Government of Russian Federation

Federal State Autonomous Educational Institution of High Education

«National Research University Higher School of Economics»

Faculty of Social science
Department of Psychology

Syllabus for the course
«Behavioral genetics and neurogenetics»

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

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Approved by:

Moscow, 2017

Summary

“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 and education 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.

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 Master’s Degree Program 37.04.01, 2014;

University curriculum of the Master’s program «Cognitive sciences and technologies: from neuron to cognition» in psychology (37.04.01) for 2017.

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

- The new field of neurogenetics, provide with historical overview, and define the place within related research fields
- 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

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
- Summarise 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.)
- Define what is meant by ‘endophenotype’ in behavioural genetic research
- Explain what is meant by ‘imaging genomics’.
- Discuss ethical, legal and societal implications of behavioural genetic research applied to medicine, education, economics and other fields – in historical and cross-cultural contexts
- Communicate effectively knowledge and understanding of the main concepts in behavioural genetics both orally and in written form
- Demonstrate successful public engagement and research dissemination strategies and skills, including presentations, publications, internet resources (websites, blogs, twitter), newsletters, film, creative design, and other media

- 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 neurogentics
- 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 understaning genetic mechanisms underlying major neurogenetic deseases
- Be able to communicate effectively in the field of neurogenetics

After completing the study of the discipline "Behavioral genetics and neurogenetics" 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 on the methods of activity studied.	SC-1	SC-M1	The student is able to reflect on the methods of activity studied based on main neurogenetics approaches.	Presentation/lectures
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 propose a model to invent and test methods and tools of neurogenetics.	Self-study, presentation
The ability to independently become acquainted with new research methods, to change scientific profile of activity.	SC-3	SC-M3	The student is able to independently become acquainted with new methods of neurogenetics.	Self-study, presentation
The ability to improve and develop intelligent and cultural level, to build track of professional development and career.	SC-4	SC-M4	The student is able to improve and develop intelligent and cultural level, to build track of professional development and career based on the knowledge of neurogenetics.	Self-study, presentation
The ability to analyze, verify and assess the completeness of information during professional activity and work under ambiguity.	SC-6	SC-M6	The student is able to analyze, verify and assess the completeness of information to solve neurogenetics problems.	Lectures, presentations, test

The ability to conduct professional (including research) activity in international environment.	SC-8	SC-M8	The student is able to conduct professional (including research) activity in international environment regarding main concepts of neurogenetics.	Presentation/lectures
Capability to organize independent scientific, research, consulting and applied activity on the basis of juridical and professional standards and duties.	PC-1	IK-M1.2p/n/i/k/pr_6.1	The student is able to organize independent scientific, research, consulting and applied activity on the basis of juridical and professional standards and duties.	Presentation/lectures
The ability to communicate orally and in written form in English in the frame of professional and scientific intercourse.	PC-2	ИК-M2.1_2.2._2.4.1_2.4.2	The student is able to discuss problems of neurosciences both orally and in written form.	Presentation, test.
The ability to present the results of the own activity in the form of report on scientific and practical work in English using modern IT technologies.	PC-3	IK-M3.1_3.2_2.4.1_2.4.2_2.5.1_2.5.2_4.2	The student is able to present the results of the own activity in the form of report on scientific and practical work in English using modern IT technologies.	Presentation

The ability to use modern IT technologies for search and processing of information, work with professional databases and net communication.	PC-4	IC-M4.1_4.3_4.4.	The student is able to use modern IT technologies for search and processing of information, work with professional databases and net communication to solve the neurogenetics problems.	Self-study, presentation
The ability to describe the problems and situations of the professional activity using the language and the apparatus of the humanitarian, economical and social sciences for solving problems at the intersection of scientific fields, in related professional fields.	PC-5	ИК-M5.3_5.4_5.6_2.4.1	The student is able to use the language and terminology of neurogenetics in conjunction with psychological language and terminology.	Lectures, presentations, test.
The ability to detect, transmit common goals in the professional and social activities.	PC-8	SPC-M3	The student is able to detect, transmit common goals in the field of the neurogenetics.	Discussion and analysis of the results of the home task and individual work
The ability to carry on professional business, make a choice follow by principles of social responsibilities.	PC-11	SPC-M7	The student is able to carry on professional business, make a choice follow by principles of neurogenetics.	Self-study, presentation

Place of the discipline in the Master's program structure

The course "Behavioral genetics and Neurogenetics" belongs to elective disciplines in the Master's program "Cognitive sciences and technologies: from neuron to cognition".

