Syllabus for the course «Visual Perception and Attention»

(4 ECTS**)**

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1. **Course Description**
   a. «Visual Perception and Attention»
   b. Pre-requisites

   The course is based on the basic knowledge:
   - A good command of English language.
   - A basic knowledge of Mathematics.

   c. Course Type: Elective
   d. Abstract

   Visual perception is an inference of a scene out there based on a sensory input from eyes. Visual attention is a process concentrating a computational force of the brain on a specific aspect of the perceived scene or of the sensory input. The processes of perception and attention interact with one another and the interaction is even indispensable for them. This course will review studies of them and of interactions between them. Theories behind perception and attention will be particularly emphasized. The first half of the course mostly covers perception: how the scene is represented in the brain, how the representation is computed in the brain, and how the perceptual process affects and is affected by attention. The second half of the course more emphasizes attention itself: types of attention, how attention affects cognitive performance, how it makes us see what we see, how it is linked to memory and consciousness, and why it is limited.

2. **Learning Objectives**

   The course «Visual Perception and Attention» is an attempt to give master course students multidisciplinary views to problems in Psychology and theoretical and analytical thinking of them via studying theories in vision science. Note that vision science is among the most multidisciplinary areas in psychology (for example, Philosophy, Applied

mathematics, Geometry, Photometry, Optics, Computer science, Physics, and Neuroscience). The course is read to the first year of the Master's program «Cognitive sciences and technologies» at HSE.

Visual perception (Tadamasa Sawada)

- Formalizing problems on vision
- 2D and 3D perception
- Color perception
- Perceptual representation
- Cue combination

Visual attention (Elena S. Gorbunova)

- Varieties of attention and early attentional theories
- The deployment of attention over space and time
- Feature-based and object-based attention
- Visual representations beyond the focus of attention
- Attention and consciousness

3. Learning Outcomes

After completing the study of the discipline «Visual Perception and Attention» the student should have the following competences:

- The ability to reflect developed methods of activity. The student can reflect developed methods to discuss and think about problems in Psychology
- The ability to improve and develop intelligent and cultural level, to build track of professional development and career. The student can improve and develop intelligent and cultural level, to build track of professional development and career based on the critical/analytical thinking learnt via studying how the theories of vision have been developed.
- The ability to analyze, verify and assess the completeness of information during professional activity and work under ambiguity. The student can analyze, verify and assess the completeness of information during professional activity and work under ambiguity based on the concepts of the ill-posedness, the ill- conditionedness, and the inverse problem.
- The ability to describe problems and situations of professional activity in terms of humanitarian, economic and social sciences to solve problems which occur across sciences, in allied professional fields. The student can describe problems and

situations of professional activity in terms of psychology by learning the multidisciplinary aspects of problems in psychology.

4. Course Plan

№	Topic
1.	Formalizing problems on vision
2.	2D and 3D perception
3.	Color perception
4.	Perceptual representation
5.	Cue combination
6.	Varieties of attention and early attentional theories
7.	The deployment of attention over space and time
8.	Feature-based and object-based attention
9.	Visual representations beyond the focus of attention
10.	Attention and consciousness

5. Reading List

Required Reading

Lu, Z.-L., Dosher, B. (2013). Visual Psychophysics: From Laboratory to Theory. Cambridge, MA: MIT Press, http://web.b.ebscohost.com/pfi/detail/detail?vid=0&sid=76621f52-2703-40d3-b9f2-ff6cc072c7cb%40sessionmgr101&bdata=JnNpdGU9cGZpLWxpdmU%3d#AN=edp2308724&db=edspub.

Sawada, T., Li, Y., & Pizlo, Z. (2015). Shape Perception. In: J. R. Busemeyer, Z. Wang, J. T. Townsend, & A. Eidels (Eds.), The Oxford Handbook of Computational and Mathematical Psychology, New York, NY: Oxford University Press, http://web.b.ebscohost.com/pfi/detail/detail?vid=2&sid=4326e3b9-04cc-48b6-98f7-27d2741e1936%40pdc-v-sessmgr05&bdata=JnNpdGU9cGZpLWxpdmU%3d#AN=edp4407472&db=edspub

Landy, M. S., Maloney, L. T., Johnston, E. B., & Young, M. (1995). Measurement and modeling of depth cue combination: in defense of weak fusion. Vision Research, 35 (3), 389-412.

Tsotsos, J. K. (2011). A Computational Perspective on Visual Attention. Cambridge, MA: MIT Press, http://web.b.ebscohost.com/pfi/detail/detail?vid=0&sid=6c04602b-b6a6-4b69-bd79-877a3e6632ef%40sessionmgr120&bdata=JnNpdGU9cGZpLWxpdmU%3d#AN=edp1155892&db=edspub.

Johnson, A., & Proctor, R. W. (2004). Attention: Theory and practice. Sage. http://opac.hse.ru/absopac/index.php?url=/notices/index/152456/default

Other readings will be suggested during the class.

Recommended Reading

Howard, I. P. & Rogers, B. J. (2012). Perceiving in Depth, New York, NY: Oxford University Press, http://web.b.ebscohost.com/pfi/detail/detail?vid=0&sid=b773bfb2-e4d1-4219-9624-35346dc32f4c%40sessionmgr120&bdata=JnNpdGU9cGZpLWxpdmU%3d#AN=edp1199471&db=edspub (vol. 1), http://web.b.ebscohost.com/pfi/detail/detail?vid=0&sid=9d441c69-1ccc-4493-bd15-c8c98083793c%40pdc-v-sessmgr05#AN=edp1199472&db=edspub (vol. 2), http://web.b.ebscohost.com/pfi/detail/detail?vid=0&sid=0309d848-3430-424f-97b1-a462739f893d%40sessionmgr101&bdata=JnNpdGU9cGZpLWxpdmU%3d#AN=edp1199475&db=edspub (vol.3).

