



Government of Russian Federation

**Federal State Autonomous Educational Institution of High Professional
Education**

«National Research University Higher School of Economics»

National Research University
High School of Economics
Faculty of Psychology

Syllabus for the course
«Decision Science and Neuroeconomics»
(Введение в нейроэкономику)

37.04.01 «Cognitive sciences and technologies: from neuron to cognition»,
Master of Science

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Approved by: Department of Psychology

Recommended by:

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1. Teachers

Author, lecturer: Vasily Klucharev,

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2. Scope of Use

The present program establishes minimum demands of students' knowledge and skills, and determines content of the course.

The present syllabus is aimed at department teaching the course, their teaching assistants, and students of the Master of Science program 37.04.01 «Cognitive sciences and technologies: from neuron to cognition».

This syllabus meets the standards required by:

- Educational standards of National Research University Higher School of Economics;
- Educational program «Psychology» of Federal Master's Degree Program 37.04.01, 2014;
- University curriculum of the Master's program in psychology (37.04.01) for 2014.

3. Summary

Economics, psychology, and neuroscience are converging today into a unified discipline of Neuroeconomics with the ultimate aim of providing a single, general theory of human decision making. Neuroeconomics provides economists and social scientists with a deeper understanding of how they make their own decisions, and how others decide. Are we hard-wired to be risk-averse or risk seeking? How is a “fair decision” evaluated by the brain? Is it possible today to predict the purchasing intentions of a consumer? Can we modulate economic behaviour affecting the brain? Neuroscience allied to psychology and economics have powerful models and evidence to explain why we make a decision. Decision-making in financial markets, trust and cooperation in teams, consumer persuasion, will be central issues in this course in neuroeconomics. You will be provided with the most recent evidence from brain-imaging techniques (PET, fMRI and TMS), and you will be introduced to the explanatory models behind them.

4. Learning Objectives

Learning objectives of the “Decision Science and Neuroeconomics” class are to provide students with the new multidisciplinary approach to study decision-making. Students will learn:

- 1 Assumptions of Neuroeconomics
- 2 Methods of Neuroeconomics
- 3 The functional role of various brain regions in decision-making
- 4 Evolutionary approach of Neuroeconomics
- 5 Neuroeconomics of decisions in groups

5. Learning outcomes

After completing the study of the “Decision Science and Neuroeconomics” the student should:



- Know the brain models of decision making and choice, neuro-cognitive models of the choice: comparison with formal models of decision making
- Understand neural representation of the subjective value, basal ganglia and choice value.
- Understand the affective mechanisms of decision making
- Understand neural mechanisms of decision making under risk
- Understand social and evolutionary perspectives in Neuroeconomics

After completing the study of the discipline «Digital signal processing» the student should have the following competences:

Competence	Code	Code (UC)	Descriptors (indicators of achievement of the result)	Educative forms and methods aimed at generation and development of the competence
The ability to reflect developed methods of activity.	SC-1	SC-M1	The student is able to reflect developed cognitive neuroscience methods to psychological fields and problems.	Lectures and tutorials, group discussions, presentations, paper reviews.
The ability to propose a model to invent and test methods and tools of professional activity	SC-2	SC-M2	The student is able to improve and develop multidisciplinary models of decision-making	Classes, homeworks
Capability of development of new research methods, change of scientific and industrial profile of self-activities	SC-3	SC-M3	The student obtain necessary knowledge in neuroeconomics methods	Homeworks, paper reviews, additional topics
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,	PC-5	IC-M5.3_5.4_5.6_2.4.1	The student is able to describe psychological problems in terms of neuroeconomics	Lectures and tutorials, group discussions, presentations, paper reviews.



Competence	Code	Code (UC)	Descriptors (indicators of achievement of the result)	Educative forms and methods aimed at generation and development of the competence
in allied professional fields.				
The ability to detect, transmit common goals in the professional and social activities	PC-8	SPC-M3	The student is able to identify neuroeconomics aspects in psychological and neurobiological research tasks. Suggest a method to tackle the problem and rank several available techniques in the order of applicability in the current situation	Discussion of paper reviews; cross discipline lectures

6. Place of the discipline in the Master's program structure

The course introduces an interdisciplinary perspective on economic choice behaviour. We are looking for students who want to go the extra mile in understanding decision making from a biological perspective; eager to learn more about how neuroscience can revolutionize economics. All students that are interested in the neurobiological underpinning of choice behaviour and financial decisions are encouraged to participate; there are no requirements of specific background knowledge.

Prerequisites

The course is based on the basic knowledge of social and natural sciences. There are no requirements of specific background knowledge.

Comparison with the other courses at HSE

This class is unique in both the scope and the level of delivery that assumes only very basic background in economics and neuroscience.

7. Schedule

One pair consists of 2 academic hours for lecture or 2 academic hours of practical session (seminar) Please, see the Course description section for assignment of lectures.

