WHAT IS «NEUROTECHNOLOGY»?

Neurotechnology combines neurobiological science with technological advances. This interdisciplinary field has developed rapidly in recent years, providing tools for neuroscientific and biomedical research and inspiring innovative business initiatives. Neurotechnologies enable the visualisation, correction and enhancement of brain activity, providing diagnostic and rehabilitation solutions for various brain disorders. They are also driving developments in neurocomputing, neurostimulation, neuroimaging, neuroeconomics, neuromarketing, and neurolaw.

WHAT IS COGNITIVE NEUROSCIENCE?

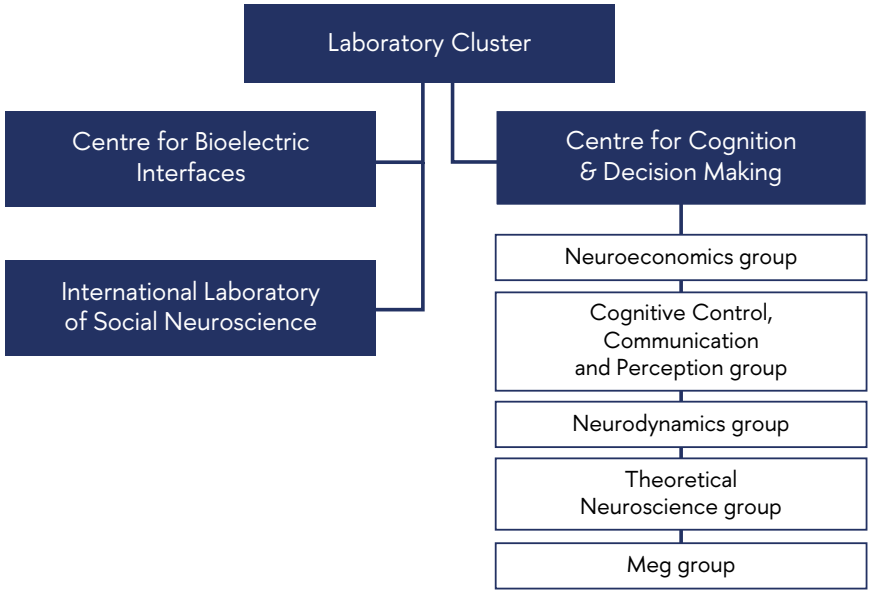
Cognitive neuroscience studies the complex neurobiological systems that underlie information processing, ranging from mechanisms of attention and memory to emotional regulation and communication. This field of contemporary neuroscience draws on a wide range of experimental methods and paradigms from cognitive psychology, neuropsychology, behavioural genetics, neuroimaging, and more.

CONTENT

OUR MISSION

Welcome to the Institute of Cognitive Neurosciences (ICN), a research unit of the National Research University Higher School of Economics (HSE). Our mission is to conduct high quality research and to seek new horizons in the field of cognitive science and neurotechnology. We also strive to reduce the gap between theoretical knowledge and its practical application.

ICN STRUCTURE



OUR NEUROTECHNOLOGY RESEARCH

At the Institute for Cognitive Neuroscience (ICN), we are deeply involved in neurotechnology research in areas such as neuroimaging of brain activity, brain-computer and neuromuscular interfaces, neurobiological feedback, neural reinforcement, and neuromarketing. Our advanced neuroimaging and neurostimulation techniques support the development of approaches that enable people, including those with paralysis, to control external devices without the use of their hands, significantly improving their quality of life. We are also actively developing neurobiological feedback paradigms for therapeutics and human performance enhancement in a variety of neurological disorders and critical occupational areas. ICN is establishing fruitful collaborations with leading neuromarketing service providers to monitor neurophysiological responses and evaluate the effectiveness of advertising campaigns.

ICN LABORATORY CLUSTER

"At the Institute for Cognitive Neuroscience (ICN), we are committed to developing an advanced laboratory cluster that stands as a benchmark both nationally and on the global stage".

Oleg Shevtsov, Lead Engineer

We have created an extensive laboratory complex equipped with state-of-the-art technological solutions from the world's leading manufacturers. This unique combination of advanced technical infrastructure and software products, including our own developments, allows us to provide diverse and accurate tools for scientific research. Our technical resources are constantly updated and improved, and our faculty members share their knowledge by teaching students at all levels and organising educational events, including schools and workshops within this laboratory complex. We also open doorsto collaborate with both business-to-business (B2B) and business-to-consumer (B2C) clients to conduct applied scientific research using the resources of our laboratory complex.

Our equipment

1

BRAIN-NAVIGATED TRANSCRANIAL MAGNETIC STIMULATION (TMS)

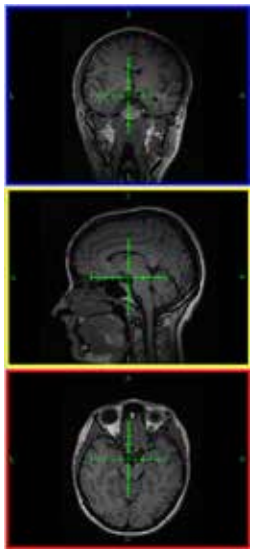
- A non-invasive method of stimulating the cerebral cortex, TMS uses short magnetic pulses to activate or inhibit specific groups of neurons.