Prerequisites:

The course is based on the knowledge in biology, physiology, anatomy and psychology. The following knowledge and competence are required to study the discipline:

1. A good command of English language.
2. Basic knowledge of biology, physiology, anatomy and psychology.

Thematic Plan of the Course

№	Topic	Total hours	Class hours		Self-study
			Lectures	Seminars	
	Introduction to Behavioural Genetics	10	2	0	3
	Molecular genetics	14	2	2	3
	Gene-environment interplay	10	2	0	3
	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	14	2	2	3
	Critical evaluation of behavioural genetics	10	2	0	3
	Ethical concerns surrounding behavioural genetics research. Ethical, Legal and Societal implications of genetic research for education, medicine, economics and other fields	10	0	2	3
	Communicating findings from behavioural genetic studies to diverse audiences	14	0	4	3
	Behavioral genetics: discussion and Revision Session (+midterm test)	14	2	2	3
	Basic concepts and methods of neurogenetics	15	3	3	6
	Neurogenetic disorders	15	3	3	6
Total:		114	14	22	78

Requirements and Grading

Type of grading	Type of work	1st year		Characteristics
		1	2	
Continuous	Mid-term control tests		*	Tests in written form, 30 minutes each.

Final	Exam		*	Oral exam. Preparation time 30 minutes.

Course Grading Criteria

Behavioral genetics

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

Final assessment: Oral 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. Student will also need to demonstrate their understanding of the relations between different course topics, as well as knowledge of other related fields. Students should demonstrate the ability to appropriately use scientific terms in the field of genetics. The oral exam is worth 50% of the overall course grade (see Neurogenetics part for information on the other 50%). Deatailed information on the Oral examination will be provided to students in Session 1.

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. Ability to understand and discuss other topics within the course scope relevant to the current question topic;
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 then 2 criteria met
3 – no pass	Less then 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:

$G_{presentation}$

Students should present short (3-5 min) presentation on some self-chosen neurogentics 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 then 2 criteria met
3 – no pass	Less then 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

G_{test}

The multiple-choice written test (45 min) will be introduced at the last day of classes, examining the understanding of basic concepts in neurogentics. 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

The overall grade for neurogenetics:

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

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

The overall final grade (cumulative formulae):

$$G_{final} = 0.5 * G_{beh\ genetics} + 0.5 * G_{neurogenetics}$$

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.

Course Content

Behavioural Genetics

Tutors: Yulia Kovas (YK); Fatos Selita (FS)

Session & Date	Lecture Topic
Session 1, Oct 30	**Introduction to behavioral genetics (YK)** 12.10 – 13.30 Introduction 13.40 – 15.00 Main concepts and methods
Session 2, Nov 1	**Molecular genetics (YK)** 13.40 – 15.00 DNA 15.10 – 16.30 Association studies; polygenic prediction
Session 3, Nov 2	**G-E interplay (YK)** 12.10 – 13.30 ge correlations, interactions, 13.40 – 15.00 epigenetic mediation
Session 4, Dec 13	**Multivariate issues in behavioural genetics (YK)** 10.30 – 11.50 Revision. Comorbidity, heterogeneity, development 12.10 – 13.30 Cognitive abilities and disabilities; education
Session 5, Dec 14	**Ethical, societal and legal implications of genetic research (FS)** 12.10 – 13.30 Data and privacy 13.40 – 15.00 Discrimination, commercialisation, liability
Session 6, Dec 15	**Critical Evaluation of Behavioural genetics & Revision**

	10.30 – 11.50 Critical Evaluation of the methodology (YK) 13.40 – 15.00 Revision: Video materials and Discussion (YK & FS)
Session 7, Dec 18	**Oral Exam (YK & FS)** 15.10 – 16.30 16.40 – 18.00

Recommended Reading
Most references are useful for more than one lecture.

Course books:

*Plomin, R., DeFries, J.C., Knopik, V.S. & Neiderhiser, J.M. (2013). *Behavioural Genetics* (6th ed). New York, Worth. OR the 7th edition (2016) of the same book.
Rutter, M. (2005). *Genes and Behaviour*. Oxford, Blackwell.

