12th Annual Conference Aspects of Neuroscience
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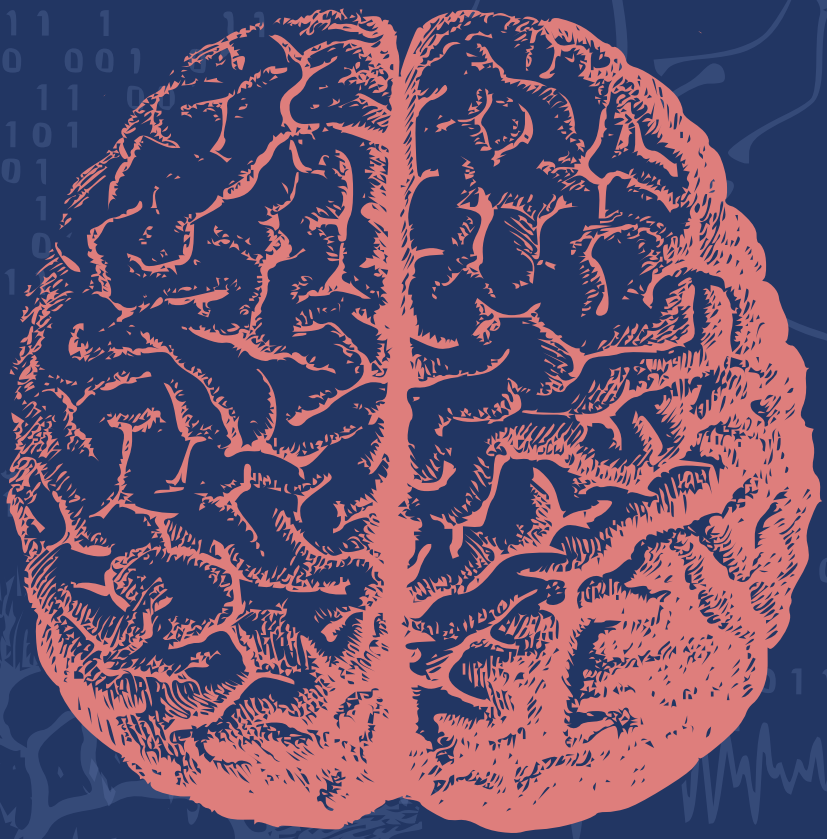
12th ASPECTS OF NEUROSCIENCE



25-27 october 2024

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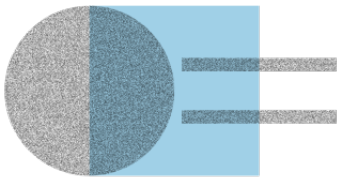

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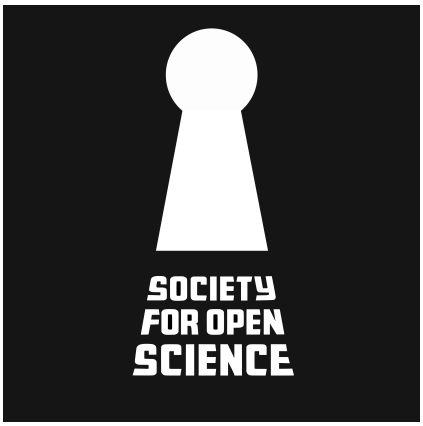

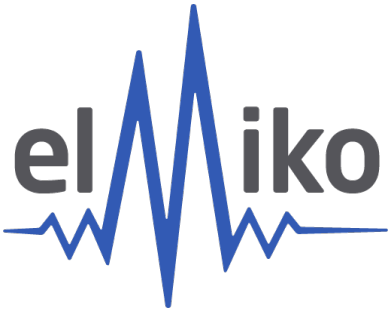

Dear Colleagues,

Welcome to the 12th International Conference Aspects of Neuroscience! We, Aspects of Neuroscience Organizing Committee members are very glad that the annual gathering of brilliant neuroenthusiasts at the Faculty of Physics, University of Warsaw, became our tradition and one of the key points among Polish neuroscientific events. During those years, Aspects of Neuroscience became recognized by members of scientific institutions from Poland and other European countries. It is our great privilege to host both experienced researchers and students from all over the world, who come to Warsaw to present their research, receive feedback from their peers, and get mutually inspired.

The program unambiguously combines the dynamic development, challenges, and important contributions of neuroscience research in the broader context of human health and life, pushing the boundaries of knowledge even further. We aim to provide you with an opportunity to actively participate in workshop sessions, to present your recent results and to listen to some of the leading researchers from different aspects of neuroscience: Biological, Computational, Cognitive, and Clinical. We firmly believe that the cooperation above disciplines and the integration of neuroscientists will result in new ideas and thinking outside of the box.

XII INTERNATIONAL CONFERENCE "ASPECTS OF NEUROSCIENCE"

During the Conference, we invite you to 6 plenary lectures given by world-renowned professors and dozens of speeches presented by PhD and Msc students, divided into 4 seminar sessions on the following topics: neurobiology, computational, clinical and cognitive. What's more, during the poster sessions you can experience many inspiring encounters with around forty of interesting research and projects. In addition, together with our partners from Nencki OpenLab, we prepared a variety of workshop sessions you can attend and learn useful and practical research skills.

Don't worry about meritorical value! The level of presented seminar speeches and posters is maintained with the help of the Scientific Committee. Each abstract submitted had at least a triple-blinded peer review.

Coferences also provide a fantastic opportunity to network within the scientific community — exchange ideas, find inspiration, and explore promising collaborations!

The conference is organized by the members of the Neuroinformatics Scientific Student Association in collaboration with the Neurobiology Scientific Student Association, both held at the University of Warsaw.

Head of the Organising Committee
Julia Jakubowska

Head of the XI International Conference “Aspects of Neuroscience”
Weronika Plichta

Head of the X International Conference “Aspects of Neuroscience”
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Special thanks to the Student Association of the Photography of Nature, University of Warsaw, and its members for capturing the event with their incredible photography skills.

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SCIENTIFIC COMMITTEE

EVENT PROGRAM DAY BY DAY

25th OCTOBER 2024 (FRIDAY)

10:00 – 16:00 Registration desk open!
10:00 – 16:00 Workshops
17:00 – 17:30 Official opening
17:30 – 18:30 Plenary Lecture – **Joseph Barnby, PhD**
Walking a Mile in Their Shoes: Using Computational Models to Understand Social Cognition in Health and Disorder

18:30 – 20:00 Welcome Reception

EVENT PROGRAM DAY BY DAY

26th OCTOBER 2024 (SATURDAY)

10:00 – 11:00 Plenary Lecture –**Jaime de la Rocha, PhD**

The dynamics of evidence accumulation and response execution during rule-guided decisions

11:15 – 12:30 Seminar Session – neurobiology

- Jadwiga Irena Zymer – *New mouse ASD model with Tsc2 gene knockout – evaluation of tissue specificity of the mutation*
- Katarzyna Sawicka – *Cortical Reinstatement is a direct approach to testing hippocampal indexing theory*
- *Gabriela Stopka – RLN3/RXFP3 signaling in the ventral dentate gyrus – a novel neuronal substrate in control of stress and anxiety related processes*
- Andrzej Łach – *Neuroprotective Efficacy of PaPE-1 in Post-Treatment of Hypoxic and Ischemic Injuries: Mechanisms and Therapeutic Potential*
- *Bernadeta A. Pietrzak-Wawrzyńska – Selective activation of non-nuclear estrogen receptors partially reverses amyloid-β-induced autophagy deficits in primary neuronal cell cultures*
- *Magdalena Gomółka – The role of lipid metabolism and circulating miRNAs in the intergenerational transmission of the effects of parental adverse childhood experiences*

12:30 – 13:00 Coffee Break

13:00 – 14:00 Plenary Lecture – **Mateusz Ambrożkiewicz, PhD**

Proteostatic mechanisms of cellular diversification in the developing brain

14:00 – 15:00 Lunch

15:00 – 15:45 Seminar Session – clinical

- Redwan Jabbar – *Virtual reality-based exposure intervention as a digital pre-med to alleviate anxiety and pain in patients undergoing spine surgery: A Randomized Controlled Trial*
- Ignacy Stachura – *Impact of reconstitution therapies – cladribine tablets and alemtuzumab – on the atrophy progression among patients with multiple sclerosis*
- Maja Wójcik – *Linking aspects of cognitive functioning and neuroprotein plasma levels in psychedelic users*

16:00 – 17:30 Poster session – clinical & neurobiology

17:30 – 18:30 Plenary Lecture – **Jan Antolink, PhD**

Learning stimulation protocols for cortical visual prosthetic systems

20:00 Integration party

EVENT PROGRAM DAY BY DAY

27th OCTOBER 2024 (SUNDAY)

10:00 – 11:00 Plenary Lecture – **Mark Hunt, PhD, DSc, Associate Professor**
The Role of Olfactory Bulb in Ketamine-Induced Abnormal Fast Brain Rhythms

11:15 – 12:15 Seminar Session – cognitive
- Tymon Rochowski – *Mental arithmetic is intrinsically linked with spatial attention*
- Sofiia Honcharova – *Disentangling spatio-temporal attention from conscious perception with EEG and a novel behavioral approach*
- Agnieszka Mankiewicz, Bartosz Miklaszewski – *The Neural Basis of Symbolic Representations: Insights from fMRI*