- TMS-Cobot, a robotic system manufactured by Axilum Robotics, is designed to automatically control the positioning and orientation of compatible TMS coils under the control of an optical navigation tracking system.

- Ultra-precise TMS navigation is achieved through synchronization with individual MRI brain models.

- Integration with EEG and fNIRS systems for comprehensive research.

- Speech mapping - Clinically oriented TMS systems also include preoperative speech mapping modules that allow the creation of customized speech area maps.



2

TRANSCRANIAL CURRENT STIMULATION (TCS)

- tCS allows non-invasive stimulation of the cerebral cortex with direct (tDCS), alternating (tACS) electrical currents and impulse stimulation.

- These methods modulate neuronal excitability and affect motor, sensory, and cognitive functions.

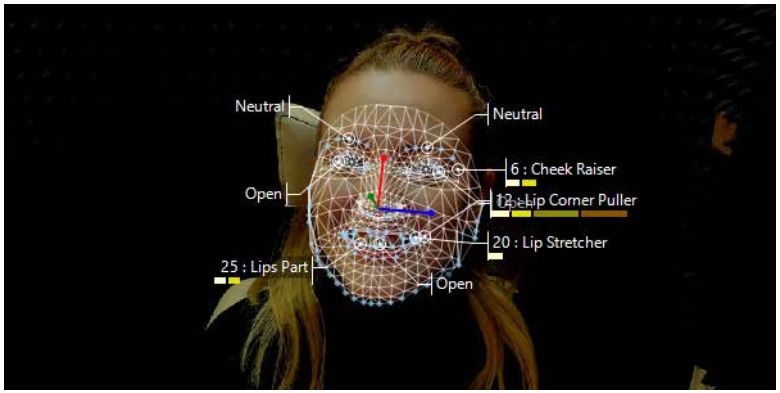
- Multi-channel tCS systems allow mapping of current flow through deep brain structures.

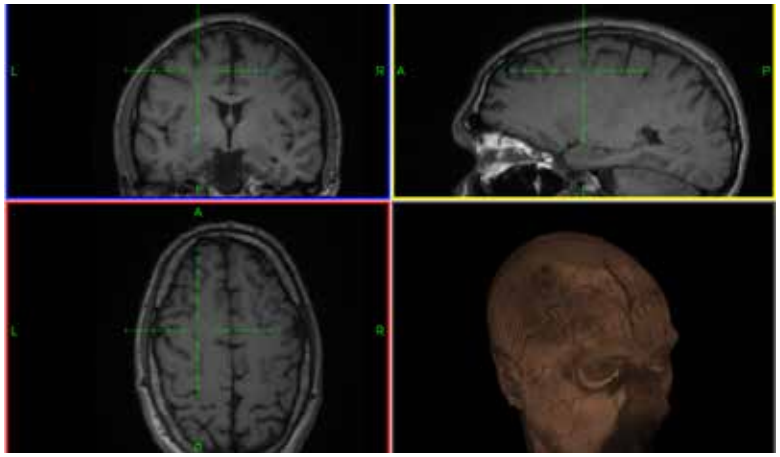
3 ELECTROENCEPHALOGRAPHY (EEG)

- A non-invasive method for recording electrical activity in various brain regions using scalp electrodes.
- We offer a wide range of EEG systems, from stationary multichannel systems to portable ones with integrated physiological sensors.
- Captrack and Polhemus digitising systems create 3D head models for precise electrode placement.

4 FUNCTIONAL NEAR-INFRARED SPECTROSCOPY (FNIRS)

- A non-invasive method of recording electrical activity in different regions of the brain using scalp electrodes.
- A wide range of EEG systems, from stationary multi-channel systems to portable systems with integrated physiological sensors.
- Captrack and Polhemus digitising systems create 3D head models for precise electrode placement.





5 EYE TRACKING

- Real-time recording of eye movements with millisecond accuracy.
- Enables in-depth analysis of gaze dynamics in cognitive domains such as perception, memory, and language processing.
- Widely used in product design, marketing research, and Internet studies.

6 VIRTUAL REALITY (VR)

- VR technology immerses individuals in virtual environments to enhance the study of consciousness and cognitive perception.
- Equipped with eye-tracking modules and peripheral infrastructure for full-body motion tracking.
- Integration with other laboratory methods enhances research capabilities.

7 BIOMECHANICAL MOTION TRACKING (BTS-SYSTEMS)

- High-resolution system for precise biological motion analysis.
- Supports kinematic data integration with various devices.
- Widely used in biomechanical analysis, sports medicine, robotics, scientific and clinical research.

8 MAGNETOENCEPHALOGRAPHY (MEG)

- Non-invasive method for recording magnetic fields generated by neuronal activity.
- Includes stationary cryogenic MEG and portable low-density OPM-MEG system.
- Used in perceptual and cognitive studies, localization of brain pathology, and neurofeedback.

9 FUNCTIONAL MAGNETIC RESONANCE IMAGING (FMRI)

- Captures blood oxygen level-dependent (BOLD) signals in the brain.
- Accurately localised brain activity, making it ideal for neuroanatomical research.