Flint, J., Greenspan R.J., & Kendler, K.S. (2010). *How genes influence behavior*. Oxford University Press.

Kovas, Y., Malykh, S. & Gaysina, D. (2016). *Behavioural Genetics for Education.* Palgrave MacMillan.

Malykh, S.B., Kovas, Y., Gaysina, D.A. (Eds) (2016). *Behavioural Genomics: Child Development and Education.* In Russian. Publishing House of Tomsk State University, Tomsk. 442 pages. ISBN 978-5-94621-585-5. This book is available in pdf format for free: http://www.tsu.ru/upload/Genomika%20Povedeniya.pdf

www.tagc.world

Law, Society and Ethics sessions:

Students are not expected to buy this book for the purposes of this course, but for those with an interest the recommended book is:

Genetics: Ethics, Law and Policy (4th Ed.) of Lori B. Andrews, Maxwell Mehlman and Mark Rothstein.

Additional Reading

Note that several publications are available to you in PDF format.
Required reading for November sessions:
Rimfeld et al., (2015) – open access; available in pdf
Krapohl et al., (2014) – open access; available in pdf
Plomin & Deary (2014) – open access; available in pdf
Selzam et al. (2016) - open access;
Rimfeld et al. (2016) – open access;

Butterworth, B. & Kovas, Y. (2013). Understanding Neurocognitive Developmental Disorders Can Improve Education for All. *Science, 340, 300-305.*

Byrne, B., Coventry, W.L., Olson, R.K., Wadsworth, S., Samuelsson, S., Petrill, S.A., Willcutt, E.G., & Corley, R. (2010). "Teacher Effects" in Early Literacy Development: Evidence from a Study of Twins. *Journal of Educational Psychology, 102(1)*, 32-42.

Caspi, A., Moffit, T. E., Kim-Cohen, J., Morgan, J., Rutter, M., Taylor, A., & Polo-Tomas, M. (2004). Maternal expressed emotion predicts children's antisocial behavior problems: Using monozygotic-Twin differences to identify environmental effects on behavioral development. *Developmental Psychology, 40(2)*, 149-161.

Caspi A, Sugden K, Moffitt TE, Taylor A, Craig IW, Harrington H, et al. (2003). Influence of life stress on depression: Moderation by a polymorphism in the 5-HTT gene. *Science, 301(5631)*, 386-9.

de Geus, E. J. C. & Boomsma, D. I. (2001). A genetic neuroscience approach to human cognition. *European Psychologist, 6*, 241-253.

Evans, D.M. & Martin, N.G. (2000). The validity of twin studies. *GeneScreen, 1*, 77-79.

Gregory AM, Rijsdijk F, Dahl RE, McGuffin P, Eley TC. (2006). Associations between sleep problems, anxiety and depression in a selected sample of twins aged 8 years. *Pediatrics, 118*, 1124-1132.

Hariri AR, Weinberger DR. (2003). Imaging genomics. *British Medical Bulletin, 65*, 259-70.

Harold, G. T., Elam, K. K., Lewis, G., Rice, F., & Thapar, A. (2012). Interparental Conflict, Parent Psychopathology, Hostile Parenting, and Child Antisocial Behavior: Examining the Role of Maternal Versus Paternal Influences Using a Novel Genetically Sensitive Research Design. *Development and Psychopathology*, *24*(4), 1283 - 1295.

Kendler, K.S. (2001). Twin Studies of Psychiatric Illness. *Arch Gen Psychiatry, 58*, 1005-1014.

Kovas Y., Garon-Carrier, et al. (2015). Why Children Differ in Motivation to Learn: Insights from 13,000 Twins from 6 Countries. *Personality and Individual Differences.*

Kovas Y, Haworth CMA, Dale PS, Plomin R. (2007) The genetic and environmental origins of learning abilities and disabilities in the early school years. Kovas, Y., Haworth, C.M.A., Dale, P.S., & Plomin, R. (2007). The genetic and environmental origins of learning abilities and disabilities in the early school years. *Monographs of the Society for Research in Child Development*, Volume 72, whole number 3, Serial No. 188, pp. 1-144.

Kovas, Y. & Plomin, R. (2006). Generalist Genes: Implications for Cognitive Sciences.*Trends in Cognitive Sciences, 10(5),* 198-203.