8. Requirements and Grading

Type of grading	Type of work	Characteristics	
		#	
	Group Task (GT)	1	Making group presentations
	Class	2	Attendance of classes



	participation		
	Final exam (FE)	3	Written exam, 120 min
Final	Grade formula	$0.3*GT + 0.7*FE$	

Note:

- **you cannot miss more than three classes**
- for Group Task you can assign a different number of points (not more than 10) to different group members to support the most active people. Example: 8 (Result of the Group X) x 5 (Number of people in the Group X) = 40 In this case you can distribute 40 points between group members depending on their contribution.

9. Assessment

The group task consists of 15 min PowerPoint presentation followed by 15 min group discussion.

Final assessment is the final exam. Students have to demonstrate knowledge of neuroeconomics theory, studies and methods.

Grading:

1. 2. Group assignment (Group Task) with a presentation at the Seminar – 30% of final mark
 3. Written exam – 70% of final mark
- You cannot miss more than three classes.

The grades are rounded in favour of examiner/lecturer with respect to regularity of class and home works. All grades, having a fractional part greater than 0.5, are rounded up.

Academic integrity policy Cheating, plagiarism, and any other violations of academic ethics at HSE are not tolerated.

Table of Grade Accordance

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	

10. Schedule and Course Description

A preliminary list of lectures:

Lecture 1: Introduction. Introduction to the course, historical overview of the field



Lecture 2 : Measuring brain activity.

Lecture 3: Introducing brain models of decision making and choice. Neuro-cognitive models of the choice: comparison with formal models of decision making.

Lecture 4: Neural representation of the subjective value, basal ganglia and choice value

Seminar 1:

- Heekeren, H.R., Marrett, S., Bandettini, P.A., and Ungerleider, L.G. (2004). A general mechanism for perceptual decision-making in the human brain. *Nature* 431, 859-862.
- Philiastides MG, Auzan R, Heekeren HR, Blankenburg F. Causal role of dorsolateral prefrontal cortex in human perceptual decision making. *Curr Biol.* 2011 Jun 7;21(11):980-3.

Lecture 5: Affective mechanisms of decision making

Seminar 2:

- Plassmann H., O'Doherty J., and Rangel A. Orbitofrontal Cortex Encodes Willingness to Pay in Everyday Economic Transactions *The Journal of Neuroscience*, September 12, 2007 27(37)
- Harbaugh, W. T., U. Mayr, et al. (2007). Neural responses to taxation and voluntary giving reveal motives for charitable donations. *Science* 316(5831): 1622-5.

Lecture 6: Dual process theory of decision making

Seminar 3:

- John M. Coates, Mark Gurnell, and Aldo Rustichini, Second-to-fourth digit ratio predicts success among high-frequency financial traders *PNAS* January 13, 2009 vol. 106 no. 2 623–628
- Sapra S, Beavin L, Zak P. (2012) Combination of Dopamine Genes Predicts Success by Professional Wall Street Traders. *PLoS ONE*, v.7

Lecture 7: Decision making under risk.

Lecture 8: The social brain: Games in the brain.

Seminar 4:

- Kosfeld M, Heinrichs M, Zak PJ, Fischbacher U, Fehr E (2005) Oxytocin increases trust in humans. *Nature* 435: 673–676
- De Dreu, C. K., Greer, L. L., Handgraaf, M. J., Shalvi, S., Van Kleef, G. A., Baas, M., et al. (2010). The neuropeptide oxytocin regulates parochial altruism in intergroup conflict among humans. *Science* 328, 1408–1411.

Lecture 9: Taking an evolutionary perspective: the 'economic animal' Primate studies of economic behaviour. Animals' economy - a model of human economy.

Seminar 5:

- Lakshminaryanan V., Chen K. and Santos L. Endowment effect in capuchin monkeys *Phil. Trans. R. Soc. B* (2008) 363, 3837–3844
- Suchak M, de Waal FB Monkeys benefit from reciprocity without the cognitive burden. *Proc Natl Acad Sci U S A.* 2012 Sep 18;109(38):15191-6. Epub 2012 Sep 4.

Lecture 10: Social perspectives in Neuroeconomics

Seminar 6:

- Izuma K, Saito DN, Sadato N. Processing of social and monetary rewards in the human striatum. *Neuron.* 2008 Apr 24;58(2):284-94.
- Fliessbach, K., Weber, B., Trautner, P., Dohmen, T., Sunde, U., Elger, C.E., and Falk, A. (2007). Social comparison affects reward-related brain activity in the human ventral striatum. *Science* 318, 1305-1308.

Seminar 7-8: "Genetic wars"



- Emlen S. T. Wreg P. H. (1988) The Role of Kinship in Helping Decisions among White-Fronted Bee-Eaters. Behavioral Ecology and Sociobiology, Vol. 23, No. 5, pp. 305-315
- Passera, L., S. Aron, et al. (2001). Queen control of sex ratio in fire ants. Science 293(5533): 1308-1310.
- Rosset H, Chapuisat M. Sex allocation conflict in ants: when the queen rules. Curr Biol. 2006 Feb 7;16(3):328-31.

