9th Annual Conference Aspects of Neuroscience
Abstract Book

Editor: Marta Paź
Assistant Editors: Magdalena Karpińska

ISBN: 978-83-954288-1-4

22-24.11
2019

Faculty of
Physics

9th
international
conference

ASPECTS OF NEUROSCIENCE

IX INTERNATIONAL CONFERENCE
ASPECTS OF NEUROSCIENCE

Abstract book

The Organizing Committee would like to thank the Faculty of Biology, Faculty of Physics, Faculty of Psychology, College of Inter-Faculty Individual Studies in Mathematics and Natural Sciences of the University of Warsaw for their financial and scientific support. Conference was also financially supported by University of Warsaw Foundation, Universitatis Varsoviensis Foundation and The University of Warsaw Students' Union.

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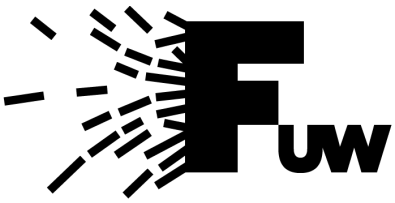

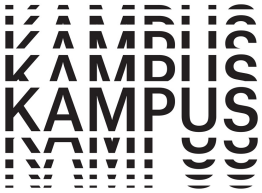

IX INTERNATIONAL CONFERENCE
ASPECTS OF NEUROSCIENCE

Dear Colleagues,

Welcome to the 9th International Conference Aspects of Neuroscience!

We, Aspects of Neuroscience Organizing Committee, are very glad that gathering brilliant neuroenthusiasts during the last weekend of November at the Faculty of Physics, University of Warsaw, became our tradition and one of the keypoints among Polish neuroscientific events. Aspects of Neuroscience is also a brand, recognized by members of scientific institutions from Poland and many more European countries. It is our privilege to host both experienced researchers and students from all over the globe who come to Warsaw in order
to present their research, receive feedback from their peers and get mutually inspired.
The programme condenses, unequivocally, the dynamic, challenges and relevant contribution of neuroscience research in the broader context of human health and pushing the boundaries of knowledge even further. Our aim is to give you opportunity to listen to some of the leading researchers of different aspects of neuroscience: Biological, Computational, Cognitive and Clinical. We firmly believe that cooperation above disciplines and integration of neuroscientists will result in new ideas and thinking outside the box.

IX INTERNATIONAL CONFERENCE
ASPECTS OF NEUROSCIENCE

Three days of the Conference are literally packed with events of high meritorical value: seven plenary lectures of internationally recognized professors, dozens of very interesting short speeches given by PhD and Msc students and over a hundred of theoretical and experimental posters. The level of presented seminar speeches and posters is maintained with the help of the Scientific Committee. Each abstract submitted had at least a double peerblinded review. Moreover, we encouraged our experts to participate in a panel discussion “How to burn the candles at both ends and not to burnout - art of doing PhD”.
However, the Conference offers you even more than fantastic scientific experiences. We put much energy to bring participants closer together and to show you the beauty and power of our great region.
Furthermore, we encourage you to join us for the Integration Party on Saturday, when you can forget for a moment about the neuroscientific buzz and relax with your colleagues (and perhaps become more familiar with delicious drinks). We hope that you will have a wonderful and engaging time at this Conference. Members of our Organizing Team will be available at any time if you have a question or need any help.

Warm regards from the AoN19 Team!

The conference is organized by the members of Neurobiology Scientific Student Assocation at the University of Warsaw

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Biomedical Physics Division, Faculty of Physics, University of Warsaw, Warsaw,

EVENT PROGRAM DAY BY DAY

22 NOVEMBER 2019 (FRIDAY)

10:30 Registration desk opens!

18:00 – 18:15 Opening Ceremony

18:15 – 19:15 Opening Lecture: Dr David Erritzoe, Imperial College London

“The psychedelic revolution in neuroscience”

Your start is: The Faculty of Physics.

Registration desk is just in front of main entrance. The registration starts at 10:30 and lasts all day.

You can pick up badges, welcome starters, invoices

or certifications there.

The Opening Lecture will be held

in FACULTY OF PHYSICS **0.06 room**

at 18:00.

EVENT SCHEDULE DAY BY DAY

23 NOVEMBER 2019 (SATURDAY)

09:00 – 10:00 Plenary Lecture: Prof. Gaspar Jekely, University of Exeter
Whole-body connectome and systems neurobiology of the Platynereis larva.

10:05 – 11:35 Seminar Session: Neurobiological

1. Monika Herian: Effects of acute and chronic administration of 25I-NBOMe on rat's brain neurotransmitters, hallucinogenic and locomotor activity
2. Izabela Ciurej: 5-HT7 receptor modulates synaptic transmission in the basal amygdala
3. Marcin Siwiec: The role of serotonin 5-HT7 receptors in regulating the activity of the hippocampal dentate gyrus
4. Mikołaj Miękus: Excitability of corticothalamic relays in mouse models of autism

11:35 – 11:55 Coffee break and Organizations' Stands

11:55 – 12:55 Plenary Lecture, Dr Wolf-Julian Neumann,
Charité – Universitätsmedizin Berlin
Neuromodulation for movement disorders: Translational neuroscience in the age of artificial intelligence

13:00 - 14:30 Seminar Session: Clinical

1. Andrzej Kubiak: Mechanical niche for the study of drug impact in brain metastasis of prostate cancer cells
2. Agnieszka K. Adamczyk: Implicit induction of emotional control. A comparative fMRI investigation of self-control and reappraisal goal pursuit
3. Aleksandra Dopierała: Are these lips speaking? The specialisation of the lipreading network in 5-month-olds.

14:30 – 15:30 Lunch break

15:30 – 17:00 Poster Session: Neurobiological & Clinical & Theoretical

17:00 – 18:00 Plenary Lecture: Prof. Tiago Maia, University of Lisbon
Using Computational Psychiatry to Develop a Rigorous and Integrative Understanding of Psychiatric Disorders

18:00 – 19:00 Discussion panel: "How to burn the candles at both ends and not to burn-out - art of doing PhD"

EVENT PROGRAM
DAY BY DAY
24 NOVEMBER 2019 (SUNDAY)

09:00 – 10:00 Plenary Lecture: Dr Christopher Madan, University of Nottingham
The role of the hippocampus in memory for associations

10:05 – 11:15 Seminar Session: Cognitive

1. Łucja Doradzińska: *Is P3b a correlate of consciousness? Event-related potentials to subliminal self-related stimuli*
2. Marcin Koculak: Performing actions influences what you see or think
3. Natalia Rutkowska: Automatic attention capture by complex naturalistic stimuli maintained in working memory - an ERP study
4. Agnieszka Romanowska: When neuroscience meets law - THEORETICAL

11:20 – 12:40 Poster Session: Computational & Cognitive

12:40 - 13:40 Lunch break

13:40 – 14:40 Plenary Lecture: Prof. Jonathan Smallwood, University of York
The neural basis of on-going conscious experience

14:45 – 15:55 Seminar Session: Computational

1. Piotr Matuszewski: The association between cognitive abilites and superior eSports performance
2. Patrycja Kałamała: Can control act as a collection of independent mechanisms?
3. Diana Piotrowska: Rat ultrasonic communication measurement as a tool in schizophrenia research.
4. Kamil Kozłowski: Synaptic plasticity and behavioural time-scales discrepancy – how to fill the gap?

15:55 - 16:15 Coffee break and Organizations' Stands

16:15 – 17:15 Plenary Lecture: Dr Juan Lupiáñez, University of Granada
Attention and Vigilance: three attentional functions and two sources of control, the ANTI-Vea task.

17:25 Award Ceremony and Closing Remarks

22-24.11.2019
FACULTY OF PHYSICS
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POSTER SESSIONS

Aspects of Neuroscience

COGNITIVE SESSION

- co02 Neurophysiological markers of reduced executive control in loneliness
- co03 Neurofeedback - trick or treat? A critical analysis.
- co06 Flexibility and context specificity of communicative rhythmic behaviours in chimpanzees
- co09 Subject level parcellation of the human amygdala based on Recurrence Quantification Analysis (RQA)
- co10 Superior auditory and visual rhythm discrimination in musicians is not related to cross-modal neuroplasticity in auditory cortex
- co12 Outcome valence and prediction error sign invariance of the reinforcement learning models
- co13 Validation of new wearable fNIRS device for frontal lobe oxygenation assesment
- co15 Are spontaneous and explicit Theory of Mind two aspects of one system? FMRI study.
- co17 High-fat diet leads to disruption of circadian rhythms in the rat dorsal vagal complex
- co18 Influence of the emotionality of stimulus, facial expression, and gaze cueing at the visual spatial attention. An eye-tracking experiment proposal.
- co19 Relationship between Western Diet and cognitive functioning
- co20 Automatic attention capture by unconsciously presented faces
- co21 Can training in strategic video game induce changes in neurocognitive functioning? Real-time strategy video game experience and attentional blink phenomenon – an ERP study.
- co22 What tastes better – Pepsi or Coke? Children's behavioural preferences for culturally familiar drinks.
- co23 Neural correlates of implicit and explicit ToM reasoning in preschool children: fNIRS study
- co25 Receptive language processing in Autism Spectrum Disorder
- co27 The imitation of facial emotions that are physically similar. Mimicry as a signal ofunconscious recognition of kinship?
- co28 The „specific task” in task-specific reorganization of the auditory cortex in the deaf

CLINICAL SESSION

- cl02 SHANK3 deficit results in abnormal neuronal morphology accompanied by alterations in postsynaptic proteins partially compensated by oxytocin treatment
- cl03 Targeting the Unfolded Protein Response signaling pathway with novel, small-molecule inhibitor in Parkinson's disease
- cl04 Effect of chronic haloperidol and aripiprazole treatment on selected physiological and behavioural parameters in chronically stressed rats
- cl05 On the relation of the neural substrates of figurative language impairments in schizophrenia with cognitive abilities and symptom severity
- cl06 On the specificity of the abnormal information flow during humor and metaphor processing in schizophrenia outpatients
- cl07 Molecular and cellular events connected with cell proliferation resulting from potential treatment of neuropsychiatric
- cl08 MOLECULAR MODELING AND PHARMACOLOGICAL STUDIES OF D2AAK2, NOVEL NON-BASIC ANTAGONIST OF D2 RECEPTOR WITH POTENTIAL ANTIPSYCHOTIC ACTIVITY
- cl09 How fearful long-term memories are processed?
- cl10 Source based effective connectivity reveals internal communication within the dorsal attentional network
- cl11 Loss of NMDA receptor in serotonergic cells influences a reinforcement learning in a task-dependent manner.
- cl12 Transcranial Direct Current Stimulation of DLPFC does not reduce negative evaluation of those who exclude us
- cl13 The role of vitamin D in the development of Multiple Sclerosis
- cl15 Executive Functioning Measured by The Numerical Stroop Task in HIV-infected Individuals on HAART
- cl16 Research proposal on a new screening method for people with autism spectrum disorder
- cl17 Diagnosis in the eyes - research proposal on a new screening method for children with autism spectrum disorder
- cl18 Diet organization and its relation to fatigue and cognitive performance.
- cl19 Volumetric abnormalities in schizophrenic brain – two different method approaches

COMPUTATIONAL SESSION

- cm01 The uncanny valley and its understanding from the neuroscience point of view
- cm02 Hidden Markov models used on dendritic spines states
- cm03 fMRIDenoise: automated fMRI data denoising, denoising strategies comparison, and functional connectivity matrices quality control
- cm04 White matter structure and cognitive functions differences between VR and computer games players
- cm05 The landscape of Uncanny Valley – theoretical and empirical studies of the impact of the Uncanny Valley Effect on the quality of Human-Computer Interaction
- cm06 Decoding of tactile abstract (Braille) numbers in the Intraparietal Sulcus of sighted Braille readers

THEORETICAL SESSION

- th01 Structural neuroplasticity induced by training in the form of a first-person shooter video game
- th02 Model of information processing in a glutamatergic neuron
- th03 Chronotype may be associated with subtle differences in tissue volume
- th04 Complexity of neural activity as a correlate of consciousness in the context of multi-dimensional models of consciousness
- th05 Critical Analysis of Comparing Interoception in Genders
- th07 Neurotechnology meets neurophilosophy: Deep Brain Stimulation (DBS) and its consequences for free will and autonomy
- th08 Modifying memory with the use of optogenetics. Eternal spotlight of the sunshine mind?
- th09 Autophagy in nervous system
- th10 The differences of frontal theta power in depressed and healthy subjects - literature review
- th11 Literacy breaks mirror invariance for both visual and tactile modality
- th12 Perception of artificial limbs
- th13 The impact of meditation in mental disorders treatment.
- th14 Correlation between sleep deprivation and Autism Disorder in children

NEUROBIOLOGICAL SESSION

- nb01 The future of Alzheimer’s disease diagnosis. New directions in biomarkers research.
- nb02 Targeting the Unfolded Protein Response signaling pathway with novel, small-molecule inhibitor in Parkinson's disease
- nb03 Beyond the Low Frequency Fluctuations: Morning and Evening Differences in Human Brain
- nb05 SHANK3-deficiencyalters ratio of hippocampal neuronal cells in early brain development
- nb06 Amisulpride, olanzapine, quetiapine, and aripiprazole single injection impact on c-Fos expression in vasopressinergic and oxytocinergic neurons of the rat hypothalamic paraventricular nucleus
- nb08 Oncogenes - characterization and role in glioma
- nb09 Molecular modeling of dopamine D2 receptor in active conformation and investigation of the effect of the length of the third intracellular loop (ICL3) on preferential coupling with Gαi1 and Gαi2 proteins
- nb10 NOVEL 3-(1,2,3,6-TETRAHYDROPYRIDIN-4-YL)-1H-INDOLE-BASED MULTI- FUNCTIONAL LIGANDS WITH PROCOGNITIVE, ANTIPSYCHOTIC-LIKE AND ANXIOLYTIC ACTIVITY
- nb11 The role of cofilin-dependent activity in dentate gyrus in alcohol seeking during withdrawal
- nb12 Effects of progressive dopaminergic degeneration and L-DOPA treatment on motor and executive function in TIF-IA<DATCreERT2> mice
- nb14 Age-related effects of cannabis on cognitive functions.
- nb16 Overview of the main functions of the hypothalamus
- nb17 Neurophysiological characterization of Interpeduncular Nucleus neurons.
- nb18 Adaptogenes - brain boosters hidden in plants. Definition, effects & questions
- nb19 Excitability of corticothalamic relays is enhanced in mouse
- nb20 Opto-electrophysiological characterisation of the cortical connections in rat brain involved in analysis of the sensual stimuli

PHD DAVID ERRITZOE

- Biography: Qualified as a medical doctor at Copenhagen University Medical School in 2001 and currently holds an Academic Clinical Lectureship in Psychiatry at Imperial College London. Alongside his clinical training in medicine/psychiatry, David has been involved in psychopharmacological research, using brain-imaging techniques such as PET and MRI. Initially working at Columbia University in New York, he then undertook a PhD at University Hospital Rigshospitalet in Copenhagen. Since 2009, under the mentorships of Profs Anne Lingford-Hughes and David Nutt at Imperial College London, he has conducted post-doc imaging research in the neurobiology of addictions and major depression. Together with Prof Nutt and Dr Carhart-Harris he is also investigating the neurobiology and therapeutic potential of MDMA and classic psychedelics.

- Abstract : The resurrection of psychedelic research in the last decade has overturned the worst period of research censorship in the history of medicine and science. This imaging-based research on psilocybin LSD and DMT has shown quite unexpected effects on brain function; these drugs do not turn on the brain rather they turn off the control centres of the brain allowing intrinsic lower level brain processing to take over. These imaging studies have led to the use of psilocybin in the treatment of mental illnesses especially resistant depression with spectacular results. My talk will talk through these studies and lay down the huge potential future for these drugs in science and medicine.

PROF. GASPAR JEKELY

- Biography: Gáspár Jékely studied Biology and obtained his PhD in 1999 at the Eötvös Loránd Universities in Budapest. He was a postdoctoral fellow at the EMBL, Heidelberg in the laboratories of Pernille Rorth and Detlev Arendt. Between 2007-2017 he was a group leader at the Max Planck Institute for Developmental Biology in Tübingen, Germany. In 2017 he became Professor of Neuroscience in the Living Systems Institute at the University of Exeter. His research interests include the structure, function and evolution of neural circuits in marine ciliated larvae and the origin and early evolution of nervous systems.

- Abstract : Our goal is to understand how neuronal circuits coordinate behaviours extending to whole organ systems or to the entire body. Achieving this at cellular resolution in an entire nervous system is possible by studying small animals amenable to genetic and other manipulations. We are actively developing the marine annelid Platynereis dumerilii as a new system for circuit neuroscience. We use whole-body connectomics, neuronal activity imaging, and behavioural analysis to understand the circuit bases of behaviour in fully mapped, stereotypical circuits. Genome editing and transgenic access to single neurons allow us to link molecular function to network activity and behaviour. I will present recent results on the integration of phototactic and UV-avoidance responses and on a hydrodynamic startle behaviour.

WHOLE-BODY CONNECTOME AND SYSTEMS NEUROBIOLOGY OF THE PLATYNEREIS LARVA.

GUESTS

PHD WOLF-JULIAN NEUMANN

- Biography: I am a young investigator and clinician scientist (MD) at the Movement Disorder and Neuromodulation Unit at Charité Berlin. I have built an expertise in movement disorders neurophysiology and deep brain stimulation. My strengths are the implementation of methods for multimodal and multidimensional data analysis for clinical neuroscience applications. My current work combines computational modelling, deep learning, structural and functional connectivity mapping (fMRI), invasive (LFP/ECoG) and non-invasive (EEG/MEG) recordings, to elucidate the role of the basal ganglia in health and disease.

- Abstract : Deep brain stimulation (DBS) is an effective treatment alternative for patients with medication refractory movement disorders, such as Parkinson's disease and dystonia. In addition to its clinical benefit, DBS represents a powerful scientific platform to investigate neural circuits in health and disease. It gives the unique opportunity to record neural activity directly from deep neural structures in human patients and allows characterization of physiological network properties across brain regions. Using multimodal and multidimensional approaches including invasive electrophysiology, magnetoencephalography, functional and structural neuroimaging and computational modelling, we havea learned key aspects about the nature of brain circuit dysfunction across the Cortex – basal ganglia thalamic axis. This gives rise to the unique opportunity to develop personalized precision medicine approaches based on artificial intelligence informed neuromodulation protocols, closing the loop between individual brain activity and network neuromodulation with DBS. The aim of this lecture is to introduce clinical concepts of the mechanism of neuromodulation, describe translational research principles to secure clinical relevance and outline future directions in the development of neurotechnological treatment strategies. The audience will learn about the neurophysiological mechanisms of neuromodulation with relation to cortico-subcortical pathways in Parkinson's disease and other movement disorders. The lecture will conclude with an outlook on clinical symptom prediction from neural time-series data for deep-learning informed clinical brain computer interfaces.

PROF. TIAGO MAIA

- Biography: Tiago V. Maia is an Associate Professor at the Faculty of Medicine of the University of Lisbon, a researcher at the Institute for Molecular Medicine in Lisbon, and a member of the Coordinating Council of the Mind-Brain College of the University of Lisbon (Portugal). He did his Ph.D. in Psychology at Carnegie Mellon University. Before returning to Portugal (his home country), he was an Assistant Professor of Clinical Neurobiology in the Department of Psychiatry at Columbia University. Research in his laboratory focuses on the integrated use of computational modeling, brain imaging, and behavioral experiments to understand the neural bases of several psychiatric disorders. His work has been published in several leading journals (e.g., Nature Neuroscience and PNAS). He has also played a very active role in the development and promotion of the emerging field of computational psychiatry (e.g., serving as guest editor or guest co-editor for special issues on the topic for Biological Psychiatry, Biological Psychiatry: Cognitive Neuroscience and Neuroimaging, and Clinical Psychological Science). He was considered a “Rising Star” by the Association for Psychological Science

- Abstract : The contemporary understanding of psychiatric disorders typically consists of a vast but often poorly interrelated set of facts and hypotheses that fail to coalesce into an integrated whole. This situation is due, in part, to the social dynamics in the scientific fields that study psychiatric disorders; it is, however, also due to the absence of rigorous theoretical tools that support the development of a more integrative understanding. This talk will show how theoretical tools from computational psychiatry can foster such integrative understanding, using Tourette syndrome (TS) as an illustrative example. Specifically, the talk will show how a computational understanding of the functions of dopamine, together with the likely nature of dopaminergic dysfunction in TS revealed in molecular-imaging studies, can provide an integrated understanding of the mechanisms of action of the various medications used to treat TS, the time course of the response to those medications, the findings of increased reward and habit learning in TS, and a vast array of functional and structural imaging findings in TS, while simultaneously explaining how and why tics arise and are expressed. This approach, combining formal rigor with substantial explanatory and predictive power, holds the promise to bring to psychiatry what has undoubtedly been one of the key drivers of success in fields such as physics (and, indeed, in the remarkable development of our technological society).

USING COMPUTATIONAL PSYCHIATRY TO DEVELOP A RIGOROUS AND INTEGRATIVE UNDERSTANDING OF PSYCHIATRIC DISORDERS

PHD CHRISTOPHER MADAN

- Biography: Christopher Madan is an Assistant Professor in the School of Psychology at the University of Nottingham. He received is Ph.D from the University of Alberta in Canada in 2014. He has worked as a researcher at the University Medical Center Hamburg-Eppendorf in Germany (2011-2012) and Boston College in the USA (2014-2017). Dr. Madan's research is quite varied, spanning several domains of cognition (including memory, decision making, emotional processing), functional and structural MRI, comparative psychology, mathematical modeling, and aging. His research has particularly focused on processes that make some experiences more memorable than others and individual differences in brain morphology.

- Abstract : Often we need to form and retain associations between distinct items in memory. While it is well established that the hippocampus is an important brain region for memory, this is particularly true for memory for associations. Here I will discuss several studies that have investigated the involvement of the hippocampus in the formation of associative memories. Results will be connected to previous findings in experimental psychology, mathematical modelling, and neuropsychology.

THE ROLE OF THE HIPPOCAMPUS IN MEMORY FOR ASSOCIATIONS

GUESTS

PHD JONATHAN SMALLWOOD

- Biography: Jonathan Smallwood (born 1975) is a reader in the Department of Psychology at the University of York. His research uses the tools of cognitive neuroscience to investigate the process by which the brain self generates thoughts not arising from perception, such as during the experience of mind-wandering and daydreaming. His research is concerned with investigating how the mind generates and sustains thoughts with no relationship to the current external environment. Common examples of these cognitions are the experience of daydreaming or mind-wandering. He studies these states by combining behavioral, subjective and physiological measurements.

- Abstract : In everyday life our thoughts and feelings are not always driven by events in the external environment. Accordingly studies of phenomena such as mind-wandering illustrate that studying cognition exclusively using task related methods will fail to account for important aspects of human experience. This talk will review evidence that combines state-of-the-art measures of neural function with novel methods of experience sampling, to reveal the brain mechanisms that underlie different aspects of ongoing conscious experience. It will demonstrate neural systems important for attention/control are critical for (i) the efficient focus on external task relevant information, as well as (ii) the prioritization of patterns of internal or externally focused cognition in a manner that is in line with the demands of the environment. Furthermore, it will show the role of the default mode network is neither to support task negative states, nor to promote episodic content. Instead our studies show that this core neural system plays a critical role in how vivid and detailed conscious experiences are. Together this work paves the way for a formal account of how on-going conscious experience can focus on different sources of information, how these are prioritized, and how they can take on rich and detailed features.

THE NEURAL BASIS OF ON-GOING CONSCIOUS EXPERIENCE

PHD JUAN LUPIÁÑEZ

- Biography: Juan Lupiáñez received his PhD in Psychology by the University of Granada, in 1996. He is currently Full Professor of Experimental Psychology and Cognitive Neuroscience at the University of Granada, where he is the director of the Cognitive Neuroscience research group. He is currently president of the Spanish Society of Experimental Psychology (SEPEX). Most of his research deals with different aspects of Cognitive Neuroscience in general, and in particular with Attention and its relation to other processes such as Emotion, Learning and Memory, Spatial Processing and Consciousness.

- Abstract : Human attention is a complex concept encompassing multiple components. In this talk I will present an integrative model in which the three attentional functions of selection (selection of information, in the input, or attentional orienting, selection in time, or alertness, and selection in the output, or cognitive control), are carried out either automatically under stimulus-driven control or rather voluntarily under top-down control. Then, I will introduce the ANTI-Vea task, which constitutes a validated tool for the measurement of the three attentional functions and their interactions, together with two differentiated vigilance components, Executive Vigilance —the ability to maintain attention to detect infrequent events— and Arousal Vigilance — the activation levels throughout the sleep-wake cycle—. Data from different experiments with the ANTI-Vea task will be presented showing its usefulness to dissociate the two vigilance components, and to characterize attentional performance in different populations.

ATTENTION AND VIGILANCE: THREE ATTENTIONAL FUNCTIONS AND TWO SOURCES OF CONTROL, THE ANTI-VEA TASK.

PHD JUAN LUPIÁÑEZ

- Biography: Juan Lupiáñez received his PhD in Psychology by the University of Granada, in 1996. He is currently Full Professor of Experimental Psychology and Cognitive Neuroscience at the University of Granada, where he is the director of the Cognitive Neuroscience research group. He is currently president of the Spanish Society of Experimental Psychology (SEPEX). Most of his research deals with different aspects of Cognitive Neuroscience in general, and in particular with Attention and its relation to other processes such as Emotion, Learning and Memory, Spatial Processing and Consciousness.