12:15 – 13:00 Coffee Break

13:00 – 14:00 Seminar Session – computational
- Agata Gut – *Analysis of the relationship between cerebral autoregulation and arterial baroreceptor sensitivity*
- Monika Najdek – *The relationship between neuroparameters and autonomic nervous system metrics in traumatic brain injury patients using canonical correlation analysis*
- Emilia Kaczmarczyk – *Comparative Analysis of Alpha Rhythm Propagation in EEG Signals: Evaluating PCMCI+ versus Granger Causality Algorithms*

14:00 – 15:00 Lunch

15:00 – 16:30 Poster session – cognitive & computational

16:30 – 17:30 Plenary Lecture – **Doc. Otto Lappi**
Gaze behavior in the wild 3+1 paradigms

17:30 – 18:00Award Ceremony and official closing

KEYNOTE SPEAKERS

Joseph Barnby, PhD

Royal Holloway, University of London, England

Joseph Barnby is a cognitive and computational scientist focused on understanding the brain and behavior in social interactions, with applications in psychiatric and neurological disorders. He develops mathematical models and experiments to study cognitive processes like social decision-making and belief formation. Currently, he is an Assistant Professor at Royal Holloway, University of London, leading the Social Computation and Representation (SoCR) lab. He also holds adjunct research positions at King's College London and the University of Western Australia and is the founder of the data science startup Hypatia.

Proteostatic mechanisms of cellular diversification in the developing brain

From the very start of life, humans engage in interactions that are foundational to development. Through interactions with parents, family, and friends, we acquire self-regulation, social, cognitive, and emotional skills. These pivotal relationships furnish us with a suite of psychological processes essential for learning and adaptation in adulthood. Although significant scientific advances have delineated the algorithms underlying these psychological mechanisms, there remains a lack of a formal, interoperable framework to unify the critical components that foster social bonding. In this presentation, I will propose a theoretical structure designed to frame and precisely testing of facets of social cognition in both healthy individuals and those with disorders, spanning phenomena from social contagion to hierarchical mentalizing. I will share novel empirical and experimental data that test these assertions drawn from diverse groups, including the general population, adolescents, and individuals with psychiatric diagnoses. Finally, I will discuss synthetic simulations that predict and test the conditions under which different algorithmic configurations may become adaptive or maladaptive, potentially leading to distress and disability.

Jaime de la Rocha, PhD

Institute for Biomedical Research August Pi i Sunyer (IDIBAPS) in Barcelona, Spain

Jaime de la Rocha is a Junior Group Leader at the Institute for Biomedical Research August Pi i Sunyer (IDIBAPS) in Barcelona (Spain). He received his PhD in 2003 in Theoretical Physics in the University Autonoma of Madrid in the laboratory of Prof. Néstor Parga. After graduating, he obtained a postdoctoral fellowship from the Spanish government to work in the laboratory of Alex Reyes in the Center for Neural Science at New York University. There he performed in vitro experiments and computational modeling to investigate the transfer of synchrony in simple neural networks. In 2008 he moved to the Center for Molecular and Behavioral Neuroscience at Rutgers, where he worked in the lab of Ken Harris performing some in vivo population recordings and network modeling on the question of neuronal correlations and brain states. In 2010 he won a Ramón y Cajal position to start his lab in IDIBAPS in Barcelona where he combines behavioral experiments in rodents, electrophysiology, quantitative analysis and modeling to study the neural circuits dynamics underlying various cognitive functions such as perception and memory. In 2015 he became a permanent Junior Group Leader at IDIBAPS and won a consolidator grant from the European Research Council to investigate the mechanisms underlying expectations in perceptual decision making.

The dynamics of evidence accumulation and response execution during rule-guided decisions

Deciding requires integrating information from multiple sources over multiple time-scales. In perceptual decisions, for instance, ambiguous stimuli require fast accumulation of sensory evidence, a process largely studied but whose underlying mechanisms remain largely debated. Recent experiences on the other hand, can also impact the way we decide by reinforcing rewarded choices and strategies creating a dynamic prior framework that guides subsequent decisions. Where in the brain these decision variables are represented, updated and integrated to drive responses, it still unknown. In this talk I will present extensive data from rats performing a two-alternative decision-making task, which requires temporal integration within or/and across trials. I will show that rats can leverage on the latent statistical structure of the task and consistently develop a tendency to predict the upcoming stimulus from the previous responses and outcomes. Then I will show that the timing and the orienting response trajectory can be explained by a novel model which, building on the standard accumulation to evidence models, incorporates proactive responses whose trajectories can be updated as the stimulus information reaches the decision bounds. Finally, using this behavioral model, pharmacological and optogenetic manipulations as well as electrophysiological recordings, I will characterize the role of several brain areas in this behavior, particularly of the dorsal striatum. Together, these results reveal that the accumulation of evidence across trials can exhibit complex dynamics and that the striatum plays a critical role in encoding this evidence and the choice biases it causes.

Mateusz Ambrożkiewicz, PhD

Charité-Universitätsmedizin Berlin, Germany

He began his scientific career with a degree in Biotechnology from the Warsaw Uniwersity of Life Science and early neuroscience research in Jacek Kuznicki's lab. His passion led him to Germany, where he joined the Fast Track PhD Program at the Planck Research School, focusing on developmental neuroscience. His work with Nils Brose and Hiroshi Kawabe highlighted the importance of ubiquination in brain development. In 2016, he moved to Berlin to study molecular pathways in proteostasis in Victor Tarabykin's lab. Now, he leds the Proteostasis Group at Charité University Hospital, advancing research on protein regulation in the brain.

Walking a Mile in Their Shoes: Using Computational Models to Understand Social Cognition in Health and Disorder

Formation of functional circuits in the adult brain is a biological fundament for its executive role in the living organism and requires specification of neurons, their correct positioning, formation of dendrites and synapses. In this talk, I will present our current research on the translational mechanisms and post-translational modifications orchestrating neuronal diversification in the developing brain. Particularly, I will shed light on the specific post-transcriptional requirements for neuronal progenitors, including the dynamics of protein synthesis as well as the role of ubiquitination-dependent degradation in healthy and diseased brain.

Jan Antolik, PhD

Charles University in Prague, Czechia

Dr. Antolik is a computational neuroscientist based in Prague, Czechia where he lead the Computational Systems Neuroscience Group at the Faculty of Mathematics and Physics of Charles University. His main research interests are systems neuroscience, visual system, sensory coding and prosthetic sensory restoration. His work seeks to understand how visual information is transformed as it passes through the various stages of visual processing to form what we experience as our everyday perception of the visual environment.

Learning stimulation protocols for cortical visual prosthetic systems

Cortical visual prosthetic systems are investigated as a means of restoring vision in subjects with impaired eye-brain connection. A central hypothesis of such endeavor is that induction of an activity pattern in visual cortex similar to that evoked by a given visual stimulus, will elicit perception of similar visual stimulus. Existing V1 prostheses stimulation strategies take into account only the retinotopic aspect of visual coding, overlooking other important coding properties of V1 neurons such as selectivity for stimulus orientation. Here we introduce a novel stimulation protocol that stimulates cortical tissue according to both retinotopy and orientation columns. To obtain this protocol, we implemented a bottlenecked rotationally equivariant convolutional neural network, that learns to predict neural responses to arbitrary stimuli solely based on the neuron's receptive field position and orientation preference. Our model outperforms the standard energy model of V1 complex cells. The high correlation between target and predicted responses suggests that position and orientation alone can explain a large portion of V1 neural response variability. To test whether stimulation of cortical tissue according to our model would indeed induce desired activity in the dynamic recurrent cortical networks, we utilized a previously published simulation framework composed of a large-scale recurrent spiking V1 model to simulate optogenetic prosthetic stimulation delivered via an LED array placed on the cortical surface. Our simulations show that the newly proposed retinotopic-and-orientation-based stimulation protocol recruits neural patterns that more accurately mimic natural vision processing than analogous protocols only relying on coding of retinotopy.

Mark Hunt, PhD, DSc, Associate Professor

Nencki Institute of Experimental Biology, Warsaw, Poland

Mark Jeremy Hunt is a biomedical research scientist (PhD in pharmacology, University of Cambridge) and is currently an assistant professor at the Nencki Institute of the Polish Academy of Sciences. He has authored over 25 international peer-reviewed papers and has served as a reviewer for a number of international academic journals.

The Role of the Olfactory Bulb in Ketamine-Induced Abnormal Fast Brain Rhythms

First synthesized in 1962 as an anesthetic, ketamine was initially found to produce short-lasting, psychotic-like dissociative states, which led to its use in modeling certain features of schizophrenia. Perhaps surprisingly, over the past two decades, ketamine has gained increased attention for its antidepressant potential. Despite ketamine's history, its mechanisms of action are still not fully understood. In this talk, I will focus on one notable electrophysiological feature reliably reported in rodents: the enhancement of abnormal high-frequency oscillations (HFOs, 130-180 Hz). These oscillations are coherent and observed across many brain regions, including cortical and subcortical areas. Interestingly, HFO increases following ketamine have been reported in various mammals. Unexpectedly, our research has identified the olfactory bulb (OB) as a critical generator of ketamine-induced HFOs, and appears to be essential for ketamine-induced HFO recorded in other brain regions. HFOs couple with slow oscillations driven by nasal respiration. Our recent findings highlight the importance of the olfactory epithelium in generating ketamine-induced HFOs, as reduced input from olfactory sensory neurons disrupts the ketamine rhythm. Notably, it seems that changes in nasal pressure, rather than specific odor presentation, provide the initial drive underpinning the generation of ketamine-induced HFOs. In summary, the OB orchestrates a hypersynchronous HFO brain rhythm produced by ketamine, and further work is required to understand the functional significance of this activity.