Lecture 12 Introduction to behavioral economics

Lecture 13 Prospect theory

Lecture 14-15 General discussion

11. Term Educational Technology

The following educational technologies are used in the study process:

- lectures
- discussion and analysis of the results of the home task;
- individual education methods, which depend on the progress of each student;

Students are required to show active participation in the course by giving presentations and by handing in questions about the literature before the start of each class. The basic concepts of the course will be examined by a written exam. Also, small teams of students will work on a literature study of their own choice that will be presented in an interactive Symposium at the end of the course.

12. Recommendations for course lecturer

Course lecturer is advised to use interactive learning methods, which allow participation of the majority of students, such as slide presentations, combined with writing materials on board, and usage of interdisciplinary papers to present connections between neuroeconomics, economics and psychology.

13. Recommendations for students

The course is interactive. Lectures are combined with classes. Students are invited to ask questions and actively participate in group discussions. There will be special office hours for students, which would like to get more precise understanding of each topic. The course introduces an interdisciplinary perspective on economic choice behaviour. We are looking for students who want to go the extra mile in understanding decision making from a biological perspective; eager to learn more about how neuroscience can revolutionize economics. All students that are interested in the neurobiological underpinning of choice behaviour and financial decisions are encouraged to participate; there are no requirements of specific background knowledge.

14. Preliminary list of exam questions

Describe the rules of the ultimatum game. How is it useful to study economic rationality)?

What is the firing rate?

What is the BOLD signal? How is the BOLD signal related to actions potentials and to fMRI method?

Describe basic principles and advantages (disadvantages) of the method:



- Lesions
- Electrical stimulation of the brain
- Transcranial Magnetic Stimulation – TMS
- Electrophysiology (cell recordings)
- functional Magnetic Resonance Imaging – fMRI

Explain the following terms:

- Voxel
- BOLD

Explain:

- ‘diffusion’ model of decision making

Illustrate decision making properties of LIP (decision-making) neurons. Why do we call LIP neurons –decision making neurons?

Please explain the following terms:

- Ordinal utility
- Cardinal utility

Explain the functional role of the orbitofrontal cortex

Explain basic findings of wine experiment: Plassmann, et al (2008) “Marketing actions can modulate neural representations of experienced pleasantness. “

Indicate the location of the ventral striatum/nucleus accumbens

What does dopamine neurons’ activity code?

What is a dopamine neuron?

What is dopamine?

Explain phenomena of self-stimulation

Explain the functional role of the nucleus accumbens

Explain the functional role of ventral striatum/nucleus accumbens, give examples

Explain results of the article Bechara, A., Damasio, H., Tranel, D., and Damasio, A. R. (1997). Deciding advantageously before knowing the advantageous strategy. *Science* 275, 1293-1295.

Explain the Iowa Gambling Task.

How impaired is the behavior of (Damasio’s) patients with damage to the ventromedial (orbitofrontal cortex) prefrontal cortex

What is the somatic-marker hypothesis, and who formulated it?

What is a dual system approach to decision making?

What is “dual processing”? Give neuroeconomics evidences of “dual processing” in the brain.

What is Temporal discounting (inter temporal-choices)?

Explain dual system approach to temporal discounting by McClure et al., 2004

Define risk, uncertainty, ambiguity.

An anticipatory affect model of risk (Brian Knutson)

What is “Decision under risk”?

Describe the Prisoner’s Dilemmas

What are mirror neurons?

Lecture N8) Describe modulation of the empathy-related responses when observing an unfair person.

Describe Empathy for pain experiments by T. Singer et al. (2004)

Explain the idea of Biological Markets (give an example)

Explain how to trade with capuchin monkeys. Do capuchin monkeys obey price theory, do they maximize expected value? (illustrate)

What is the Endowment effect?



Be prepared to explain the results of all papers discussed in the seminars.

15. Reading and Materials

Unfortunately, there is no single book and we will draw from a range of books listed below.

16. Required Reading

Paper for seminars (see section 10)

17. Recommended Reading

Literature will be made available to the students by means of electronic articles. The required literature will include:

- selected chapters from the Handbook of “Neuroeconomics: Decision Making and the Brain” by Paul Glimcher et al. (2008).
- selected chapters from handbooks on anatomy and brain imaging methods
- journal articles in neuroeconomics, selected for their clarity and accessibility

All readings can be accessed through the website/email. The quality of this seminar depends on everyone attending class, participating in discussion and doing the readings. Assigned readings should be completed before coming to class.

18. List of papers for review

Will be provided as the class progresses

19. Course support

Students are provided with links on relevant papers, tests, electronic books, articles, etc.

15. Equipment

The course requires no special equipment

Lecture materials, course structure and the syllabus are prepared by Vasily Klucharev