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SPEECHES

Neurobiological session

Monika Herian
Department of Pharmacology, Maj Institute of Pharmacology, Polish Academy of Sciences, Smętna Str. 12, 31-343, Kraków, Poland

Effects of acute and chronic administration of 25I-NBOMe on rat's brain neurotransmitters, hallucinogenic and locomotor activity

Novel psychoactive substances (NPS) have become popular as recreational drugs of abuse in recent years. Hallucinogens, a class of NPS, powerfully alter perception and mood but do not produce dependence and addiction. NBOMe compounds are substituted phenethylamine hallucinogens acting mainly through serotonin 5-HT2A/2C and 5-HT1A receptors. 4-Iodo-2,5-dimethoxy-N-(2-methoxybenzyl)phenethylamine (25I-NBOMe) is a N-benzylmethoxy derivative of the 2C family of hallucinogens that mimics LSD effect. There is not much data on neurochemical properties of NBOMes.
The aim of this study was to investigate the effect of acute (0.3, 1, 3 and 10 mg/kg sc) and chronic (7 x 0.3 mg/kg sc) administration of 25I-NBOMe on neurotransmitter extracellular levels in the rat brain. The release of dopamine (DA), serotonin (5-HT) and glutamate (GLU) was studied using in vivo microdialysis in the rat frontal cortex. Drug-elicited head-twitch response (HTR) and exploratory activity was also examined.
Acute administration of 25I-NBOMe increased release of DA, 5-HT and GLU in the frontal cortex in non linear manner. Chronic administration increased basal level of DA, but not affected 5-HT and GLU release. The response of DA and 5-HT neurons, but not glutamate neurons, was decreased to challenge dose of 25I-NBOMe (0.3 mg/kg) in animals treated chronically with the drug. The single doses of 25I-NBOMe decreased locomotor activity of rats. This effect was potentiated by repeated 25I-NBOMe doses. 25I-NBOMe administered acutely increased number of head shakes, but after chronic injections the number of episodes declined on each subsequent day.

Neurobiological session

Our data suggests that hallucinogenic activity of 25I-NBOMe seems to be related to the increase in extracellular GLU level mediated via cortical 5-HT2A receptors. Neurotransmitters' level and behavioural activity seem to be under control of 5-HT2A receptors but both effects may be negatively modulated by serotonin 5-HT1A and 5-HT2C receptors located on both pyramidal excitatory cells and inhibitory GABAergic interneurons. An attenuation of 25I-NBOMe effect on neurotransmitter release and behavioural response after chronic administration may be related with decreased sensitivity of 5-HT2A receptors.

Acknowledgment
The study was supported by the National Science Centre Grant No 2016/21/B/NZ7/01131 (Kraków, Poland). MH acknowledges the support of InterDokMed project no. POWR.03.02.00-00-I013/16

Neurobiological session

Izabela Ciurej
Jagiellonian University in Kraków, Institute of Pharmacology PAN in Kraków

5-HT7 RECEPTOR MODULATES SYNAPTIC TRANSMISSION IN THE BASAL AMYGDALA

Introduction

The amygdala mediates emotional memory formation and attachment of subjective emotional valence to various stimuli. It expresses 5-HT7 receptors (5-HT7R) in a high density, which suggests their contribution to emotional processing. The role of 5-HT7R in brain regions involved in the pathophysiology of affective disorders has been studied by many, however, the function of the receptor in the amygdala remains poorly understood.

Aim

The present experiments were aimed at determining the role of 5-HT7R activation on membrane properties and synaptic transmission in pyramidal-like basal amygdala (BA) neurons.

Neurobiological session

Methods

Whole-cell patch clamp recordings in both current and voltage clamp mode were performed to investigate mechanisms following 5-HT7R activation. Brain slices were prepared and incubated at 30°C in aCSF for minimum 3 h, then transferred to the recording chamber and superfused with aCSF. Cells were identified by the shape, membrane resistance and a response to depolarizing current pulses. Spontaneous postsynaptic currents were then recorded in the voltage-clamp mode - excitatory and miniature postsynaptic currents (sEPSCs and mEPSCs) at a holding potential of -70 mV and spontaneous and miniature inhibitory postsynaptic currents (sIPSCs and mIPSCs) at a holding potential of 0 mV with pipette filled with cesium gluconate-containing solution. The measured parameters of the currents were their frequency and amplitude. To selectively activate 5-HT7Rs, 5-CT, an agonist of 5-HT1A/5-HT7 receptors, was applied for 15 min in the presence of 2μM WAY100635, a selective 5-HT1A receptor antagonist.

Conclusions

Activation of 5-HT7Rs resulted in a decrease of the mean frequency of sEPSCs and increased frequency and amplitude of sIPSCs. The amplitude of sEPSCs, as well as the amplitudes and frequencies of mEPSCS and mIPSCs, remained unchanged. The effect was not observed in presence of 5-HT7R antagonist, SB 269970, or in 5-HT7R knockout mice. These data suggest that the observed changes may result from activation of 5-HT7Rs located on GABAergic interneurons that in turn innervate BA projection neurons.

Supported by grant 2016/21/B/NZ4/03618 financed by the National Science Center, Poland, and by statutory funds from Maj Institute of Pharmacology, Polish Academy of Sciences, Krakow, Poland

Neurobiological session

Marcin Siwiec
Maj Institute of Pharmacology of the Polish Academy of Sciences

The role of serotonin 5-HT7 receptors in regulating the activity of the hippocampal dentate gyrus

Many years have passed since the discovery of the 5-HT7 receptor - the youngest member of the serotonin receptor family. Yet we still lack answers to fundamental questions. Which neuron subpopulations express it in different brain regions? What are the effects of its activation at the single cell and circuit level?

Our group studies 5-HT7 receptor function in brain regions associated with affective processing, such as the amygdala, frontal cortex and hippocampus. The hippocampal dentate gyrus (DG) is rich in 5-HT7 receptor-expressing neurons. It is well-known for its role in the pathophysiology of affective disorders and responsiveness to antidepressant treatment. Yet there have been no studies documenting 5-HT7 receptor function in the DG.

We investigated 5-HT7 receptor-expressing neurons in the ventral DG using transgenic mice expressing enhanced green fluorescent protein (EGFP) under the control of the Htr7 promoter. We found that EGFP expression was mostly confined to hilar parvalbumin- and somatostatin-immunoreactive GABAergic interneurons, with no expression in glutamatergic granule or mossy cells. Whole-cell patch clamp recordings from dentate granule cells showed that activation of 5-HT7 receptors increased spontaneous inhibitory transmission, consistent with interneuronal receptor expression. Patched EGFP-expressing cells had electrophysiological characteristics of basket or HIPP interneurons and visualization of their morphology following biocytin labelling confirmed this phenotype.

Our findings suggest that activation of 5-HT7 receptors promotes inhibitory control of dentate gyrus output by increasing GABAergic interneuron activity. Reliable inhibition of the dentate gyrus granule cell network is critical to healthy hippocampal function. Therefore further investigation of the functional consequences of 5-HT7 receptor signalling in the dentate gyrus could give us new insights into the pathophysiological mechanisms related to dentate gyrus disinhibition.

Funding for this study was provided by the Polish National Science Centre Grant 2016/23/N/NZ4/03224

Neurobiological session

Mikołaj Miękus
Nencki Institute of Experimental Biology, Polish Academy of Sciences

Excitability of corticothalamic relays in mouse models of autism

Autism spectrum disorders (ASD) are characterised by handicapped ability to initiate and engage in social interaction, impairments in communication skills, pervasive repetitive behaviours and, last but not least, by disturbed sensory processing [1,2]. According to Markram and Markram [3], the core neuropathology is hyper-activity and hyper-plasticity across multiple regions of the brain leading to over-sensitivity. The Intense World theory of autism, similarly to much ASD research, is centred on the neocortex and the amygdala circuits. Little is known about the effect of ASD on the central station of sensory pathways – the thalamus – and their corresponding corticothalamic connections. In this pilot study, electrophysiological properties of neurons in the higher order somatosensory thalamus (posterior medial nucleus – PoM) were investigated in mouse models of ASD.Two mouse models of autism were used: BTBR T+ Itpr3tf/J (BTBR, 6 cells) and Fmr1 knockout (5 cells). C57BL/6J (C57, 13 cells) and Fmr1 heterozygous (7 cells) mice served as respective control groups. Using current-clamp whole-cell recordings in thalamocortical slices, we obtained electrophysiological characteristics of individual PoM neurons. Then, using another electrode located in the capsula interna, series of electrical impulses (5 impulses, 200 μs each, 100 μA – 600 μA, 20 Hz) were applied to stimulate descending cortical fibres. Excitatory postsynaptic currents (EPSCs) were recorded in voltage-clamp mode to characterize properties of corticothalamic synapses in the studied cells. Each cell was stimulated with the train of impulses from 5 to 8 times and the recordings were averaged to obtain a mean response of the cell.

Neurobiological session

No significant differences were found in intrinsic excitability of the cells from different experimental groups. When postsynaptic responses were analysed, the corticothalamic EPSCs in BTBR strain were larger and displayed stronger frequency dependent facilitation than currents in the control C57 mice. The differences were statistically significant (two-way ANOVA mouse strain x current amplitude: $F(4, 64) = 13{,}01$, $p < 0.0001$ and mouse strain x facilitation: $F(4, 56) = 3.626$, $p < 0.05$). Similar but weak trend was observed between Fmr1 groups' amplitudes. The experiment showed that excitability of corticothalamic pathways may be enhanced in autism, presumably contributing to overwhelming tactile sensations affecting individuals with ASD.

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Acknowledgment:
Supported by Polish National Science Centre grant 2013/08/W/NZ4/00691

Clinical session

Andrzej Kubiak
Institute of Nuclear Physics Polish Academy of Science, Radzikowskiego 152, 31342 Kraków, Poland, Krakow, Poland

Mechanical niche for the study of drug impact in brain metastasis of prostate cancer cells

Mechanical forces play crucial role in cancer development and progression. Changes in matrix rigidity result in induction of epithelial-mesenchymal transition1 as well as in increased drug resistance2. Those phenomena are caused by process called mechanotransduction. Its principle is transmission of mechanical stimuli from the cell surroundings to cytoskeleton and further to cell nucleus. Particular groups of antitumor drugs acting on microtubules lead to the inhibition of cell divisions due to depletion of mitosis. Action of those drugs does not only affect mitotic spindle formation but also microtubules organization. Such changes in microtubules organization affect cancer cells response to stimuli from their surroundings. This is extremely important in studies of brain metastases, in which brain elasticity is one of the lowest in human body3. The aim of our studies is to understand how drug-tubulin binding directs the mechanical response of cells upon drug treatment. To stimulate brain elasticity we created polyacrylamide (PA) and polydimethylsiloxane (PDMS) substrates. PA gels were prepared from 0.4% bis-acrylamide and 4-12% acrylamide. Acrylamide concentrations of 4% and 5 % mimic precisely the brain tissue elasticiy with with the range of Young's modulus 2-2,5 kPa. PDMS stiffness were tuned by changing crosslinking concentration between 1:20 to 1:60. PDSM 1:60 exhibited physiological stiffness of several kPa. Among those two materials, PDMS possess important adventage over PA, because of its high viscosity, which make it more similar to viscoelastic properties of brain tissue. Two types of microtubules-interacting agents were used in our study: stabilizing (docetaxel) and destabilizing (vinflunine and colchicine).

Clinical session

By means of atomic force microscopy (AFM) measurements, we showed that direction of mechanic changes is drug effect dependent. For stabilizing agents, it leads to stiffening of nuclear area, while for docetaxel to softening. Nuclear localization of those changes bring us to conclude that opposite effects of drugs will spread out also on genetical changes in cells due to opposite mechanotransducive stimulation. Those findings were in line with the results obtained from cells imaging. Confocal images of cells showed that for lower doses of drugs destabilizing agents microtubules organization was preserved while for docetaxel such treatment leads to the formation of tubulin ring around nucleus. We observed similar trends in nuclear morphology, where lack of robust changes was observed between control and destabilizing agents with parallel significant decrease in nuclear size in docetaxel treated cells. Analysis of cells volume followed drug-dependent trend with increase of cell volume for destabilizing agents and decrease for docetaxel.Our findings coupled together strongly support the thesis that mechanical effect of antitumor drug is dependent on drug-tubulin binding mechanisms. In field of recent development in mechanobiology such findings create a great opportunity to propose therapy tuned to mechanosensitive events.

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Clinical session

Mikołaj Miękus
Nencki Institute of Experimental Biology, Polish Academy of Sciences

Excitability of corticothalamic relays in mouse models of autism

Autism spectrum disorders (ASD) are characterised by handicapped ability to initiate and engage in social interaction, impairments in communication skills, pervasive repetitive behaviours and, last but not least, by disturbed sensory processing [1,2]. According to Markram and Markram [3], the core neuropathology is hyper-activity and hyper-plasticity across multiple regions of the brain leading to over-sensitivity. The Intense World theory of autism, similarly to much ASD research, is centred on the neocortex and the amygdala circuits. Little is known about the effect of ASD on the central station of sensory pathways – the thalamus – and their corresponding corticothalamic connections. In this pilot study, electrophysiological properties of neurons in the higher order somatosensory thalamus (posterior medial nucleus – PoM) were investigated in mouse models of ASD.Two mouse models of autism were used: BTBR T+ Itpr3tf/J (BTBR, 6 cells) and Fmr1 knockout (5 cells). C57BL/6J (C57, 13 cells) and Fmr1 heterozygous (7 cells) mice served as respective control groups. Using current-clamp whole-cell recordings in thalamocortical slices, we obtained electrophysiological characteristics of individual PoM neurons. Then, using another electrode located in the capsula interna, series of electrical impulses (5 impulses, 200 μs each, 100 μA – 600 μA, 20 Hz) were applied to stimulate descending cortical fibres. Excitatory postsynaptic currents (EPSCs) were recorded in voltage-clamp mode to characterize properties of corticothalamic synapses in the studied cells. Each cell was stimulated with the train of impulses from 5 to 8 times and the recordings were averaged to obtain a mean response of the cell.

Clinical session

Agnieszka K. Adamczyk
Psychophysiology Lab, Institute of Psychology, Jagiellonian University

Implicit induction of emotional control. A comparative fMRI investigation of self-control and reappraisal goal pursuit

Implicit forms of emotion regulation are of growing interest and have been shown to be efficient in controlling emotional responses despite the fact that they operate without deliberate attempts and depletion of cognitive resources (Braunstein, Gross, & Ochsner, 2017; Gyurak, Gross, & Etkin, 2011). Although such forms of affective modulation are considered natural and crucial for mental health (Etkin, Prater, Hoeft, Menon, & Schatzberg, 2010; Powers, Etkin, Gyurak, Bradley, & Jovanovic, 2015), their brain mechanisms have hardly been studied until now. For this reason, the present study aimed to investigate neural mechanisms of one of the understudied forms of IER strategies - implicit regulatory goal induction - by comparing its effects to the effects of more extensively studied (implicit) reappraisal strategy with the use of BOLD fMRI. In order to hide emotion regulation goal, we designed a paradigm utilizing the Scrambled Sentence Task(Srull & Wyer, 1979). 40 healthy female participants took part in our study. They were instructed to construct eight grammatically correct sentences from word jumbles that were followed by the presentation of eight unpleasant or neutral images derived from the IAPS database. In the implicit emotion regulation condition, half of all sentences conveyed regulatory message, while the other half had neutral meaning that was unrelated to the pictures' content. In the control condition, all preceding sentences had neutral and unrelated meaning. Both induction methods showed robust attenuation of visual, attentional and emotion-related areas.

Clinical session

Moreover, after induction of the self-control goal we could observe increases in several areas of the bilateral middle frontal gyrus and the right insula, both of which are considered to be regions involved in top-down modulation of emotional responses. After the reappraisal goal induction, only a weak increase in the right middle frontal gyrus could be seen, but it was localized similarly as in the self-control induction. Our results not only confirm the effectiveness of implicit induction of affective control, but importantly also indicate the similarities in underlying neural mechanisms that are putatively shared with conscious forms of emotional regulation.

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Clinical session

Agnieszka K. Adamczyk
BabylabUW, Faculty of Psychology, Warsaw University

Are these lips speaking? The specialisation of the lipreading network in 5-month-olds.

From birth, speech processing involves multiple modalities, as infants not only hear but also observe talking faces. From a very early age, infants were found to be sensitive to audiovisual speech. Even before learning to babble, they start to show basic visual speech processing skills. Already around three months of age, infants can match auditory speech sounds to corresponding mouth movements. Four- to six-month-olds can successfully discriminate between native and non-native languages just by looking at silently moving lips. These early visual speech processing skills were found to be important for the development of infant phonological representations and later language production and comprehension. The development of the underlying network of regions involved in speech and face processing is relatively well researched. Infant neuroimaging studies show that both frontal and superior temporal regions are involved in speech and face processing already at birth, gradually becoming increasingly adult-like with age. However the development of cortical organisation supporting visual speech processing in preverbal infants is not yet fully understood. Between six and ten months of age infants become more and more specialised in audiovisual speech processing, which is observable both on a behavioural and neural level. In adults, a dedicated network consisting of the inferior frontal gyrus (IFG), superior temporal sulcus and gyrus (STS/STG) is recruited during visual speech perception. Visual representations of speech sounds (visemes) are thought to be processed within the posterior temporal cortex- an area dubbed temporal visual speech area (TVSA).

Clinical session

It is at the present time not known whether these regions are specialised for silent visual speech processing in preverbal infants. The current study therefore aims to examine the development of brain bases for lipreading within the second half of the first year of life. Two cross-sectional experiments, testing infants at around five- and nine-months of age were planned. Five- to six-month-olds' cortical responses to silent visual speech and non-speech mouth movements (gurning) were recorded with a 32-channel NTS Gowerlabs fNIRS system, using a custom-made headgear designed to cover the IFG, STS/STG, and the putative TVSA. Results from the younger age group show a network of regions non-specifically involved in face motion processing. That is, at five- to six-months of age, infants are found to recruit similar regions during perception of visual speech and gurning. Therefore, it is suggested that at such an early age, cortical organisation is not yet specialised for visual speech processing, which is instead processes just as other types of mouth movements. Future results from the older age group will confirm whether with increasing abilities to process native speech and human faces, a more specialised visual speech processing network emerges.

Cognitive session

Łucja Doradzińska
Laboratory of Brain Imaging, Nencki Institute of Experimental Biology, 3 Pasteur Street, 02-093 Warsaw, Poland.

Is P3b a correlate of consciousness? Event-related potentials to subliminal self-related stimuli

Perception of a stimulus evokes brain activity reflecting both, access of a stimulus to consciousness and simultaneous cognitive processing. Therefore, dissociating neuronal mechanisms of these two processes remains one of the main challenges of consciousness science [1]. It has been proposed that the P3b event-related potential (ERP) - a relatively late brain response observed over centro-parietal electrodes - is an important candidate for the Neural Correlate of Consciousness (NCC) [2]. However, recent studies challenge this idea by showing that, firstly, P3b might be related to attentional processing rather than conscious access per se and, secondly, that a late subcomponent of the P3b can be evoked by unconscious stimuli when these stimuli are salient or important [3]. The aim of the present study was to further investigate the P3b mechanism. Specifically, we tested a hypothesis that stimuli related to "self", which are extremely salient [4] and evoke P3b when presented consciously [5], will generate the P3b component also when presented unconsciously.
In the conducted experiment we used 3 types of stimuli: each subject's own name, other name matched by gender and length, or blank (empty) screen. Stimuli were presented for 33 ms, font and case size of names varied across trials (in order to vary the sensory input while keeping the meaning). We used a block design - our procedure consists of blocks which differed by task and visibility of presented words. In the first block stimuli were followed by a backward mask, which interferes with visual processing resulting in subliminal (unconscious) processing. Participants (n=30) performed the subjective evaluation task - within each trial they were asked to rate the quality of their subjective experience using a Perception Awareness Scale [6].

n the second block stimuli were also masked, but participants performed a forced choice identification task. In the third and fourth blocks no mask was used, which allowed conscious perception (supraliminal condition) and subjects performed respectively, the subjective evaluation task and identification task. EEG was recorded throughout the experiment.An average proportion of trials in which PAS ratings indicate lack of conscious identification was 0.97 in the subliminal condition, and 0.03 in the supraliminal condition. Based on the identification task data the d' index was calculated. It indicates that perception was highly degraded in the masked (M = 0.26), but not in the unmasked trials (M = 4.04). Analysis of the P3b component (time window: 350-550 ms; electrodes: CPz, CP1, and CP2) showed that, in contrast to other names, unconscious perception of the self name was related to greater P3b in the identification task ($Z = 328$, $p = 0.03$), but not during the subjective evaluation task ($t(29) = 0.97$ $p = 0.17$). Preferential processing of consciously presented self name resulted in higher amplitude of P3b in both, the identification task ($Z = 378$, $p < 0.001$) and the subjective evaluation task ($t(29) = 3.45$, $p < 0.001$) The present study demonstrates that P3b can be evoked by an unconscious stimulus, provided it is task relevant and salient. It shows that attentional processes related to automatic preference of subjects for their own name can affect the amplitude of P3b. More generally, by showing that unconscious stimuli can cause spatially widespread and temporally delayed brain activations our finding falsify P3b component as NCC, and confirms it's association with initiation of cognitive processing.

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Cognitive session

Marcin Koculak
C-Lab, Institute of Psychology, Jagiellonian University

Performing actions influences what you see or think

Theories of conscious perception focus predominantly on processes that translate external stimulation into subjective experience. From that perspective, the crucial influence on perception comes from qualities of stimulation and organization of brain regions involved in processing it. However, recent advances are broadening this view by highlighting the impact of non-perceptual information and neuronal processes on creation of subjective experiences. In several experiments we demonstrate how involvement of motor system, especially performing behavioral responses, influences participants subjective response on visual stimuli they are perceiving.
In all experiments participants performed a non-complicated perceptual discrimination task. Experimental manipulation included 1) introducing additional response not related to main task; 2) having participants performing a button press or not as a form of communicating their perceptual decision; and 3) evoking activation in motor cortex externally with TMS that was related to the response participants made or not.
Results indicate that introducing additional motor activation, either through second response or TMS pulse, increased participants subjective reports (both visibility and confidence ratings), while not affecting their general performance in the task itself. Moreover, performing behavioral responses improved error monitoring, making participants more adequately recognize their incorrect responses. Together with findings from other groups, our research shows how perception and action systems work in cooperation to construct the most accurate representation of reality where the subject is an active agent and not just a passive viewer.

Cognitive session

Natalia Rutkowska
Laboratory of Brain Imaging, Nencki Institute of Experimental Biology

Automatic attention capture by complex naturalistic stimuli maintained in working memory - an ERP study

Recent studies suggest that when a stimulus is actively maintained in working memory (WM) it will automatically capture visual attention when perceived [1,2]. However, such a guidance effect has been so far observed only for relatively simple features, such as colour [3], and its efficacy for more complex stimuli is still a matter of debate [4,5].
In the present study we investigated the interaction between WM and attention using complex naturalistic stimuli, such as faces and houses. The experiment comprised two conditions – a WM condition, in which participants were instructed to remember a presented stimulus for a later recollection; and an exposure condition, in which a stimulus was merely seen without an instruction to remember. After remembering or being exposed to a stimulus, subjects performed several trials of a dot-probe task, in which pairs of stimuli were presented laterally (remembered/seen on the one side, control stimulus on the other) and followed by a target dot, to which subjects had to react by pressing a button. Reaction times (RTs) to target dots and the N2pc ERP component were analyzed as markers of automatic attention shifts.

Cognitive session

In the WM condition RTs were significantly faster when the target dot followed a memorized stimulus then when it followed a neutral stimulus, in both faces($t(25) = -4.08$, $p < 0.001$, $BF = 152.24$) and houses condition ($W = 53.00$, $p < 0.001$, $BF = 6.71$). That the memorized item automatically captured attention is further confirmed by electrophysiological data, as the memory-matching stimuli evoked the N2pc component in both faces ($t(25) = -2.96$, $p < 0.01$, $BF = 13.33$) and houses condition ($t(25) = -1.99$, $p = 0.03$, $BF = 2.18$). Importantly, neither RT effect, nor N2pc effect were observed in the exposure condition.The results indicate that the mechanism of automatic attention capture by the WM contents works for complex naturalistic stimuli analogically as for simple features. As such guidance effects have not been observed in previous studies using abstract shapes as complex stimuli [5], our results seem to shed a new light on the nature of the mechanism in question. Such findings seem to leave room for further exploration of the interaction between WM and attentional selection, with the focus on naturalistic stimuli.

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Cognitive session

Agnieszka Romanowska
University of Warsaw

When neuroscience meets law
An extremely dynamic development of neuroscience, which mostly provides more advanced nformations about human brain and its functioning, allows us to read the reactions of human body that are not under control of the examined person. It is a common view that techniques that are developed by neuroscience holds out the promise of helping to address a number of practical legal problems. Perhaps this should be the possibility of introducing and justifying a legal response to what, on the one hand, brings civilization progress and the development of science in the form of the development of neurotechnology and a wide spectrum of their application, on the other hand, refers to the right to which really arises in people's minds. One of the most interesting areas of neuroscience seems to be the methods of studying brain function that corresponds to many areas of law, including intellectual property law, tort law, consumer law, medical law, labor law, insurance law, criminal law and constitutional law . All of that can be called as an emerging specialist field of law, known as Neurolaw. The speech points to three basic areas of criminal law in the broad sense in which one of the techniques of neuroimaging can be used, which is fMRI. One of the problem is the admissibility of the neuroimaging methods in the criminal procedure. The speech analyses in detail whether the technique of neuroimaging, mainly in the form of functional magnetic resonance, can be used as a medical examination in the criminal trial in the case of a witness or a defendant but the author will also attempt to demonstrate that the information obtained through fMRI and afterwards analyzed by a specialist who possesses adequate knowledge may be regarded as witness testimony. The author will show four cases in which neuroscientific evidence had been used in courts. In other words, the question is whether what is possible from the point of view of modern science and technology should be legally permissible.