CENTRE FOR COGNITION & DECISION MAKING (CCDM)

Founded in

2013

Founded in 2013, CCDM is at the forefront of cognitive and neuroscience research in Russia. We use interdisciplinary approaches to study decision making, neuroeconomics, neurodynamics, psychophysiology, neurobiology of language, attention, memory, theoretical neuroscience, and neuroimaging. Our team includes experts from diverse fields, including psychology, cognitive neuroscience, economics, mathematics, engineering, physics, linguistics, medicine, and computer science. Using EEG, MEG, fMRI, TMS and other methods, we investigate the fundamental mechanisms of cognition and actively develop innovative neurotechnologies. Our goal is to produce world-class research that advances our understanding of the mind and brain in health and pathology.

NEUROECONOMICS GROUP

"Recent advancements in neurobiological research allow us to gain a better understanding of the biological basis of decision making. In combination with economics, psychology, information science and other fields of science, this new discipline - sometimes called neuro-economics - makes it possible to create a new representation of the mechanisms of decision making and helps to successfully modulate human economical behaviour".

Anna Shestakova, PhD,
head of the Neuroeconomics group.

SELECTED PUBLICATIONS

1. Gorin, A., Klucharev, V., Ossadtchi, A., Zubarev, I., Moiseeva, V., & Shestakova, A. (2021). MEG signatures of long-term effects of agreement and disagreement with the majority. Scientific reports, 11(1), 3297.

2. Martinez-Saito, M., Andraszewicz, S., Klucharev, V., & Rieskamp, J. (2022). Mine or ours? Neural basis of the exploitation of common-pool resources. Social Cognitive and Affective Neuroscience, 17(9), 837-849.

3. Martinez-Saito, M., Konovalov, R., Piradov, M. A., Shestakova, A., Gutkin, B., & Klucharev, V. (2019). Action in auctions: neural and computational mechanisms of bidding behaviour. European Journal of Neuroscience, 50(8), 3327-3348.

5. Zinchenko, O., Nikulin, V., & Klucharev, V. (2021). Wired to Punish? Electroencephalographic Study of the Resting-state Neuronal Oscillations Underlying Third-party Punishment. Neuroscience, 471, 1-10.

6. Panidi, K., Vorobiova, A. N., Feurra, M., & Klucharev, V. (2022). Dorsolateral prefrontal cortex plays a causal role in probability weighting during risky choice. Scientific Reports, 12(1), 16115.

Neuroeconomics grew out of several scientific disciplines. Broadly speaking, neuroeconomics is the neuroscience of decision making. Currently, the scope of neuroeconomic studies in our centre includes research on brain mechanisms of decision making in various contexts: under risk and uncertainty, intertemporal choice, social influence, fake news, urban environment, and many more.

The group focuses on neurobiological mechanisms of economic decision making as well as social and marketing effects on human behaviour. We study such fundamental aspects of human decision making as risk taking, time discounting, cognitive dissonance, learning-based valuation, pro- and anti-social behaviour, social competition, and many other rational and emotional aspects of decision making and many others. We use TMS, tDCS, tACS, EEG, MEG, fNIRS and fMRI as well as computational modelling to map the corresponding brain processes. Overall, our research contributes to the creation of a new interdisciplinary theory of the economic decision-making process that will enable scientists to model and optimise economic behaviour.

COGNITIVE CONTROL, COMMUNICATION & PERCEPTION GROUP

"One of the main aims of our research is to investigate the brain mechanisms of encoding, storing, and communicating knowledge as well as to study multifaceted interactions between these mechanisms and other neurocognitive systems (such as attention and executive control). In the future, these investigations will help us in developing non-invasive protocols for mapping brain functions and techniques for addressing various cognitive, neurological, and developmental disorders".

Yury Shtyrov, PhD, head of Cognitive control, Communication and Perception group.

SELECTED PUBLICATIONS

1. Bermúdez-Margaretto, B., Gallo, F., Novitskiy, N., Myachykov, A., Petrova, A., & Shtyrov, Y. (2022). Ultra-rapid and automatic interplay between L1 and L2 semantics in late bilinguals: EEG evidence. Cortex, 151, 147-161.

2. Alekseeva, M., Myachykov, A., Bermudez-Margaretto, B., & Shtyrov, Y. (2022). Neurophysiological correlates of automatic integration of voice and gender information during grammatical processing. Scientific Reports, 12(1), 13114.2

3. Gallo, F., Novitskiy, N., Myachykov, A., & Shtyrov, Y. (2021). Individual differences in bilingual experience modulate executive control network and performance: behavioural and structural neuroimaging evidence. Bilingualism: Language and Cognition, 24(2), 293-304.

4. Martín-Luengo, B., Myachykov, A., & Shtyrov, Y. (2022). Deliberative process in sharing information with different audiences: Eye-tracking correlates. Quarterly Journal of Experimental Psychology, 75(4), 730-741.

5. Ulanov, M. & Shtyrov, Y. (2022). Oscillatory beta/alpha band modulations: A potential biomarker of functional language and motor recovery in chronic stroke?. Frontiers in Human Neuroscience, 16, 940845.