Otto Lappi, Doc.

University of Helsinki, Finland

Otto Lappi is a distinguished scientist who explores the complex cognitive and neural mechanisms behind everyday tasks that may seem simple at first glance. His work highlights the remarkable adaptability of the human brain – something that becomes especially apparent in the context of artificial intelligence and robotics, where even tasks like driving a car or walking can present enormous challenges. Otto also studies the development of expert skills, pushing the limits of human cognitive and physiological capacities. His research combines laboratory and field experiments, cognitive modeling, and qualitative methods.

Gaze behavior in the wild 3+1 paradigms

Eye movements modulate all visual input to the brain. Understanding them is therefore is essential for understanding all aspects of visual brain function, such as perception, attention, memory and dynamic real-world decision making. For neuroscientists who want to venture outside of the lab, mobile eye tracking offers means to investigate how active gaze is deployed "in the wild".

I natural task environments, the movement of the eye is always embedded in head movement and locomotor patterns. Yet much what we think goes on in the visuomotor system during active visual tasks is extrapolated from oculomotor research in highly simplified laboratory paradigms, where (1) observable parameters of interest are fixed a priori (independent and dependent variables) and (2) the physical implementation of stimulus features and response options (e.g. images rendered on displays, e.g. response buttons or head-fixed eye-movements) are chosen based on this task parametrization and (3) a statistical model determines the sampling of different "conditions" (trial structure).

By contrast, when investigating natural everyday & expert performance the primary concern is often how to determine useful ways to parametrize (1) the naturally occurring patterns of complex dynamic behavior, and (2) the rich environmental structure and (3) the dynamic patterns in how gaze is used to actively sample the visual world. Different parametrization choices yield different "natural paradigms" (different ways of seeing the phenomena) and are appropriate for posing and answering different research questions.

In this talk I will identify and compare four approaches to parametrizing gaze behavior in the wild, which I will call the #1 Oculomotor, #2 Scene, #3 Timing and #4 Localization paradigms. I will argue that #1 – #3 make sense also in the lab, but #4 (which is based on localizing the point of vantage) only makes sense in locomotor contexts) and therefore remains underused, unrecognized as conceptually distinct, and consequently the associated research questions relatively unexplored. Paradigmatic examples from high-speed sport are discussed.

WORKSHOPS

WORKSHOPS

Paweł Lenartowicz

Society for Open Science

Monte Carlo modelling - Monte Carlo power analysis, permutation and bootstrap statistical tests

Monte Carlo methods are relatively simple methods that, especially today when we have a lot of computing power, allow us to solve many statistical problems. They are particularly useful where there is a lack of standardised analytical methods, such as classical t-tests or ANOVA, as well as in more complex models. The workshop is intended to introduce participants to the idea of statistical modelling and show how to easily design a complex data analysis using R or Python languages, using data from neuroscience research. During the workshop, users will learn what is needed to prepare such an analysis, how to combine it with a study preregistration, how to use Monte Carlo to select appropriate statistical tests and sample size, and how to interpret the obtained results. Workshop organized in cooperation with Society for Open Science.

WORKSHOPS

Ewelina Elert-Dobkowska, PhD

Department of Genetics, Institute of Psychiatry and Neurology, Warsaw, Poland

Analysis of dynamic mutations and assessment of the number of microsatellite repeats in neurodegenerative disorders

A World Health Organization (WHO) report shows that up to one bilion people around the world suffer from neurological disorders. Among them, there is a heterogeneous group of neurodegenerative diseases. These may be multifactorial as well as genetically determined disorders. Repeat expansions of microsatelite sequences are involved in a number of neurodegenerative disorders, including Fragile X syndrome, Huntington disease, spinocerebellar ataxias, myotonic dystrophy, spinal and bulbar muscular atrophy. The expansion of microsatelitte repeats, not exlusively trinucleotide repeat sequences, is termed a dynamic mutation. This mutational mechanism results from repeats instability and their expansion due to form an unusual DNA structures during replication. In the workshops the main neurodegenerative conditions caused by dynamic mutations will be presented. Furthermore, we will perform a genetic analysis of dynamic mutations, including the assessment of the number of microsatellite repeats in particular genes and the interpretation of these results in terms of clinical significance.

WORKSHOPS

Paweł Szufliński, Robert Kwaśniak
Elmiko Biosignals and Cortivision

Monitoring and non-invasive brain stimulation based on fNIRS and TMS methods. Theory and practice.

The workshop is aimed at students and young researchers interested in modern methods of monitoring brain activity and brain stimulation. During three hours, participants will gain theoretical and practical knowledge of two key technologies: functional near-infrared spectroscopy (fNIRS) and transcranial magnetic stimulation (TMS). The first part will discuss the fNIRS method, its application in neuroscience research, and its ability to monitor brain activity in real time. The second part will focus on TMS technology, its role in neurological and psychiatric therapy, and its impact on brain plasticity. The workshop combines theoretical discussion of the technology and practical aspects of its use in research and therapy.

WORKSHOPS

Natalia Szejko, MD, PhD, ScD

Medical University of Warsaw, Clinical and Research Fellow in the University of Calgary

Gilles de la Tourette syndrome - only tics? A practical workshop about pathophysiology and clinical aspects of tics and co-existing conditions

Gilles de la Tourette syndrome (GTS) is often associated with obscene words and gestures and quite dramatic symptoms. In the reality, however, vast majority of patients have mild symptoms. In this practical workshop we will discuss pathophysiology of GTS and show clinical examples of how the disease really is with illustrative videos of most common tics. As GTS is not only tics, we will also discuss most common comorbidities such as OCD and ADHD. The workshop will be closed with case discussion during which participants will have the opportunity to put learned knowledge in practice and decide how to treat/manage real life cases.

SPEECHES

NEUROBIOLOGICAL SESSION

Katarzyna Sawicka
Monika Falińska, Rafał Czajkowski
Nencki Institute of Experimental Biology, Polish Academy of Sciences

Cortical Reinstatement is a direct approach to testing hippocampal indexing theory

Episodic memories are crucial for our identity and heavily depend on the hippocampus. Despite this, understanding how these memories form, are maintained, and retrieved is still developing. The indexing theory suggests that hippocampal neurons are interconnected with sensory and associative cortical regions, yet it's unclear if cortical reinstating occurs neuron-to-neuron. By optogenetically stimulating cortical neurons, we aim to understand how the hippocampus and cortex interact during memory processes. These findings could enhance our understanding of memory formation and retrieval mechanisms, offering insights into conditions like amnesia and neurodegenerative diseases. This research was done on mice, wild type and TRAP2. During stereotaxic surgery, we did cranial window above the retrosplenial cortex, injected viral vectors (pAAV-CamKIIa-C1V1(t/t)-mScarlet-KV2-cortex, pAAV-EF1a-double floxed-hChR2(H134R)-mCherry-WPRE-HGHpA-hippocampus, pAAV.Syn.GCaMP6f.WPRE.SV40-cortex) to the hippocampus and retrosplenial cortex, and optic fiber were implanted. We perform optogenetics stimulation using LED diode and optic fiber. For in vivo imaging we used coordinated system with 2photon microscope and laser for optogenetic stimulation. Optogenetic stimulation of cortical random neuronal population (creating index) led to increased c-fos protein expression in the hippocampus, that suggests c-fos is a marker of hippocampal index. We found that significant colocalization C-fos/Chr2 in the hippocampus. Reactivation of c-fos protein+ cells by optogenetic activation of Channelrhodopsin in the hippocampus caused activation of GCaMP/C1V1 cells in the cortical area.

NEUROBIOLOGICAL SESSION

Jadwiga Irena Zymer
Marcin Lipiec, Ewelina Knapska
University of Warsaw; Nencki Institute of Experimental Biology, Polish Academy of Sciences

New mouse ASD model with Tsc2 gene knockout – evaluation of tissue specificity of the mutation

Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterised by repetitive behaviours and deficits in social interaction. One possible component of ASD neurobiology is altered ratio between excitatory and inhibitory neurotransmission in the brain. In order to elucidate the relationship between ASD and altered function of inhibitory neurons, we recently developed a new mouse model with tissue-specific mutation of the Tsc2 gene (murine equivalent of the human gene associated with tuberous sclerosis, a genetic disorder highly comorbid with ASD). The mutation is introduced in all cells expressing GAD2, enzyme responsible for producing the inhibitory neurotransmitter GABA. The aim of my project was to evaluate tissue specificity of Tsc2 mutation in the new model by 1) confirming that the mutation is present in GABAergic neurons, and 2) identifying affected cells outside the brain. The study was conducted on mice with cell type-specific Tsc2 knockout (KO) and wild-type conspecifics (WT). All mice expressed tdTomato reporter gene in Gad2-positive cells. Brains and selected non-neural tissues were isolated, fixed, sectioned and analysed with the use of fluorescent microscopy to identify cells affected by the mutation. As expected, GABAergic inhibitory neurons are affected by the mutation. However, I also identified affected cells in numerous non-neural tissues, including sensory organs, gastrointestinal system, and kidney. Moreover, mice with the conditional Tsc2 knockout have enlarged brains, and one of them developed kidney tumours. I have identified multiple cell populations affected by the Tsc2 mutation in the new ASD model. These findings should be taken into account while planning and analysing further research utilising the new strain: the Tsc2 mutation may have an effect not only on the function of inhibitory neurons, but also, among others, on sensory perception, renal, and gastrointestinal function.