Computational session

Piotr Matuszewski
University of Warsaw Faculty of Psychology

The association between cognitive abilites and superior eSports performance

According to the Global Games Market Report (Newzoo, 2017), there are some 2.2 billion video game players worldwide. While the popularity of video games as a leisure and entertainment activity has very visibly grown to such proportions since the advent of home computing, a more recent branch of video game related activity has begun to gain traction worldwide: electronic sports (eSports). Among various eSports genres, the most popular one is Multiplayer Online Battle Arena (MOBA) (Casselman, 2015). However, despite the worldwide popularity of MOBA games, this genre is in the initial stage of research (Mora-Cantallops i Sicilia, 2018). The main purpose of this study is to broaden the knowledge regarding superior MOBA games players and their performance on various cognitive tasks. In order to do so, we focused on DOTA 2 game – one of the most popular games within the genre.

31 DOTA 2 players were recruited in this study. To examine each player's level of DOTA 2 expertise, the Matchmaking Rating (MMR) indicator was retrieved. MMR is a numerical variable, calculated for each player in order to match him with allies and enemies on the similar level of expertise. Higher levels of MMR indicate player's superior performance. Eight cognitive tasks were used in this study: Multiple objects tracking (MOT), Sustained Attention to Response Task (SART), Memory Updating: Numerical, Stop Signal Task, Visual Motion Direction Discrimination (VMDD), Ordinal Number Task (ONT), Dual Task and Visual Working Memory. In order to examine the relationship between cognitive abilities and DOTA 2 level of expertise, Pearson's correlation was used.

The results indicate that in our DOTA 2 players sample, MMR was positively related to K scores (estimated capacity of visual short-term memory), load 5 of Memory Updating: Numerical task (which is the most difficult level of this task), as well as next to last difficulty level of VMDD task. Based on the stated results, we assume that the relationship between superior DOTA 2 performance and certain cognitive abilities exists. It is worth to note that because of the correlational nature of the presented study, we are unable to point out the causal relationship between obtained variables.

Computational session

The long, flat 22 kHz calls appear also after a footshock or during fighting. Rat pups emit 40 kHz calls during mother separation paradigm. As ultrasounds are not hearable by the predators and humans, communication in this range serves as a signal to conspecifics only. In the presented study, USVs were recorded in three paradigms: mother isolation test on rat pups (8 PND), Social Play test on 30 PND and during tickling in a rat neurodevelopmental model of schizophrenia. Both male and female animals were tested. Sex differences in play behavior and in USVs were noted. MAM-treated juveniles exhibited shorter play duration time and a decreased number of emitted 50 kHz calls. Additionally MAM-exposed animals emitted calls of lower bandwidth which suggest decreased complexity of calls. These results demonstrate that MAM-exposed rats display an atypical repertoire of ultrasonic calling and reduced play behavior, which reflect the social withdrawal of schizophrenia patients. In addition, changes in USVs on very early stages of life may reflect the prodromal symptoms of schizophrenia.

Computational session

Daniel Kozłowski
the University of Warsaw

Synaptic plasticity and behavioural time-scales discrepancy – how to fill the gap?

Synaptic plasticity, i.e. changes in the connectivity of neurons due to, for example, long-term potentiation (LTP) or long-term depression (LTD), is thought to be the basis of behavioural learning. The rules that govern it exist at the scale of tens of milliseconds (Markram 1997). However, at a behavioural level, learning requires seconds or minutes to occur. For example, in classical conditioning, an animal has to relate the sound of a bell (neutral stimulus) to the piece of food (rewarding or punishing stimulus) that can show up after some time (Pavlov 1927; Izhikevich 2007). This discrepancy is known in the behavioural and machine learning sciences literature as, respectively, the “distal reward problem” (Hull 1943) or the “credit assignment problem” (Minsky 1963; Sutton and Barto 1998). Some solutions to bridge the gap between the time-scales at both, synaptic plasticity and behavioural, levels include incorporating the ‘third factor’ into neoHebbian rules (Gerstner at al. 2018) or compressing the timescale of hundreds of milliseconds to the millisecond span while inhibition-driven theta oscillations occur, e.g. in hippocampal CA1 area (Mehta et al. 2002). In my presentation, I would like to discuss recent theoretical models (Gerstner at al. 2018) trying to solve the problem, and experiments, both in vitro and in vivo, that support them. I mainly focus on the ‘eligibility traces’ model and experiments that seem to confirm the existence of this ‘third factor’ (e.g. Yagishita et al 2014; He et al. 2015; Bittner at al. 2015, 2017) and its importance in linking the synaptic and behavioural level of explanations. Learning is related to many brain activities like creating spatial maps in new environments (to navigate in space properly) (Bittner et al. 2017) or generating behaviour adequately, for example, to avoid harmful stimuli (Antonov et al. 2003). Therefore, finding out the rules that drive the processes of learning can help us make a step further in understanding how nervous systems create and direct behaviour.

Computational session

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POSTERS

Neurobiological session

Alicja Szadziewska
Insitute of Zoology and Biomedical Research, Jagiellonian University, Cracow, Poland

The future of Alzheimer's disease diagnosis. New directions in biomarkers research.

Alzheimer's disease(AD) is a neurodegenerative disease that becomes more relevant as the population ages. Finding new biomarkers is an interest of scientific groups. Discovering a traceable substance in organism that reflects patology in the brain allows allowing earlier diagnosis. It provides better understanding of pathophysiology and supports drug discovery as well as development of new therapeutic strategies. Determining the most suitable sample type, methodology and diagnostic reference range is a goal in research. Acquiring specificity is important for clinical practice.
For diagnostic purposes three CFS biomarkers have been thoroughly studied (Aβ42, T-tau, and P-tau). Availability of new methods in laboratory conditions encourages further analysis in the field. Among current targets in research there's interest in microRNA, immune biomarkers (signalling molecules-cytokines/ chemokines, soluble immune receptors, YKL-40), plasma neurofilament light.
Development of accurate biomarkers allows observations of disease progression and tracking the drugs effects. Combining different methods and creating a panel that describes
the Alzheimer disease is currently a direction that is perceived as very promising.

Neurobiological session

Natalia Siwecka
Department of Clinical Chemistry and Biochemistry, Medical University of Lodz, Poland

Targeting the Unfolded Protein Response signaling pathway with novel, small-molecule inhibitor in Parkinson's disease

Parkinson’s disease (PD) constitutes an age-dependent, progressive, neurodegenerative disease, characterized by selective loss of dopaminergic neurons of the midbrain in the substantia nigra pars compacta. The selective neuronal loss is caused by the accumulation of abnormal aggregates of α-synuclein protein, called Lewy bodies, which represents the main hallmark of PD. Mentioned event evokes in turn Endoplasmic Reticulum (ER) stress and triggers activation of the Unfolded Protein Response (UPR) signaling pathway. Among three major branches of the UPR, the protein kinase RNA-like endoplasmic reticulum kinase (PERK)-dependent one is considered the most relevant, since it may orchestrate neuronal cell apoptosis under chronic ER stress conditions via induction of pro-apoptotic CCAAT-enhancer-binding protein homologous protein (CHOP). Thus, it is regarded as one of the main molecular mechanisms involved in the process of neurodegeneration. The aim of the study was to evaluate the effectiveness of the selected PERK inhibitory compound. Experiments were performed on SH-SY5Y human neuroblastoma cell line which demonstrates, likewise dopaminergic neurons, expression of enzymes such as tyrosine hydroxylase and catecholamines, including dopamine.

Neurobiological session

Cells were cultured in appropriate cell culture medium, under standard conditions. For the experiment, cells were incubated with the PERK inhibitor in the concentration range of 3μM-50μM for 1h, and next with thapsigargin (500nM), as an ER stress inducer, for 2h. To evaluate the level of the phosphorylation of eukaryotic initiation factor 2α (eIF2α), as the main substrate of PERK, the Western blot technique was used. Detection of immune complexes was performed using the chemiluminescence. Evaluation of the PERK inhibitor cytotoxicity was carried out using the colorimetric XTT assay, in wide concentration range of 0,75μM-50μM and additionally 0,5mM. The results showed that PERK inhibitor significantly inhibited eIF2α phosphorylation at 25μM concentration (52%). In addition, the small-molecule PERK inhibitor did not induce a cytotoxic effect at any concentration and incubation time used. Therefore, we can conclude that investigated PERK inhibitor may constitute a potential, novel therapeutic strategy for PD treatment in the near future. This work was supported by grant of Medical University of Lodz, Poland no. 564/1-000-00/564-20-035.

Neurobiological session

Magdalena Fąfrowicz 1,2; Bartosz Bohaterewicz 1; Monika Cichocka 3; Koryna Lewandowska 1; Barbara Sikora-Wachowicz 1; Halszka Ogińska 1; Anna Bereś 1; Justyna Olszewska 4; Tadeusz Marek 1.
1 Department of Cognitive Neuroscience and Neuroergonomics, Institute of Applied Psychology, Jagiellonian University, Krakow, Poland
2 Neuroimaging Group, Malopolska Centre of Biotechnology, Jagiellonian University, Krakow, Poland
3 Chair of Radiology, Medical College, Jagiellonian University, Krakow, Poland
4 Department of Psychology, University of Wisconsin—Oshkosh, Oshkosh, WI, United States*Department of Clinical Chemistry and Biochemistry, Medical University of Lodz, Poland*

Beyond the Low Frequency Fluctuations: Morning and Evening Differences in Human Brain

It has been proven, that human performance and most biological functions express rhythmic fluctuations across a 24-h period. This phenomenon is believed to originate from differences in both circadian and homeostatic sleep-wake regulatory processes. Interactions between these processes influence not only behavior modulation but also brain activity patterns. Furthermore, there are interindividual differences in the timing of sleep-wake cycles, subjective alertness and functioning throughout the day. The number of studies concerning differences of circadian typology has increased during the last few years. Especially there is a growing number of research on extreme chronotypes, which provide a unique way to investigate the effects of sleep-wake regulation on cerebral mechanisms. In this study using functional magnetic resonance imaging (fMRI), the influence of chronotype and time-of-day on resting-state functional connectivity was investigated. After a careful selection, twenty-nine extreme morning and thirty-four extreme evening-type participants underwent two fMRI sessions: about 1 h after wake-up time (morning session) and about 10 h after wake-up time (evening session). The acquisition times were selected according to their regular sleep-wake cycles on a working day based on the actigraphy results. Session order was counterbalanced across participants. The analysis indicated different patterns of functional connectivity between morning and evening sessions and no differences between extreme morning and evening-type individuals. It may be concluded that the time of day has stronger effect on the functional organization of the certain regions of the brain than the chronotype.

Neurobiological session

Matteo Chighizola2, Natalia Bryniarska3, Joanna Komperda4, Justyna Bobrowska1, Klaudia Suchy1, Carsten Schulte2, Agnieszka Basta-Kaim3, Alessandro Podesta2, Piotr Laidler3, Malgorzata Lekka11 Department of Biophysical Microstructures (NZ55), Institute of Nuclear Physics Polish Academy of Science, Radzikowskiego 152, 31-342 Kraków, Poland2 Interdisciplinary Center of nanostructured Materials and Interdaces (CIMaINa) and Department of Physics, Universita degli Studi di Milano, via Celoria 16,20133 Milano, Italy3Department of Experimental Neuroendocrinology, Maj Institute of Pharmacology, Polish Academy of Sciences, 12 Smętna St. 31-343 Kraków, Poland4 Department of Biophysics, Faculty of Biochemistry, Biophysics and Biotechnology, Jagiellonian University, Gronostajowa 7, Krakow, 30-387, Poland5 Chair of Medical Biochemistry, Collegium Medicum, Jagiellonian University, Kopernika 8, 31-034 Kraków, Poland

Mechanical niche for the study of drug impact in brain metastasis of prostate cancer cells

Mechanical forces play crucial role in cancer development and progression. Changes in matrix rigidity result in induction of epithelial-mesenchymal transition1 as well as in increased drug resistance2. Those phenomena are caused by process called mechanotransduction. Its principle is transmission of mechanical stimuli from the cell surroundings to cytoskeleton and further to cell nucleus. Particular groups of antitumor drugs acting on microtubules lead to the inhibition of cell divisions due to depletion of mitosis. Action of those drugs does not only affect mitotic spindle formation but also microtubules organization. Such changes in microtubules organization affect cancer cells response to stimuli from their surroundings. This is extremely important in studies of brain metastases, in which brain elasticity is one of the lowest in human body3. The aim of our studies is to understand how drug-tubulin binding directs the mechanical response of cells upon drug treatment. To stimulate brain elasticity we created polyacrylamide (PA) and polydimethylsiloxane (PDMS) substrates. PA gels were prepared from 0.4% bis-acrylamide and 4-12% acrylamide. Acrylamide concentrations of 4% and 5 % mimic precisely the brain tissue elasticiy with with the range of Young’s modulus 2-2,5 kPa. PDMS stiffness were tuned by changing crosslinking concentration between 1:20 to 1:60. PDSM 1:60 exhibited physiological stiffness of several kPa

. Among those two materials, PDMS possess important adventage over PA, because of its high viscosity, which make it more similar to viscoelastic properties of brain tissue. Two types of microtubules-interacting agents were used in our study: stabilizing (docetaxel) and destabilizing (vinflunine and colchicine). By means of atomic force microscopy (AFM) measurements, we showed that direction of mechanic changes is drug effect dependent. For stabilizing agents, it leads to stiffening of nuclear area, while for docetaxel to softening. Nuclear localization of those changes bring us to conclude that opposite effects of drugs will spread out also on genetical changes in cells due to opposite mechanotransducive stimulation. Those findings were in line with the results obtained from cells imaging. Confocal images of cells showed that for lower doses of drugs destabilizing agents microtubules organization was preserved while for docetaxel such treatment leads to the formation of tubulin ring around nucleus. We observed similar trends in nuclear morphology, where lack of robust changes was observed between control and destabilizing agents with parallel significant decrease in nuclear size in docetaxel treated cells. Analysis of cells volume followed drug-dependent trend with increase of cell volume for destabilizing agents and decrease for docetaxel.Our findings coupled together strongly support the thesis that mechanical effect of antitumor drug is dependent on drug-tubulin binding mechanisms. In field of recent development in mechanobiology such findings create a great opportunity to propose therapy tuned to mechanosensitive events.

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Neurobiological session

Alexander KIss, Koprdova Romana, Osacka Jana
Institute of Experimental Endocrinology, Biomedical Research Center, Slovak Academy of Sciences, Bratislava, Slovakia

Amisulpride, olanzapine, quetiapine, and aripiprazole single injection impact on c-Fos expression in vasopressinergic and oxytocinergic neurons of the rat hypothalamic paraventricular nucleus

The hypothalamic paraventricular nucleus (PVN) cytoarchitectonally represents a complex structure containing vasopressinergic (AVP) and oxytocinergic (OXY) neurons. Impact of a single dose of amisulpride (AMI), olanzapine (OLA), quetiapine (QUE), and aripiprazole (ARI) (second generation of antipsychotics, APs) on c-Fos expression (indicator of cell activity) was studied in 6 functionally different PVN cell segregations including: 1) the anterior, 2) the dorsal cup, 3) the wing-shaped, 4) the periventricular zone 5) the caudal half, and 6) the core and shell cell segregations. For the evaluation, the c-Fos protein expression was visualized by DAB-Ni intensified ABC immunocytochemistry and the stimulated AVP- and OXY-synthesizing neurons by Alexa Flour 564 fluorescence dye. Visual and numerical assessments were performed on 2-3 representative sections, which revealed that the stimulation efficacy of the APs could be aligned as follows: CON < AMI < OLA < ARI < QUE. We showed that all the APs, although with different impact, activated both AVP- and OXY-ergic perikarya in all 6 PVN areas, whereas, none of the APs impact was spatially specific within the PVN. We assume that the effect of all the APs employed could be direct on the PVN neurons, since all the types of receptors associated with the APs action occurs in the PVN. Actually, all the APs, via the affected PVN cell segregations, although in varying degree, may affect functionally different brain areas associated with the endocrine, behavioural, and autonomic regulations. The present data clearly speak out for the fact that the selected APs do not operate only in the brain prefrontal striatal areas, which are typical for their actions, but also in the extra-striatal areas, represented by the PVN, which might be one of the places of the possible APs side-effect actions.
This work was supported by the grant of the Research and Development Agency of the Slovak Republic - APVV-15-0037 and VEGA grant of the Slovak Academy of Sciences – 2/0037/19.

Neurobiological session

Justyna Żuk
Department of Synthesis and Chemical Technology of Pharmaceutical Substances with Computer Modeling Laboratory, Faculty of Pharmacy with Division of Medical Analytics, Medical University, 4A Chodzki St., PL-20093 Lublin, Poland

Agnieszka A. Kaczor 1; Damian Bartuzi 1;
1. Department of Synthesis and Chemical Technology of Pharmaceutical Substances with Computer Modeling Laboratory, Faculty of Pharmacy with Division of Medical Analytics, Medical University, 4A Chodzki St., PL-20093 Lublin, Poland;

Molecular modeling of dopamine D2 receptor in active conformation and investigation of the effect of the length of the third intracellular loop (ICL3) on preferential coupling with Gαi1 and Gαi2 proteins

Dopamine D2 receptor belongs to aminergic G protein-coupled receptors and is involved in many diseases, including schizophrenia, Parkinson's disease, addictions and mood disorders, thus, it represents an important therapeutic target. The aim of the study was to construct models of the dopamine D2 receptor in an active conformation with a short and long intracellular loop (ICL3) to investigate their interactions with dopamine, coupling with Gi1 and Gi2 proteins and the early stadium of receptor activation. The receptor models with Gi1 and Gi2 proteins were constructed using homology modeling with the β2-adrenergic receptor in complex with Gs protein as the main template and structures of the human dopamine D2, D3 and D4 receptors as additional templates. The Yasara software was used to generate receptors short and long loop while the Modeller was used to build the entire structure of the D2 dopamine receptor. The models with the lowest values of DOPE were validated using Verify3D, ANOLEA and ProCheck. Dopamine was docked with the Molegro software. The membrane environment for the ligand-receptor complexes was prepared using the Charm-Gui membrane builder server. The receptor was immersed in an asymmetrical membrane composed of 8 types of lipids in proportions appropriate to membrane rafts.

Neurobiological session

Dopamine D2 receptor belongs to aminergic G protein-coupled receptors and is involved in many diseases, including schizophrenia, Parkinson's disease, addictions and mood disorders, thus, it represents an important therapeutic target. The aim of the study was to construct models of the dopamine D2 receptor in an active conformation with a short and long intracellular loop (ICL3) to investigate their interactions with dopamine, coupling with Gi1 and Gi2 proteins and the early stadium of receptor activation. The receptor models with Gi1 and Gi2 proteins were constructed using homology modeling with the β2-adrenergic receptor in complex with Gs protein as the main template and structures of the human dopamine D2, D3 and D4 receptors as additional templates. The Yasara software was used to generate receptors short and long loop while the Modeller was used to build the entire structure of the D2 dopamine receptor. The models with the lowest values of DOPE were validated using Verify3D, ANOLEA and ProCheck. Dopamine was docked with the Molegro software. The membrane environment for the ligand-receptor complexes was prepared using the Charm-Gui membrane builder server. The receptor was immersed in an asymmetrical membrane composed of 8 types of lipids in proportions appropriate to membrane rafts. Combination of the Amber force fields was used to describe the interactions of protein and ligand while the Slipids to the cell membrane. Molecular dynamics simulations were performed using Gromacs v. 5.0.7. in native-like conditions. The trajectories were analyzed using the PCA (Principal Component Analysis). RMSD and RMSF values for the Cα backbone were calculated for 200 ns simulation in order to check for the stability of the models using the Gromacs tools. The loop regions had a notably high RMSF compared with all other regions and it is the most flexible part of all protein. The results of 1 μs MD simulations also demonstrate a preferential interaction of the dopamine D2 receptor isoforms with Gi1 and Gi2 proteins. The changes in distance between α5-Gα helix and the highly conserved motif of the receptor NPxxY, K 2.46, I 3.46, T 5.54, V 6.40 have been studied and the dependence of the loop length on interaction with the G protein was found. The rearrangements of the molecular switches have been examined. Studies conducted on receptor interactions with Gi1 and Gi2 proteins and conformational changes in the receptor interactions with Gi1 and Gi2 proteins and conformational changes in the receptor structure have shown the role of third intracellular loop involved in activation processes.

Neurobiological session

Magdalena Kondej
Department of Synthesis and Chemical Technology of Pharmaceutical Substances with Computer Modeling Laboratory, Faculty of Pharmacy with Division of Medical Analytics, Medical University, 4A Chodzki St., PL-20093 Lublin, Poland
Tomasz M. Wróbel (1,2), Andrea G. Silva (3), Piotr Stępnicki (1), Oliwia Koszła (1), Ewa Kędzierska (4), Agata Bartyzel (5), Grażyna Biała (5), Dariusz Matosiuk (1), Maria I. Loza (3), Marián Castro (3), Agnieszka A. Kaczor (1,6)
1)Department of Synthesis and Chemical Technology of Pharmaceutical Substances, Faculty of Pharmacy with Division of Medical Analytics, Medical University of Lublin, 4A Chodźki St., PL-20093, Lublin, Poland
2)Department of Drug Design and Pharmacology, Faculty of Health and Medical Sciences, University of Copenhagen, Universitetsparken 2, 2100, Copenhagen, Denmark
3)Department of Pharmacology, Universidade de Santiago de Compostela, Center for Research in Molecular Medicine and Chronic Diseases (CIMUS), Avda de Barcelona, Santiago de Compostela, E-15782, Spain
4)Department of Pharmacology and Pharmacodynamics, Faculty of Pharmacy with Division of Medical Analytics, Medical University of Lublin, 4A Chodźki St., PL-20093, Lublin, Poland
5)Department of General and Coordination Chemistry, Maria Curie-Skłodowska University, M. Curie-Skłodowskiej Sq. 2, PL-20031, Lublin, Poland
6)School of Pharmacy, University of Eastern Finland, Yliopistonranta 1, P.O. Box 1627, FI-70211, Kuopio, Finland

NOVEL 3-(1,2,3,6-TETRAHYDROPYRIDIN-4-YL)-1H-INDOLE-BASED MULTI-FUNCTIONAL LIGANDS WITH PROCOGNITIVE, ANTIPSYCHOTIC-LIKE AND ANXIOLYTIC ACTIVITY

Schizophrenia is a serious mental disorder in which people interpret reality abnormally. Schizophrenia may result in some combination of hallucinations, delusions, and extremely disordered thinking and behavior that impairs daily functioning, and can be disabling. The pathomechanism of this disease is not fully understood but involves many neurotransmitters and their receptors [1]. The aim of studies was synthesis, structural, thermal and pharmacological studies of 3-(1,2,3,6-tetrahydropyridin-4-yl)-1H-indoles. These compounds was and synthesized from indole or 5-alkoxyindoles and N-substituted piperidin-4-ones in MeOH/KOH.

Neurobiological session

The docking poses of newcompounds in the orthosteric pockets of dopamine D 2 and serotonin 5-HT 1A and 5-HT 2A receptors are comparable and correspond to the previously reported bonding mode of the virtual hit D2AAK1 [2]. One of the synthesized compound was selected for X-ray studies to get knowledge about its energetically stable conformation in the solid state. The interatomic distances and angles for this compound are in agreement with those described in the literature and are similar to those observed for the other closely related indole derivatives. SAR indicated the bulkiness of 5-alkoxy substituent is not favorable for activity while the effect of N-methyl aryl substituent is less important. Compound with most favorable multi-receptor profile was subjected to in vivo investigations. Examined compound decreased amphetamine-induced hyperactivity in mice and increased memory consolidation in the passive avoidance test and decreased immobility time in the forced swim test for antidepressant activity [3]. In conclusion, the new multi-target compounds have a good multi-receptor properties and can contribute to the development of better and more effective treatment of diseases with complexpathomechanisms such as schizophrenia.

Neurobiological session

Agata Sapieja
Laboratory of Molecular Basis of Behavior Nencki Institute of Experimental Biology of Polish Academy of Sciences ul. L. Pasteura 3, 02-093 Warsaw, POLAND
Edyta Skonieczna, Małgorzata Piechota, Roberto Pagano, Ashish Gorule
Magdalena Ziółkowska, Kasia Radwańska

The role of cofilin-dependent activity in dentate gyrus in alcohol seeking during withdrawal

Alcohol addiction is chronic, relapsing disease that leads to severe social and medical consequences. This disorder affects both mental health and also neurochemistry of brain. The molecular mechanisms that lead to addiction and those that prevent chronic consumers from such transition are not sufficiently understood. Cofilin is an actin binding protein which disassembles actin filaments therefore promoting actin cytoskeleton dynamics and can increase or decrease levels of F-actin. It's increased activity was linked with shrinkage of dendritic spines and loss of neural connections. These changes may contribute to behavioral disorders during alcoholism, however the role of cofilin and actin cytoskeleton in molecular mechanism of addiction is not entirely understood. Here we wanted to verify if the activity of cofilin and remodeling of actin cytoskeleton affect mouse behavior during alcohol training. To test this hypothesis we analyzed levels of F-actin in the hippocampus of the mice trained to drink alcohol. Results show that during withdrawal F-actin level is increased. Next we overexpressed adeno-associated viruses (AAV2/9) coding cofilin in DG of the C57BL6/cmdb mice. We injected: AAV9-CaMKIIα0,4-CofilinS3A-HA (constitutively active cofilin), AAV9-CaMKIIα0,4-eGFP-HA (EGFP expression control), AAV-9-CaMKIIα0,4-CofilinWT-HA (cofilin control) and trained mice to drink alcohol in IntelliCage system. Our data suggests that mice with constitutively active cofilin (S3A) in DG increased alcohol seeking during withdrawal. Next we trained C57BL6/cmdb females mice with overexpressed constitutively active cofilin(S3A) or eGFP to drink alcohol for 30 days. The analysis of fEPSP was performed in the molecular layer of DG. Results show that withdrawal affects synaptic transmission in DG and this change is prevented by the overexpression of constitutively active cofilin (S3A). Taken together our data suggests the role of cofilin in DG in regulation of alcohol addiction.