One of the central questions in cognitive science is what role general systems (e.g., attention, memory) play in the acquisition, storage, and retrieval of abstract and concrete representations encoding words, images, concepts, and so on. Projects in our group cover a number of related research areas, including the role of domain-general (e.g., attention) and domain-specific (e.g., perceptual, sensorimotor) systems in the representation of abstract and concrete knowledge, time perception and numerical knowledge, neurophysiological and behavioural research on bilingual and multilingual populations, ageing and cognitive reserve, and neurophysiological research on communication disorders such as aphasia. Our research employs a variety of theoretical approaches (with a particular focus on the embodied/grounded cognition framework) and research methods (e.g., behavioural and online experiments, eye-tracking, EEG, MEG, MRI, brain stimulation) to investigate the cognitive processes and neuroanatomical correlates of human communication.

The neurotechnological aspects of this research are related to the development of objective, non-invasive methods for the assessment of neurocognitive functions both in healthy individuals (e.g., in the process of learning new skills) and in various disorders. One of our goals is to develop optimal protocols for non-invasive mapping of human brain activity underlying language comprehension and production, which could be important in neurosurgery, for example. We use behavioural methods as well as state-of-the-art neuroimaging techniques that are both patient-friendly and suitable for routine clinical use, such as MEG and tDCS.

NEURODYNAMICS GROUP

"Complex neurodynamic approach has important advantages in describing neuronal processes. The estimates of the brain functioning, obtained with these methods, may indicate a proximity of the neuronal activity to the optimal state required for the efficient processing of information in the human brain, this in turn provides a basis for cognitive neuromonitoring and for the detection of pathological neuronal states in diverse neurological and psychiatric disorders".

Evgeny Blagoveshensky, PhD,
head of Neurodynamics group.

SELECTED PUBLICATIONS

1. Bredikhin, D., Agranovich, O., Ulanov, M., Koriakina, M., Shestakova, A. N., Kadieva, D., ... & Blagovechtchenski, E. (2023). Altered evoked responses for motor-related words in children with upper limb motor impairments. Clinical Neurophysiology, 145, 11-21.

2. Popyvanova, A. V., Koriakina, M. A., Pomelova, E. D., Ilyukina, N. A., Agranovich, O. E., Shestakova, A. N., & Blagovechtchenski, E. D. (2023). The Possibility of Increasing the Effectiveness of Correcting Motor Skills and Cognitive Functions Using Noninvasive Brain Stimulation in Humans. Neuroscience and Behavioral Physiology, 53(2), 230-241.

3. Koriakina, M., Agranovich, O., Petrova, E., Kadieva, D., Kopytin, G., Ermolovich, E., ... & Blagovechtchenski, E. (2021). Aberrant auditory and visual memory development of children with upper limb motor disorders. Brain Sciences, 11(12), 1650.

4. Blagovechtchenski, E., Agranovich, O., Kononova, Y., Nazarova, M., & Nikulin, V. V. (2019). Perspectives for the use of neurotechnologies in conjunction with muscle autotransplantation in children. Frontiers in Neuroscience, 13, 99.

5. Mitina, M., Nikulin, V., Kulikova, S., Ushakov, V., Kartashov, S., Blagoveshchensky, E., ... & Nazarova, M. (2019). P31-S Variability and interhemispheric asymmetry of the responses to paired-coil TMS of the primary motor cortex. Clinical Neurophysiology, 130(7), e103-e104.

The research of the Neurodynamics Group is based on the understanding of the brain as a complex system in which neuronal activity develops in parallel at different spatial and temporal scales. We are particularly interested in studying the sources and effects of inter- and intra-subject neural variability during the performance of various sensory, motor and cognitive tasks. Using EEG, MEG and TMS, we investigate the hypothesis that neural variability in its various forms represents a trade-off between stability and adaptability of brain activity. We focus n the following topics:

- Prediction of cognitive, motor and sensory performance on the basis of resting state neuronal dynamics.

- Description of pathological neuronal states in neurological (Parkinson's disease, Stroke, Essential Tremor) and psychiatric disorders (Schizophrenia, Depression).

- Neuroplasticity in normal subjects and in patients with motor impairments (e.g. stroke, arthrogryposis).

- Methodological and computational approaches in cognitive neuroscience to study central questions relating to neuronal bases of sensorimotor learning and motor control in healthy and clinical populations.

- Adaptive brain stimulation, neuromonitoring and brain-computer interface.

THEORETICAL NEUROSCIENCE GROUP

"The brain is an extremely complex object. To better understand it, we have to consider both biological, chemical, and physical aspects of cognitive processes. This requires the use of a complex interdisciplinary approach, which ultimately should lead us to the construction of mathematical models that correctly describe the basic mechanisms of brain functioning. In fact, this is the main goal of computational neuroscience. The constructed models play an important role in understanding the brain processes and provide significant progress in all areas of psychophysiology and neurobiology: from designing brain-computer interfaces to economic modelling of consumer behaviour".