NEUROBIOLOGICAL SESSION

Gabriela Stopka
Aleksandra Trenk, Anna Gugula, Kinga Przybylska, Aleksandra Nogaj, Andrew L. Gundlach, Anna Blasiak

Department of Neurophysiology and Chronobiology, Institute of Zoology and Biomedical Research, Jagiellonian University, Krakow, Poland; Doctoral School of Exact and Natural Sciences, Jagiellonian University, Krakow, Poland; The Florey Institute of Neuroscience and Mental Health, and Florey Department of Neuroscience and Mental Health, The University of Melbourne, Parkville, Victoria, Australia

RLN3/RXFP3 signaling in the ventral dentate gyrus – a novel neuronal substrate in control of stress and anxiety related processes

The ventral hippocampus (vHPC) is a crucial brain structure involved in processing contextual information and controlling stress and anxiety. Particularly, the ventral dentate gyrus, part of the vHPC, is strongly implicated in anxiety disorders. The vHPC remains under the control of innervation from the brainstem nucleus incertus (NI), whose neurons display remarkable sensitivity to stress. In addition, the NI is the main source of the neuropeptide relaxin-3 (RLN3), and activation of its receptor, RXFP3, modulates stress- and anxiety- related behaviours. Importantly, RXFP3 is mainly expressed on vDG interneurons that control vDG granule cells (GCs) activity. However, the role of the RLN3/RXFP3 signaling in shaping the activity of the vDG remains largely unknown. Therefore, this study focused on the impact of RLN3 on GCs excitability ex vivo and the anatomical features of NI – vDG innervation. The electrophysiological whole-cell patch clamp method was used to determine the effect of RLN3 on GCs excitability. Furthermore, viral-based neural tract-tracing and fluorescence in situ hybridization were conducted to define the neurochemical features of NI – vDG inputs. The whole-cell patch-clamp studies revealed modulatory effects of RLN3 (100 nM) on GCs excitability. Viral-based neural tract-tracing and fiber density analysis revealed co-localization of RLN3-positive and NI-originating fibers, distributed across individual layers of the vDG. Moreover, fluorescence in situ hybridization showed that RXFP3 mRNA is expressed by vDG parvalbumin- and somatostatin-positive interneurons. In conclusion, our data suggests that RLN3 originating mainly from the brainstem NI can modulate GCs activity through activation of RXFP3 on specific hilar interneurons. The obtained electrophysiological and anatomical findings indicate possible role of RLN3/RXFP3 signaling within the vDG in control of anxiety and stress related behaviours.
Funding: National Science Centre, Poland grants UMO-2018/30/E/NZ4/00687, UMO-2023/49/B/NZ4/01885 and MiniGrant2023-ID.UJ.

NEUROBIOLOGICAL SESSION

Andrzej Łach
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Neuroprotective Efficacy of PaPE-1 in Post-Treatment of Hypoxic and Ischemic Injuries: Mechanisms and Therapeutic Potential

Pathway Preferential Estrogen-1 (PaPE-1) is a novel compound designed to target non-nuclear estrogen receptors (ERs), and its neuroprotective effects present a promising path for developing therapeutic strategies for pathologies of nervous system associated with hypoxia and ischemia, such as perinatal asphyxia and ischemic stroke. This study investigates the mechanisms of action of PaPE-1 and further substantiates its effectiveness in mitigating injuries caused by hypoxic and ischemic events. Notably, this study focuses on PaPE-1 effects in post-treatment paradigm, addressing the time-dependent limitations of existing therapies targeting the abovementioned pathologies. In our research we employed an in vitro model of hypoxic/ischemic injury, constituted by subjecting primary neocortical cell cultures to hypoxic or ischemic conditions for 6 hours, followed by 18 hours of reoxygenation with PaPE-1, reflecting the reperfusion phase occurring in vivo. In our findings, administering PaPE-1 six hours post-injury effectively restored parameters disrupted due to hypoxia and ischemia. This included a reduction in cell death, an increase in cell survival, and the restoration of neurite outgrowth. Additionally, PaPE-1 positively influenced neurodegenerative processes, such as neuroinflammation, excitotoxicity and oxidative stress-induced DNA/RNA damage. In hereby work we also prove that the neuroprotective mechanisms of PaPE-1 are linked to the activation of kinases mTOR and MEK1/2, while pathways involving JNK and p38/MAPK remain unaffected. Furthermore, PaPE-1 was able to partially normalise the gene expression of factors related to neuronal damage (such as Mmp2, Mmp9 and Hif1a) and neuroinflammation (such as Il1b and Il10). This data strongly suggest that PaPE-1 is a promising candidate for protecting neurons from hypoxic and ischemic damage, even when treatment is initiated several hours after the initial injury.

NEUROBIOLOGICAL SESSION

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Selective activation of non-nuclear estrogen receptors partially reverses amyloid-β-induced autophagy deficits in primary neuronal cell cultures

Alzheimer's disease (AD) is characterized by amyloid-β (Aβ) accumulation and tau hyperphosphorylation, leading to cognitive decline and memory loss. Estrogen receptors (ERs) are recognized for their neuroprotective role. Recent research distinguishes the activation of nuclear ER from non-nuclear ER, with the latter being a safer option that avoids the cardiovascular and cancer risks associated with nuclear ERs. Apoptosis and autophagy, along with their interaction, are crucial in AD pathology. We previously demonstrated that PaPE-1, a selective activator of non-nuclear ER pathways, effectively counteracts Aβ-induced apoptosis. However, its impact on autophagy has not been explored. We modeled AD using mouse primary neocortical cell cultures exposed to Aβ oligomers for 24 hours. PaPE-1 was then administered for 6 hours. We assessed the effects of Aβ and PaPE-1 on autophagy. Autophagy inhibitors (SBI-0206965, Spautin-1, MRT68921, and Temsirolimus) were used to evaluate the effects of autophagy reduction on Aβ-induced caspase-3 elevation. CYTO-ID staining was employed to analyze autophagosome and autophagolysosome formation, while western blot and qPCR were used to measure protein and mRNA expression of autophagy-related factors ATG5/Atg5, NUP62/Nup62, AMBRA1/Ambra1 and MAP1LC3AB/Lc3a, Lc3b. Our findings indicate that inhibiting autophagy-related factors Spautin-1 and MRT68921 increases apoptosis, highlighting the interplay between these processes in the utilized model. Aβ exposure reduced autophagosome and autophagolysosome formation, while PaPE-1 partially reversed this effect. Additionally, Aβ caused dysregulation of autophagy evidenced by decreased MAP1LC3AB levels, which PaPE-1 effectively upregulated, along with increases in Atg5, Ambra1, and Lc3b expression. Aβ induces autophagy deficits, and in the utilised model autophagy inhibition may exacerbate apoptosis. Crucially, PaPE-1 partially counteracts Aβ-induced autophagy deficits, positioning it as a promising neuroprotective strategy against amyloid-β toxicity.

This research was funded by National Science Centre of Poland, grant number 2020/39/NZ7/00974

NEUROBIOLOGICAL SESSION

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The role of lipid metabolism and circulating miRNAs in the intergenerational transmission of the effects of parental adverse childhood experiences

Adverse childhood experiences (ACE) are associated with detrimental effects on adult physical and mental health. Emerging evidence suggests that behavioral and metabolic perturbations associated with ACE are transmissible across generations. However, the exact mechanisms underlying the effects of ACE on germline for such intergenerational transmission of symptoms remain elusive. Synergizing parallel investigation in a mouse model of ACE induced via unpredictable maternal separation and unpredictable maternal stress (MSUS) and human ACE cohorts, we hypothesize that lipid-associated microRNAs (miRNAs) communicate the effects of ACE to the germline for intergenerational transmission. Small RNA sequencing (sRNA-seq) followed by RT-qPCR was performed on human ACE cohorts. Parallel investigations in mice involved intergenerational phenotyping after MSUS, as well as lipid-modifying interventions high-fat diet (HFD) and voluntary exercise (VE). Phenotyping included the elevated plus maze test, novel object recognition test and glucose tolerance test. Furthermore, miRNA carriers were isolated from each group and injected (intravenous tail injections) into male control and MSUS mice, which were then bred with naïve females. sRNA-seq revealed overlapping miRNA changes in the serum collected from children, as well as the sperm from adult men with a history of ACE. Importantly, the differentially expressed miRNAs were closely connected to lipids, both in terms of their transport and regulatory functions. Offspring of both MSUS- and HFD-exposed male mice showed impaired glucose tolerance and behavioral deficits. Notably, cross-injections from MSUS into control mice recapitulated the offspring phenotype associated with MSUS, whereas, cross-injections from VE mice into MSUS mice partially mitigated the metabolic phenotype associated with MSUS. Together, these studies provide proof-of-concept for the role of lipids and circulating miRNAs in communicating the effects of ACE to the germline for intergenerational sequelae.