Neurobiological session

Anna Radlicka
Department of Molecular Neuropharmacology, Maj Institute of Pharmacology, Polish Academy of Sciences

Judyta Jabłońska, Łukasz Szumiec, Monika Bagińska, Zofia Harda, Łucja Kudła, Maria Kaczmarczyk, Joanna Pera, Grzegorz Kreiner, Jan Rodriguez Parkitna

Effects of progressive dopaminergic degeneration and L-DOPA treatment on motor and executive function in TIF-IA<DATCreERT2> mice

Parkinson's disease (PD) is associated with progressive loss of dopaminergic neurons in the nigrostriatal pathway, and manifests in both motor and non-motor symptoms. The latter are of particular interest, as some of them emerge in the prodromal phase of PD. Treatment of PD with L-DOPA alleviates at least part of the motor symptoms, however, it was reported to have mixed effects on cognitive functions.
Here, we explore cognitive function in TIF-IADATCreERT2 transgenic mice, a strain with tamoxifen-induced progressive loss of dopaminergic neurons and subsequent impairment of motor capabilities. The animals were tested for motor performance on CatWalk gait analysis system, and their executive capacity was assessed in operant sensation seeking (males) and probabilistic reversal learning task (females) paradigms. The tests were performed for 3 months, starting with early stages of degeneration, and assessed the behaviour before, during, and after a 14-days-long treatment with L-DOPA or placebo.

Neurobiological session

Our results show differences between genotypes in several motor parameters related to motor coordination and paw print area touching the ground during walking. L-DOPA influenced gait parameters regarding paw print area in both sexes. We also observed that mutant mice, on average, exhibited a higher number of choices and visits to drinking compartments, and higher saccharin preference in probabilistic reversal learning task, as well as higher number of correct choices in operant sensation seeking test. Mutant females treated with L-DOPA made more visits to drinking compartments throughout the time of treatment and withdrawal in comparison to mutant females that received placebo. For the same period of time, wild-type females treated with placebo showed significantly lower number of choices, as opposed to other groups. Interestingly, treatment with L-DOPA did not influence performance in the operant sensation seeking test. In summary, progressive loss of dopaminergic neurons influences motor capabilities and executive function in TIF-IADATCreERT2 mice. L-DOPA affected only specific gait parameters and led to a higher number of visits in probabilistic reversal learning task, regardless of the genotype. L-DOPA did not have a consistent and prominent effect on all executive functions in mice, as exemplified by the lack of its impact on operant sensation seeking test

Neurobiological session

Diana Piotrowska
Department of Behavioral Neuroscience and Drug Development, Maj Institute of Pharmacology, Polish Academy of Sciences
Agnieszka Potasiewicz, Agnieszka Nikiforuk, Piotr Popik

Rat ultrasonic communication measurement as a tool in schizophrenia research.

Schizophrenia is a complex mental disorder that is also associated with impairment in social functioning. Social withdrawal is a persisting schizophrenia symptom, which is usually resistant to treatment with antipsychotics. Nowadays, schizophrenia is considered a neurodevelopmental disorder with both genetic and environmental basis. Even though it is usually diagnosed in early adulthood, some deficits are often evident even before the onset of psychosis. Thus, a good animal model of this disease should cover not only psychotic-like behaviors but also social impairment and prodromal symptoms. Administration of mitotoxin methylazoxymethanol acetate (MAM) during rat pregnancy is considered as a good model of disturbances in early brain development. Rats born of such treated dams exhibit a wide range of behavioral abnormalities, reflecting core symptoms of schizophrenia.

Neurobiological session

The discovery of ultrasonic communication of laboratory rodents led to creation of new standards in behavioral testing as it provides an insight into animals' emotional state. Various categories of those sounds were distinguished on the basis of their acoustic features. In infant rats, ultrasonic vocalizations (USVs) are of about 40 kHz. The adult rats' calls, which first appear in adolescence are divided into two main categories: the appetitive 50 kHz and the aversive 22 kHz calls. 50 kHz calls are emitted by rats in positive social context or when subjected to a reward, drugs of abuse etc, whereas 22 kHz vocalization serves as a warning, for example from a predator presence. The long, flat 22 kHz calls appear also after a footshock or during fighting. Rat pups emit 40 kHz calls during mother separation paradigm. As ultrasounds are not hearable by the predators and humans, communication in this range serves as a signal to conspecifics only. In the presented study, USVs were recorded in three paradigms: mother isolation test on rat pups (8 PND), Social Play test on 30 PND and during tickling in a rat neurodevelopmental model of schizophrenia. Both male and female animals were tested. Sex differences in play behavior and in USVs were noted. MAM-treated juveniles exhibited shorter play duration time and a decreased number of emitted 50 kHz calls. Additionally MAM-exposed animals emitted calls of lower bandwidth which suggest decreased complexity of calls. These results demonstrate that MAM-exposed rats display an atypical repertoire of ultrasonic calling and reduced play behavior, which reflect the social withdrawal of schizophrenia patients. In addition, changes in USVs on very early stages of life may reflect the prodromal symptoms of schizophrenia.

Neurobiological session

Klaudia Krystecka
University SWPS
Alicja Bińkowska

Age-related effects of cannabis on cognitive functions.

The main function of the endogenous cannabinoid system is thought to be the regulation of synaptic transmission. Cannabinoid receptors type 1 (CB1) are found throughout the central nervous system, particularly in the hippocampus, basal ganglia and cerebellum. These brain regions play major role in emotional and cognitive processing. Bilkei-Gorzo et al. (2005) demonstrate that young mice with a genetic deletion of the cannabinoid CB1 receptor, performed most tests at the same level as old animals, suggesting that the decline in cognitive functions is accelerated in the absence of CB1 receptors.Tetrahydrocannabinol (THC), the main psychoactive substance in cannabis, is a partial agonist of CB1 receptors (Ramirez, 2005). Many studies revealed CB1 receptor-mediated memory deficits caused by THC intoxication. While there are other research shedding new light at this topic and showing biphasic effects of THC on memory and cognition. The most prominent evidence comes from animal studies (Quinn et al., 2007; Bilkei-Gorzo et al., 2017). Studies conducted in mouse models revealed that treatment with low dose of THC improved cognitive performance in the old age group to the level observed with the young controls (Sarna, 2019). Older people are seldom examined or treated with THC. Therefore, it is difficult to prove its effectiveness in human model, while early studies pointed to the therapeutic potential of cannabinoid drugs for neurological disorders (Milton, 2002; Lastres-Becker et al., 2005). At the same time, THC treatment worsened performance in young mice, in good agreement with the known detrimental effects of THC on cognition in young animals and humans (Curran et al., 2002; Crane et al., 2013).

Neurobiological session

Deteriorating and ameliorating effects of cannabinoids have been often reported in different studies that used different experimental setups, including different cells, animals, drugs, doses and assays. The exact range of therapeutic doses, as well as the required frequency of administration, requires clinical investigation. That dualism shows the need for further research about cannabis, the most consumed illicit substances worldwide.

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Neurobiological session

Agata Staszelis
Departament of Neuroscience, University of Lodz

Overview of the main functions of the hypothalamus

The hypothalamus is a subcortical structure being a part of the diencephalon. It has multiple small nuclei and plays several critical roles. It is located near the third ventricle, hence, it is close to the cerebrospinal fluid along with the substances inside. Furthermore, the pituitary gland is situated right next to it and the hypothalamus is involved in the connection between the nervous and the endocrine system. That all combined makes it highly involved in the hormonal release due to controlling a part of the anterior pituitary. Other principal functions of the hypothalamus encompass the participation in hunger, thirst, temperature, sleep and circadian rhythm regulation and some aspects of parenting, attachment and sexual behaviours.

Neurobiological session

The medial anterior nuclei include: medial preoptic nucleus (thermoregulation), supraoptic nucleus (release of vasopressin and oxytocin), paraventricular nucleus (regulation of apetite, stress, regulation of autonomic functions in the spinal cord and brainstem, release of somatostatin, vasopressin, oxytocin, thyrotropin-releasing hormone and corticotropin-releasing hormone), anterior hypothalamic nucleus (sleep regulation, sexual behaviour, thermoregulation, panting, sweating, and inhibition of thyrotropin, TSH) and suprachiasmatic nucleus (circadian rhythms' control). There is only one nucleus considered as lateral anterior – the lateral nucleus, whose orexin neurons participate in the mediation of food intake, arousal, thermoregulation, pain and many others. In terms of the tuberal nuclei in the medial area, there are three nuclei. The dorsomedial hypothalamic nucleus is engaged in body-weight regulation, circadian activity, the regulation of blood pressure and heart rate, and in the stimulation of the gastrointesinal tract. The ventromedial nucleus is involved in satiety, fear, thermoregulation and sexual activity. The arcuate nucleus participated in the homeostasis and regulation of feeding, fertility and the blood system. The lateral tuberal nuclei constitute the lateral hypothalamus, along with the lateral anterior and lateral posterior nuclei.The medial posterior nuclei include the posterior hypothalamic nucleus,the supramammillary nucleus, the tuberomammillary nucleus and the mammillary nucleus. And they are involved in the processes of blood pressure, learning, memory, thermoregulation and energy balance.

Supported by NCN grant No. 2017/25/B/NZ4/01476.

Neurobiological session

Aleksandra Aniszewska-Stańczuk
Institute of Psychology, Polish Academy of Sciences
dr. hab. Łukasz Okruszek
Neurophysiological characterization of Interpeduncular Nucleus neurons.

Perceived social isolation (PSI; “loneliness”) is defined as a subjective perception of inadequate number or quality of one’s social relationships. PSI is currently believed to lie among the most challenging problems in modern society, and is one of the central topics of investigation in social neuroscience. However, certain aspects of its neurophysiological mechanisms remain unclear. According to Evolutionary Theory of Loneliness, attentional processes in individuals with high PSI are biased towards social stimuli, which may results in reduced top-down control. The key goal of the present study was to investigate electrophysiological correlates of executive control and emotional response among lonely young adults. A paradigm combining inhibitory control task (Go/No-Go task) with affective distractors (IAPS pictures with social/nonsocial x positive/neutral/negative content) was utilized. Participants (n=27, age 18-34, 17 females) were divided into two groups according to their R-UCLA Loneliness scale results (scores in a range 21-34 for non-lonely individuals, NLI; 41-61 for lonely individuals, LI). Then, participants completed the task that involved short (1000 ms.) IAPS picture presentation prior to each Go/No-Go trial (600 ms.). Upon completion of the EEG paradigm, participants were asked to evaluate presented pictures on the arousal and valence scales. The analysis of pictures' ratings and EEG potentials evoked by IAPS pictures revealed no differences between LI and NLI. However, robust effect of decreased P3 amplitude in No-Go trials for lonely compared to non-lonely individuals was found. P3 component is believed to be an indicator of inhibition control during Go/No-Go task, thus presented results indicate a link between loneliness and reduced executive control. Additionally, this effect was not modulated by a type of affective distractor, thus suggesting that this effect was not elicited by type or a content of the distractor. The results of the present study, which has shown decreased neurophysiological markers of executive control in LI compared to NLI suggest that LI may present reduced ability to flexibly adapt to complex real-life situations.

Neurobiological session

Stanislava Bukatová 1
Alexandra Reichova 2, Jan Bakos 1,2, Zuzana Bacova 1
1 Biomedical Research Center, Institute of Experimental Endocrinology, Slovak Academy of Sciences, Bratislava, Slovakia
2 Institute of Physiology, Faculty of Medicine, Comenius University, Bratislava, Slovakia

SHANK3-deficiency alters ratio of hippocampal neuronal cells in early brain development

Neurogenesis is a highly dynamic process under control of various signaling pathways. Disruption in these pathways may lead to neurodevelopmental diseases, such as autism spectrum disorder (ASD). In recent years, there has been an increased interest in oxytocin (OXT) as a potential treatment for the core symptoms of autism. Recent studies have suggested that OXT affects differentiation of various cells types and it modulates neural cell´s proliferation and neurogenesis. Alteration in synaptic scafolding protein SHANK3 (SH3 and multiple ankyrin repeat domains 3) is one of the most accepted mice model of autism. The aim of this study was 1) to evaluate the effects of OXT on gene expression of specific neuronal markers in the hippocampus of neonatal mice and 2) to measure different proportions of primary hippocampal neurons incubated with OXT for 8 days. Oxytocin (0,1 μg/μl s.c.) or saline was administrated to neonatal SHANK3 deficient mice or wild type (WT) on the second and third postnatal day. Hippocampus was isolated on fifth postnatal day. Gene expression of glial and neuronal markers (GFAP–astrocytes, CNPase–oligodendrocytes, NSE–neurons) was detected by RT qPCR. OXT administration to WT mice significantly decreased the expressions of GFAP and CNPase, while mRNA level of NSE increased. SHANK3 deficient mice had significantly higher gene expression of NSE. Primary hippocampal cells isolated from neonatal mice were incubated with 1μM oxytocin for 8 days. Proportional representation of neurons compared to other (not specified) cells was determined by ImageJ software. The proportion of neurons in WT group was significantly higher after 8 days of incubation with OXT compared to the control group. No such effect was present in primary hippocampal cells isolated from SHANK3 deficient mice. In conclusion, it could be suggested that SHANK3-deficiency alters ratio of hippocampal neuronal cells, while oxytocin may affect neuronal and glial specialization during normal brain development.
Supported by grants APVV-15-0205, APVV-15-0045 and VEGA 2/0038/18.

Neurobiological session

Authors: Monika Dopierała, Gabriela Vykysala

Adaptogenes - brain boosters hidden in plants. Definition, effects & questions

Adaptogens are natural compounds or plant extracts, which have ability to modify organisms' non-specific reactions to stress and adverse environmental conditions by raising its possibility of adaptation and survival. The term "adaptogen" was created in the first half of the 20th century by the soviet scientist Nikolai Lazarev but some adaptogenic plants have been used in the traditional Chinese medicine and Ayurveda for ages. The main objects of researchers' interest are plants like: Withania somnifera (Ashwaganda), Rhodiola rosea, Schisandra chinensis, Eleutherococcus senticosus.
Adaptogenic plants have been classified based on their three basic features, which are:
1. Non-specific response to wide spectrum of stressors
2. Normalizing impact on physiology and maintaining of homeostasis
3. Not causing harm to the normal functions of the body.
Further studies in this field have been coming up with wide range of new modified definitions. Over time, the molecular level of adaptogens' effects became more intelligible as it relates to common molecular targets, signaling pathways and networks.
Many studies have revealed the potential role of adaptogens in such aspects of body functioning as regulation the HPA (hypothalamic–pituitary–adrenal) axis in response to stimulation by external stress. They also influence neuritic regeneration, synaptic reconstruction and neuroplasticity. What is important, the scientists have found thatadaptogens can increase cellular energy levels, prevent oxidative damages, improve the tolerance of humans to drug cytotoxicity or change the levels of molecular chaperons (e.g. Hsp 70) and nitric oxide.In our poster we would like to present the concept of adaptogenic plants and critically review the existing literature related to the modus operandi of Withania somnifera. Not only do we aim to consider possible pathways in which adaptogens affect molecular processes taking place in brain, but also try to answer the question whether the matter under consideration has potential to promote from lacking of empirical data alternative medicine to evidence-based complimentary therapy.

Neurobiological session

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Neurobiological session

Mikołaj Miękus
Nencki Institute of Experimental Biology, Polish Academy of Sciences
Marek Bekisz, Ewa Kublik

Excitability of corticothalamic relays is enhanced in mouse

Autism spectrum disorders (ASD) are characterised by handicapped ability to initiate and engage in social interaction, impairments in communication skills, pervasive repetitive behaviours and, last but not least, by disturbed sensory processing [1,2]. According to Markram and Markram [3], the core neuropathology is hyper-activity and hyper-plasticity across multiple regions of the brain leading to over-sensitivity. The Intense World theory of autism, similarly to much ASD research, is centred on the neocortex and the amygdala circuits. Little is known about the effect of ASD on the central station of sensory pathways – the thalamus – and their corresponding corticothalamic connections. In this pilot study, electrophysiological properties of neurons in the higher order somatosensory thalamus (posterior medial nucleus – PoM) were investigated in mouse models of ASD. Two mouse models of autism were used: BTBR T+ Itpr3tf/J (BTBR, 6 cells) and Fmr1 knockout (5 cells). C57BL/6J (C57, 13 cells) and Fmr1 heterozygous (7 cells) mice served as respective control groups. Using current-clamp whole-cell recordings in thalamocortical slices, we obtained electrophysiological characteristics of individual PoM neurons. Then, using another electrode located in the capsula interna, series of electrical impulses (5 impulses, 200 μs each, 100 μA – 600 μA, 20 Hz) were applied to stimulate descending cortical fibres. Excitatory postsynaptic currents (EPSCs) were recorded in voltage-clamp mode to characterize properties of corticothalamic synapses in the studied cells. Each cell was stimulated with the train of impulses from 5 to 8 times and the recordings were averaged to obtain a mean response of the cell.

No significant differences were found in intrinsic excitability of the cells from different experimental groups. When postsynaptic responses were analysed, the corticothalamic EPSCs in BTBR strain were larger and displayed stronger frequency dependent facilitation than currents in the control C57 mice. The differences were statistically significant (two-way ANOVA mouse strain x current amplitude: $F(4, 64) = 13,01$, $p < 0.0001$ and mouse strain x facilitation: $F(4, 56) = 3.626$, $p < 0.05$). Similar but weak trend was observed between Fmr1 groups' amplitudes.

The experiment showed that excitability of corticothalamic pathways may be enhanced in autism, presumably contributing to overwhelming tactile sensations affecting individuals with ASD.

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Acknowledgment:

Supported by Polish National Science Centre grant 2013/08/W/NZ4/00691

Neurobiological session

Robert Bińkowski
Nencki Institute of Experimental Biology, Polish Academy of Sciences
Jan Jabłonka, Ewa Kublik

Opto-electrophysiological characterisation of the cortical connections in rat brain involved in analysis of the sensual stimuli

Rats have visible somatotopic organisation of somatosensory cortex. The important component of somatosensory cortex is called barrel field (BF). Its name is associate with the specific neuronal organisation in the forth layer of neocortex. These neurons are organised in the barrel-like structure. The particular barrel receives signals from the specified whisker which is located on the snout. The stimulation of the whisker on the contralateral side due to piezoelectric influences on the increase in activity among the neurons located in a particular barrel field. This increase in neuronal acticity may be recorded with the use of the electrode. However as it appears, some small increase in neuronal activity is also recorded in the ipsilateral hemisphere. The communication between both hemispheres happens due to corpus callosum, the structure which consists of myelinated nervous fibers. The aim of this master project was to characterise cortex interhemispherical connections and explaining the possibie mechanisms that control interhemispheric interactions.

Neurobiological session

Michał Zaręba
Department of Cognitive Neuroscience and Neuroergonomics, Institute of Applied Psychology, Jagiellonian University, Kraków, Poland
Aleksandra Domagalik-Pittner (Brain Imaging Core Facility, Malopolska Centre of Biotechnology, Jagiellonian University, Kraków, Poland)Tadeusz Marek (Department of Cognitive Neuroscience and Neuroergonomics, Institute of Applied Psychology, Jagiellonian University, Kraków, Poland)Magdalena Fąfrowicz (Department of Cognitive Neuroscience and Neuroergonomics, Institute of Applied Psychology, Jagiellonian University, Kraków, Poland)

Chronotype may be associated with subtle differences in tissue volume

Humans exhibit diurnal patterns of activity. Based on individual preferences of sleep and wakefulness time, it is possible to distinguish between early, intermediate and late chronotypes. However, the structural basis of varying chronotypes in humans remains poorly explored. Voxel-based morphometry analysis of grey matter and white matter was performed in Computational Anatomy Toolbox (CAT12) using T1-weighted images of 174 subjects (107 females; mean age 24.16 ± 3.84 years). The volumetric data of each subject was correlated against their score on the morningness-eveningness scale. A number of sites of differences was identified throughout the brain, however, none of these survived the correction for multiple comparisons. This sheds a new light on the structural basis of chronotype in humans as our findings stay in opposition to the results reported in a study by Rosenberg et al. [1].
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Clinical session

Alexandra Reichova1, Martina Zatkova1,2, Karel Frimmel3, Veronika Meliskova1,2, Daniela Ostatnikova2, Zuzana Bacova1, Jan Bakos1,2
1Biomedical Research Center, Institute of Experimental Endocrinology, Slovak Academy of Sciences, Bratislava, Slovakia
2Institute of Physiology, Faculty of Medicine, Comenius University, Bratislava, Slovakia
3Institute for Heart Research, Centre of Experimental Medicine, Slovak Academy of Science Bratislava, Slovakia

SHANK3 deficit results in abnormal neuronal morphology accompanied by alterations in postsynaptic proteins partially compensated by oxytocin treatment

Alterations of oxytocin receptor signaling are supposed to contribute to the pathology of neurodevelopmental disorders. We have previously demonstrated that oxytocin increases neurite outgrowth and affects expression of actin-binding and scaffolding proteins. „SH3 and multiple ankyrin repeat domains protein 3“ (SHANK3) belongs to cytoskeletal, scaffolding proteins essential for the postsynaptic cell membrane integrity and ion channel functioning. Mutations in SHANK proteins have been associated with autistic spectrum. Whether oxytocin can affect morphology of neurons and neuritogenesis in SHANK3 downregulated conditions is not known. The aim of the present study was to investigate the oxytocin effects on neurite outgrowth and expression of selected scaffolding proteins, adhesion molecules and GTPases using SHANK deficient mice and in the model of in vitro transient silencing of SHANK3 in neuron-like SH-SY5Y cells. Transient silencing of SHANK3 with specific siRNA resulted in decrease of expression of SHANK3 without effect on SHANK1 and SHANK2 proteins. In vitro silencing of SHANK3 has been accompanied by lower levels of postsynaptic protein Neuroligin3. Both SHANK3 and Neuroligin 3 decreases have been partially restored by incubation of cells for 48h with oxytocin.

Contrary to in vitro studies, levels of Neuroligin3 has been significantly increased on 5th postnatal day in SHANK3 deficient compared to wild-type mice. Same trend has been found for the expression of postsynaptic density protein 95. Evaluation of neurite outgrowth shown that oxytocin
compensated decreased number of neurites and their lower distance from nucleus in primary hippocampal neurons isolated from SHANK3 deficient
mice. Overall, it appears that oxytocin contributes to the regulation of expression of postsynaptic and scaffolding proteins known to be associated with clusters of calcium channels at the cell membrane. The present data also suggest that SHANK deficit may be modulated by activation of oxytocin receptors. Supported by VEGA2/0038/18, VEGA 2/0116/16, APVV-15-205 and APVV-15-0045.

Clinical session

Natalia Siwecka
Department of Clinical Chemistry and Biochemistry, Medical University of Lodz, Poland
Adam Wawrzynkiewicz1, Dariusz Pytel2, J. Alan Diehl2, Ireneusz Majsterek1, Wioletta Rozpędek11 Department of Clinical Chemistry and Biochemistry, Medical University of Lodz, Poland; 2 Department of Biochemistry and Molecular Biology, Hollings Cancer Center, Medical University of South Carolina, Charleston, SC 29425, USA

Targeting the Unfolded Protein Response signaling pathway with novel, small-molecule inhibitor in Parkinson's disease

Parkinson’s disease (PD) constitutes an age-dependent, progressive, neurodegenerative disease, characterized by selective loss of dopaminergic neurons of the midbrain in the substantia nigra pars compacta. The selective neuronal loss is caused by the accumulation of abnormal aggregates of α-synuclein protein, called Lewy bodies, which represents the main hallmark of PD. Mentioned event evokes in turn Endoplasmic Reticulum (ER) stress and triggers activation of the Unfolded Protein Response (UPR) signaling pathway. Among three major branches of the UPR, the protein kinase RNA-like endoplasmic reticulum kinase (PERK)-dependent one is considered the most relevant, since it may orchestrate neuronal cell apoptosis under chronic ER stress conditions via induction of pro-apoptotic CCAAT-enhancer-binding protein homologous protein (CHOP). Thus, it is regarded as one of the main molecular mechanisms involved in the process of neurodegeneration. The aim of the study was to evaluate the effectiveness of the selected PERK inhibitory compound. Experiments were performed on SH-SY5Y human neuroblastoma cell line which demonstrates, likewise dopaminergic neurons, expression of enzymes such as tyrosine hydroxylase and catecholamines, including dopamine.

Clinical session

Cells were cultured in appropriate cell culture medium, under standard conditions. For the experiment, cells were incubated with the PERK inhibitor in the concentration range of 3μM-50μM for 1h, and next with thapsigargin (500nM), as an ER stress inducer, for 2h. To evaluate the level of the phosphorylation of eukaryotic initiation factor 2α (eIF2α), as the main substrate of PERK, the Western blot technique was used. Detection of immune complexes was performed using the chemiluminescence. Evaluation of the PERK inhibitor cytotoxicity was carried out using the colorimetric XTT assay, in wide concentration range of 0,75μM-50μM and additionally 0,5mM. The results showed that PERK inhibitor significantly inhibited eIF2α phosphorylation at 25μM concentration (52%). In addition, the small-molecule PERK inhibitor did not induce a cytotoxic effect at any concentration and incubation time used. Therefore, we can conclude that investigated PERK inhibitor may constitute a potential, novel therapeutic strategy for PD treatment in the near future. This work was supported by grant of Medical University of Lodz, Poland no. 564/1-000-00/564-20-035.