Pizlo Z., Li Y., Sawada T., Steinman R. M. (2014). Making a Machine That Sees Like Us. New York, NY: Oxford University Press, http://web.b.ebscohost.com/pfi/detail/detail?vid=7&sid=4326e3b9-04cc-48b6-98f7-27d2741e1936%40pdc-v-sessmgr05&bdata=JnNpdGU9cGZpLWxpdmU%3d#AN=edp2889183&db=edspub

Pizlo, Z. (2008). 3D Shape: Its Unique Place in Visual Perception. Cambridge, MA: MIT Press, http://web.b.ebscohost.com/pfi/detail/detail?vid=0&sid=18b52557-07b0-4e37-9174-1500bf048d7a%40pdc-v-sessmgr01&bdata=JnNpdGU9cGZpLWxpdmU%3d#AN=edp586863&db=edspub.

Wolfe, J. M., Kluender, K. R., Levi, D. M. (2009). Sensation & Perception - 2nd ed. Sunderland, MA: Sinauer Associates, Inc., http://opac.hse.ru/absopac/index.php?url=/notices/index/181900/.

Nobre, K. (2014). The Oxford handbook of attention. Oxford University Press. http://opac.hse.ru/absopac/index.php?url=/notices/index/324194/default

Other readings will be suggested during the class.

6. Grading System

Cumulative grade (Gc) for the student's work during the semester consists of lecturer's assessment of the student's work at seminars and lectures (homework, presence, participation, quality and quantity of answers, quality of presentations) (Gp) and the mid-term exam score (Gt).

Gc = 0.6*Gp + 0.4*Gt.

The finale grade (Gf) is the sum of cumulative grade (Gc) and the final assessment (exam) mark (Gex):

Gf = Gc + Gex

where Gc = 0.7 and Gex = 0.3.

The final grades are rounded in favour of the student. Namely, the grades having a fractional part equal to or greater than 0.5 are rounded up and the grades having a fractional part lower than 0.5 will be rounded down.

Table of Grade Correspondence

Ten-point Grading	Scale Five-point Grading Scale	
1 - very bad 2 – bad 3 – no pass	Unsatisfactory – 2	FAIL
4 – pass 5 – highly pass	Satisfactory – 3	PASS
6 – good 7 – very good	Good – 4	
8 – almost excellent 9 – excellent 10 – perfect	Excellent – 5	

The final grade, which is the resultant grade for the course, goes to the certificate of Master's degree.

7. Guidelines for Knowledge Assessment

Type of grading	Type of work	Characteristics
Continuous	Homework	Quiz and short essays
	Mid-term exam	Take home exam

Final	Exam	Written test

Continuous assessment:

Students must demonstrate their understanding of theories in vision science. It is also expected that the students will be able to apply their knowledge in their independent work on topics, connected with the discipline.

All essays will be checked for plagiarism.

Ten-point grade	**Criteria**
0 – not accepted	Less 5%, or the test was not taken
1 – very bad	Not less than 5, but less than 15%
2 – bad	Not less than 15, but less than 25%
3 – no pass	Not less than 25, but less than 35%
4 – pass	Not less than 35, but less than 45%
5 – highly pass	Not less than 45, but less than 55%
6 – good	Not less than 55, but less than 65%
7 – very good	Not less than 65, but less than 75%
8 – almost excellent	Not less than 75, but less than 85%
9 – excellent	Not less than 85, but less than 95%
10 – perfect	Not less than 95% and greater

Final exam assessment:

Final assessment is the final exam. Students have to demonstrate the knowledge of theories and facts in cognitive science of attention and perception. Students should be able to demonstrate the ability to discuss important topics and problems in the field of cognitive science, to understand relations both between course topics and with knowledge of other related fields including psychology, philosophy, and neuroscience. Students should demonstrate the ability to appropriately use scientific terms in the field of cognitive science.

The final exam grading criteria are:

The final exam is a set of multiple choice questions. The exam is graded using the 10-point scale.

Provisional Topics for mid-term exam:

1. Formalizing problems on vision
2. 2D and 3D perception

3. Color perception
4. Perceptual representation
5. Cue combination

Final exam questions (provisional):

1. Cause vs. effect theories of attention. Neural dissociation
2. Attention in light of the modern theory of vision
3. Parallel and serial processes in vision. Preattention and attention
4. The deployment of attention over space. Posner's cue task
5. Attention and eye movements
6. Inhibitory processes in spatial attention and neural correlates
7. Feature-based and object-based attention vs. spatial attention.
8. The binding problem and Feature integration theory
9. Attention engagement theory and Guided search model
10. Top-down and bottom-up determinants of visual saliency.
11. Attention and consciousness
12. Attention and automaticity

8. Methods of Instruction

The following educational technologies are used in the study process:

- Lectures involving continuous use of multimedia presentations and on-line simulations
- Seminars involving team oral discussions
- Homework assignments
- Self-study of presentation
- Self-study of recommended literature

Course lecturer is advised to use interactive learning methods, which allow participation of the students, such as discussions. It is also expected that multimedia presentations and video materials will be intensively used for the study process.

Students are required to study the presentations, which will be posted on the LMS educational portal, and the recommended reading. Students are required to actively participate in oral discussions during seminars and to take all tests.

9. Special Equipment and Software Support (if required)

The course requires a computer or laptop, projector, and acoustic systems for multimedia presentations and video.