CLINICAL SESSION

Redwan Jabbar
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Virtual reality-based exposure intervention as a digital pre-med to alleviate anxiety and pain in patients undergoing spine surgery: A Randomized Controlled Trial

The overall prevalence of pre-operative anxiety varies and is reported in a range of 60-80% while other studies showed a wider range of 11-80%. It occurs as a compatible response to surgical encounters and stress, which might occur anytime pre-operatively. Pre-operative stress-related signs are associated with a potential change in patients' psychological responses and hemodynamic parameters, including increased blood pressure and heart rate, that may pose a danger to the patients' health. Thus, these changes might affect the quality of anaesthesia and demand for analgesics, post-operative pain, and possible delirium. Research studies have shown that addressing pain by therapeutic interventions (i.e., by interacting with immersive virtual reality) results in slower response to incoming pain signals. Therefore, controlled pre-operative anxiety and decreased pain reduces hospital stay lengths, healthcare costs, and post-operative complications. The study included 20 patients aged approximately 52 within virtual reality (VR) group and 56 within control group (14% Female and 86% Male). All participants within VR group qualified for spine surgery exposed to a preoperative 10-minute 360˚ video with immersive audio-visual environment describing pre-operative and post-operative experience through measuring STAI-S, VAS, and PSS-10. And postoperatively, STAI-S, VAS and EVAN-G. Statistically significant correlations were observed between preoperative and postoperative VAS (p-val: 0,795), with preoperative anxiety (p-val: 0,279)), depression (p-val: 0.739), In this study, patients with preoperative VR exposure revealed better VAS scores and better functional outcome measured by postoperative satisfaction questionnaire (EVAN-G) ranging between 88-96 among all participants. The results of this study suggest that postoperative pain, anxiety and functional outcome could be improved by certain selected psychosocial measurements. Therefore, further studies to address these associated psychosocial factors may help spine surgeons to better manage patients with overlapping spinal diseases and poor postoperative functional outcome and pain.

CLINICAL SESSION

Ignacy Stachura
Aleksandra Pogoda-Wesołowska, Adam Stępień, Jacek Staszewski, Marzena Maciągowska-Terela
University of Warsaw

Impact of reconstitution therapies – cladribine tablets andalemtuzumab – on the atrophy progression among patients with multiple sclerosisl

The overall prevalence of pre-operative anxiety varies and is reported in a range of 60-80% while other studies showed a wider range of 11-80%. It occurs as a compatible response to surgical encounters and stress, which might occur anytime pre-operatively. Pre-operative stress-related signs are associated with a potential change in patients' psychological responses and hemodynamic parameters, including increased blood pressure and heart rate, that may pose a danger to the patients' health. Thus, these changes might affect the quality of anaesthesia and demand for analgesics, post-operative pain, and possible delirium. Research studies have shown that addressing pain by therapeutic interventions (i.e., by interacting with immersive virtual reality) results in slower response to incoming pain signals. Therefore, controlled pre-operative anxiety and decreased pain reduces hospital stay lengths, healthcare costs, and post-operative complications. The study included 20 patients aged approximately 52 within virtual reality (VR) group and 56 within control group (14% Female and 86% Male). All participants within VR group qualified for spine surgery exposed to a preoperative 10-minute 360˚ video with immersive audio-visual environment describing pre-operative and post-operative experience through measuring STAI-S, VAS, and PSS-10. And postoperatively, STAI-S, VAS and EVAN-G. Statistically significant correlations were observed between preoperative and postoperative VAS (p-val: 0,795), with preoperative anxiety (p-val: 0,279)), depression (p-val: 0.739), In this study, patients with preoperative VR exposure revealed better VAS scores and better functional outcome measured by postoperative satisfaction questionnaire (EVAN-G) ranging between 88-96 among all participants. The results of this study suggest that postoperative pain, anxiety and functional outcome could be improved by certain selected psychosocial measurements. Therefore, further studies to address these associated psychosocial factors may help spine surgeons to better manage patients with overlapping spinal diseases and poor postoperative functional outcome and pain.

CLINICAL SESSION

Maja Wójcik
Agata Chrobak, Arkadiusz Dudek , Aleksandra Bolek, Paweł Kubicki, Lucyna Pomierny-Chamioło, Michał Wierzchoń, Justyna Hobot, Maciej Pilecki, Grzegorz Kazek
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Linking aspects of cognitive functioning and neuroprotein plasma levels in psychedelic users

The need to research the long-term influence of psychedelics on neurobiological and cognitive functioning of their users stems from their increasingly widespread use and significant gaps in knowledge about their effects. Psychedelics act mainly as agonists for the 5-HT2A receptors, affecting serotonergic transmission and therefore – numerous biological processes. The serotonergic system plays a crucial role in various cognitive aspects such as memory, attention, spatial navigation, and decision-making. The influence of psychedelics on various proteins that are of essential importance in neurobiological functions and their links to cognitive functioning remain unclarified, especially in naturalistic users (outside of the laboratory context). Accordingly, the aim of the study was to examine the cognitive functions of naturalistic psychedelic users and the levels of selected neural proteins, along with analyzing their interrelations. We also aimed to check whether effects from psychedelic clinical studies would replicate on naturalistic users. Cognitive functions were measured in 46 psychedelics users using the Cogstate battery of behavioral tests (GML, GMR, IDN, OCL, SETS, TWOB, DET). Protein analyses (BDNF, NRG1B1, PDGF-AB) were performed in blood plasma using xMAP technology with simultaneous quantitative determination of multiple proteins in a single sample. Then, Spearman's non-parametric correlations with confidence intervals bootstraped (10 thousand times) were conducted for all variables and with control for age, cannabis use and other psychoactive substances use. Some cognitive function parameters showed significant correlations with the protein concentrations: GMR with BDNF, PDGF-AB, and NRG1B1, SETS correlated with BDNF and PDGF-AB, and OCL with BDNF. No statistically significant differences were found between the users and non-users group in terms of the results of cognitive function tests. The number of lifetime psychedelics uses correlated only with BDNF levels. This study is the first to demonstrate the links between these proteins and the cognitive tests of the Cogstate battery. Our results indicate that clinical and animal studies can't be that highly extrapolated on naturalistic users of psychedelics. There are many differences between people using naturalisticly and people recruited for clinical studies. This has significant clinical implications for healthcare professionals, especially psychiatrists and psychotherapists. They also show that psychedelics might be relatively safe in terms of long term changes in cognitive functioning, but further research is required to confirm these findings.

COMPUTATIONAL SESSION

Agata Gut
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Analysis of the relationship between cerebral autoregulation and arterial baroreceptor sensitivity

Cerebral autoregulation (CA) maintains adequate cerebral blood flow (CBF) in response to fluctuations in mean arterial blood pressure (ABP). The autonomic nervous system (ANS) helps regulate blood pressure, which in turn influences CBF. Despite intensive research, the link between CA and ANS remains a subject of ongoing debate. Our study aims to investigate this relationship in healthy subjects at rest. ABP was measured non-invasively using photoplethysmography, and cerebral blood flow velocity (CBFV) was assessed using transcranial Doppler ultrasonography in healthy young volunteers (approval: KB-179/2023/N). Data were recorded over a 5-minute resting period in the sitting position. CO2 levels were controlled during measurement. Baroreflex sensitivity (BRS), which describes a part of the ANS function, was estimated using pulse interval variability and systolic pressure variability in the time domain (xBRS), as well as using time-frequency (TF) representation (BRSTF) in the low-frequency range (0.04–0.15 Hz). CA was assessed using transfer function phase shift (PS) and gain between slow-wave oscillations (0.02-0.07 Hz) in CBFV and ABP. The relationships between analysed metrics were assessed using Spearman correlation coefficient (rS). This work was supported by the National Science Centre, Poland (grant no UMO-2022/47/D/ST7/00229). 21 subjects were included in the study (male/female: 38%/62%; median age [Q1-Q3]: 23 [21-25] years). Gain correlated significantly with BRSTF (rS=0.56, p=0.018) and xBRS (rS = 0.52, p = 0.033), indicating that poorer CA (i.e. smaller suppression of CBFV changes in response to ABP fluctuations) is associated with higher BRS (i.e. worse ANS function). A decrease in PS (i.e. worse CA) was also observed with increasing xBRS and BRSTF, but these associations were not statistically significant (rS = 0.20 and rS= –0.16, respectively). Our preliminary findings suggest a reciprocal relationship between CA and BRS. Further research involving physiological stimuli and a larger group of subjects is needed to confirm those findings.