Clinical session

Jana Osacka
Institute of Experimental Endocrinology, Biomedical Research Center, Slovak Academy of Sciences, Bratislava, Slovakia
Koprdova Romana, Mach Mojmir, Kiss Alexander

Effect of chronic haloperidol and aripiprazole treatment on selected physiological and behavioural parameters in chronically stressed rats

Antipsychotics represent a class of medicaments used for treatment of schizophrenia, bipolar disorders, and other psychotic diseases. Generally, they are divided into typical and atypical ones. Several studies have shown interaction between stress exposure and antipsychotics action. This work was aimed to study the effect of the chronic administration of the typical haloperidol (HAL) and atypical aripiprazole (ARI) antipsychotics on the physiological parameters and behavioural changes in chronically stressed rats. Animals were exposed to series of mild stressors (CMS) for 3 weeks and from the 7th day intraperitoneally injected with vehicle (10%DMSO), HAL (1mg/kg) or ARI (10mg/kg) within following 4 weeks. The sucrose preference test and the elevated plus maze (EPM) were used to assess the anxiety- and depression-like behaviour of animals. During the experiment, the weight of the animals and at the end the weight of adrenals, thymus and spleen, and corticosterone (CORT) plasma levels were measured. HAL and ARI treatment suppressed the weight gain in the unstressed animals. CMS decreased the weight of VEH treated rats. Unstressed HAL animals had increased the adrenals and spleen weight compared to the ARI and VEH treated ones. CMS exposure elevated the spleen weight in VEH and ARI injected animals. CMS or antipsychotic treatment does not significantly affect the level of CORT. HAL and ARI in the unstressed and CMS in the VEH rats reduced 1% sucrose solution intake. HAL treated unstressed animals exhibited less anxiety-like behaviour as indicated by more frequent time spent in the open arms of EPM in comparison with the ARI and VEH ones. These results affirm that the CMS model used leads to anhedonia, which was restored by HAL and ARI. HAL administration seems to induced a resilience in the stress conditions, while ARI did not reveal major impact on the CMS-induced changes.

This work was supported by the grant of the Research and Development Agency of the Slovak Republic - APVV-15-0037 and VEGA grant of the Slovak Academy of Sciences – 2/0037/19.

Clinical session

Martin Jáni
Uniwersytet Jagielloński
O. Płonka, M. Wyczesany, A. Daren, P. Błądziński, A. Kalisz, A. Cechnicki, P. Adamczyk

On the relation of the neural substrates of figurative language impairments in schizophrenia with cognitive abilities and symptom severity

Introduction: Impairments of figurative speech processing (e.g. humor, metaphor, irony, sarcasm) has been widely reported in schizophrenia on a behavioral level. While neural substrates of this impairment has been identified in abnormal engagement of figurative language circuit, its association to psychopathology remains unknown. We address this issue by implementing punchline-based task of humor and metaphor comprehension as two most studied aspects of figurative language.
Methods: We conducted two experiments, where we recruited 40 patients with schizophrenia for humor and 30 for metaphor comprehension. Patients were assessed with punchline-based humor/metaphor comprehension task where they rated stories for their comprehensibility and funniness/metaphoricity. We estimated the direction and strength of cortical information flow during figurative language processing by the EEG Directed Transfer Function. Symptom severity were assessed by Positive and Negative Syndrome Scale (PANNS) and cognitive performance by Montreal Cognitive Assessment (MoCA).

Results: Schizophrenia patients with more severe disorganization and positive symptoms tended to consider absurd punchlines as more meaningful and interpret figurative meaning within neutral/literal and absurd punchlines. The cognitive deficit in schizophrenia was associated with difficulties understanding figurative meaning in both funny and metaphoric punchlines. The effective connectivity between prefrontal, temporal and parietal areas during both humor and metaphor processing were associated with cognition as well as symptom severity. The precuneus played a central role in metaphor processing, as it altered connectivity was associated with cognitive abilities, positive, negative and excitement symptoms. In addition, connectivity form left IFG playing key role in negative symptoms severity, while disorganized and excitement symptoms more relied on connectivity with prefrontal and temporo-parietal areas. Conclusion: Both humor and metaphor comprehension impairments in schizophrenia were associated with cognitive deficit and more severe schizophrenia psychopathology, that was also reflected in altered effective connectivity in fronto-temporo-parietal network of figurative language processing. The study was supported by the National Science Centre, Poland (grant no 2014/13/B/HS6/03091 and grant no 2016/23/B/HS6/00286).

Clinical session

Przemysław Adamczyk
Psychophysiology Lab, Institute of Psychology, Jagiellonian University, Krakow

Miroslaw Wyczesany1, Olga Płonka1,2, Martin Jáni1,3, Piotr Błądziński4, Aneta Kalisz4, Artur Daren 4, Andrzej Cechnicki4
[1] Psychophysiology Laboratory, Institute of Psychology, Jagiellonian University, Krakow, Poland
[2] Department of Cognitive Neuroscience and Neuroergonomics, Institute of Applied Psychology, Jagiellonian University, Krakow, Poland
[3] Department of Psychiatry, Faculty of Medicine, Masaryk University and University Hospital Brno, Brno, Czech Republic
[4] Department of Community Psychiatry, Chair of Psychiatry, Medical College, Jagiellonian University, Krakow, Poland
[*] The study was conducted by the Krakow Schizophrenia Research Group, Krakow, Poland

On the specificity of the abnormal information flow during humor and metaphor processing in schizophrenia outpatients

Introduction: Figurative meaning of speech processing (e.g. humor, metaphor) are commonly impaired in schizophrenia. While disruption of figurative language network has been proposed as a substrate of the deficit, little is known about the dynamics of this network. In the present study we investigated the propagation of information flow within neural circuit related to the figurative meaning of speech, specifically, as a neural substrate of impaired humor and conventional metaphor comprehension processing in schizophrenia outpatients.
Methods: The study included 40 schizophrenia outpatients and 40 healthy controls (age-sex-education matched) assessed with an EEG punchline-based-humor/metaphor-comprehension-task; including literal (neutral), figurative (funny/metaphorical) and nonsense (absurd) endings. The direction and strength of cortical information flow in the time course of task processing was estimated by the 64-channels EEG Directed Transfer Function. The linear mixed model procedure was used to test the effects of condition for groups separately (within-group comparisons), as well as for between-group interaction effects in three pairs of directional contrasts: absurd vs neutral punchline, 2. funny/metaphorical vs absurd punchline 3. funny/metaphorical vs neutral punchline.

Results: Along to the behavioral manifestation of the figurative language deficit in schizophrenia, we found various differences in effective connectivity in fronto-temporo-patieral circuit. Schizophrenia outpatients, when compared to healthy controls, revealed abnormal pattern of connectivity during humor and metaphor processing, which was related to the hypoactivation of the RH and the LH, respectively. Moreover, we found reversed lateralization patterns, i.e. leftward-shifted source localizations during humor processing, and the rightward-shifted pattern during metaphor processing in schizophrenia, compared to control group. Conclusion: Presented findings indicate the dissociation and specificity of the humor and conventional metaphor processing in normotypic brain (i.e. LH<RH - humor and LH>RH - metaphor), as well as diversity of neural underpinning of these deficits observed in schizophrenia. Finally, presented results supports the evidences on reversed lateralization of language neural network and on existence of compensatory recruitment of alternative neural circuits in schizophrenia. The study was supported from National Science Centre, Poland, grants no 2014/13/B/HS6/03091 and 2016/23/B/HS6/00286.

Clinical session

Oliwia Koszła
Department of Synthesis and Chemical Technology of Pharmaceutical Substances, Lublin, 4A Chodzki St., 20-093 Lublin, Poland

Oliwia Koszła(1), Przemysław Sołek(2), Sylwia Woźniak(1), Magda Kondej(1), Piotr Stępnicki(1), Tomasz M. Wróbel(1), Agnieszka A. Kaczor(1,3)1) Department of Synthesis and Chemical Technology of Pharmaceutical Substances, Lublin, 4A Chodzki St., 20-093 Lublin, Poland2) Department of Animal Physiology and Reproduction, Faculty of Biotechnology, University of Rzeszow, Werynia 502, 36-100 Kolbuszowa, Poland3) University of Eastern Finland, Yliopistonranta 1, FI-70211 Kuopio, Finland

Molecular and cellular events connected with cell proliferation resulting from potential treatment of neuropsychiatric

It is increasingly recognized that major neuropsychiatric disorders are associated with cerebral communication disorders. One strategy to treat neuropsychiatric disorders is to focus on hippocampal neurogenesis. The hippocampus is highly plastic and is particularly sensitive to changes in the environment, which makes it a promising target for mental illness research [1]. Neurogenesis in the hippocampus reflects the region's unique, large-scale plasticity and can be a potential modulation center for a subset of cognitive and affective behaviors that are affected by many psychiatric disorders. Drugs and other treatments for mental disorders may potentially promote the proliferation of new neurons [2].
Here we present cells morphology, cytotoxicity and assessment of the proliferation properties of a selected compound using the HT-22 and SH-SY5Y cell lines, its effect on the production of reactive oxygen and nitrogen species (ROS and RNS, respectively) and on the activation of mechanisms to combat free radicals (reduction of glutathione). We also show the compound’s influence on cell viability and the amount of damage at the DNA level.
In conclusion, the studied compound is a promising starting point to develop novel treatments for cognitive symptoms of neuropsychiatric disorders.

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Clinical session

Piotr Stępnicki
Department of Synthesis and Chemical Technology of Pharmaceutical Substances with Computer Modeling Laboratory, Faculty of Pharmacy with Division of Medical Analytics, Medical University of Lublin, 4A Chodźki St., PL-20093 Lublin, Poland
1) Katarzyna Targowska-Duda,Department of Biopharmacy, Faculty of Pharmacy with Division of Medical Analytics, Medical University of Lublin, 4A Chodźki St., PL-20093 Lublin, Poland 2) Marta Kruk-Słomka,Department of Pharmacology and Pharmacodynamics, Faculty of Pharmacy with Division of Medical Analytics, Medical University of Lublin, 4A Chodźki St., PL-20093 Lublin, Poland 3) Andrea G. Silva,Department of Pharmacology, Universidade de Santiago de Compostela, Center for Research in Molecular Medicine and Chronic Diseases (CIMUS), Avda de Barcelona, E-15782 Santiago de Compostela, Spain 4) Anna Kozak,Department of Synthesis and Chemical Technology of Pharmaceutical Substances with Computer Modeling Laboratory, Faculty of Pharmacy with Division of Medical Analytics, Medical University of Lublin, 4A Chodźki St., PL-20093 Lublin, Poland 5) Tomasz M. Wróbel,Department of Synthesis and Chemical Technology of Pharmaceutical Substances with Computer Modeling Laboratory, Faculty of Pharmacy with Division of Medical Analytics, Medical University of Lublin, 4A Chodźki St., PL-20093 Lublin, Poland 6) Grażyna Biała,Department of Pharmacology and Pharmacodynamics, Faculty of Pharmacy with Division of Medical Analytics, Medical University of Lublin, 4A Chodźki St., PL-20093 Lublin, Poland 7) Marián Castro,Department of Pharmacology, Universidade de Santiago de Compostela, Center for Research in Molecular Medicine and Chronic Diseases (CIMUS), Avda de Barcelona, E-15782 Santiago de Compostela, Spain 8) Agnieszka A. Kaczor,Department of Synthesis and Chemical Technology of Pharmaceutical Substances with Computer Modeling Laboratory, Faculty of Pharmacy with Division of Medical Analytics, Medical University of Lublin, 4A Chodźki St., PL-20093 Lublin, Poland;School of Pharmacy, University of Eastern Finland, Yliopistonranta 1, P.O. Box 1627, FI-70211 Kuopio, Finland

MOLECULAR MODELING AND PHARMACOLOGICAL STUDIES OF D2AAK2, NOVEL NON-BASIC ANTAGONIST OF D2 RECEPTOR WITH POTENTIAL ANTIPSYCHOTIC ACTIVITY

Schizophrenia is listed among the most severe and difficult to treat psychiatric disorders due to its still unclear and complex pathomechanism, as well as variety of symptoms, it manifests. Antipsychotic drugs available on the market often lack effectiveness against symptoms of the disease and may cause severe adverse effects. In search for novel compounds with potential antipsychotic activity, structure-based virtual screening was performed, aimed at identifying new antagonists of dopamine D2 receptor [1]. From among ten found novel ligands, four with the best affinities to dopamine D2 receptor were subjected to further in silico, in vitro and behavioral studies to evaluate their potential antipsychotic properties. Second from among identified hits, the compound D2AAK2 (Fig. 1), does not possess a protonatable nitrogen atom, which is a key element of interaction with orthosteric binding site of aminergic G protein-coupled receptors. However, it has an amide nitrogen atom with a hydrogen atom, that may exhibit electrostatic interaction with the conserved Asp(3.32). The D2AAK2 analogues with an alkylated amide nitrogen atom turned out to be inactive, what can support the orthosteric binding mode. On the other hand, its derivatives with an additional protonatable nitrogen atom are also inactive, what can suggest the allosteric mode of action.Radioligand binding assays and behavioral studies (amphetamine-induced hyperactivity test, elevated plus maze test, passive avoidance test), performed in order to evaluate the studied compound as potential antipsychotic drug, revealed its affinity to receptors that constitute key molecular targets in schizophrenia, and its antipsychotic, anxiogenic and procognitive effects.References[1] Kaczor AA, Silva AG, Loza MI, Kolb P, Castro M, Poso A. ChemMedChem 2016;11(7):718-29.

Clinical session

Kamil Filip Tomaszewski
Laboratory of Molecular Basis of Behavior, Nencki Institute of Experimental Biology, Warsaw

Magdalena Robacha, Kacper Łukasiewicz, Magdalena Ziółkowska, Katarzyna Radwańska

How fearful long-term memories are processed?

A traumatic memory formed by acquiring a strong, aversive stimuli can become longlasting and in serious cases could even lead to a Post Traumatic Stress Disorder (PTSD). Psychiatry uses a treatment based on presenting the previously acquired aversive stimuli in safe conditions to attenuate the fear response. This is called extinction treatment. Since traumatic memories are harder to manipulate thus harder to attenuate the fear response to the aversive stimuli causing extinction therapy less effective. Moreover little is known about the mechanisms and neuronal networks behind REMOTE (ie. 30-day-old) fear memory extinction.

Here we wanted to find and understand brain regions responsible for remote fear extinction memory in WT mice. By mapping brain-wide expression of the activity-regulated gene c-fos, we identified a networks of brain regions co-activated by RECENT (1-day-old) and REMOTE (30-day-old) fear memory. Next we attenuate activity of their main components using DREADD (Designer Receptor Exclusively Activated by Designed Drug) tool, to verify its role on fear memory extinction processing over time.

Recent fear memory extinction induced cFos expression in lateral septal area (LS), central medial (CM), central division of central amygdala nucleus (CeM), while remote fear memory extinction strongly activates amygdalar region (BLA, LA, CeM, CeC), Septal region (LS, MS), mediodorsal nucleus of thalamus (MD) and nucleus reuniens (RE), together with cortices: primary visual (V1), enthorinal (ENT) and infralimbic (IL). In vivo attenuation of activity in hub nodes showed no significant effects on consolidation of fear memory extinction in V1 and IL but revealed for the first time importance of MS in reorganization of old, fearful memories and the time-dependent modality of (RE). Together, this study supports a “multiple trace theory” as well, as “standard consolidation theory” of remote memory processing and suggests a new targets for therapeutic approaches against traumatic memories with special emphasis on RE and MS.

Clinical session

Mirek Wyczesany
Jagiellonian University
Spadone S1, Wyczesany M2*, Della Penna S1, Corbetta M34, Capotosto P1
1. Department of Neuroscience Imaging and Clinical Science and ITAB, Institute for Advanced Biomedical Technologies, D'Annunzio University, Chieti, Italy 2. Institute of Psychology, Jagiellonian University, Krakow, Poland 3. Department of Neuroscience and Padova Neuroscience Center, University of Padova, Italy 4. Department of Neurology, Washington University, St. Louis, Missouri, USA*presenting author

Source based effective connectivity reveals internal communication within the dorsal attentional network

Endogenous allocation of spatial attention is controlled by the dorsal attention network (DAN) comprised of the frontal eye fields (FEFs), the superior parietal lobes (SPL), the intraparietal sulci (IPS) (Corbetta et al., 2002). Its parietal portion is divided into subsystems devoting to reorienting (i.e. SPL) or maintaining attention (i.e. ventral IPS) (Capotosto et al., 2013, 2015). Our MEG study uses the effective connectivity approach to examine the causal relationship between frontal and parietal DAN regions.
MEG signal was recorded in 18 subjects during an attention task, where cues indicated either to maintain or to reorient covert attention (Spadone et al., 2015). By focusing on selected DAN regions in the post cue period (0-600 ms), we examined how attentional processes modulated their causal relations. To reconstruct ROI signals, we combined the timecourse of brain-derived ICA sources and subjected it to the PCA analysis. Spatial localization was performed using weighted minimum norm method applied on IC spatial weights. Effective connectivity was estimated using the sDTF method (Kaminski et al., 2001) in 150-ms sliding windows.
In the beta band shift versus stay cues induced stronger connectivity from RdFEF to RSPL, in early phases (100÷250 ms and 120÷270 ms). Such directionality was reversed in two following periods, 420÷570 ms and 440÷590 ms, with stronger DTF value observed from RSPL to RdFEF. In contrast, when considering stay-related increase of connectivity, a stronger flow was observed between bilateral vIPS. Initially higher connectivity reported from left to right vIPS in the time window 160÷310 ms was reversed in 260÷410 ms period. In alpha band no significant increases of DTF after shift with respect to stay cues whereas the sequence of communication flow between ventral parietal areas was preserved.

Clinical session

The results indicate that reorienting vs. maintaining attention is associated with the sequence of top-down and bottom-up fronto-parietal information exchange of right hemisphere in beta, but not in alpha band. This suggests that beta oscillations convey the information within the DAN during attentional operations. In this view, attentional reorienting requires a stronger frontal to parietal regions communication followed by a feedback, than maintenance. Conversely, both alpha and beta bands showed an increase of directional interaction between ventral parietal nodes of the DAN during maintaining vs. reorienting of attention.

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Clinical session

Judyta Jablonska
Jagiellonian University
Łukasz Szumiec, Jan Rodriguez Parkitna

Loss of NMDA receptor in serotonergic cells influences a reinforcement learning in a task-dependent manner.

Aims
Here we assess the effect of selective loss of NMDA receptors on serotonergic cells on cognitive abilities in two distinct reinforcement learning tasks.
Methods
The first task employed Skinner boxes, where food-restricted male mice were tested in a probabilistic reversal learning paradigm. The second one was based on the IntelliCage system, where a group of female mice chose freely between two alternatives with probabilities of receiving access to saccharin (0.1% w/v) being reversed every 2 days. Both tasks were used to assess the effects of the loss of functional NMDA receptors in serotonergic neurons (the NR1Tph2CreERT2 mice) on reinforcement learning. Analysis of the behavioral data was based on fitting computational models to the observed decision sequences.
Results
All animals developed preference for the choice with higher reward probability, irrespective of genotype. In the case of the unconstrained task the mutation decreased the number of choices made and increased mean interval after rewarded trials. The observed behavior was well explained by a computational model introducing a time-dependent correction. Surprisingly, we found out that a strategy accounting for an evaluation of the non-chosen option was more likely for the food-deprived animals.
Conclusions
In line with expectations, we found a difference in decision timing related to selective loss of NMDA receptors on serotonergic cells.
Keywords: reinforcement learning, saccharin, NMDA receptors, reward-related behavior, serotonin

Clinical session

Marta Chrustowicz
The Maria Grzegorzewska University
Joanna Rajchert, Ph.D.

Transcranial Direct Current Stimulation of DLPFC does not reduce negative evaluation of those who exclude us

Previous researches report that mental pain associated with rejection activates similar brain areas as physical pain (Vijayakumar, Cheng, Pfeifer, 2017; Eisenberger, Lieberman, Williams, 2003). Studies on social exclusion show that negative social behaviour is often reaction to rejection (Chow, Tiedens, and Govan, 2008). One type of that negative behaviour towards others may be devaluation – low assessment of person A by person B. Riva et al. (2014, 2015) show that anodal transcranial direct current stimulation (atDCS) of rVLPFC can significantly reduce aggressive behaviour resulted from social exclusion.
Current study aims to investigate the impact of anodal tDCS of right DLPFC and cathodal stimulation of left DLPFC on the effect of exclusion on devaluation of excluders. It has been expected that subjects in excluding condition would devaluate excluders more than in including condition, however stimulation would reduce this effect. We also suspected that the tDCS effect on exclusion – devaluation relationship would be stronger when people expect inclusion than when they expect exclusion.
The results of the study showed, as predicted, significant differences between exclusion and inclusion conditions in devaluation. There were also significant differences between those who expected and received inclusion and those who expected but did not receive it. However, the stimulation did not affected the exclusion effect on devaluation. This lack of effect was discussed with regard to results suggesting that rather rVLPFC than DLPFC region is engaged in control of pain resulted from social exclusion but also other negative social situations.

Clinical session

Monika Puchalska
Department of Animal and Human Physiology, Faculty of Biology, Univeristy of Gdańsk
Klaudia Konieczna-Wolska, Ziemowit Ciepielewski

The role of vitamin D in the development of Multiple Sclerosis

Multiple Sclerosis (MS) is an autoimmune disease of the central nervous system, and is one of the most frequent immune-mediated disorders affecting nerve cells. It is characterized by inflammation and demyelination in the central nervous system (CNS). Despite major research efforts in the past few decades, the etiology of MS is still not fully understood; although, the role of both genetic susceptibility and environmental agents and risk factors has been well documented. Season of birth, some viral infections, vitamin D deficiency, and smoking are strongly involved in the development of MS. MS includes a multitude of functional symptoms such as abnormal gait, deficient balance, muscle weakness, spasticity, foot drop, and fatigue. The cause of multiple sclerosis is believed to be: (i) a viral infection of the CNS; (ii) an autoimmune disorder mediated by myelin-reactive lymphocytes; (iii) a primary neurodegenerative disorder; (iv) toxic encephalopathy. It is equally clear that inflammation and autoimmunity, involving infiltration of immune cells into the CNS, are closely linked to a demyelinating process. Progressing demyelination causes disruption in neural transmission that results in many different symptoms, including physical (i.e. double vision, blindness in one eye, troubles with coordination), mental and psychiatric problems.

Clinical session

Anna Żochowska
Laboratory of Language Neurobiology, Nencki Institute of Experimental Biology PAS
Marta Sobańska, Agnieszka Pluta, Tomasz Wolak, HARMONIA group and prof. Emilia Łojek

Executive Functioning Measured by The Numerical Stroop Task in HIV-infected Individuals on HAART

The aim of the present study was to assess the impact of the human immunodeficiency virus (HIV) infection and age on the executive functioning of HIV-infected individuals on highly active antiretroviral therapy (HAART). The final sample included in the study consisted of 96 subjects - 49 seropositive (experimental group) and 47 seronegative (control group). They all underwent a neuropsychological assessment and performed a few fMRI tasks, including the Numerical Stroop Task which is considered to be a good measure of attentional and inhibition mechanisms. Despite no significant differences between the groups in executive functioning measured by pencil-and-paper tests, the Numerical Stroop Task revealed the poorer performance of HIV+ subjects. What is more, in the HIV-infected group, a positive correlation between age and RT was observed in the most difficult condition. Thus, seropositive participants revealed a subtle decline in executive functioning in comparison to the controls. Moreover, the Numerical Stroop Task turned out to be a sensitive diagnostic tool in the clinical assessment of executive functioning of HIV-infected individuals on HAART.

Clinical session

Natalia Minczanowska
SWPS University
Agnieszka Ozimek, Marta Agnieszczak, Marta Mikołajczak

Research proposal on a new screening method for people with autism spectrum disorder

The prevalence of the autism spectrum disorder (ASD) has an average rate of 1% around the world. Early screening and diagnosis are crucial for patients, but existing methods are not congruent. Previous scientific work on the diagnosis of autism has used eye-tracking. It enables detection of insufficient eye contact, shorter focus on social stimuli or difficulties in reading emotions, which are diagnostic criteria for ASD according to ICD 10. Based on the literature, we propose a research project which goal will be to verify the effectiveness of the various eye-tracking techniques in screening ASD. We will be basing on three characteristics of people with autism: visual preference or geometric repetition, deficits in social attention and difficulty in integration auditory and sensory modalities. Fourty participants will be invited, half of them with ASD and twenty healthy people of similar age. First task will be based on displaying geometric figures and people's faces (first separately, then at the same time). The objective of this task would be to check the object of visual attention preferences in children with ASD - they would hypothetically prefer figures, which would result in longer fixations in these areas. Then dynamic social stimuli (faces) showing different emotions. The aim of the task will be to recognise emotions correctly. We will focus on gaze patterns of children with and without autism while recognising emotions. Previous researches have shown that children with ASD have less fixtations on eyes while scanning faces and their ability to recognise them correctly is worse. The third task will be about faces of the people speaking with the imposed sound consistent with the movements of the lips and incoherent. According to other scientific works, children with autism have difficulties to integrate auditory and visual sensory modalities, so they will be less efficient than children without autism. All those tasks will help to create one, congruent method of diagnosing ASD based on many rates.