Denis Zakharov, PhD,
head of Theoretical Neuroscience group

SELECTED PUBLICATIONS

1. Dogonasheva, O., Kasatkin, D., Gutkin, B., & Zakharov, D. (2021). Robust universal approach to identify travelling chimeras and synchronized clusters in spiking networks. Chaos, Solitons & Fractals, 153, 111541.

2. Dogonasheva, O., Kasatkin, D., Gutkin, B., & Zakharov, D. (2022). Multistability and evolution of chimera states in a network of type II Morris–Lecar neurons with asymmetrical nonlocal inhibitory connections. Chaos: An Interdisciplinary Journal of Nonlinear Science, 32(10).

3. Lussange, J., Lazarevich, I., Bourgeois-Gironde, S., Palminteri, S., & Gutkin, B. (2021). Modelling stock markets by multi-agent reinforcement learning. Computational Economics, 57, 113-147.

4. Ghambaryan, A., Gutkin, B., Klucharev, V., & Koechlin, E. (2021). Additively Combining Utilities and Beliefs: Research Gaps and Algorithmic Developments. Frontiers in Neuroscience, 15, 704728.

5. Zakharov, D. G., Krupa, M., Gutkin, B. S., & Kuznetsov, A. S. (2018). High-frequency forced oscillations in neuronlike elements. Physical Review E, 97(6), 062211.

The main goal of our research is to develop mathematical models, computational techniques, and algorithms that can shed light on the neural mechanisms that drive brain computation and dynamics. Using an interdisciplinary approach that combines aspects of mathematics, physics, computer science, and economics, we construct and analyze models and theories that reveal the relationship between the structure and dynamics of brain network activity and cognitive and behavioral functions. Major research topics include theories of drug addiction, theories of the interplay between physiological stability of the organism and motivational systems of the brain, analysis of the functional role of neural oscillations in cognitive processes (such as working memory and speech recognition). In addition, we can highlight work on the theory of neural network synchronization, which allows us to analyze the collective dynamics of neural populations. The group also develops neuroeconomic models, in particular models of consumer behavior and the role of human cognition in the dynamics of financial markets.

MOTOR CONTROL GROUP

"Non-Invasive Brain Investigation techniques allow us to study relationships between brain regions and their functions. Recent advances in methodological research gave us an opportunity to use different types of stimulation, ranging from electrical to magnetic techniques. At the same time, we can shape the frequency of stimulation and try to interact with the endogenous oscillatory activity for studying cortical plasticity processes and modulation of behaviour. What we are doing in our group is investigating the sensory-motor system and the plasticity of the motor cortex by using Non Invasive Brain Stimulation such as Transcranial Magnetic Stimulation and Transcranial Electrical Stimulation".

Matteo Feurra, PhD,
head of Motor Control Group.

SELECTED PUBLICATIONS

1. Panidi, K., Vorobiova, A. N., Feurra, M., & Klucharev, V. (2022). Dorsolateral prefrontal cortex plays causal role in probability weighting during risky choice. Scientific Reports, 12(1), 16115.

2. Rossi, S., Santarnecchi, E., & Feurra, M. (2022). Noninvasive brain stimulation and brain oscillations. Handbook of Clinical Neurology, 184, 239-247.

3. Pozdniakov, I., Vorobiova, A. N., Galli, G., Rossi, S., & Feurra, M. (2021). Online and offline effects of transcranial alternating current stimulation of the primary motor cortex. Scientific Reports, 11(1), 3854.

4. Feurra, M., Pasqualetti, P., Bianco, G., Santarnecchi, E., Rossi, A., & Rossi, S. (2013). State-dependent effects of transcranial oscillatory currents on the motor system: what you think matters. Journal of Neuroscience, 33(44), 17483-17489.

5. Vorobiova, A. N., Pozdniakov, I., & Feurra, M. (2019). Transcranial direct current stimulation effects on memory consolidation: Timing matters. Eneuro, 6(3).

Research interests: Motor imagery, action observation, real movement, visuomotor processes.We use multiple approaches including behavioural methods, Noninvasive Brain Stimulation (NIBS), EEG, fMRI, and genetic testing to investigate neural networks of motor processes. We are specifically interested in neuroenhancement by NIBS which aims to induce facilitation effects on cortical excitability and behaviour by stimulation of a specific cortical area or network (e.g. phase coupling stimulation by tACS). We investigate motor imagery and motor action observation networks by using state-dependent online tACS-TMS approach. Our protocols pave the way for clinical applications on patients with motor.

MEG GROUP

"Neuronal currents in the human brain give rise to oscillatory activity which regulates our cognitive functions. These neural oscillations resonate in different frequencies over diverse cortical structures. Extremely weak magnetic fields, associated with those currents, are a direct reflection of the dynamical organisation of neural networks. Magnetoencephalography allows the recording of brain magnetic fields with high temporal and spatial resolution. We believe that the investigation of the interplay among oscillatory neural networks represents the fundamental framework to unveil underlying physiological mechanisms and to identify pathological conditions".

Alexey Ossadtchi, PhD,
head of MEG group.