COMPUTATIONAL SESSION

Monika Najdek
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Wrocław University of Science and Technology

The relationship between neuroparameters and autonomic nervous system metrics in traumatic brain injury patients using canonical correlation analysis

Paroxysmal sympathetic hyperactivity (PSH) is a syndrome characterised by increased activity of the sympathetic nervous system following traumatic brain injury (TBI). Canonical Correlation Analysis (CCA) is a statistical technique that measures relationships between two sets of variables. Our aim was to investigate whether CCA of autonomic nervous system metrics: heart rate variability in the low-frequency range (HRV LF) and heart rate (HR) and neuroparameters: intracranial pressure (ICP) and pressure reactivity index (PRx) can differentiate between patients with likely and unlikely PSH. The study was approved by the bioethical committee of Wroclaw Medical University (KB-133/2023) and supported by the National Science Centre, Poland (UMO-2022/47/D/ST7/00229). Signals of arterial blood pressure and ICP in 52 severe TBI patients, monitored for 24 hours, were retrospectively analysed. PSH diagnosis was performed using the Clinical PSH Assessment Measure. Patients were divided into cohorts of 5 and 47, corresponding to likely and unlikely PSH. Signal variables, including the amplitude, phase, and frequency of the main signal component, as well as coefficients of second-degree polynomial approximation and spectral entropy, were computed in 6-hour window with a 2-hour step. The first five components obtained by CCA were analysed. The first canonical correlations for ICP vs HRV LF, PRx vs HRV LF, ICP vs HR and PRx vs HR were 0.78, 0.82, 0.74, and 0.72, respectively, in the likely PSH group, compared to 0.27, 0.27, 0.27, and 0.41, respectively, in the unlikely PSH group. The variables that had the greatest impact on canonical variates within these groups were the amplitude of the main signal component and the coefficients of second-degree polynomials. The relationship between ANS metrics and neuroparameters, as analyzed using CCA, may significantly differ between patients with and without PSH. Further study on larger groups are needed to confirm these observations.

COMPUTATIONAL SESSION

Emilia Kaczmarczyk
Maciej Kamiński
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Comparative Analysis of Alpha Rhythm Propagation in EEG Signals: Evaluating PCMCI+ versus Granger Causality Algorithms

This research aims to investigate the propagation of the alpha rhythm in EEG signals using the PCMCI+ algorithm and to compare its effectiveness with Granger causality-based algorithms. The study focuses on how these algorithms perform in detecting causal relationships at different sampling frequencies (128 Hz, 512 Hz, 2048 Hz) and evaluates their ability to identify known causal relationships in both artificially generated and real EEG data. By comparing the two methods, we seek to determine whether PCMCI+ offers advantages in accuracy and reliability over traditional Granger causality approaches in analyzing EEG signal propagation. This research uses the PCMCI+ algorithm to analyze the propagation of the alpha rhythm in EEG signals. PCMCI+ is a graph-based method that identifies causal relationships by iteratively performing conditional independence tests to build a Bayesian network. The results are compared to those from Granger causality-based algorithms, which assess causality based on the predictive power of past values. The results indicate that the PCMCI+ algorithm can effectively identify some causal relationships in the propagation of the alpha rhythm at different sampling frequencies without time lag. In artificially generated data, the detected causal dependencies remained consistent across all sampling frequencies. However, in real EEG data, these dependencies were more dependant on the sampling rate due to noise. Apart from that, some granger causality test haven't been conducted yet at this moment. The preliminary findings suggest that the PCMCI+ algorithm may have advantages over Granger causality in detecting causal relationships in EEG signals, particularly at lower sampling frequencies. However, the study is ongoing, and more tests are needed to confirm these results. As the research is not yet complete, it is currently not possible to draw definitive conclusions about the effectiveness of PCMCI+.

COGNITIVE SESSION

Tymon Rochowski
Maciej Haman
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Mental arithmetic is intrinsically linked with spatial attention

This study explores the phenomenon of reversed Operational Momentum (OM) within the context of an Inhibition of Return (IOR) task, focusing on nonsymbolic arithmetic. OM is the tendency to overestimate outcomes in addition or underestimate them in subtraction, often associating these operations with the right or left side of space, respectively. Mental arithmetic has been linked to shifts in spatial attention along the Mental Number Line (MNL). A key marker of spatial attention is IOR, where individuals respond more slowly to stimuli in locations they have previously attended to. In some experimental setups, OM effects are reduced or even reversed, suggesting that IOR might play a role in mental arithmetic. This study aims to combine traditional OM and IOR designs to rigorously test the attentional hypothesis in arithmetic. Twenty-eight participants solved nonsymbolic arithmetic tasks involving both addition and subtraction. Some trials were modified by adding a flashing lateral cue. In each trial, a group of dots was shown falling into a box. In addition trials, a second group of dots fell into the box; in subtraction trials, dots fell out. After the box opened, participants indicated whether the final number of dots was correct. The study identified significant IOR effects on reaction times based on the arithmetic operation. In addition if the outcome was shown 300ms after cue flashing at right, reaction times were relatively slowed down; in subtraction cue at left had the same effect. The influence of IOR on reaction times supports the attentional hypothesis in arithmetic. The IOR effect typically requires two spatially incongruent cues: one cue was a brief screen flash, and the arithmetic operation itself acted as a second cue on the same internal spatially organized numerosity representation. These findings suggest that spatial-numerical representations are crucial in shaping arithmetic processes.

COMPUTATIONAL SESSION

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Disentangling spatio-temporal attention from conscious perception with EEG and a novel behavioral approach

Most studies have failed to dissociate exogenous attention and perceptual awareness on the behavioural (e.g. reaction times) and neural level (e.g. ERP components). This may stem from (1) the fact that current behavioural measures are not sensitive enough to capture subtle changes in, e.g., the time course of perception and (2) the problematic contrastive approach widely used in the analyses of electrophysiological data. The current work aimed to address these problems by using a novel measure of consciousness – the LAG. The LAG task captures the subjective onset of awareness of a continuously changing stimulus. It has been confirmed that LAG values are not redundant with reaction times, and that the variance in LAG values is not due to subjects' poor precision in estimating stimulus length. Here the LAG task was combined with an attentional cueing paradigm during which participants' whole-head 64 channel EEG was recorded. Previous research findings were replicated, confirming a strong link between exogenous attention and conscious perception. LAG ratings were more precise for right visual field target stimuli, while reaction times were quicker for left-side target stimuli. The time interval between cue and target stimulus was found to be the strongest predictor in all conditions. Importantly, it was found to explain more variability for reaction times than for LAG indicating a potential dissociation in the time course of attention-related processes and conscious perception. In the EEG, attentional effects were observed in both early and late time windows, whereas the LAG tended to correlate with EEG amplitude only in the late time windows. The results indicate several ways in which attention and conscious perception can be dissociated on the behavioural and neural level. Further analysis should concentrate on EEG latencies to describe the temporal dynamics of attention vs consciousness in even more detail.

COGNITIVE SESSION

Agnieszka Mankiewicz, Bartosz Miklaszewski
Joanna Rączaszek-Leonardi, Katarzyna Chyl, Julian Zubek, Agnieszka Dębska
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The Neural Basis of Symbolic Representations: Insights from fMRI

The ability to use symbols is a key feature of human cognition. This study investigated neural correlates underlying the processing of abstract linguistic symbols using C.S. Peirce's semiotic framework (Hartshorne et al., 1931). The experiment examined brain-level differences in processing three types of newly created signs: icons, indexes, and symbols, differentiated by their sign-object link – through resemblance, pointing attention, or conventional association. We explored whether brief exposure to new abstract symbols is enough to create the neural underpinnings for orthographic representation and whether this process depends on the newly acquired orthography level. The brain activity during the artificial orthography learning task was investigated with functional magnetic resonance in 40 Polish adults (Mean age = 21,38; SD = 2,34). A short language localizer task was performed to identify the parts of the brain responsible for processing orthographic and phonological information in each subject. During the experimental task, participants were first shown abstract shapes and heard unfamiliar Armenian words separately (icons), followed by both modalities presented together (indexes), and finally presented simultaneously according to predefined rules (symbols). After scanning, participants evaluated auditory visual stimulus combinations in a test to assess learning effects. Reading skills, attention, and working memory were also measured through onsite tests. We have obtained preliminary results summarizing activations for icon signs in visual and auditory modalities, along with activity from pre-known conventional symbols. Analysis of results for previously unknown indexes and symbols acquired during the task is still in progress. Based on the results, activations for newly introduced icons do not differ from simple visual or auditory stimuli responses. The familiar symbols activate a much broader set of structures, that apart from regions activated by icons, involve areas belonging to the language network. The visual and auditory symbols selectively activate separate language processing hubs.

POSTER SESSIONS

NEUROBIOLOGY SESSION

Liliana Kozłowska
Justyna Naworcka
University of Łódź

Neurobiological effects of essential oils

Essential oils (EOs) are oily liquids produced by plants, containing volatile chemical compounds responsible for their odour. They have been used in folk medicine since ancient times in treating various diseases. They have shown neuropharmacological properties such as nootropic, sleep improvement, anti-anxiety and depression, anti-dementia, analgesic effect, anti-epileptic, neuroprotective. The neurobiological effects come from activation of the olfactory receptors on a nasal olfactory epithelium by the component of EOs. The stimulation of olfactory nerves and transmission of a signal to the central nervous system – hypothalamus, limbic system, and prefrontal cortex, can modulate parameters such as blood pressure, muscle tone, pulse rate, brain wave activities, and cortisol serum levels with associated psychological effects. Some EOs have also shown the ability to induce neurite outgrowth. EOs are considered as a potential tool in the treatment of mental illnesses such as depression, anxiety or neurodegenerative diseases. However, more research is needed to prove the EOs pharmacological efficacy in the human nervous system, which may enable the development of essential oil-based drugs.