Clinical session

Natalia Minczanowska
SWPS University
Agnieszka Ozimek, Marta Agnieszczak, Marta Mikołajczak

Research proposal on a new screening method for people with autism spectrum disorder

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Clinical session

Aleksandra Bramorska
1University of Social Sciences and Humanities, Warsaw, Poland; 2Polish-Japanese Academy of Information Technology, Warsaw, Poland
Aneta Brzezicka, PhD, prof. SWPS1 3Wanda Zarzycka, MSc1,Jagna Żakowicz, MSc1 2,Katarzyna Kuć, PhD1,1University of Social Sciences and Humanities, Warsaw, Poland2Polish-Japanese Academy of Information Technology, Warsaw, Poland3Cedar-Sinai Medical Centre, Los Angeles, USA

Diet organization and its relation to fatigue and cognitive performance.

Components of the diet, such as food products, physical activity, well-balanced diurnal rhythm are important factors affecting human organism functioning. Nutrients have an influence on brain functioning and maintains blood-brain-barrier (Noble et al., 2017). Specific nutrients can improve cognitive performance, such as memory (Devore et al., 2012) or they may be the reason of deterioration of cognitive functioning due to hippocampal disruption caused by dietary factors (Kanoski et al, 2010) or insulin disturbance (Noble et al., 2017).
Well-organized diet is a lifestyle, not just food related components. Feeding habits and regularity of the meals are as important, as a physical activity or quality of sleep (Rogers et al., 2016). Fatigue is experienced by more and more healthy people caused by chronic stress (De Vries et al., 2003) or factors related to diet (Ellithorpe et al., 2003), reflected in lack of energy or apathy (Impellizzeri et al., 2013). Disorganized diet and diurnal rhythm disturbances are important factors leading to gut dysbiosis (Rogers et al., 2016). Dysbiosis causes deterioration of gut microbiota functioning, while microbiota is crucial for brain development and functioning not only for digestive or immune system (Forsythe et al., 2016). Supplying food subtracts to gut microbiota is a necessity, however, there have to be also specific bacterial species defined in the gut to produce metabolic products (Wu et al., 2016). Dysbiosis affects cognitive functioning (Noble et al., 2017) since gut and brain are directly connected in bidirectional communication system named gut-brain axis (Forsythe et al., 2016).
The aim of the presented study was to examine the relation of the diet with: quality of life and fatigue measured by Fatigue Assessment Scale (FAS) and cognitive functioning using The SynWin test allowing for measure multitasking abilities (Elsmore, 1994). Food Frequency Questionnaire (FFQ) was used to obtain indicators of quality and organization of participants diet within last year.

Clinical session

Total of 204 healthy adults, aged 20-55 participated in the study. Analysis revealed that balanced diet is related to better performance in cognitive task, reflected in learning. Fatigue and lower quality of the diet are reflected in decrease performance during cognitive task. The results will be discussed in the light of current knowledge of the prominent role of gut-brain axis in human functioning.The study was supported by BST grant no WP/2018/A/90.

Clinical session

OlgaPłonka
Psychophysiology Laboratory, Institute of Psychology, Jagiellonian University, Krakow, Poland
Dagmara Mętel, Martin Jáni, Przemysław Adamczyk

Volumetric abnormalities in schizophrenic brain – two different method approaches

Since the publication of the first neuroimaging study by Johnson (1976), where the enlargement of the ventricles in chronic schizophrenia patients was presented, the scientists are trying to reveal the exact pattern of abnormalities in anatomical structure of the schizophrenic brain. Some indicate the reduction in the total brain volume, frontal cortices, superior and middle temporal gyrus or hippocampus [1,2]. One possible explanations for inconsistent neuroanatomical abnormalities in schizophrenia can result from different methods of morphometry analysis. Hence aim of our study was to compare volumetry of the brain between group of schizophrenia outpatients (SCH, n=30) and healthy controls (CON, n=30) using two complementary analyses conducted with different softwares: FreeSurfer (FS) and FSL. The volume in global scale (e.g. grey and white matter total volume) and selected subcortical and cortical structures were compared. Moreover volume measurements were related to psychopathological symptoms (based on results from PANSS, MoCA, BNSS scales) in SCH. Global measurements showed no differences in both cases. The FS analysis revealed smaller volume in the right inferior frontal gyrus pars opercularis ($p = 0.036$) in SCH comparing to CON. Moreover there was a trend in smaller volume of the caudate and the inferior frontal gyrus pars triangularis in both hemispheres. The FSL analysis showed that SCH had a significantly ($p<0.05$) smaller volume in the left amygdala, the hippocampus and the thalamus in both hemispheres and the brainstem comparing to CON.

None of the measurements in both analyses correlated with the psychopathology of the disease. Our results show that volumetric measurements in schizophrenia can be method-depend, what should be taken into consideration during further studies. The study was supported from National Science Centre, Poland, grant no 2016/23/B/HS6/00286.1. Kuo SS, Pogue-Geile MF, Variation in Fourteen Brain Structure Volumes in Schizophrenia: A Comprehensive Meta - Analysis of 246 Studies, Neuroscience and Biobehavioral Reviews (2019)2. Torres US, et al., Patterns of regional gray matter loss at different stages of schizophrenia:A multisite, cross-sectional VBM study in first-episode and chronic illness, NeuroImage: Clinical 12 (2016)

Clinical session

Natalia Bryniarska
Maj Institute of Pharmacology Polish Academy of Sciences
Ewa Trojan, Agnieszka Basta-Kaim

The role of selected chemokines in the treatment of ischemic stroke

Stroke is the second most common cause of death in the world. Ischemic stroke results in neuronal degeneration not only through oxygen and glucose deficiency within the damaged tissue, but also as a result of the development of a strong inflammatory response. Hence, understanding of the neuroimmunological basis of ischemic stroke will allow the development of new therapies for this disease. The aim of study was to determinate the role of selected chemokines and the modulation of their receptors in oxygen and glucose deprivation (OGD) model of stroke.

To mimic brain complexity, organotypic hippocampal cultures (OHC) were performed. To set up cultures hippocamps were isolated from 6-7 days old rat pups. After 7 days of cultures, oxygen and glucose deprivation was performed - which involved changing the medium into serum-free and glucose-free medium, and then transfer of plates to the hypoxic chamber for 40 minutes. Immediately after OGD, chemokine modulators were added. After 24 hours viability and biochemical tests were carried out. OGD resulted in a significant increase in HIF-1α transcription factor expression and significantly increased neuronal mortality in OHC, what was confirmed by LDH and NO colorimetric tests. Staining of hippocampi with propidium iodide showed that the highest neuronal mortality occurs in the CA1 region of the hippocampi. The use of irbesartan, a CCR2 receptor antagonist, resulted in reduced mortality in OHC subjected to OGD, while modulation of CXCR4 with its antagonist AMD3100 led to increased mortality of hippocampal slices. Activation of the CCL2-CCR2 system appears to be unfavorable during the ischemia process and the use of CCR2 antagonist, which inhibit the effect of CCL2, has a neuroprotective effect. Blockade of the main receptor for CXCL12 using an antagonist of this chemokine potentiates adverse changes induced by OGD. To sum up, the above studies indicate that modulation of chemokines receptors can be an attractive therapy for ischemic stroke.

Natalia Bryniarska acknowledges the support of InterDokMed project no. POWR.03.02.00-00-I013/16

Theoretical session

Patrycja Oleniacz
Faculty of Biochemistry, Biophysics and Biotechnology, Jagiellonian University
Piotr Kalita

Model of information processing in a glutamatergic neuron

Developing a truly realistic model of how different neurons process information is possible only when we get to know the precise structure of the cell of interest - the amount of required data and computing power is unbelievable. Simulating cells using too simplified models is easier but can lead to false results and be insufficient to explain how exactly TMS or ephaptic coupling affect neural signaling. This model consist of neurotransmitter detection in synapses, changes in current flow through dendrites, generation of action potentials and neurotransmitter release in the ends of axon. It is implemented in SciLab and the part of it relies on well-known Hodgkey-Huxley formalism and Marsden, Sirovich and Wiggins methods. Model can be considered a bit realistic as it is based on experimentally derived information about protein kinetics to create ordinary differential equations simulating ion current flow throughout the cell. Also, it can be considered simplified because it contains only a chosen small group of transmembrane proteins and has many structural assumptions.

Theoretical session

Paweł Orłowski
Laboratory of Brain Imaging, Neurobiology Center, Nencki Institute of Experimental Biology of Polish Academy of Sciences, Warsaw, Poland; Institute of Philosophy, University of Warsaw, Warsaw, Poland
dr Michał Bola

Complexity of neural activity as a correlate of consciousness in the context of multi-dimensional models of consciousness

The question of what biological mechanisms are the basis of the subjective "stream of consciousness" is probably one of the most difficult challenges for modern science. The two most important theoretical proposals on consciousness: integrated information theory (IIT; Tononi, 2008) and global workspace theory (GWT, Baars, 2005), emphasize the segregation and integration of information in the brain as a necessary process for the emergence of consciousness. The structural connection between the phenomenon of consciousness and the dynamics of neuronal activity enables the development of a neuronal correlate underlying the phenomenon of consciousness. In practice, such a correlate is based on a description of neuronal dynamics showing simultaneously high integration and segregation of information in the cortical networks of the brain - collectively called the complexity of brain activity.

The aim of the presentation is to describe the theoretical assumptions and results of previous research aimed at searching for neural correlates of consciousness. To date, it has been shown that the complexity of the brain activity is a neuronal correlate of global states of consciousness (Massimini et al., 2005; Casali et al., 2013). Compared to resting wakefullness, it has been shown that signal complexity is lower during unconscious states (Casali et al., 2013; Pigorini et al., 2015; Sarasso et al., 2015; Casarotto et al., 2016) and higher during psychedelic experiences (Schartner et al., 2017; Wang et al., 2017). The likely interpretation of the results of these studies indicates that the complexity of brain activity corresponds to the phenomenal richness in subjective experience (Seth, 2009).

However, the unanswered question remains to what extent changes in the complexity of neuronal signals are specific to consciousness and how exactly they reflect changes in consciousness understood per se. Research conducted in this trend has achieved significant success in recent years, however, it seems that the approach treating consciousness as a one-dimensional phenomenon is burdened with highly non-intuitive and controversial assumptions.

Theoretical session

This presentation aims to draw attention to the problems of the most respected consciousness research concepts and to indicate the benefits of multidimensional analysis of global states of consciousness (Bayne et al., 2016).

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Theoretical session

Aida Grabauskaitė
Vilnius University (Department of Neurobiology and Biophysics, Vilnius University, Vilnius, Lithuania)
Inga Griškova-Bulanova, Department of Neurobiology and Biophysics, Vilnius University, Vilnius, Lithuania

Critical Analysis of Comparing Interoception in Genders

Interoception is a sensation of internal body states (Seth, 2013). The research of interoception is gaining increased attention due to recent discoveries on its importance to emotions, decisions involving risk, self-awareness and personality traits. In our previous research, we found that some aspects of interoception differ between genders. We sought to critically evaluate what is known about gender differences in interoception (Grabauskaitė, Baranauskas, & Griškova-Bulanova, 2017).

Throughout Pubmed and Science Direct databases, extensive search was performed using the following keywords: “interoception”, “body awareness”, “gender” and “sex”. The total number of search results for scientific articles was 891. Based on the inclusion criteria – direct evaluation of sex role in interoception, available in English as a full-text - 68 were selected for further analysis.

The analysis revealed main aspects were gender differences in interoception-related aspects are observed: psychological stress, emotions, symptom exaggeration, psychotropic substance use, proprioception, body composition, eating disorders. Also, for many for some interoception-related aspects conflicting results were observed: self-reported interoception, heartbeat perception, acute and chronic pain, functional anatomy, body awareness during sex, personality traits. Based on these observations, gender aspect of interoception warrants further research.

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Theoretical session

Przemysław Zawadzki
Jagiellonian University
Agnieszka Adamczyk

Neurotechnology meets neurophilosophy: Deep Brain Stimulation (DBS) and its consequences for free will and autonomy

Deep brain stimulation (DBS) is an invasive method of electrical stimulation of targeted brain regions via an implanted electrode. It is systematically used as a medical procedure as it shows great therapeutical potential for individuals with psychiatric conditions for whom previous treatments proved ineffective e.g. Parkinson's disease, dystonia, essential tremor and obsessive–compulsive disorder (Fitzgerald & Segrave, 2015).

Despite its beneficial impact, DBS may also pose various threats for patients. Its utilization may result in physical, cognitive, affective, and communicational impairments, and unrealistically optimistic expectations. The aforementioned issues can be categorized as traditional dangers in the field of bioethics. However, except from traditional dangers, DBS can also lead to non-traditional ones. After the emergence of qualitative studies concerning patients' reports on the use of this treatment many neuroethicists expressed their concerns about the influence of DBS on the Self of patients (Gilbert, 2018; Schüpbach et al., 2006).

We will undertake an attempt to answer the question of what are the possible ways in which DBS can impact on the brain of a patient and how it can pose a danger to one's Self.

Theoretical session

One of the most important and revealing questions for neuroscience and neuroethics concerning potential implications of DBS on the Self is the one regarding human free will and autonomy (Gilbert, 2015). Thus, we will center our discussion around the following issues: freedom and autonomy of patients' decisions, actions as well as their capability of self-management, especially in the context of various therapies employing new kinds of DBS systems (e.g., BCI-DBS), which influence human brain in an entirely new way. For instance, the emerging forms of DBS treatments offer the possibility of closed-loop therapy by decoding the brain's electrical activity, classifying it as "healthy" or "adverse" state, and adjusting the location or intensity of stimulation in response to this operation. One possible danger of such treatment is that patient may be kept "out of the loop", i.e., have no way of deciding whether or not to give up device intervention (Goering, Klein, Dougherty, & Widge, 2017). In our presentation we will comment on this as well as other issues related to patients' autonomy and free will in the lens of various theories derived from neuroscientific considerations. More specifically, we will attempt to provide answers to the following questions: is a person still self-determined if DBS performs actions that are beyond her control? What role play person's mental states induced directly by DBS in governing person's actions? To what extent are person's attitude, actions and responses determined by herself and to what extent by BCI-DBS system itself?References Fitzgerald, P. B., & Segrave, R. A. (2015). Deep brain stimulation in mental health: Review of evidence for clinical efficacy. Australian & New Zealand Journal of Psychiatry, 49(11), 979–993. Gilbert, F. (2015). A Threat to Autonomy? The Intrusion of Predictive Brain Implants. AJOB Neuroscience, 6(4), 4–11.Gilbert, Frederic. (2018). Deep Brain Stimulation: Inducing Self-Estrangement. Neuroethics, 11(2), 157–165. Goering, S., Klein, E., Dougherty, D. D., & Widge, A. S. (2017). Staying in the Loop: Relational Agency and Identity in Next-Generation DBS for Psychiatry. AJOB Neuroscience, 8(2), 59–70. Schüpbach, M., Gargiulo, M., Welter, M. L., Mallet, L., Béhar, C., Houeto, J. L., … Agid, Y. (2006). Neurosurgery in Parkinson disease: a distressed mind in a repaired body? Neurology, 66(12), 1811–1816.Bibliography:

Theoretical session

AgnieszkaAdamczyk
Jagiellonian University
Przemysław Zawadzki

Modifying memory with the use of optogenetics. Eternal sunshine of the spotless mind?

Combining genetic engineering with optics, optogenetics allows to not only record, but also manipulate the activity of individual neurons in the living tissue with the use of light and observe the effects of such manipulation in real-time (Boyden, Zhang, Bamberg 2005). Thanks to this procedure, specific neurons can be activated or deactivated “at will”, making optogenetics a highly selective and precise technique for manipulating neural activity. Despite the fact that optogenetics is a relatively new neuromodulation technology whose various implications are, to a large extent, difficult to foresee at the current stage of research, its therapeutic potential has already prompted approval for first human trials in the hope of developing novel treatments for intractable diseases, such as blindness.
Moreover, some (Delbeke, Hoffman, Mols, Braeken, & Prodanov, 2017) argue that, in the near future, it could also become an alternative form of therapy to the Deep Brain Stimulation (DBS) - another form of invasive neuromodulation technology, that over the last 10 years has become a widely-accepted way of treatment for patients struggling with different types of neurological or psychiatric disorders. Optogenetics’ unsurpassed precision and selectivity of action makes it an extremely powerful, yet highly invasive, neuromodulation tool, involving the virus injection, genetic modifications and the intracranial implantation of a light stimulation device. As the first clinical trials (1*,2*) are already underway, it appears necessary to consider both, opportunities and dangers it may entail.

Theoretical session

Particularly, studies on memory modification are one of the research areas that can give us an insight into what optogenetics is capable of, and how tremendously it differs from other forms of memory modifying techniques (Phelps, Hofmann, 2019). This presentation will aim to demonstrate how recent breakthroughs in memory modifying research achieved due to optogenetics can inform us about potential threats and opportunities it offers. In particular, we will present the new possibilities offered by optogenetics compared to existing memory-modifying technologies (e.g. memory modifying drugs) (see e.g., Guskjolen et al., 2018; Nabavi et al., 2014) and provide re-evaluation of the previously raised concerns expressed towards these technologies in the light of optogenetics. Specifically, we will focus on three issues: safety, potential disruptions of personal identity and the 'duty to remember'.Literature:Boyden, E., Zhang, F., Bamberg, E. et al. Millisecond-timescale, genetically targeted optical control of neural activity. Nat Neurosci 8, 1263–1268 (2005) https://doi.org/10.1038/nn1525Delbeke, J., Hoffman, L., Mols, K., Braeken, D., & Prodanov, D. (2017). And Then There Was Light: Perspectives of Optogenetics for Deep Brain Stimulation and Neuromodulation. Frontiers in Neuroscience, 11, 663. https://doi.org/10.3389/fnins.2017.00663Guskjolen, A., Kenney, J. W., de la Parra, J., Yeung, B. ru A., Josselyn, S. A., & Frankland, P. W. (2018). Recovery of "Lost" Infant Memories in Mice. Current Biology, 1–8. https://doi.org/10.1016/j.cub.2018.05.059Nabavi S., Fox R., Proulx C.D., Lin J.Y., Tsien R.Y., Malinow R. (2014). Engineering a memory with LTD and LTP. Nature. 2014 Jul 17;511(7509):348-52. doi: 10.1038/nature13294. Phelps, E.A. & Hofmann, S.G. (2019). Memory editing from science fiction to clinical practice. Nature, 572, 43-50. 1* https://clinicaltrials.gov/ct2/show/NCT02556736 2* https://clinicaltrials.gov/ct2/show/NCT03326336

Theoretical session

Elżbieta Gołdyn
Wrocław University of Science and Technology

Autophagy in nervous system

Autophagy is a significant cellular process that is responsible for clearing cell from detrimental components and for keeping homeostasis. Degradation on the lysosomal pathway may apply to both proteins and damaged organells. Neuronal autophagy also takes part in normal synapsis development and nerves regeneration. In glial cells it plays an important role in immunological response. It also participates in astrocyte differentiation and reduces neuropathic pain. Autophagy disorders are present in many neurodegenerative diseases like Alzheimer's disease, Parkinson's disease and amyotrophic lateral sclerosis in which proteins aggregate intra- or extracellular. Ablation of autophagic genes may influence different aspects of organism functioning like hormone's level (POMC, αMSH), control of body mass or even triggering disease phenotype (for example autistic). Knowledge of precise functions and mechanism of autophagy can allow to develop effective treatment for still incurable diseases.

Theoretical session

Jan Kundziołka
SWPS University of Social Sciences and Humanities

The differences of frontal theta power in depressed and healthy subjects - literature review

Depression and mood disorders have a massive influence on society. One of the most common electrophysiological measures in the research on depressive disorders is the frontal alpha asymmetry index, previously referred to as a biomarker of depression (Iosifescu et al. 2009; Baskaran, Milev, and McIntyre 2012).
However, meta-analyses do not confirm previous reports (Olbrich and Arns 2013; Thibodeau, Jorgensen, and Kim 2006; van der Vinne et al. 2017), suggesting that alpha asymmetry effect is not strong enough to be considered a biomarker of depression. Similar results disconfirming the effect were also noted in experiments by Kołodziej, Magnuski, Ruban, Brzezicka (in preparation). The review paper on electrophysiological measures in depression (Alexander A. Fingelkurts and Fingelkurts 2015; Andrew A. Fingelkurts et al. 2007) discussed frontal theta power as a promising alternative to the frontal alpha asymmetry index. It has been known from previous reports that diagnosed patients had higher theta power in the frontal cortex in comparison to healthy subjects (Arns et al. 2015; Bailey et al. 2019; Benvenuti et al. 2017). Some researchers observed lower theta power in the brain activity of people with clinical depression compared to healthy subjects (Bailey et al. 2019), whereas others reported no statistically significant differences between the two groups (Reid, Duke, and Allen 1998).
In the light of the ambiguous reports, we have decided to focus on the review of findings regarding the power of theta rhythm in the frontal areas measured using electroencephalography in the group of patients with depressive disorders. We expect differences between the subjects with depressive disorders and healthy controls in the power of frontal theta. We discuss the frontal theta power as a possible alternative to the frontal alpha asymmetry index.

Theoretical session

Kinga Izdebska
Jagiellonian University, Institute of Psychology
Maksymilian Korczyk, Marcin Szwed

Literacy breaks mirror invariance for both visual and tactile modality

Mirror invariance (also mirror generalization) refers to humans' intrinsic tendency to consider shapes, faces or objects as corresponding to the same object regardless of its' orientation in space. Ventral visual system processes different retinal projections as referring to the same object and therefore, it facilitates view-invariant object recognition (Pegado, Nakamura, Cohen & Dehaene, 2011). Despite the undeniable benefits of this phenomenon, it has to be overcome during learning to read and write. It was demonstrated that children during the literacy acquisition show greater difficulty in recognition letters such as "b" and "d" (Fernandes, Leite & Kolinsky, 2016). Moreover, some of the kids use mirror writing which is characterized by reversing letters (for review see: Schott & Schott, 2004). Full acquisition of literacy results in reorganization of cognitive skills (for review see: Dehaene, Cohen, Morais & Kolinsky, 2015), so that literate people are able to distinguish between mirrored letters.

Although writing and reading skills have been studied in the visual modality, study by de Heering, Collignon and Kolinsky (2018) showed for the first time that congenitally blind Braille readers, are also able to break mirror invariance. The results suggests, that breaking mirror invariance is not limited to the visual modality and thus this process is modality independent. Pegado et al. (2011) found that visual word form area (VWFA) underlies breaking mirror invariance in the visual modality. It has also been shown that in the congenitally blind individuals this brain region is cooped for reading Braille (Reich, Szwed, Cohen & Amedi, 2011). In the light of those results, the question unanswered is whether the VWFA in the blind may also be involved in breaking mirror invariance in the tactile modality.

Theoretical session

Kacper Makowski
Jagiellonian University, Institute of Psychology

Perception of artificial limbs

In recent years, there have been numerous studies conducted delving into our bodies' reactions towards artificial limbs, either supernumerary robotic ones or other, which substitute our regular body parts.My work scrutinizes various mechanisms described by those studies and presents an outlook on the most important advances made in this field. Main parts of the poster will cover the brain's perception of famous rubber hand illusion, as well as the perception of artificial supernumerary limbs.Using comparative analysis of data produced by different laboratories I will present changes ongoing in cortical homunculus during various experiments and the subjective feelings of the examined people in regards to their sense of agency and ownership of the artificial limbs.Research in the field of artificial limbs is crucial in modern times for several reasons. First of all, advances in this field can greatly relieve the disabled by improving the technology of current prosthetics. Aside from that, understanding the mechanisms standing behind the sense of the limbs ownership can prove essential to creating controllable robotic implants such as the third arm, laying the important groundwork for future robotics and bionics.

Theoretical session

Joanna Wójcik

The impact of meditation in mental disorders treatment.

According to World Health Organization's findings, one in four people in the world will suffer from
mental or neurological disorders at some point in their lives. As claimed by numerous studies,
meditation is one of the leading forms of non-pharmacological mental-illness therapy. Scientist
examined it's effects on many mental disorders, including Post Traumatic Stress Disorder, schizophrenia and depression, in order to answer how and why it (meditation) might be therapeutic. In our poster we are reviewing those studies.
Mindfulness type of meditation is said to have a major positive impact on mental disorders, including: patient's well-being, enhancing cognitive functions or being therapeutic in
regulation of emotions. What is more, meditation improves parts of the brain associated with
increasing neuroplasticity and boosting long-term memory.
We summarize and review the current status of research on meditation and psychopathology in terms of theory, experimental evidence, and clinical outcomes.

Theoretical session

Anna Lesniewska
Jagiellonian University

Correlation between sleep deprivation and Autism Disorder in children

Autism is a comprehensive growth abnormality in which social skills, language, communication, and behavioral skills are developed with delay and as diversionary. The reasons for autism are unclear, but various theories of genetics, immunity, biological, and psychosocial factors have been proffered. In fact, autism is a complex disorder with distinct causes that usually co-occur. Children with autism spectrum disorder are known to have more sleep problems than typically developing children. Over half of children with autism – and possibly as many as four in five – have one or more chronic sleep problems. ASD poor sleepers differed from ASD good sleepers on actigraphic (sleep latency, sleep efficiency, fragmentation) and polysomnographic (sleep latency) measures, and were reported to have more inattention, hyperactivity, and restricted/repetitive behaviors. Fragmentation was correlated with more restricted/repetitive behaviors. Sleep-onset insomnia and nocturnal awakenings are the most frequent and consistent findings. A recent consensus statement identified the treatment of insomnia in ASD to be a high priority area. Treating disordered sleep in ASD also represents a potential avenue to improve daytime behavior and family functioning in this population.