SELECTED PUBLICATIONS

1. Hein, T. P., Gong, Z., Ivanova, M., Fedele, T., Nikulin, V., & Herrojo Ruiz, M. (2023). Anterior cingulate and medial prefrontal cortex oscillations underlie learning alterations in trait anxiety in humans. Communications Biology, 6(1), 271.

2. Hein, T. P., Gong, Z., Ivanova, M., Fedele, T., Nikulin, V., & Herrojo Ruiz, M. (2023). Anterior cingulate and medial prefrontal cortex oscillations underlie learning alterations in trait anxiety in humans. Communications Biology, 6(1), 271.

3. Azanova, M., Herrojo Ruiz, M., Belianin, A. V., Klucharev, V., & Nikulin, V. V. (2021). Resting-state theta oscillations and reward sensitivity in risk taking. Frontiers in neuroscience, 15, 608699.

4. Gorin, A., Klucharev, V., Ossadtchi, A., Zubarev, I., Moiseeva, V., & Shestakova, A. (2021). MEG signatures of long-term effects of agreement and disagreement with the majority. Scientific reports, 11(1), 3297.

5. Kuznetsova, A., Nurislamova, Y., & Ossadtchi, A. (2021). Modified covariance beamformer for solving MEG inverse problem in the environment with correlated sources. NeuroImage, 228, 117677.

Since 2018, HSE and MSUPE (Moscow State University of Psychology and Education) have been working together to establish the only MEG (magnetoencephalography) laboratory in Russia, focusing on cognitive brain function in healthy individuals and neurophysiological biomarkers in clinical populations. We support several areas of MEG research, including cognitive studies, speech and language research, neuroeconomics, neurodynamics, neuroimaging development, and more. Our core research explores dynamic brain interactions, emphasising memory, motor learning, and motor control in healthy individuals. We also address topics such as epileptogenic zone localization and amyoplasia, while pioneering advanced OPM-MEG technology. We address the inverse problem of EEG and MEG, developing software and algorithms to improve the accuracy and speed of brain imaging, including novel methods for functional connectivity in MEG data and visualisation of epileptic brain activity.

CENTRE FOR BIOELECTRIC INTERFACES

"Intracranial brain-machine interfaces use high-quality cortical and subcortical signals to extract information contained in neural activity. In addition, they can be used to deliver information to the brain using multichannel electrical stimulation. As the technologies to safely and efficiently interface with the brain evolve, these approaches will lead to revolutionary clinical applications and insights into how the brain works. Diagnostic solutions based on the established information link to the brain provided by non-invasive neuroimaging enable patient diagnosis. Real-time neuroimaging solutions make users aware of their own brain activity and help them learn to control it, paving the way for cures for a range of neurological disorders and improved well-being".

Alexey Ossadtchi,
head of the Centre for bioelectric interfaces.

The Centre for Bioelectric Interfaces (CBI) is pioneering electrocorticographic neural interfaces to advance bionic prostheses with natural control. We are decoding brain activity into hand prosthetic movements with minimal training, and exploring brain-controlled speech prosthetics. CBI is also advancing neuroimaging with MEG, EEG, and neurofeedback. We are developing user awareness of brain activity and diagnostic tools for epilepsy. Basic research is exploring the neurological effects of speech interpretation and mindful meditation, advancing brain science.

SELECTED PUBLICATIONS

1. Kuznetsova, A. A., & Ossadtchi, A. E. (2022). Analysis of the Local Dynamics of Interictal Discharge Propagation Using a Traveling Wave Model. Neuroscience and Behavioral Physiology, 52(9), 1436-1447.

2. Kleeva, D., Soghoyan, G., Komoltsev, I., Sinkin, M., & Ossadtchi, A. (2022). Fast parametric curve matching (FPCM) for automatic spike detection. Journal of Neural Engineering, 19(3), 036003.

3. Petrosyan, A., Sinkin, M., Lebedev, M., & Ossadtchi, A. (2021). Decoding and interpreting cortical signals with a compact convolutional neural network. Journal of Neural Engineering, 18(2), 026019.

4. Koshev, N., Butorina, A., Skidchenko, E., Kuzmichev, A., Ossadtchi, A., Ostras, M., ... & Vetoshko, P. (2021). Evolution of MEG: A first MEG-feasible fluxgate magnetometer. Human Brain Mapping, 42(15), 4844-4856.

5. Kuznetsova, A., Nurislamova, Y., & Ossadtchi, A. (2021). Modified covariance beamformer for solving MEG inverse problem in the environment with correlated sources. NeuroImage, 228, 117677.

LABORATORY OF SOCIAL NEUROSCIENCE

"The use of movies and narratives as naturalistic stimuli is increasingly extending the reach of human neuroimaging to phenomena that are otherwise difficult to investigate in the domains of social cognition, emotions, cultural background influences, and decision making".

Vasily Klucharev, PhD,
head of International Laboratory of Social Neurobiology.

The main interests of the International Social Neuroscience Laboratory include how narratives, stories that go viral, influence decision-making mechanisms in the brain, how an individual's cultural background shapes their perception of narrated information, and how some information comes to be perceived as credible and other information as unreliable in the human brain. To address these and other open questions, we use complementary neuroimaging, neurostimulation, physiological, and behavioural measures. The rich and multidimensional data are analysed using a variety of computational approaches, ranging from intersubject synchrony measures to the application of machine learning algorithms.