NEUROBIOLOGY SESSION

Karolina Raczek
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Chronotypological aspect of emotional processing in sleep deficit states

Human cyclic functioning is regulated by three clocks: social, sundial, and internal (biological). The biological clock is driven by internal processes at cellular and behavioral levels, with genetic and environmental factors influencing individual synchronization with the light-dark cycle. This variation is described as chronotype (morning, intermediate, evening), which determines peak activity times and preferred sleep schedules. Evening chronotypes and sleep deficits have been linked to an increased risk of mental disorders, though the mechanisms remain unclear. This study examined the impact of sleep deficits (chronic deprivation—5 days/5 hours, acute deprivation) and chronotype (assessed via the KCh 2.0 questionnaire) on emotional processing (responses to emotional stimuli). Twenty-eight healthy young participants (16 women, mean age 23.6±3.7) were exposed to emotional and neutral audiovisual stimuli while undergoing MRI scans (MAGNETOM Skyra 3T). Data were collected over 10 minutes, with participants' subjective feelings assessed using PANAS, CHICa, and KSS questionnaires. Daily activity was tracked with actigraphs (MotionWatch8, Camntech Ltd.). Data pre-processing was conducted with fMRIprep (ver. 23.2.0), and post-analysis with AFNI (ver. 21.3.04). ANOVA was used to identify clusters showing differences across conditions, with a statistical threshold of p=0.05. In summary, our results show that positive affect decreases and negative affect increases after sleep deprivation, with evening chronotypes particularly affected after acute deprivation. Functional MRI indicated that emotional processing, specifically the feeling of being moved, significantly deteriorated only during acute sleep deprivation, linked to reduced activity in brain regions responsible for empathy. These effects may contribute to social isolation and mental health issues like anxiety and depression. Understanding the role of chronotype in emotional processing under sleep deficit conditions, especially given the prevalence of chronic sleep deprivation in evening types, may lead to individualized strategies to mitigate the negative effects associated with this chronotype. Funding: National Science Center No. 2018/29/B/HS6/01934.

NEUROBIOLOGY SESSION

Gabriela Czerniak
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Jagiellonian University

Unveiling Anxiety Pathways: The Role of Nucleus Incertus and Interpeduncular Nucleus in Regulating Ventral Dentate Gyrus

The ventral hippocampal dentate gyrus (vDG) plays a pivotal role in regulating stress, anxiety, and social interactions. The vDG has a dense innervation from the highly stress-sensitive brainstem nucleus incertus (NI) and midbrain interpeduncular nucleus (IPN). The neuropeptide relaxin-3 (RLN3) is primarily synthesised by the nucleus incertus (NI) and activates the relaxin-3 cognate receptor RXFP3 in the vDG, which has been shown to induce anxiety and social avoidance. Nevertheless, the neuronal mechanisms underlying RLN3/RXFP3 signalling in the ventral hippocampus (vHP), as well as the neurochemical characteristics of NI neurons innervating vDG, remain underexplored. Similarly, the nature of the IPN-vDG connection remains unknown. Therefore, to elucidate the role of this pathway fluorescent retrograde tracers were used in stereotaxic injections into the vHP of Sprague Dawley rats. Multi-electrode array (MEA) ex vivo recordings were conducted to assess the effects of RLN3 on the vDG network activity. A greater contribution from NI RLN3-positive neurons innervating the vHP was observed compared to those containing pro-cholecystokinin, with their projections predominantly ipsilateral. Neurons innervating the vHP were found in the lateral, caudal, rostral, and dorsomedial subnuclei of the IPN, which remained under the control of NI. RLN3 was found to exert both inhibitory and excitatory effects on the vDG network activity. These observations allow to conclude that the vDG remains under the control of both NI and IPN, and provide new insight into the neurochemical and neurophysiological mechanisms underlying anxiety and social interactions.

NEUROBIOLOGY SESSION

Natalia Siwecka
Grzegorz Galita, Zuzanna Granek, Wojciech Wiese, Wioletta Rozpędek-Kamińska, Ireneusz Majsterek
Medical University of Lodz

Neuroprotective effect of JNK inhibition in 6-OHDA model of Parkinson's disease

Parkinson's disease (PD) is the second most common neurodegenerative disorder marked by the death of dopaminergic neurons. The molecular pathogenesis of PD is complex, but it is known that the disease might be initiated by exposure to neurotoxins like 6-hydroxydopamine (6-OHDA). 6-OHDA induces dopaminergic neurodegeneration in the mechanism involving endoplasmic reticulum (ER) stress, oxidative stress and apoptosis. JNK is a major pro-apoptotic kinase involved in the pathogenesis of many diseases, and it was also reported to play a critical role in PD. Therefore, the present study aimed to investigate the effect of pharmacological JNK inhibition in the cellular, 6-OHDA-based model for PD. The study was conducted on SH-SY5Y cells differentiated with retinoic acid. Neurodegeneration was induced by treatment with 6-OHDA at EC50. Cells were treated with JNK V inhibitor either before or after 6-OHDA-induced damage. The mechanism of JNK V-induced neuroprotection was assessed in terms of cell morphology, cell viability, mRNA and protein expression levels of the specific ER stress markers. Inhibition of JNK partially restored cell morphology and significantly improved cell viability, even when the inhibitor was applied after 6-OHDA-induced damage. Gene expression analysis revealed a significant downregulation of MAPK10, XBP1 and DDIT3 by JNK inhibitor, and Western blot analysis showed that the neuroprotective effect of JNK V involves downregulation of p-eIF2α, p-JNK and CHOP levels, and upregulation of XBP1s. The results obtained indicate the neuroprotective effects of pharmacological JNK inhibition against 6-OHDA-induced damage in differentiated SH-SY5Y cells. Thus, JNK inhibitors could potentially be applied for the selective treatment of PD. This work was supported by grant no. 2021/43/O/NZ5/02068 from the National Science Centre, Poland.

NEUROBIOLOGY SESSION

Kinga Kruszewska

Jagiellonian University

Neurobiological impacts of Duchenne muscular dystrophy: a theoretical review

Duchenne muscular dystrophy (DMD) is an X-linked recessive disorder caused by mutations in the dystrophin gene, leading to progressive muscle and heart weakness, primarily affecting boys. Dystrophin has at least eight isoforms: three full-length (Dp427m, Dp427p, Dp427c) and five shorter isoforms (Dp260, Dp140, Dp116, Dp40, Dp71), most of which are expressed in the brain. While research has largely focused on the muscular and heart effects of DMD, emerging evidence underscores significant brain involvement. Based on current research, this work aims to synthesize a neurocognitive profile of DMD patients. Cognitive impairments in DMD patients are non-progressive and independent of muscular dysfunction. DMD patients exhibit a one-standard-deviation shift in full-scale IQ compared to the general population. They also have a higher prevalence of neurological impairments. The approximate prevalence of some of them in DMD are as follows: epilepsy 2-12%, autism 20%, depression 17-27%, anxiety 24-29%, OCD 5-14%, ADHD 12-32%, reading disability 40-50%. DMD patients also show short- and long-term memory deficits. These symptoms are often clustered, as over a third of boys show at least two comorbidities. Patients with more distal mutations, lacking Dp140 and/or Dp71, have a particularly high incidence of neurodevelopmental disorders, intellectual disability, and working memory deficits. However, emotional and behavioral deficits did not differ based on the proximity of the mutation. Animal models of DMD also show neuromotor disturbances and maladaptive stress responses. Several studies find no gross CNS structural differences while other researchers do identify disturbances. Among these are: slight cerebral atrophy, EEG abnormalities, larger head circumference, reduced glucose metabolism, reduced grey matter volume and cerebral blood flow as well as altered structural and functional connectivity. Both animal and human studies on DMD have consistently identified molecular abnormalities primarily located in the hippocampus, amygdala, and cerebellum.

NEUROBIOLOGY SESSION

Aleksandra Bramorska
Wiktoria Podolecka, Taisiia Prosvirova, Mark Jeremy Hunt
University of Łódź

How does the nasal epithelium impact the generation electrophysiological rhythms in the olfactory bulb of rats?