Autism: Pathophysiology and Promising Herbal Remedies.
Bahmani M, Sarrafchi A, Shirzad H, Rafieian-Kopaei M
Can We Predict Which Children With Autism Will Have Obstructive
Sleep Apnea?
Commentary on Tomkies et al. Obstructive sleep apnea in children with autism. J Clin, Emily V. Singer, MD, Althea R. Shelton, MD, MPH; Beth A. Malow, MD, MS
www.autismspeaks.org//sleep
Defining the Sleep Phenotype in Children with Autism
Suzanne E. Goldman, PhD,1 Kyla Surdyka, MA, Ramon Cuevas MD, Karen Adkins, MA,Lily Wang, PhD,and Beth A. Malow, MD, MSpsychopathology in terms of theory, experimental evidence, and clinical outcomes.

Theoretical session

Hanna Nikanava
Institute of Zoology and Biomedical Research, Jagiellonian University in Kraków

The uncanny valley and its understanding from the neuroscience point of view

Nowadays robots are common in our culture and have become popular in education and clinical treatment. So, the research on how humans respond to artificial agents is highly demanded. The appearance of robots is important for our perception of them, however, the idea that robots should look as human-like as possible can be wrong. The uncanny valley phenomenon describes human's negative reaction to artificial human forms that look almost-but-not-quite-human. There are attempts to explain the uncanny valley effect and find neural mechanisms responsible for it. Using functional MRI the representation of uncanny valley reactions was discovered in ventromedial prefrontal cortex (Astrid M. Rosenthal-von der Pütten, Nicole C. Krämer, Stefan Maderwald, 2019). Other studies, using prediction coding theory, gave arguments that the uncanny valley can be explained by expectation violation, that occurs when human encounters with agents that appear human-like, but move unrealistic (Saygin et al., 2012; Urgen, Kutas, & Saygin, 2018). In my poster I would like to present the attempts of explaining the uncanny valley phenomenon, as the understanding of such effect is important for future developing of artificial agents and their application in our social milieu.

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Theoretical session

Agata Staszelis
Departament of Neuroscience, University of Lodz

Overview of the main functions of the hypothalamus

The hypothalamus is a subcortical structure being a part of the diencephalon. It has multiple small nuclei and plays several critical roles. It is located near the third ventricle, hence, it is close to the cerebrospinal fluid along with the substances inside. Furthermore, the pituitary gland is situated right next to it and the hypothalamus is involved in the connection between the nervous and the endocrine system. That all combined makes it highly involved in the hormonal release due to controlling a part of the anterior pituitary. Other principal functions of the hypothalamus encompass the participation in hunger, thirst, temperature, sleep and circadian rhythm regulation and some aspects of parenting, attachment and sexual behaviours.
The medial anterior nuclei include: medial preoptic nucleus (thermoregulation), supraoptic nucleus (release of vasopressin and oxytocin), paraventricular nucleus (regulation of apetite, stress, regulation of autonomic functions in the spinal cord and brainstem, release of somatostatin, vasopressin, oxytocin, thyrotropin-releasing hormone and corticotropin-releasing hormone), anterior hypothalamic nucleus (sleep regulation, sexual behaviour, thermoregulation, panting, sweating, and inhibition of thyrotropin, TSH) and suprachiasmatic nucleus (circadian rhythms' control). There is only one nucleus considered as lateral anterior – the lateral nucleus, whose orexin neurons participate in the mediation of food intake, arousal, thermoregulation, pain and many others.

Theoretical session

In terms of the tuberal nuclei in the medial area, there are three nuclei. The dorsomedial hypothalamic nucleus is engaged in body-weight regulation, circadian activity, the regulation of blood pressure and heart rate, and in the stimulation of the gastrointesinal tract. The ventromedial nucleus is involved in satiety, fear, thermoregulation and sexual activity. The arcuate nucleus participated in the homeostasis and regulation of feeding, fertility and the blood system. The lateral tuberal nuclei constitute the lateral hypothalamus, along with the lateral anterior and lateral posterior nuclei.The medial posterior nuclei include the posterior hypothalamic nucleus,the supramammillary nucleus, the tuberomammillary nucleus and the mammillary nucleus. And they are involved in the processes of blood pressure, learning, memory, thermoregulation and energy balance.
Supported by NCN grant No. 2017/25/B/NZ4/01476.

Theoretical session

Karolina Warzecha
Jagiellonian University, Krakow, Poland

Oncogenes - characterization and role in glioma

Oncogenes are the genes that, when expressed in the cell, may significantly contribute to cancer initiation and development. They originate as a result of dominant loss of function mutations of protooncogenes - normal genes, which products play key regulatory roles in processes that conduct cell's growth, differentation, division and apoptosis. This molecules are constituents of many crucial molecular pathways on different levels, from signal molecule and receptor to transcription factor. Most of them are highly conservative in numerous evolutionary varied species, which only emphases their principal role in fundamental cellular processes.
In most cases, oncogenes are present in the genome as a result of mutation that takes place during a lifespan of an organism. Compared to the protooncogenes' products, they occur in the particular cell type as molecules somewhat changed, or with the same structure, but in much higher level. Oncogenes' products contribute to the initiation, development, progression and invasiveness of cancer tumors. Glioma is no exception. It originate from different types of glial cells of the central or peripherial nervous system.
One of the classic examples of oncogenes in glioma is glioma-associated oncogene homolog 1 (GLI1), transcription factor containing a zinc-finger and component of the sonic-hedgehog pathway, that is often overexpressed in tumor cells. SOX family members are also oncogenes in glioma, as well as myc, widely known for its oncogenic properties in many types of cancers.
In glioblastoma, the most common malignant brain tumor, researchers recently reportered oncogenes as Cyclin-dependent kinase 1 (CDK1), which is a serine/threonine kinase, that has a role in transitions of cell cycle phases, or programmed death ligand-1 (PD-L1), transmembrane protein that is involved in processes connected with immune system.
Owing to the fact that oncogenes are so vital for the initiation and dynamic of cancer, they may have a promising role in the development of new strategies of the cancer molecular targeted therapies.

Cognitive session

Aleksandra Aniszewska-Stańczuk
Institute of Psychology, Polish Academy of Sciences
dr. hab. Łukasz Okruszek

Neurophysiological markers of reduced executive control in loneliness

Perceived social isolation (PSI; “loneliness”) is defined as a subjective perception of inadequate number or quality of one’s social relationships. PSI is currently believed to lie among the most challenging problems in modern society, and is one of the central topics of investigation in social neuroscience. However, certain aspects of its neurophysiological mechanisms remain unclear. According to Evolutionary Theory of Loneliness, attentional processes in individuals with high PSI are biased towards social stimuli, which may results in reduced top-down control. The key goal of the present study was to investigate electrophysiological correlates of executive control and emotional response among lonely young adults. A paradigm combining inhibitory control task (Go/No-Go task) with affective distractors (IAPS pictures with social/nonsocial x positive/neutral/negative content) was utilized. Participants (n=27, age 18-34, 17 females) were divided into two groups according to their R-UCLA Loneliness scale results (scores in a range 21-34 for non-lonely individuals, NLI; 41-61 for lonely individuals, LI). Then, participants completed the task that involved short (1000 ms.) IAPS picture presentation prior to each Go/No-Go trial (600 ms.). Upon completion of the EEG paradigm, participants were asked to evaluate presented pictures on the arousal and valence scales. The analysis of pictures' ratings and EEG potentials evoked by IAPS pictures revealed no differences between LI and NLI. However, robust effect of decreased P3 amplitude in No-Go trials for lonely compared to non-lonely individuals was found. P3 component is believed to be an indicator of inhibition control during Go/No-Go task, thus presented results indicate a link between loneliness and reduced executive control. Additionally, this effect was not modulated by a type of affective distractor, thus suggesting that this effect was not elicited by type or a content of the distractor. The results of the present study, which has shown decreased neurophysiological markers of executive control in LI compared to NLI suggest that LI may present reduced ability to flexibly adapt to complex real-life situations.

Cognitive session

Klaudia Jakubowska
Uniwersytet Jagielloński
Klara Szweda

Neurofeedback - trick or treat? A critical analysis.

Neurofeedback is a type of biofeedback that heavily relies on teaching the participant to modulate bioelectrical activity of their own brain. Neurofeedback was hailed the „wonder therapy" of 21st century by its supporters. It originated in 20th century when Joe Kamiya created the first protocol of brain wave training – deep relaxation training, which was supposed to increase the amplitude of alpha band. In the following years Barry Sterman demonstrated the benefits of neurofeedback in treating epilepsy. Nowadays it is used as a form of therapy in treating a wide variety of conditions including depression, anxiety, schizophreny or ADHD (attention deficit hyperactive disorder).
During the standard training session real-time brainwave activity is displayed for the participant – usually with the use of EEG or fMRI. fMRI results indicate that areas associated with cognitive control, directing and holding attention show activity during the session. Therefore, neurofeedback is often used as a tool in training cognitive abilities such as operating memory or attention.
Due to the lack of conclusive research that would include statistically significant number of subjects, the question arises as to whether neurofeedback is actually working and possibly even leads to neuroplastic changes or its influence can be attributed solely to the placebo effect.
In our presentation we refer to the research on the use of neurofeedback protocols in treating the symptoms of ADHD and depression. Bearing in mind both the fact that the neuroplastic effects of neurofeedback are not confirmed and the view that neurofeedback brings only behavioral changes we contrast this research with the notion that all of neurofeedback's benefits can be attributed to the placebo effect. Our aim is to present a holistic view of the effects and analyze them in order to estimate the most probable explanation of neurofeedback's effects.

Cognitive session

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Cognitive session

Jagoda Złakowska
Cognitive Science, Lund University, Sweden
GA Sauciuc1,2, J Złakowska1, KJ Klang1, T Persson1,2
1 Lund University, Cognitive Science
2 Lund University Primate Research Station Furuvik

Flexibility and context specificity of communicative rhythmic behaviours in chimpanzees

Rhythmic behaviors (in short RB), such as applauding, dancing or rocking a baby to sleep are part of humans everyday life. Recently there has been a growing interest in the RB of other species, as a way of tracking the evolutionary roots of human musicality. RB have been initially studied in arthropods, insects, anurans and songbirds, where a single behaviour is tied to reproductive function. Emergent evidence shows that this connection extends to some mammalian species as well. Very little is known, however, about the presence of RB and their likely adaptive significance in our closest genetic relatives - the chimpanzees (Pan troglodytes). Evidence is limited to mentions of rocking during courtship, or as abnormal behaviour in captivity, and to descriptions of so-called “buttress drumming”. This “drumming”, whose function remains controversial, is very different from musical rhythmicity, as it is aperiodic, and results typically from 2-5 foot stomps on a resonant surface.

To address the absence of data on chimpanzee RB and their likely functional relevance, we conducted an observational study, and recorded RB in the contexts in which they occurred. One aim of this study was to examine the context specificity of RB in chimpanzees, i.e. to investigate if particular RB are context-bound, thus having a specific function (e.g. facilitating reproduction like in other species) or if they are flexibly presented in a variety of contexts, without being obligatory in one specific context.

Observations were collected from 4 chimpanzee groups housed at Lund University Primate Research Station Furuvik, Sweden (61 h) and MONA Foundation, Spain (57,5 h). Preliminary results suggest that RB are frequent in chimpanzees, i.e. the currently analysed data subset consisting of 18,5 observation hours from Furuvik we recorded 262 bouts, of which 246 were constituted by one of 7 highly frequent RB. An RB x context chi-square test showed that RB types were not independent from contexts ($\chi 2$= 548, df = 64, $P < 0.001$). Two RB showed context exclusivity ($p < 0.01$, binomial test): teeth clacking (N=30) occurred only during grooming, and copulatory display (N=14) occurring only during courtship. One RB - surface hitting (N=31) - was primarily used for initiation of social interaction ($p < 0.05$, binomial test). Four additional RB that occurred frequently (≥ 19) were not tied to a specific context. Overall, the RB exhibited by chimpanzees appeared to accomplish a communicative purpose.

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Cognitive session

Sylwia Adamus
Laboratory of Emotions Neurobiology, Nencki Institute of Experimental Biology PAS
Adamus, S.1, Bielski, K.1, Kolada, E.1 Rączaszek-Leonardi, J.2, Szatkowska, I.11Laboratory of Emotions Neurobiology, Nencki Institute of Experimental Biology PAS, Warsaw, Poland2Faculty of Psychology, University of Warsaw, Warsaw, Poland

Subject level parcellation of the human amygdala based on Recurrence Quantification Analysis (RQA)

The amygdala is considered a part of the limbic system and plays a role in numerous emotion-related processes, e.g. emotional perception or associative learning. This small brain structure comprises functionally different groups of nuclei (subdivisions), but distinct subdivisions are not well recognized in humans. Specifically, because of relatively low resolution of images acquired with an MRI scanner, there is no direct way of in vivo differentiating between subdivisions of the human amygdala. Handling cross-individual variance and low resolution together, the aim of this study was to develop an individually reliable method of the human amygdala parcellation. To achieve this goal we used Recurrence Quantification Analysis (RQA), which is useful in describing distinguishable features of dynamical systems, such as the brain. The fMRI data were collected from 36 subjects (25 - 30 years old males) during the 15-minute rest period (Simens Vario 3T, TR = 1.4 s, voxel size = 2.3 x 2.3 x 2.3 mm). We calculated RQA measures for fMRI data from the left and right amygdalae with four different masks. Multiple clustering algorithms for different numbers of clusters were applied to vectors consisting of RQA measures for every voxel in each subject from our dataset. The internal and external stability of the clusterings were checked to choose the most stable solutions and their internal validation and external validation measures were calculated. The results showed that the human amygdala could be in vivo parcellated into two main clusters which corresponded to the basolateral and central subdivisions. Importantly, these results were stable between subjects. This preliminary finding suggests that, in the future, our method could be used in parcellating the human amygdala and, since the subdivisions are obtained on the basis of the signal dynamics, in studying their functions and connectivity. This work was supported by a grant from the National Science Centre (Poland) based on decision number DEC-2014/15/B/HS6/03658.

Cognitive session

Maksymilian Korczyk
Department of Psychology, Jagiellonian University, 30-060 Krakow, Poland
Maria Zimmermann, Łukasz Bola, Marcin Szwed

Superior auditory and visual rhythm discrimination in musicians is not related to cross-modal neuroplasticity in auditory cortex

Temporal information is best processed in the auditory modality, but can be processed in other modalities as well (visual, tactile). In our recent work, we (Bola et al., 2017) we showed that congenitally deaf subjects recruit their auditory cortex for visual rhythm processing. This indicates that the high-level auditory cortex in the deaf switches its input modality from sound to vision but preserves its task-specific (rhythm-specific) activation pattern independent of input modality. Here, we examined whether similar cross-modal plasticity could be observed in professional pianists.

17 professional pianists and 20 non-musicians participated in an fMRI study during which they discriminated between sequences (rhythms) presented in visual (flashes) or auditory (beeps) modalities. In the control condition, the same flashes/beeps were presented at a constant pace. In an additional condition, participants were asked to imagine rhythms.

Musicians performed both visual and auditory rhythmical tasks better than non-musicians. fMRI revealed that compared to the control condition, the visual task recruited the right-hemisphere auditory cortex in musicians. However, a weaker but similar activation was also observed in non-musicians for the same contrast. Comparison of the two groups revealed no significant between-group effects in the auditory cortex, only an increased activation in the right Angular Gyrus for musicians vs. non-musicians.

Our results indicate that in the group of musicians, the higher level of performance in visual and auditory rhythmical tasks is not strictly related to cross-modal neuroplasticity in the auditory cortex. We speculate that this effect may be related to the plasticity of higher cognitive abilities, specifically, the capacity to deploy attentional resources to complex temporal patterns and that this process might be related to the activation in the right Angular Gyrus.

Cognitive session

Kamil Bonna
Nicolaus Copernicus University
Karolina Finc, David Meder, Kristoffer Madsen, Włodzisław Duch, Oliver Hulme

Outcome valence and prediction error sign invariance of the reinforcement learning models

Reinforcement learning models based on the idea of the temporal-difference (TD) learning can quantitatively account for learning by trial-and-error. These models postulate that stimulus values are updated proportionally to the prediction error (PE) weighted by adjustable learning rate (Rescorla and Wagner 1972). However, it remains unclear if the learning rate is invariant to the sign of PE and the outcome valance. Here we collected behavioral data from N=32 participants performing probabilistic reversal learning task in the (1) reward-seeking and (2) punishment-avoiding conditions. We constructed four competing behavioral models with varying number of learning rates depending on the tested invariance properties. For model selection and parameter estimation we created Bayesian hierarchical latent-mixture model with weakly informative priors. We found that the PE sign dependent and outcome valence invariant model is most likely the model of the behavioral data (protected exceedance probability > 0.95). We also found moderate evidence (Bayes factor = 3.06) for the PE dependent vs PE independent family of models. Posterior distributions of the winning model parameters revealed significantly higher learning rates for positive compared to negative prediction errors. Moreover, difference between estimated learning rates for positive and negative PEs was correlated with probability matching behavior indicated by the number of choice reversals. Taken together, these finding suggest that models with separate learning rates for positive and negative prediction errors provide better account for observed behavior during probabilistic reversal learning task.

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Cognitive session

Paweł Augustynowicz
The John Paul II Catholic University of Lublin
Dariusz Zapała, Marek Karwacki

Validation of new wearable fNIRS device for frontal lobe oxygenation assesment

The present study aims to assess a new wearable 20-channel dual-wavelength continuous wave fNIRS headband prototype and its ability to monitor a user's mental states. For this purpose, we used three experimental procedures that were aimed to evaluate different aspects of the prototype's functions. This testing protocol could also be used for validation of other fNIRS devices with similar properties and applications.

A group of participants conducted three experiments: one for simple evaluation of the prototype's ability to track HbO and HbR changes of human brain tissues and another two for assessing attentional states. In the first procedure, a head tilt movement hemodynamic changes were tracked. During the second experiment, we introduced a modified version of Mental Calculation Task (Tsunashima et al., 2012) to assess oxygenation changes in brain activity under different levels of cognitive workload. During the third experiment, participants performed the multi-source interference task (MSIT) that was aimed to measure low and high levels of engagement over time (Harrivel et al., 2013).

Results show the ability of the device being evaluated to measure both the gross HbO and HbR changes induced by physiological processes like head tilt hemodynamic changes as well as more subtle effects of cognitive workload affected by low- and high-engaging experimental conditions.

We propose a set of procedures that are suitable to evaluate fNIRS devices and their data quality properties that are important for the end-user. This set of procedures is tailored to devices that measure the cortical activity of frontal brain regions, particularly for wearables and portable devices that are designed for sustainable measures. At a later stage, we plan to develop a methodology for testing fNIRS devices that would account for ergonomics, susceptibility to artifacts and more accurate measures of signal quality for real-life use cases.

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Cognitive session

Karolina Golec
Faculty of Psychology, University of Warsaw
Joanna Wysocka1, Agnieszka Pluta1, Tomasz Wolak2, Maciej Haman11 Faculty of Psychology, University of Warsaw, Poland2 Bioimaging Research Center, Institute of Physiology and Pathology of Hearing, World Hearing Center, Kajetany (Warsaw), Poland

Are spontaneous and explicit Theory of Mind two aspects of one system? FMRI study

Theory of Mind (ToM), is a socio-cognitive ability underlying effective social interactions, which enables to infer and attribute feelings, intentions and beliefs to others. Traditional tasks assessing ToM require taking others' perspective and on that basis giving explicit answers regarding their expected behavior. However, behavioral studies using measures like reaction times or spontaneous looking patterns in adults and infants provide evidence that the ability to track beliefs of others may be also engaged spontaneously and unintentionally.
There is an ongoing debate on whether spontaneous and explicit forms of ToM are based on the same neural mechanisms or rather reflect qualitatively different processes. To our knowledge there have been very few studies which examined brain activation for both spontaneous and explicit ToM in the same participants with conflicting results. Moreover, in only one of these experiments identical stimuli and procedures have been used in spontaneous and explicit tasks in order to increase the accuracy of conclusions.
The goal of the current study is to directly compare brain activity related to spontaneous and explicit ToM with the use of within subject-design and exactly alike stimuli sets and procedures. 25 healthy adults took part in the session of functional magnetic resonance imaging (fMRI) and were presented with spontaneous and explicit versions of a custom-designed belief attribution task. Preliminary comparisons between task versions show that the brain activation patterns generally overlap in the posterior superior and medial regions of temporal cortex, which are regarded as parts of so called mentalizing neural network. Initial results therefore support the hypothesis that spontaneous and explicit ToM constitute the two aspects of single system.

Cognitive session

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Cognitive session

Jasmin Klich
Department of Neurophysiology and Chronobiology, Jagiellonian University in Krakow, Poland
Lukasz Chrobok, Jagoda S. Jeczmien-Lazur, Katarzyna Palus-Chramiec, Anna Sanetra, Marian H. Lewandowski

High-fat diet leads to disruption of circadian rhythms in the rat dorsal vagal complex

Consumption of food with high fat content is a common social health problem, as inappropriate nutrient composition leads to perturbations in diverse physiological functions. Food intake, itself orchestrated by central nervous system, can reciprocally influence neuronal activity.

In physiological conditions organisms display robust circadian rhythms; cyclic changes of 24 h period, seen from molecular to behavioral level. Impaired rhythmicity has a negative impact on a correct adaptation to the dynamically changing environment.

Dorsal motor nucleus of the vagus (DMV), located in the brainstem, together with the nucleus of the solitary tract (NTS) and the area postrema form the dorsal vagal complex (DVC) that serves as a powerful hub for cardiovascular, metabolic and ingestive signals. Specifically, the DMV is a source of parasympathetic innervation of subdiaphragmatic visceral organs. Due to its projections, the DMV controls e.g. the intestinal tract motility or the secretion of pancreatic hormones - features which display clear circadian patterns.

As obesity was shown to alter clock gene expression in the DVC, the aim of our study was to examine an influence of high fat diet (HFD) on basic electrophysiological properties of DMV neurons and accessibility of metabolic cues as well as c-fos expression in the DMV/NTS.To address these issues, we used patch clamp ex vivo electrophysiology (day/night) together with immunohistochemical stainings(4 time points across 24h).

Here we show that DMV neurons display clear circadian differences in electrophysiological features and c-fos expression, what is blunted by HFD. Additionally, HFD disturbs peptidergic input to the DVC, reflected in lowered density of fibers immunoreactive to metabolic peptides.

The present study shows that diet has an impact on circadian functioning of structures involved in homeostatic regulation. Moreover, it strengthens the evidence that improper dietary habits can lead to anomalies seen even at the level of basic neuronal properties.

Supported by Polish National Science Centre grants:2018/28/C/NZ4/00099 and 2017/25/B/NZ4/01433.

Cognitive session

Wioeltta Karina Ozga
The John Paul II Catholic University of Lublin

Influence of the emotionality of stimulus, facial expression, and gaze cueing at the visual spatial attention. An eye-tracking experiment proposal.

Emotions aroused by an element of the visual scene determine the speed of gaze shifting towards the object, the time of focusing the gaze on it, and even turning the gaze away from it (Nummenmaa, Hyona, and Calvo, 2006). The attention bias model created by Mathews and Mackintosh (1998), supplemented and tested on a sample of low and average anxiety trait individuals, suggests that information about stimuli triggers a threat assessment system based on the automatic and unconscious processing of threatening stimuli (Koster, Verschuere, Crombez and Van Damme, 2005). Then occurs the orienting reflex in the direction of the threating object (Sagliano, Trojano, Amoriello, Migliozzi and D'Olimpio, 2014). A characteristic pattern of attention engagement was observed in healthy people with an average intensity of anxiety traits - an early tendency to divert attention from aversive stimuli and a later orientation towards them (Wilson and MacLeod, 2003). As research has shown, visual attention is more disengaged from threatening, fearful stimuli than from neutral ones (Yiend and Mathews, 2001). On the other hands, the behavior of other people, what they are looking at, can direct our visual attention. The use of eye movement to direct the interlocutor's attention to an essential object in space is called shared attention. Observation of the gaze of the interaction partner starts a motor program for the observer, which directs his or her gaze in the same direction as the observed person (Frischen, Bayliss and Tipper, 2007). The gaze of the interaction partner serves as a socio-biological cue (Gregory, Hermens, Facey and Hodgson, 2016; Gregory and Hodgson, 2012). Following the eye movement of the subjects, spontaneous saccades (movement of eyes) were found to occur in the same direction in which the presented face was "looked at" - even if the subjects were asked to maintain their gaze in the middle of the screen (MansÞeld, Farroni, and Johnson, 2003). At the same time, observing the eye movement of the interaction partner we pay attention to the emotional expression of the face. The results of the study show that the fearful expression seems to modulate visual spatial attention to the greatest extent, regardless of the type of research procedure and participants (Tipples, 2006).

