

Syllabus for the course
«Behavioral genetics and neurogenetics»
(4 ECTS)

Approved
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1. Course Description

a. Title of a Course:

“Behavioral genetics and neurogenetics”

b. Pre-requisites

none

c. Course Type

elective

d. Abstract

“**Behavioral genetics**” will promote an understanding of the current state of affairs with regards to behavioural genetics. Basic principles as well as recent developments will be explored in relation to a broad range of phenotypes. Historical and ethical issues will be discussed. The structure and function of DNA will be studied in the context of investigations into individual variation in psychological traits. Students will be introduced to behavioural genomic analysis, such as investigating gene-environment interaction, testing educational interventions, and testing the generalist genes hypotheses - using information on measured genes and measured environments. The course also covers ethical and legal considerations of genetic research. Additionally, an important part of scientific research is the dissemination of ideas and the open discussion of empirical findings. Research into the interplay between genes, psychology, education, and justice system - is relatively new and easily misunderstood. Thus, the sharing of scientific information and ideas with experts, the scientific community in general and the

wider public is critical. This module facilitates cross-cultural exchange, research dissemination, and public engagement activities. "**Neurogenetics**" is a basic course dealing with genetic underpinnings of development and function of central nervous system designed for the Master Program "Cognitive sciences and technologies: from neuron to cognition". The major genetic mechanisms, working on molecular and behavioral levels, will be discussed. The focus of the course will be the gene-cell-brain-behavior approach. As an example some neurophysiological endophenotypes will be introduced. The progress and perspectives of applying of genetic knowledge to understanding the neurological and psychiatric conditions will be also covered. The recent progress in neurogenetics provides new direction for the study of cognitive processes.

2. Learning Objectives

"**Behavioral genetics**" part will provide a systematic introduction to behavioural genetics. Conceptual, historical, theoretical and ethical issues will be discussed alongside developments in specific fields (e.g. behavioural genetics and psychopathology). The course will cover the methodology used in contemporary Quantitative Genetics, including Twin Studies, Adoption Studies, Adoption at Conception/IVF designs, and the latest addition to the Quantitative genetics tool box – the GCTA analysis. The course will also introduce students to research questions and methods in contemporary Molecular Genetics, extending to Behavioural Genomics. The aim of the course is not to train molecular geneticists, but rather to provide enough background and training in this field to engage in successful interdisciplinary collaborations with geneticists and molecular biologists, as well as to be able to conduct behavioural genomic investigations.

Learning objectives of the part "Neurogenetics" are to introduce students to

"**Neurogenetics**" part will provide with historical overview, and define the place of neurogenetics within related research. The course will cover:

- The multilevel approach to human cognition (gene-cell-brain-behavior)
- Methods used in neurogenetics
- Basic concepts of neurogenetics
- Promising neurophysiological endophenotype
- Neurogenetic disorders
- Problems and perspective in neurogenetics
- Practical application of knowledge obtain in neurogenetics

3. Learning Outcomes

After completing the study of the course "Behavioral genetics and neurogenetics" the student should:

- Describe the techniques used in Quantitative genetic research
- Describe the techniques used in Molecular genetic research
- Describe the theoretical foundations of current molecular genetic research
- Critically evaluate Quantitative genetic techniques
- Critically discuss the strengths and limitations of linkage and association methods
- Critically assess the logic of whole genome association approaches
- Critically evaluate the state of affairs in the current quest for molecular underpinnings of individual variation in psychological and neurophysiological traits.
- Describe step-by-step methodology of molecular analyses and the relevant technology
- Summarize and draw conclusions from quantitative and molecular genetic reports.
- Demonstrate significant insight into the structure and function of DNA
- Integrate knowledge of molecular issues into individual variation research
- Describe Quantitative genetic research exploring the origins of one or more variable
- Discuss associations between genetic and environmental influences (gene-environment correlations, interactions, epigenetic regulation, etc.)
- Discuss ethical, legal and societal implications of behavioural genetic research applied to medicine, education, economics and other fields
- Communicate effectively knowledge and understanding of the main concepts in behavioural genetics both orally and in written form
- Know basic notions and definitions in neurogenetics, its connections with other sciences.
- Know the methods used in neurogenetics.
- Be able to critically evaluate the studies, related to neurogenetics
- Be able to connect some brain process to genes
- Be able to describe some neurophysiological endophenotypes
- Be able to describe current state of affairs in understanding genetic mechanisms underlying major neurogenetic diseases
- Be able to communicate effectively in the field of neurogenetics

4. Course Plan

Topics:

1. Introduction to Behavioural Genetics
2. Molecular genetics (DNA, associations studies, polygenic prediction)

3. Gene-environment interplay (ge correlations, interactions, epigenetic mediation)
4. Multivariate Questions in quantitative genetics. (e.g. Co-morbidity, development, heterogeneity). Behavioural genetic research into cognitive/learning abilities and disabilities. Behavioural genetic research into psychopathology.
5. Ethical, Legal and Societal implications of genetic research. Processing of genetic data, protection of genetic privacy; Discrimination on genetic information – insurance, employment, education, consumer rights; Ethical implication of use of genetic knowledge and of access to genetic science benefits.
6. Revision, test, exam preparation, Final exam
7. Basic concepts and methods of neurogenetics
8. Neurogenetic disorders