Kovas, Y. & Plomin, R. (2008). Genetics of learning abilities and disabilities: Implications for cognitive neuroscience and translational research. In Reed, J. & Warner-Rogers, J. (Eds.). *Child neuropsychology: Concepts, theory and practice.* (pp. 46-57). Oxford: Wiley-Blackwell.

Kovas, Y. & Selita, F. (2014). Applying genetic discoveries to education. *International Innovation*, 133, 88-90.

Kovas, Y., Voronin, I., Kaydalov, A., Malykh, S.B., Dale, P.S., & Plomin, R. (2013). Literacy and numeracy are more heritable than intelligence in primary school. *Psychological Science,* 24(10), 2048-2056.

Krapohl, E., Rimfeld, K., Nicholas G. Shakeshaft, N. , Trzaskowski, M., McMillan, A., Pingault, J-B., Asbury, K., Harlaar, N., Kovas, Y., Dale, P.S. & Plomin, R. (2014). The high heritability of educational achievement reflects many genetically influenced traits, not just intelligence. *PNAS*, www.pnas.org/cgi/doi/10.1073/pnas.1408777111

Liang, H. & Eley, T.C. (2005). A monozygotic twin differences study of nonshared environmental influence on adolescent depressive symptoms. *Child Development, 76 (6),* 1247-1260.

Moffitt, T. E. (2005). The New Look of Behavioral Genetics in Developmental Psychopathology: Gene–Environment Interplay in Antisocial Behaviors. *Psychological Bulletin, 131,* 533-554.

Moffitt, T. E., Caspi, A., & Rutter, M. (2005). Strategy for investigating interactions between measured genes and measured environments. *Archives of General Psychiatry, 62 (5),* 473-481.

Nunfield Council on Bioethics (2002). Genetics and human behaviour: the ethical context. Summary and Recommendations. PDF available from internet.

Parens, E. (2004). Genetic Differences and Human identities. On why talking about behavioural genetics is important and difficult. Hastings Center Report Special Supplement, 34(1). PDF available from internet.

Plomin, R. & Deary, I. (2014). Genetics and Intelligence Differences: five special findings. Molecular Psychiatry, 20, 98-108.

Plomin, R., Haworth, C.M.A., Davis, O.S.P. (2009). Common disorders are quantitative traits. Nature Reviews Genetics, advance online publication.

Viding E, Blair RJR, Moffitt TE, Plomin R. (2005). Evidence for substantial genetic risk for psychopathy in 7-year-olds. J Child Psychol Psychiat, 46(6), 592-7.

Ethics, Law, Society

https://www.ncbi.nlm.nih.gov/pubmed/23452225

Ethical, legal, social, and policy implications of behavioral genetics.
Berryessa CM1, Cho MK.
https://www.ncbi.nlm.nih.gov/pubmed/23452225

Towards a new digital ethics Data, dignity and technology
https://secure.edps.europa.eu/EDPSWEB/webdav/site/mySite/shared/Documents/Consultation/Opinions/2015/15-09-11_Data_Ethics_EN.pdf

Genetic Information: Legal Issues Relating to Discrimination and Privacy
By Nancy Lee Jones

Legislative Attorney
American Law Division
http://biotech.law.lsu.edu/crs/RL30006_20080310.pdf

The collection, linking and use of data in biomedical research and health care: ethical issues
Published: February 2015 by Nuffield Foundation
http://nuffieldbioethics.org/project/biological-health-data/

ASSOCIATION FOR MOLECULAR PATHOLOGY ET AL.
v. MYRIAD GENETICS, INC., ET AL.
https://www.supremecourt.gov/opinions/12pdf/12-398_1b7d.pdf

Brief of Amici Curiae for the American Medical Association, et al.
By: Andrews, Lori
2013-02-19
http://dukespace.lib.duke.edu/dspace/handle/10161/7583

Charting a course for genomic medicine from base pairs to bedside
Eric D. Green, Mark S. Guyer & National Human Genome Research Institute
http://www.nature.com/nature/journal/v470/n7333/abs/nature09764.html

Education and personalized genomics: deciphering the public's genetic health report
Neil E Lamb, Richard M Myers, and Chris Gunter†
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2821046/

UK scientists gain licence to edit genes in human embryos
Team at Francis Crick Institute permitted to use CRISPR–Cas9 technology in embryos for early-development research.
Ewen Callaway
http://www.nature.com/news/uk-scientists-gain-licence-to-edit-genes-in-human-embryos-1.19270

UNESCO panel of experts calls for ban on "editing" of human DNA to avoid unethical tampering with hereditary traits
http://en.unesco.org/news/unesco-panel-experts-calls-ban-editing-human-dna-avoid-unethical-tampering-hereditary-traits

Neurogenetics

TOPIC 1. NEUROGENETICS WITHIN MODERN SCIENCES. BASIC CONCEPTS IN NEUROGENETICS.