Cognitive session

No such effects were reported for facial expression of happiness (Holmes, Richards and Green 2006; Pecchinenda, Pes, Ferlazzo and Zoccolotti, 2008). According to Tripples (2006), such results are obtained because, during the expression of fear, the surface of the visible sclera is enlarged. Based on these studies, we would like to present an idea for making eye-tracking experiments to show the functioning of the mechanisms of attentional bias of threatening stimuli in the context of the shared attention theory.ReferencesFrischen, A., Bayliss, A. P., Tipper, S. P. (2007). Gaze cueing of attention: Visual attention, social cognition and individual differences. Psychological Bulletin, 133(4), 694–724. Gregory, N. J., Hermens, F., Facey, R., & Hodgson, T. L. (2016). The developmental trajectory of attentional orienting to socio-biological cues. Experimental Brain Research, 234(6), 1351– 1362. doi:10.1007/s00221-016-4627-3Gregory, N. J., & Hodgson, T. L. (2012). Giving Subjects the Eye and Showing Them the Finger: Socio-Biological Cues and Saccade Generation in the Anti-Saccade Task. Perception, 41(2), 131–147. doi:10.1068/p7085 Holmes, A., Richards, A., Green, S. (2006). Anxiety and sensitivity to eye gaze in emotional faces. Brain and Cognition, 60(3), 282-294, doi: 10.1037/0096-1523.29.6.1228.Koster, E. H. W., Verschuere, B., Crombez, G., Van Damme, S. (2005). Time-course of attention for threatening pictures in high and low trait anxiety. Behaviour Research and Therapy, 43, 1087−1098.Mansfield, E. M., Farroni T., Johnson, M. H. (2003). Does gaze perception facilitate overt orienting? Visual Cognition. 10:7–14, doi: 10.1080/71375667.Mathews, A., Mackintosh, B. (1998). A cognitive model of selective processing in anxiety. Cognitive Therapy and Research, 22, 539–560.Nummenmaa, L., Hyönä, J., Calvo, M. G. (2006). Eye movement assessment of selective attentional capture by emotional pictures. Emotion, 6(2), 257–268. doi: 10.1037/1528-3542.6.2.257.Pecchinenda, A., Pes, M., Ferlazzo, F., Zoccolotti, P. (2008). The combined effect of gaze direction and facial expression on cueing spatial attention. Emotion, 8(5), 628-634, doi: 10.1037/a0013437.Sagliano, L., Trojano, L., Amoriello, K., Migliozzi, M., & D'Olimpio, F. (2014). Attentional biases toward threat: The concomitant presence of difficulty of disengagement and attentional avoidance in low trait anxious individuals. Frontiers in Psychology, 5, 685, 1-7. Tipples, J. (2006). Fear and fearfulness potentiate automatic orienting to eye gaze. Cognition and Emotion, 20(2), 309–320. Wilson, E., Macleod, M. (2003). Contrasting two accounts of anxiety-linked attentional bias: Selective attention to varying levels of stimulus threat intensity. Journal of Abnormal Psychology, 112, 212−218.Yiend, J., Mathews, A. (2001). Anxiety and attention to threatening pictures. Quarterly Journal of Experimental Psychology Section A: Human Experimental Psychology, 54(3), 665–681.

Cognitive session

Wanda Zarzycka
University of Social Sciences and Humanities
Aleksandra Bramorska, MSc1 2,Jagna Żakowicz, Msc1 2,Katarzyna Kuć, PhD1,Aneta Brzezicka, PhD, prof. SWPS1 3 1University of Social Sciences and Humanities, Warsaw, Poland2Polish-Japanese Academy of Information Technology, Warsaw, Poland3 Cedar-Sinai Medical Centre, Los Angeles, USA

Relationship between Western Diet and cognitive functioning

Many studies indicate that Western Diet, diet high in fat and sugar (WD), negatively affects many aspects of humans physical health (eg. cardiovascular problems, obesity, diabetes). However, to date, few studies have been conducted to test the relationship between a WD and human cognitive performance. Evidence from rodents (Kanoski and Davidson, 2011) as well as human studies (Francis and Stevenson, 2011; Baym et al., 2014) indicate that the diet rich in highly processed foods negatively affects the hippocampus, resulting in decline of learning and memory processes (Noble et al., 2017). Worse results in cognitive functioning were observed in rats fed with saturated fats and sugar (Kanoski et al., 2010). Consumption of large amounts of sugar by pregnant women has clear consequences for the cognitive functioning of their children. These children perform worse in cognitive tasks (Cohen et al., 2018). Children who consume more sugar have significantly worse results in the Test of Creative Thinking than children who consume more fiber (Hassevoort et al., 2018).

In our study we have checked the relation between diet and cognitive functions. Total of 204 participants filled in several questionnaires: Food Frequency Questionnaire (Kowalkowska i in., 2018), Short dietary questionnaire to assess intake of saturated fat and free sugar (Francis and Stevenson, 2013), own questionnaire regarding health and lifestyle. Participants performed also cognitive task SynWin (Elsmore, 1994; Morgan i D'Mello, 2016), which measures multitasking abilities. We observed that the more sugar and fat in the diet the worse the cognitive task performance is, especially in memory subtest. Moreover, we have noticed that pattern of eating habits of products high in fat and sugar differ between genders and some of these products are linked with cognitive performance differentially in men and women.

The results of this study point towards negative relationship WD not only with our physical health but also with our cognitive abilities.

The study was supported by BST grant no WP/2018/A/90.

Cognitive session

Marta Paź
Laboratory of Brain Imaging, Nencki Institute of Experimental Biology, 3 Pasteur Street, 02-093 Warsaw, Poland.
Łucja Doradzińska, Anna Nowicka, Michał Bola

Automatic attention capture by unconsciously presented faces

Introduction

Multiple studies have shown that self-related information, including self-face and self-name, is processed preferentially. In our recent work we have shown that the self-face automatically attracts attention, even when processed without consciousness (subliminally). In the present study we aimed to: first, replicate our previous finding regarding attention capture by unconsciously perceived self-face on a bigger sample; and second, to investigate whether a repeatedly seen "familiar" face can also capture attention without consciousness.

Methods

We used a dot-probe paradigm, in which pairs of faces were displayed laterally, and followed by a target dot presented on one side. Subjects were asked to ignore faces and indicate the side of dot presentation with a button press. For each subject we use a pool of 12 face images: a self-face; a "familiar" face; and 10 other (unfamiliar) faces. In the self block in each dot-probe trial a self-face is presented on one side, and one of the unfamiliar faces on the other side. The familiar block started with a long presentation of the "familiar" face and a short story about the presented person, to establish basic familiarity. Then in each dot-probe trial the "familiar" face was presented on one side, and unfamiliar on the other side. Faces were always presented for 32 ms and were either backward-masked (subliminal) or unmasked (supraliminal). Thus, the experiment consisted of 4 dot-probe blocks (self masked; familiar masked; self unmasked; familiar unmasked). Additionally, subjects performed an identification task to measure their ability to recognize faces.

Cognitive session

Results
The d’ index calculated based on the identification task data indicate that subjects were able to reliably recognize both self (M = 2.79, SD = 1.11) and “familiar” face (M = 2.63, SD = 1.04) in the unmasked condition, but their performance was close to chance level in the masked condition (self: M = 0.31, SD = 0.40 ; “familiar”: M = 0.19, SD = 0.29). The N2pc ERP component was analyzed as an index of automatic attention shifts (electrodes P8/P7; 200-300 ms time window). We found that self-face evoked robust N2pc when it was consciously perceived (t(29) = -4.95, p = 0.001; BF = 1468.57), but also when it was processed without consciousness (t(29) = -2.63, p = 0.007; BF = 6.91). However, the repeatedly presented “familiar” face did not attract attention, neither in the unmasked (t(29) = -0.57, p = 0.28; BF = 0.33), nor in the masked condition (t(29) = -0.79, p = 0.22; BF = 0.40).
Conclusions
We found that the self-face automatically attracts attention, even when it is processed without consciousness. However, the “familiar” face, which has been repeatedly seen by participants during the experiment, did not cause such an effect. This indicates that the self-face attracts attention due to exceptional salience and importance, but not because of a mere familiarity.

Cognitive session

NataliaJakubowska
SWPS University of Social Sciences and Humanities
Natalia Rutkowska, dr hab. prof SWPS Aneta Brzezicka

Can training in strategic video game induce changes in neurocognitive functioning? Real-time strategy video game experience and attentional blink phenomenon – an ERP study.

The attentional blink (AB) phenomenon is a transitory impairment of attention consisting in the inability of subjects to report on the second target (T2) when it is presented between 200-500 ms after the first one (T1). Current evidence suggest, however, that T2 might reach working memory - as reflected in the modulation of the P3 component (Kranczioch, Debner &Engel, 2003) - and that experience with action video games may improve T2 detection (Green & Bavalier, 2003).
The aim of the present study - using Event-Related Potential (ERP) technique - was to examine whether the training in Real-Time Strategy (RTS) game influence the detection of the T2 and whether such impact is reflected on the neurophysiological level. Forty-four healthy participants (non-players) were recruited to the experiment. Twenty-one subjects were assigned to the control group training Starcraft II in static version and twenty-three subjects to the experimental group training the dynamic version of the same game. The training consisted of 30 hours of playing. The EEG recording sessions were performed before the beginning of the training and right after its end.
The results indicate that the experimental group after training improved their performance, detecting significantly more T2 stimuli than did control group. Following the training, the difference in the modulation of P3 component in response to the T2 targets was also observed between the groups - with the increased P3 in experimental as compared to control one. What is more, for the experimental group, the strength of neurophysiological response (P3) in the 1st session appeared to be predictive of the achievements of subjects in the game (the number of games at advanced levels) and for the control group the easier the training (more games at easy levels), the worse improvements in the AB task.
Our results are in line with existing research showing the impact of action video games on AB phenomenon and indicate its potential reflection on the neurophysiological level.

Cognitive session

Magdalena Wielgus
Jagiellonian University
Magdalena Wielgus, Anna Beres, Koryna Lewandowska

What tastes better – Pepsi or Coke? Children's behavioural preferences for culturally familiar drinks.

Background: In 2004 McClure and colleagues showed that there are no significant differences between Coca Cola and Pepsi when it comes to the participants' stated and behavioral preferences for flavor. Having said that, when exposed to Coca Cola logotype, subjects had a tendency to show a behavioral bias towards the labeled drink. This correlated with an increased activation in the dorsolateral prefrontal cortex and the bilateral hippocampus. This was, however, not the case when subjects were shown a Pepsi label with their drink. Those results might suggest that cultural message, in this case carried by the Coca Cola label, may modify behavioral preferences.

Aim of the study: Fifteen years later, when sugared drinks are widely known for being unhealthy, we decided to revisit this study and see whether the behavioural outcomes would replicate in a group of 10-11 year olds in Poland. The project aims to answer the question whether the influence of cultural message related to Coca Cola still holds among the most vulnerable consumers - children.

Methods: A large sample of children will participate in the experiment as part of their enrollment at the Children's University in Krakow. Each was assigned to one of the three conditions: condition A, in which each child was asked to taste a drink from two cups, none of which was labeled and in which each cup contained different drink; condition B, in which children were asked to drink from two cups containing the same drink (Pepsi) but only one cup was labeled; and condition C which saw participants drinking from two cups, both containing Coke but only one of them was labeled.

Results: We have hypothesized that, in line with McClure et al. (2004), children will not show strong preferences for taste in conditions A and B, but will be more likely to choose the labeled Coca-Cola cup in condition C.

Cognitive session

Joanna Wysocka
University of Warsaw, Faculty of Psychology
Karolina Golec (University of Warsaw, Faculty of Psychology), Agnieszka Pluta (University of Warsaw, Faculty of Psychology), Tomasz Wolak (World Hearing Center, Bioimaging Research Center), Maciej Haman (University of Warsaw, Faculty of Psychology), Magdalena Krysztofiak (University of Warsaw, Faculty of Psychology)

Neural correlates of implicit and explicit ToM reasoning in preschool children: fNIRS study

Theory of mind (ToM) is the ability to attribute mental states to others. It is typically measured by false-belief tasks (FBT). The proportion of correct answers in verbal FBT increases significantly between the age of 3 and 5, showing a consistent pattern of development. It is considered that explicit reasoning develops along with the ongoing progress in language and executive functioning.However, compelling evidence of early emerging ToM comes from the field of eye-tracking research. It has been documented that infants are able to consider others' beliefs while interpreting their behaviour during their first year of life, engaging spontaneous, implicit ToM. The possible explanatory paths of ToM development have been widely discussed in literature. The dual system approach implies that explicit and implicit ToM appear to be distinct abilities, whereas according to the unitary approach, ToM could be recognised as a single, continuously developing system. Previous neuroimaging studies in adults demonstrated that neural correlates of both verbal and non-verbal ToM tasks performance activate a complex ToM network of frontal and temporal structures, and stressed the importance of the temporoparietal junction (TPJ). As for now, there have been no analogous studies in children at the transitional stage made with the use of comparable stimuli sets. Sixteen preschool-aged children took part in two near-infrared spectroscopy (fNIRS) sessions. The participants were presented with both verbal and non-verbal authors' FBT task. The preliminary results support the unitary approach assumptions, revealing a similar pattern of activation in ToM network structures in both tasks. Bibliography:Apperly, I. A., & Butterfill, S. A. (2009). Do humans have two systems to track beliefs and belief-like states?. Psychological review, 116(4), 953.Saxe, R. (2009). Theory of mind (neural basis). Encyclopedia of consciousness, 2, 401-410.Schneider, D., Slaughter, V. P., & Dux, P. E. (2015). What do we know about implicit false-belief tracking?. Psychonomic Bulletin & Review, 22(1), 1-12.Wellman, H. M., Cross, D., & Watson, J. (2001). Meta-analysis of theory-of-mind development: The truth about false belief. Child development, 72(3), 655-684.

Cognitive session

Izabela Chalatkiewicz
SWPS
Hanna Górecka

Receptive language processing in Autism Spectrum Disorder

Deficits in language are one of the main criteria, next to reciprocal social interaction and repetitive behaviour, when diagnosing Autism Spectrum Disorder (ASD). Individuals with ASD show differentiation in language abilities ranging from mute to normally speaking. Approximately 50% percent of individuals with ASD never acquire functional language ability. Interestingly, a fMRI study showed, that when presenting vocal and non-vocal auditory stimuli to a participant with ASD no difference was seen in brain activation (Gervais et al., 2004). This may have an impact on the difficulty which in common in ASD, of distinguishing particular speech from background noise. This behaviour can be seen in early age of children with ASD, as not responding to their names when called, as if they did not hear it.

Language can be categorized as expressive and receptive. Our focus is put on receptive aspect of language, which include input of both auditory and visual linguistic stimuli, such as presenting words or letters. This includes mostly phonetic differentiation and semantic comprehension. We will show results from several research focusing on brain abnormalities in structures, functions and connectivity when solving linguistic tasks, comparing ASD to typically developing individuals.

Main brain regions important for language development are Broca's and Wernicke's area, which both are located in the left hemisphere. Auditory stimuli is a bigger challenge to process for people with ASD, comparing to visual input stimuli. Several neuroimaging studies indicate that individuals with ASD process auditory and linguistic stimuli differently at a cortical level. Research show many inter- and intra- hemispheric abnormalities in brain activity of ASD individuals when solving linguistic tasks, indicating reduced or altered activity in the left hemisphere, and increased activity in the right hemisphere. We would like to present gathered results of several research done in this area, with the use of different neuroimaging techniques.

Cognitive session

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Cognitive session

Agnieszka Ozimek i Patrycja Lewandowska

The imitation of facial emotions that are physically similar. Mimicry as a signal ofunconscious recognition of kinship?

The context-dependent mimicry model (Hess and Fischer, 2014) assumes that observersare more likely to imitate the facial expressions of people they like, people that are similar tothem or members of their own group. At the same time, similarity (including physical) ischaracteristic that has a significant impact on making social assessments/judging. Facesthat are physically similar, even if the similarity is not consciously seen, cause greaterconfidence, but are not necessarily judged to be attractive. This suggests the functioning ofan evolutionarily developed relationship detection mechanism. However, the question iswhether face similarity will also evoke different mimic imitation patterns?In our research, participants were presented with short films which were a computer-generated mix of a face unknown to the participant (prototype face) with his own face(experimental condition) or just prototype face (control condition). These faces showedexpressions of joy and anger with a random order in both conditions. The task was to look atthe films and to give a judgment about the presented face on the scale which concerned theconfidence and attractiveness of the presented faces. At the same time, zygomatic (smilingreaction) and corrugator muscles (frowning reactions) were registered during faceobservation. The results indicate an increased imitation of the smile of similar faces, but alsoavoidance of imitating the anger of faces mixed with the prototype ("foreign"). Theassessment confirmed the higher confidence and lower attractiveness for similar faces. Thisindicates the functioning of the mechanism postulated by the concept of mimicry - that is,imitation of mimic expressions serving to strengthen bonds within one's own group and toavoid imitation of antagonizing expressions. Importantly, our study suggests that thismechanism may work even in the absence of full awareness of the belonging of the imitatedperson.

Cognitive session

Maria Zimmermann
Jagiellonian University, Cracow, Poland
Ł. Bola, P. Mostowski, P. Tomaszewski, P. Krzysztofiak, P. Rutkowski, K. Jednorog, A. Marchewka, M. Szwed

The „specific task" in task-specific reorganization of the auditory cortex in the deaf

Previous studies (e.g. Bola et al., PNAS 2017) suggest that the deafs' auditory cortex preserves its task-specific function (i.e. rhythm processing) despite switching to a different sensory modality (visual). Still however remains unclear what exactly is „the specific task" persisting in the task specific cross-modal reorganization.

Here we ask whether the role of task-specific in the auditory cortex in deaf humans concerns strictly particular function of rhythm processing, or can it be extrapolated to cognitively similar function without "rhythmical" component. Preliminary results show that the rhythm discrimination tasks activate the auditory cortex (posterior right STG) in the deaf and not in the hearing subjects for both visual and tactile modality. Interestingly, he interaction effect analysis (rhythmicality x cognitive load) shows that „task-specificicity" for the rhythms discrimination task is more prominent for tactile modality, than for visual modality. Moreover, simple effect analysis suggest that spatial sequences lead to the auditory cortex activation in the deaf independently on cognitive load, while for rhythm perception the cognitive load is crucial for cross modal activation to occur. Overall, the result suggests that the effect of cross modal reorganisation in the deaf can be less „task specific" than previously claimed.

Cognitive session

Maciej Gaca
Nencki Institute of Experimental Biology, Polish Academy of Sciences; SWPS University of Social Sciences and Humanities
Natalia Kowalczyk, PhD, SWPS; Monika Myśliwiec, SWPS; Maciek Skorko, IP Polish Academy of Sciences; Paweł Dobrowolski, PhD, IP Polish Academy of Sciences; Artur Chudzik, Polish-Japanese Academy of Information Technology; Aneta Brzezicka, PhD, SWPS/CEDARS-SINAI MEDICAL CENTER, LOS ANGELES, USA

Structural neuroplasticity induced by training in the form of a first-person shooter video game

Over the last few years, computer games have evolved from an unrealistic and straightforward two-dimensional environment to experience becoming more similar to a real-life activity. Due to the increasing impact that video games playing has been having on global society, the cognitive effects of video games have become an exciting matter to be considered on a scientific level. While many studies show that playing action video games has a positive impact on a vast range of cognitive skills, numerous studies show negligible or no cognitive effect. There is nevertheless only a handful of studies that focus on possible structural changes as an effect of playing a video game. Those do show that playing action video games induces grey matter thickness changes in structures like the parahippocampal cortex, somatosensory cortex, superior parietal lobule or insula. The first aim of the presented study was to see whether or not approximately 30 hours of training is sufficient for any cognitive and structural changes to occur. The region of interest (ROI) approach was used to select structures of the brain that could be related to the gaming experience. The second aim of the study was to see whether or not the cortical thickness in specific structures can be predictive of the quality of the training process. A strong effect of insula did occur – while its right side did negatively change its thickness as an effect of training, the left side correlated positively with the game achievements.

Computational session

Paulina Urban
1 Center of New Technologies, University of Warsaw, Warsaw, Poland 2 College of Inter-Faculty Individual Studies in Mathematics and Natural Sciences, University of Warsaw, Warsaw, Poland
Vahid Rezaei Tabar 3,4,1,Michał Denkiewicz 1,2,5Dariusz Plewczynski 1,51 Center of New Technologies, University of Warsaw, Warsaw, Poland2 College of Inter-Faculty Individual Studies in Mathematics and Natural Sciences, University of Warsaw, Warsaw, Poland3 Department of Statistics, Faculty of Mathematical Sciences and Computer Sciences, Allameh Tabataba'i University, Tehran, Iran. 4 School of Biological Science, Institute for Research in Fundamental Sciences (IPM), Tehran, Iran5 Faculty of Mathematics and Information Science, Warsaw University of Technology, Warsaw, Poland

Hidden Markov models used on dendritic spines states

Dendritic spines play, a crucial role in learning and memory processes. The functional and structural reorganization of synapses depends on brain plasticity, which is important in learning and memory processes. This reorganization depends on the molecular mechanism. Depends on the molecular mechanisms dendritic spine can be in one of the six states as is present in Barret [1]. We aimed to find how Markov models can help in the calculation probability of numbers of dendritic spines in each state or even process (long-term potentiation (LTP) and long-term depression (LTD)).

In our work, we use the Hidden Markov model (HMM) [2] and Autoregressive HMM (ARHMM) [3]. The ARHMM parameters are estimated by the Expectation-Maximization (EM) algorithm, and parameters in HMM are estimated by the Baum-Welch algorithm.

Our results show us the best and the worst situation (by situation we mean how many dendritic spines were in LTP or LTD process) between timestamps (which can be in minutes/hours/days). In our work, we also show and discuss which algorithm estimates parameters better and which model better explains the observations.

This work was supported by the Polish National Science Centre (2014/15/B/ST6/05082), Foundation for Polish Science (TEAM to DP).

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[2] Rabiner L.R. (1989)
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Computational session

Karolina Finc
Centre for Modern Interdisciplinary Technologies
Karolina Finc, Mateusz Chojnowski, Kamil Bonna, William H. Thompson, Paweł Drojecki

fMRIDenoise: automated fMRI data denoising, denoising strategies comparison, and functional connectivity matrices quality control

Functional connectivity (FC) became a prominent method of functional magnetic resonance (MRI) data analysis. Before estimating FC, fMRI data have to be denoised to minimize the effect of motion and physiological processes via regressing out potentially confounding variables from the fMRI time-series. Great variability in denoising strategy choices used by researchers makes comparisons across FC studies hardly possible. This problem raises the necessity to develop tools supporting reproducible fMRI data processing. One good example is the fMRIPrep tool for preprocessing fMRI data that requires minimal user input and provides detailed reports for further data quality control (Esteban et al., 2019).
Here we present fMRIDenoise, a tool for automatic denoising and denoising strategies comparison, working directly on fMRIPrep derivatives. The tool performs denoising using common denoising strategies and provides the output including: (1) subject-level reports and the information which subjects should be excluded from further analyses due to high motion, (2) FC quality control benchmarks estimated on group level (Parkes et al., 2018), (3) recommendation of the best-performing pipeline given the data. We believe that fMRIDenoise can make a selection of the denoising strategy more objective, help researchers to obtain FC quality control metrics with almost no effort, and improve the reproducibility of the FC research.

Computational session

Paulina Lewandowska
SWPS University of Social Sciences and Humanities
Natalia Kowalczyk, Aneta Brzezicka

White matter structure and cognitive functions differences between VR and computer games players

For many decades there has been an increased interest in how computer games are associated with positive changes in the functioning of processes such as perception abilities, motoric and cognitive functions (Bavelier et al., 2012; Greenfield, 2014). When it comes to an experience with action video games, certain studies reported better performance of complex cognitive functions such as cognitive control, the ability to switch between tasks and refreshing information in short-term memory(Basak et al., 2008; Colzato and et al., 2010). The transfer of cognitive functions progress probably occurs since computer games and especially first-person shooters (FPS) provide dynamic and multisensory stimulation that requires their users to manage their cognitive resources effectively. In order to achieve high results in the game, players must cope in a very complex and rapidly changing environment, quickly respond to sudden stimuli and switch between tasks in the game (Basak et al., 2008; Colzato and et al., 2010). Whereas lately, a technology of Virtual Reality (VR) is increasingly used in the research area. VR provides a simulation of a realistic environment in three-dimensional (3D) and immersive environment that allows players to be more involved in the game than while playing traditional computer games (Hubbard et al., 2017). Until this time VR was mostly used in cognitive rehabilitation for patients with brain damage (Grealy et al., 1999) or as a cognitive assessment tool for elders (Bisson et al., 2006). Also, some of the research indicates that using VR has effective results as a medical operations simulator (Aggarwal et al., 2006). Although, there is still not much known about how VR affects the human brain structure and mainly white matter (WM) of the brain. Due to the immersive capabilities of VR, comparing to traditional computer games, this technology seems to be a possibly better tool to stimulate neuroplasticity. Therefore in our future study, the main goal is to distinguish the differences in white matter structure with diffusion tensor imaging (DTI) technique and cognitive functions between VR first-person shooters (FPS) players, computer FPS games players and nonplayers.

Computational session

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Computational session

Maria Czarnecka
Institute of Psychology, Jagiellonian University, Krakow, Poland;
Katarzyna Rączy1, Jakub Szewczyk1, Małgorzata Paplińska2, Guido Hesselmann3, André Knops4, Marcin Szwed1
1 Department of Psychology, Jagiellonian University, Krakow, Poland;
2 The Maria Grzegorzewska University, Warsaw, Poland;
3 Department of General and Biological Psychology, Psychologische Hochschule Berlin, Berlin, Germany;
4 Laboratory for the Psychology of Child Development and Education, University Paris Descartes, Paris, France

Decoding of tactile abstract (Braille) numbers in the Intraparietal Sulcus of sighted Braille readers

The IPS plays a key role in processing numbers. According to the "triple-code theory" (Dehaene, 1992), it contains a modality-independent abstract magnitude code, co-existing with modality-specific symbolic codes (visual Arabic digits, number words...).In an fMRI multi-voxel pattern analysis (MVPA) experiment, sighted Braille readers were presented with blocks of numerosities in tactile abstract (Braille), visual abstract and visual non-abstract formats. Previous studies (e.g. Bulthé et al., 2014) found that abstract visual numbers had low decoding accuracy, interpreted as symbolic numbers being mapped onto a subset of a broader population of IPS neurons tuned for corresponding non-symbolic representations. Non-symbolic numbers were assumed to be easier to decode because of their wider representation. Here, we found that tactile numbers, despite being abstract, were robustly decodable in parietal regions. This suggests that low accuracy for visual abstract stimuli is due to their visual nature and/or overtraining, not to their abstract nature itself.

THANK YOU FOR PARTICIPATING IN 9TH EDITION OF ASPECTS OF NEUROSCIENCE

Marta Paé

Aspects of Neuroscience
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