5. Reading List

a. Required

1. Behavioural genetics for education / Ed. [Y. Kovas](#), [S. Malykh](#), [D. Gaysina](#). – New York: Palgrave Macmillan, 2016. – 311 с. – На англ. яз. - ISBN 9781137437310.
2. Plomin, R., DeFries, J.C., Knopik, V.S. & Neiderhiser, J.M. (2016). Behavioural Genetics (7th ed). New York, Worth. На англ. яз

b. Optional

1. Statistical theory and methods for evolutionary genomics / [X. Gu](#). – Oxford; New York: Oxford University Press, 2011. – 259 с. – На англ. яз. - ISBN 978-0-19-921326-9.
2. Principles of genetics / [D. P. Snustad](#), [M. J. Simmons](#). – 2nd ed. – New York: John Wiley & Sons, 2000. – 876 с. – На англ. яз. - ISBN 9780471298007.

6. Grading System

Neurogenetics:

The overall grade for neurogenetics:

$$G_{\text{neurogenetics}} = 0.3 * G_{\text{presentation}} + 0.2 * G_{\text{class}} + 0.5 * G_{\text{test}}$$

Behavioural Genetics:

$$\text{Behavioural genetics} = 0.2 * \text{Revision Test} + 0.8 * \text{Written Exam}$$

The overall final grade (cumulative formulae):

$$G_{\text{final}} = 0.6 * G_{\text{beh genetics}} + 0.4 * G_{\text{neurogenetics}}$$

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	Mid-term control tests	Tests in written form, 30 minutes each.
Continuous	Presentation	Students should present short (3-5 min) presentation on some self-chosen neurogenetics problem
Continuous	Attendance	Students should attend lectures and seminars and actively participate in discussions to earn the class grade

Penultimate Session	Test	Students should actively participate during the revision session, answering questions from the provided list.
Final Session	Final Exam	2 hours. 2 essays (out of a choice of 6 questions)

Behavioral genetics

Continuous assessment: Students have an opportunity to practice Test Questions throughout the course – as class exercises/continuous assessment.

Test: Students will be assessed during the Test session on the questions from the provided list (20% of the grade). Detailed information on the Oral examination will be provided to students in Session 1.

Final assessment: Written 2-hour exam. Students have to demonstrate the knowledge of theories and facts in behavioural genetics, the ability to discuss important topics and problems in the field of genetics. 2-essay style answers to 2 questions (from a list of 6).

The final exam grading criteria are:

1. Compliance of the answer to the current question topic;
2. Sufficient volume of knowledge on the current question topic;
3. Supporting the argument with specific examples from research
4. Ability to logically organize the answer and to structure the answer in a way that makes it clear and easy to follow
5. Ability to correctly use scientific terms within the course scope.

Ten-point grade	Criteria
0 – not accepted	No answer
1 – very bad	No criteria met
2 – bad	Less than 2 criteria met
3 – no pass	Less than 3 criteria met
4 – pass	At least 3 criteria are partially met
5 – highly pass	At least 3 criteria are met
6 – good	At least 4 criteria are partially met

7 – very good	At least 4 criteria are met
8 – almost excellent	All criteria are met.
9 – excellent	All criteria are met, and at least 3 criteria are fully met.
10 – perfect	All criteria are fully met

Neurogenetics:

The overall grade for neurogenetics:

$$G_{\text{neurogenetics}} = 0.3 * G_{\text{presentation}} + 0.2 * G_{\text{class}} + 0.5 * G_{\text{test}}$$

The class grade (G_{class}) is given by the teacher for attendance and activity during class hours.

Gpresentation

Students should present short (3-5 min) presentation on some self-chosen neurogenetics problem, including, but not limiting to description of some neurogenetic syndromes, neurophysiological endophenotypes, recent neurogenetics breakthrough.

The presentation grading criteria are:

1. Relevance to the neurogenetic research;
2. Sufficient volume of knowledge on the current question topic;
3. Quality of power point slides - relevant pictures/schemas;
4. Ability to logically organize the answer and to present evidence in adequate order;
5. Ability to correctly use scientific terms within the course scope.

Ten-point grade	Criteria
0 – not accepted	No answer
1 – very bad	No criteria met
2 – bad	Less than 2 criteria met
3 – no pass	Less than 3 criteria met
4 – pass	At least 3 criteria are partially met
5 – highly pass	At least 3 criteria are met

6 – good	At least 4 criteria are partially met
7 – very good	At least 4 criteria are met
8 – almost excellent	All criteria are met.
9 – excellent	All criteria are met, and at least 3 criteria are fully met.
10 – perfect	All criteria are fully met

Gtest

The multiple-choice written test (45 min) will be introduced at the last day of classes, examining the understanding of basic concepts in neurogenetics; two-choice questions - each correct answer adds one point. The grade is calculated as the proportion of correct answers to the total number of questions.

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

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.