SELECTED PUBLICATIONS

1. Ntoumanis, I., Davydova, A., Sheronova, J., Panidi, K., Kosonogov, V., Shestakova, A. N., ... & Klucharev, V. (2023). Neural mechanisms of expert persuasion on willingness to pay for sugar. Frontiers in Behavioral Neuroscience, 17, 1147140.

2. Jääskeläinen, I. P., & Kosonogov, V. (2023). Perspective taking in the human brain: complementary evidence from neuroimaging studies with media-based naturalistic stimuli and artificial controlled paradigms. Frontiers in Human Neuroscience, 17, 1051934.

3. Ntoumanis, I., Panidi, K., Grebenschikova, Y., Shestakova, A. N., Kosonogov, V., Jääskeläinen, I. P., ... & Klucharev, V. (2022). "Expert persuasion" can decrease willingness to pay for sugar-containing food. Frontiers in Nutrition, 9, 926875.

4. Kosonogov, V., Kovsh, E., & Vorobyeva, E. (2022). Event-Related Potentials during Verbal Recognition of Naturalistic Neutral-to-Emotional Dynamic Facial Expressions. Applied Sciences, 12(15), 7782.

5. Jääskeläinen, I. P., Glerean, E., Klucharev, V., Shestakova, A., & Ahveninen, J. (2022). Do sparse brain activity patterns underlie human cognition?. NeuroImage, 263, 119633.

STUDY PROGRAMMES

MASTER'S PROGRAMME

"Our Master's programme 'Cognitive Sciences and Technologies: From Neuron to Cognition' offers courses in cognitive psychology, cognitive neuroscience, and neuro-modelling. Taken together, these subjects cover how memory, emotions, cognition and consciousness actually work. Taught in close cooperation with the École Normale Supérieure and Aarhus University, our programme combines lectures in English with practical training at prominent laboratories in Moscow and at international partner institutions. Leading scientists supervise students' practical training and writing of Master's thesis during the second year. Our students get fantastic opportunities to get skills to start their career in academia and in industry".

Oksana Zinchenko, Academic Supervisor of the Master's programme "Cognitive Sciences and Technologies: from neuron to cognition".

Our international master's program is conducted entirely in English and is dedicated to the study of cognitive processes and cognitive technologies. This is the first program of its kind in the Russian Federation. Our students, who come from Russia and many other countries (e.g. Italy, Turkey, USA), represent a variety of scientific backgrounds, such as mathematics, physics, linguistics, psychology and biology. The students' projects are interdisciplinary by nature, and they can choose between two flexible educational tracks.

- Track 1 "Computational Sciences" focuses on general principles of information processing.
- Track 2 "Cognitive Sciences" focuses on the neurobiological mechanisms of perception and information processing.

Our courses are taught by the academic staff of the Centre, as well as by scientists from other departments, universities and renowned international scientists. The program offers courses in brain mapping, cognitive science, statistical analysis of brain signals, cognitive neurobiology, neuroeconomics, etc. Training is carried out both in the Centre and in the leading laboratories of Moscow.

More about the program

PHD PROGRAMME

"One of the most important directions being developed in the centre is bringing up a new generation of world-class researchers. We are going to achieve this aim by opening one of the first PhD schools for cognitive sciences in Russia. It allows postgraduates to conduct advanced scientific research and defend their PhD theses in our dissertation council in all specialties 5.12 "Cognitive Sciences"".

Denis Zakharov, PhD,
Academic director of the PhD school of cognitive sciences

HSE is the first Russian university to establish a PhD programme and the dissertation council in Cognitive Science. The Council currently accepts projects and dissertations in the following areas (as per the Federal list of scientific degrees):

- 5.12.1 Interdisciplinary Research of Cognitive Processes,
- 5.12.2 Interdisciplinary Brain Research,
- 5.1.2.3 Interdisciplinary Language Research
- 5.12.4 Cognitive Modeling

The Council awards Doctor of Philosophy (PhD) and Doctor of Science (Dr.Sci.) degrees in psychology, biology, linguistics, and the physical and mathematical sciences.

Our PhD program is taught by world-renowned experts in cognitive and neuroscience research. Our students are trained in all the experimental methods available at the Center and can use any of them in their research. Our students also have the opportunity to spend a semester abroad at one of the internationally renowned universities. Our typical PhD student publishes at least three peer-reviewed publications before their formal PhD defense. One of our current top priorities is to establish a combined MRes - PhD program (2+3), which will provide a direct route to a PhD in Cognitive Sciences for BSc and BA graduates.

