored on each class with 2 points standing for a substantial contribution, 1 point standing for an occasional contribution (maximum 20 points / term). Relevance, time discipline, and other rules of discussion will be considered in the assesment.

	Additional activities will be included in the final score subject to prior agreement with the lecturer. Some elements of peer evaluation may be introduced to the assesment of student presentations, contribution to discussion, and additional activities.
Attendance rules	Up to 3 unexcused absences during the term are allowed. Student is expected to pass an extended test based on the introductory and at least one advanced reading for each missed class.
Prerequisites	Specify in case students need to have completed certain courses or need to possess some specific skills, competences or expertise to be allowed to participate in this course. This is of particular importance for first semester courses. Students come to CogSci with very diverse skills, knowledge, and experience. Providing detailed information about your baseline expectations (together with resources, e.g., textbooks) will help both you and the group. The requirements you provide here will be passed to interested candidates during the recruitment stage.
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	Any remarks you would like students to know