History of neurogenetics/related fields. The subject of neurogenetics. The branches and fields of study within neurogenetics.

Basic concepts in neurogenetics. Methods (in short).

Classes: 4 hours
Self-study: 4 hours

Suggested reading:

Bogdan, R., Hyde, L. W., & Hariri, A. R. (2013). A neurogenetics approach to understanding individual differences in brain, behavior, and risk for psychopathology. Molecular Psychiatry, 18(3), 288–299. http://doi.org/10.1038/mp.2012.35

Fatemi, A. (2014). Neurogenetics. Seminars in Neurology, 34(03), 237–238. http://doi.org/10.1055/s-0034-1386761

Flint, J., & Munafò, M. R. (2013). Candidate and non-candidate genes in behavior genetics. Current Opinion in Neurobiology, 23(1), 57–61. http://doi.org/10.1016/j.conb.2012.07.005

Greenspan, R., & Petit, C. (2013). Neurogenetics. Current Opinion in Neurobiology, 23(1), 1–2. http://doi.org/10.1016/j.conb.2012.12.001

Hariri, A. R., Drabant, E. M., & Weinberger, D. R. (2006). Imaging Genetics: Perspectives from Studies of Genetically Driven Variation in Serotonin Function and Corticolimbic Affective Processing. Biological Psychiatry, 59(10), 888–897. http://doi.org/10.1016/j.biopsych.2005.11.005

Kerner, B. (2015). Psychiatric genetics, neurogenetics, and neurodegeneration. Frontiers in Genetics, 5. http://doi.org/10.3389/fgene.2014.00467

Kwak, D., Kam, A., Becerra, D., Zhou, Q., Hops, A., Zarour, E., … Waldispühl, J. (2013). Open-Phylo: a customizable crowd-computing platform for multiple sequence alignment. Genome Biology, 14(10), R116.

TOPIC 2. BIOLOGICALLY INFORMED APPROACH, NEUROPHYSIOLOGICAL ENDOPHENOTYPE.

Gene-cell-brain-behavior approach. Philosophical aspects/multilevel gaps/bridges.

Concept and examples of endophenotype/neurophysiological phenotype. Debated about the relation of 5-HTT polymorphism to psychological traits. Examples of how neurogentics helped to shed the light on mechanisms of cognition.

Classes: 4 hours
Self-study: 4 hours

Suggested reading:

Anokhin, A. P. (2014). Genetic psychophysiology: Advances, problems, and future directions. International Journal of Psychophysiology, 93(2), 173–197.

Geus, E. J. de. (2010). From genotype to EEG endophenotype: a route for post-genomic understanding of complex psychiatric disease? Genome Medicine, 2(9), 63. http://doi.org/10.1186/gm184

Daly, E. M., Deeley, Q., Ecker, C., Craig, M., Hallahan, B., Murphy, C., … Murphy, D. G. M. (2012). Serotonin and the Neural Processing of Facial Emotions in Adults With Autism: An fMRI Study Using Acute Tryptophan Depletion. Archives of General Psychiatry, 69(10). http://doi.org/10.1001/archgenpsychiatry.2012.513

Sysoeva, O. V., Tonevitsky, A. G., & Wackermann, J. (2010). Genetic determinants of time perception mediated by the serotonergic system. Retrieved from http://dx.plos.org/10.1371/journal.pone.0012650

TOPIC 3. NEUROGENETIC DISORDERS

Several neurogenetic disorders will be discussed as illustration of basic concepts in neurogentics. Particular emphasis will be put into neurodevelopmental disorders with high heritability, such autism spectrum disorder.