INTERVIEW

Federico Gallo, PhD

"I first learned about the PhD program at the Institute of Cognitive Neuroscience at the National Research University Higher School of Economics from my supervisor while studying for my master's degree at Vita Salute San Raffaele University in Milan, Italy. Professor Jubin Abutalebi suggested I speak with Professors Yuri Shtyrov and Andrei Myachikov, who ended up becoming my supervisors at National Research University Higher School of Economics. Prof. Abutalebi told me that joining this institute would be a fantastic career decision, and he was right. At the institute, I experienced a distinct atmosphere where I discovered one of the best research labs globally, but more importantly, I established a warm and welcoming relationship with my colleagues. I rapidly found both mentors and friends. During my time as a grad student, my mentors recognized my abilities and helped me publish many scientific papers within a few years of starting my PhD. During this time, I served as an editor and keynote speaker at conferences. This level of support and freedom is priceless to me, and I doubt I could find it elsewhere. Right after defending my thesis, I received the esteemed Marie Sklodowska-Curie Postdoctoral Fellowship. This confirmed my belief that the Institute of Cognitive Neurosciences at the National Research University Higher School of Economics was the ideal choice for me".

NEUROTECHNOLOGIES AND APPLIED RESEARCH

NEUROIMAGING

At ICN, we analyse brain signals from imaging experiments with computational methods and develop software to solve brain mapping challenges. Our new algorithms solve real-time EEG and MEG problems using adaptive ray filters and the Minimum Current Estimation method.

BRAIN-COMPUTER INTERFACE TECHNOLOGY

We are developing a groundbreaking technology that allows bidirectional communication with the human brain. Our approach involves an ECoG interface and advanced data analysis methodologies to provide somatosensory feedback through either direct electrical stimulation or sensory substitution, which promotes comprehension. The tiny electrodes placed on the brain for mapping transmit signals in both directions. This technology enhances the efficiency of intelligent prosthetics by incorporating somatosensory feedback, facilitating direct communication between brains.

NEUROFEEDBACK

We examine the effectiveness of neurofeedback in improving individuals' awareness of their brain activity and focus. We examine various factors that can influence the effectiveness of the training, such as the timing of feedback delivery and the software's capacity to process multiple signals simultaneously.

How do people perceive product packaging?
A joint project of the Institute of Cognitive Neuroscience and the School of Design (HSE)

PRESURGICAL MAPPING

Our team specialises in using EEG-MEG integrated mapping, ECoG mapping, and MEG mapping techniques to map the brain before surgery. These methods improve the evaluation before surgery, leading to better results for patients with epilepsy or brain tumours.

NEUROPROTECTORS. BILINGUALISM AND AGEING

Advances in health care have increased life expectancy in today's world. But, this has also led to a rise in age-related diseases such as dementia. As there are no pharmacological solutions yet, our research examines the effects of lifestyle factors that can mitigate brain ageing. Specifically, we focus on the benefits of being bilingual. Our research program studies the connection between the effects of life experiences on ageing and the neurocognitive consequences of bilingualism. This study has important economic effects by enhancing the well-being of elderly individuals and those who take care of them, while also lowering healthcare expenses for the public.

NEUROMARKETING AND NEUROFORECASTING

Our research delves into the decision-making processes of consumers. We investigate how the brain assigns value to items, analyse individual preferences, and explore the impact of social factors on choices. Beyond theoretical work, we also develop practical applications. We utilise neuromarketing techniques such as market trend prediction, price setting, and multisensory experience creation. Our objective is to collaborate with prominent players in the industry to enhance product development and customer satisfaction.

LECTURES & EVENTS

OUR EVENTS:

- Journal club (weekly)
- Research seminar (weekly)
- School for young scientists (annual):
International school for young scientists "Active and passive methods of brain research"
- School for young scientists (annual):
International school for young scientists «From idea to an article»
- Annual conference:
Cortex and Cognition: Communication Principles
- Annual conference:
International Conference on Social Neuroscience

LECTURES AND ADDITIONAL EDUCATIONAL PROGRAMS:

- Microdegree "Applied Cognitive Neuroscience"
ncmu.hse.ru/prog_mag_2.6
- Online Course "Brain and Mind"
openedu.ru/course/hse/BRAPS
- Lecture Series on Neuroeconomics
postnauka.org/themes/klucharev

OFFER FOR CORPORATE CLIENTS:

Advanced training of specialists in the field of neuromarketing research (Certificate of advanced training of the state sample).

COLLABORATIONS AND PARTNERS

Lomonosov Moscow State University

St Petersburg University

MOSCOW STATE UNIVERSITY OF PSYCHOLOGY & EDUCATION

H.Turner National Medical Research Center for Children's Orthopedics and Trauma Surgery of the Ministry of Health of the Russian Federation

Federal Center for Brain and Neurotechnologies

MOSCOW STATE UNIVERSITY OF MEDICINE AND DENTISTRY

SIBERIAN BRANCH OF THE RUSSIAN ACADEMY OF SCIENCES

SKLIFOSOVSKY

Skoltech
Skolkovo Institute of Science and Technology

LOBACHEVSKY UNIVERSITY

PIROGOV RUSSIAN NATIONAL RESEARCH MEDICAL UNIVERSITY

The Research Center of Neurology

SECHENOV UNIVERSITY

ZHEJIANG UNIVERSITY

Institute of Psychology of Russian Academy of Sciences

Federal State Budgetary Institution
National Medical Research Center for Therapy and Preventive Medicine
of the Ministry of Healthcare of the Russian Federation

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OUR WEBSITE

JOIN US ON TELEGRAM

NON SCHOLAE SED VITAE DISCIMUS