Classes: 4 hours
Self-study: 4 hours

Suggested reading:

Anney, R., Klei, L., Pinto, D., Almeida, J., Bacchelli, E., Baird, G., … Devlin, B. (2012). Individual common variants exert weak effects on the risk for autism spectrum disorders. Human Molecular Genetics, 21(21), 4781–4792. http://doi.org/10.1093/hmg/dds301

Ben-David, E., & Shifman, S. (2012). Networks of Neuronal Genes Affected by Common and Rare Variants in Autism Spectrum Disorders. PLoS Genetics, 8(3), e1002556. http://doi.org/10.1371/journal.pgen.1002556

Chen, C.-H., Huang, C.-C., Cheng, M.-C., Chiu, Y.-N., Tsai, W.-C., Wu, Y.-Y., … Gau, S. S.-F. (2014). Genetic analysis of GABRB3 as a candidate gene of autism spectrum disorders. Molecular Autism, 5(1), 36. http://doi.org/10.1186/2040-2392-5-36

Constantino, J. N., Zhang, Y., Frazier, T., Abbacchi, A. M., & Law, P. (2010). Sibling Recurrence and the Genetic Epidemiology of Autism. American Journal of Psychiatry, 167(11), 1349–1356. http://doi.org/10.1176/appi.ajp.2010.09101470

Fu, R., Ceballos-Picot, I., Torres, R. J., Larovere, L. E., Yamada, Y., Nguyen, K. V., … for the Lesch-Nyhan Disease International Study Group. (2014). Genotype-phenotype correlations in neurogenetics: Lesch-Nyhan disease as a model disorder. Brain, 137(5), 1282–1303. http://doi.org/10.1093/brain/awt202

Gomez, C. M., & Kawakami, H. (2015). Neurogenetics: The expanding horizons of diagnosis and disease pathogenesis. Neurology, 84(11), 1070–1071. http://doi.org/10.1212/WNL.0000000000001372

Li, X., Zou, H., & Brown, W. T. (2012). Genes associated with autism spectrum disorder. Brain Research Bulletin, 88(6), 543–552. http://doi.org/10.1016/j.brainresbull.2012.05.017

Rommelse, N. N. J., Geurts, H. M., Franke, B., Buitelaar, J. K., & Hartman, C. A. (2011). A review on cognitive and brain endophenotypes that may be common in autism spectrum disorder and attention-deficit/hyperactivity disorder and facilitate the search for pleiotropic genes. Neuroscience & Biobehavioral Reviews, 35(6), 1363–1396. http://doi.org/10.1016/j.neubiorev.2011.02.015

Educational Technology

The following educational technologies are used in the study process:

-Lectures involving continuous use of multimedia presentations and educational movies
-Seminars involving team oral discussions
-Tests, including two-choice tests
-Self-study of presentation
-Self-study of recommended literature

Recommendations for course lecturer

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.

Recommendations for Students

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.

Sample test questions:

Decide whether the statement is true or false:

1. Galton first described the link between circadian rhythms and genes and is considered by some to be the father of neurogetics.
3. Autism Spectrum disorder is likely to be caused by one or two genes.
4. Open Phylo is computer game, design to help geneticists to solve gene alignment problem
5. DNA meilinization is one of the epigenetic mechanisms
6. Transgenic animal models is an animal, in which an existing gene has been inactivated, through genetic engineering by replacing it or disrupting it with an artificial piece of DNA.
7. Resting EEG characteristics are highly heritable.

Reading and Materials

1. Obligatory reading

Purves D., Augustine G.J., Fitzpatrick D., Hall W.C., LaMantia A.-S., White L.C. (eds.) Neuroscience, 5th edition. Sinauer Associates, 2012.

2 Additional reading

Barker R., Cicchetti F. Neuroanatomy and Neuroscience at a Glance, 4th Edition. Wiley-Blackwell, 2012.

Blumenfeld H. Neuroanatomy through Clinical Cases, 2nd edition. Sinauer Associates, 2010.

Kandel E.R., Schwartz J.H., Jessell T.M., Siegelbaum S.A., Hudspeth A. J. (Eds.) Principles of Neural Science, 5th Edition. McGraw-Hill Professional, 2012

Squire L.R., Berg D., Bloom F. E., du Lac S., Ghosh A., Spitzer N. C. (Eds.). Fundamental Neuroscience, 4th ed. Academic Press, 2012.

Watson C., Kirkcaldie M.T.K., Paxinos G. The Brain: An Introduction to Functional Neuroanatomy. Academic Press, 2010.

All books are available in electronic form.

Equipment

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