Changes in olfaction are emerging as early warning signs of several major neurological diseases, such as Alzheimer's disease. Neurological diseases are also associated with aberrant brain rhythms. Olfactory sensory neurons deliver input from the nasal epithelium to the olfactory bulb (OB). Here, we examine the role of sensory input from the nasal epithelium in the generation of electrophysiological rhythms in the OB. Rats were implanted with electrodes in the OB and post-surgery gadolinium or saline was infused bilaterally to both nares. Olfactory function was assessed using a hidden cookie test accompanied by local field potential recordings at the end of each session. Olfactory marker protein (OMP) levels were examined at days 5 and 15 post infusion. We found rats infused with gadolinium took longer to find the hidden cookie, compared to saline controls, an effect that lasted around 10 days. Analyses of wake-related LFPs in the OB revealed reduced amplitude of respiration rhythm (1-10 Hz) in gadolinium-infused rats which correlated with impaired performance in the hidden cookie test. Gadolinium infusion was associated with reduced OMP staining in the nasal epithelium at day 5 suggesting reduced drive onto the OB neurons was responsible for this effect. Although wake-related OB LFPs had reduced in amplitude following gadolinium infusion to the nares, during slow-wave sleep large amplitude slow-waves were present in the OB at equivalent amplitude to saline-infused rats. We conclude that olfactory sensory neurons in the nasal epithelium most likely drive wake-related rhythms in the OB in a bottom-up manner, but during slow-wave sleep this is dramatically shifted and top-down drive of slow-waves prevails.

NEUROBIOLOGY SESSION

Izabela Szpręgiel, Agnieszka Bysiek

Maj Institute of Pharmacology, Polish Academy of Sciences

Is neurotoxic effect of psilocybin dependent on the dose?

Psylocybin as selective agonist of 5-HT2A receptor seems to exhibit rapid antidepressant and anxiolytic effect in comparison to currently used antidepressant drugs. The therapeutic properties of psilocybin depend on doses used and time after administration, however there is no data regarding the neurotoxic effect of psilocybin on brain regions. The aim of this study was to investigate the effects of different doses of psilocybin on possible genotoxic damage to the brain. The study was conducted on naive male Wistar-Han rats. The animals were treated with single (0.6, 2 and 10 mg/kg) dose of psylocybin. Ketamine (10 mg/kg) and MDMA (10 mg/kg) were used in this test as a comparators. Genotoxicity was evaluated 7 days after drugs administration in tissue homogenates from frontal cortex and hippocampus using Comet Assay. The results of the experiment showed that psilocybin differentially produce DNA damage and this effect depends on the dose. Psilocybin at the dose of 0.6 and 2 mg/kg did not produce DNA damage by reactive oxygen species (ROS) in nuclei of the rat frontal cortex and hippocampus. However, psilocybin at a higher dose of 10 mg/kg as well as ketamine and MDMA significantly increased oxidative stress in both brain regions. Psilocybin dose-dependently induces neurotoxic effects in the brain. The observed genotoxic effect induced by higher doses of psilocybin is most likely related to excessive release of glutamate and dopamine which may induce excitotoxicity resulting in oxidative stress and neuronal atrophy. Low dose of psilocybin appear to be harmless to DNA integrity, which is particularly important in the use of this substance as a potential antidepressant drug. Acknowledgments: This research was funded by National Science Centre grant no. 2020/37/B/NZ7/03753 and statutory funds of the Maj Institute of Pharmacology, Polish Academy of Sciences.

NEUROBIOLOGY SESSION

Zuzanna Kościuk
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Effects of Psilocin and 25I-NBOMe on Changes in Levels of Released Neurotransmitters in the Claustrum

Psychoactive substances belonging to the group of psychedelics (psychoplastogens) show high effectiveness in abolishing depressive and anxiety symptoms, even in cases of drug resistance to classical pharmacotherapy. Their therapeutic properties are due to their effects on neuroplastic processes in the brain, which are related to their action on 5-HT2A receptors. It turns out that the highest density of 5-HT2A receptors is present in one of the subcortical structures, the claustrum. The goal of the experiment is to investigate the role of claustrum in the mechanism of action of serotonergic psychedelics by determining the effects of psilocin and 25I-NBOMe on the neurotransmission and neuronal activity of claustrum following activation of 5-HT2A receptors. The research will utilize a rat model to investigate the role of the claustrum in the mechanism of action of serotonergic psychedelics. Stereotactic surgery will be performed to implant a cannula guide into the claustrum, allowing precise administration of substances. Microdialysis will be employed to collect cerebrospinal fluid, and high-performance liquid chromatography (HPLC) will measure changes in neurotransmitter levels (serotonin, dopamine, norepinephrine, glutamate, gamma-aminobutyric acid, acetylcholine) before and after psilocin (100 µM or 500 µM) or 25I-NBOMe (100 µM or 500 µM) administration. Psilocin is the active form of psilocybin, which has the ability to bind to serotonergic receptors. And 25I-NBOMe is a potent agonist toward 5-HT2A receptors, which are being studied in the experiment. The results show statistically significant increases in the levels of the neurotransmitters after activation of 5-HT2A receptors in the claustrum. The obtained data will allow us to understand better the mechanism of action of psychedelic substances. A definitive determination of which neurotransmitters are released due to activation of 5-HT2A in the claustrum receptors will enable the development of a theory regarding the mechanism of action of psychedelic substances and more precise medical applications. This research was funded by National Science Centre grant no. 2020/37/B/NZ7/03753 and statutory funds of the Maj Institute of Pharmacology, Polish Academy of Sciences

NEUROBIOLOGY SESSION

Anna Szukało
Anna Żochowska, Anna Nowicka
Nencki Institute of Experimental Biology, Polish Academy of Sciences

Gender Differences in Face Processing: An ERP Study

The present study aimed to investigate gender differences in face processing, particularly in relation to self-referential information. While numerous studies have emphasized the prioritization of self-relevant information, the role of gender in this phenomenon remains underexplored, and existing findings are inconsistent. This research examined how men and women process various face types, including their own face, the face of a close person, a smiling face, and a neutral face. Participants were tasked with detecting visual stimuli, and their brain activity was recorded using event-related potentials (ERP). Key ERP components (P100, N200, P3, and Late Positive Potentials – LPP) were analyzed to explore interactions between face type and gender. A two-way analysis of variance (ANOVA) with repeated measures and a between-subject factor was employed to test the hypotheses. The results revealed significant gender differences in face processing. For the early P100 component, both genders showed the highest activation in response to smiling faces, though post-hoc comparisons indicated no significant differences. In the N200 component, women exhibited more negative activation in response to their own face compared to smiling and unknown faces, while men showed no notable differences. For the P3 component, both genders had higher amplitudes in response to their own face than to other face types. Notably, early LPP analyses indicated that women had a stronger response to their own face, whereas men showed heightened activation to their own face in comparison to smiling and unknown faces. Overall, the findings suggest that women process faces, particularly their own and those of close individuals, with greater precision, as evidenced by the P3 and LPP components. In contrast, men displayed a less pronounced self-prioritization effect, implying gender-related differences in the neural mechanisms underlying face recognition.

NEUROBIOLOGY SESSION

Hanna Trebesova

Nencki Institute of Experimental Biology, Polish Academy of Sciences

A Combined Neuropharmacological Approach: From Behavioral Testing to Flow Cytometric Analysis

Neuroscientific research has developed rapidly in recent years, providing new insights into the pathophysiology of several neurodegenerative diseases, neuroinflammatory conditions, and the basis of neurological development. Several neurodegenerative diseases cause locomotor disabilities and mood disorders. Therefore, we need to define behavioral schemes to either predict the diagnosis or recognize mood alterations as a comorbidity in neurodegenerative processes. In addition, neurodegenerative diseases may be related to synaptic dysfunction and toxicity. Several causes of synaptic derangements has been identified such as neurotoxic compounds, oxidative stress, and inflammation. A combined behavioral analysis protocol has been applied to assess anxiety-like and stress disorders. For this purpose mice under various conditions, including age, sex, and drug treatments were used. Furthermore, in order to explore specific aspects, this approach was also applied to some disease models (EAE and G93A mice) in which early onset, features not previously evaluated and clustering of animals were investigated. On the other hand there is a growing need for innovative techniques and methods to find the cause of synaptic dysfunction and toxicity as early as possible and prevent the consequences. Alongside a flow cytometric method was carried out for the investigation of synaptic toxicity on isolated nerve endings. Flow cytometry is widely used to check neuronal death, detect neurotoxic compounds, and analyze synaptic proteins and biomarkers of neurodegenerative diseases. This method has enabled me to analyze synaptic toxicity in various contexts, including the pruning phenomenon. Natural compound have shown anxiolytic-like effects in some behavioral experiments. Additionally a repurposed drug, Niaprazine, has demonstrated sedative and anxiolytic effects in orally treated mice. While through a double staining protocol, a synaptotoxicity was assessed in presence of beta-amyloid and its fragments. The combination of these two approaches in vivo and in vitro could allow us to intervene earlier with pharmacological treatment and highlight common features of neurodegenerative diseases.

NEUROBIOLOGY SESSION

Anik Kumar Das
Anita Cybulska-Klosowicz, Ksenia Meyza, Ewelina Knapska
Nencki Institute of Experimental Biology, Polish Academy of Sciences

Mapping c-Fos expression using the iDISCO technique

The objective was to assess the feasibility of the use of iDisco clearing approach to visualize neuronal activation patterns in the brain of mice subjected to behavioral stimuli. The iDISCO technique enables whole-brain clearing and high-resolution mapping of neuronal activity, making it a powerful and precise tool for studying brain-wide activation patterns in response to behavioural stimuli. In this study, we applied iDISCO combined with c-Fos immunolabeling to map neuronal activation in intact mouse brains following specific behaviours, such as social interaction and food reward. c-Fos, an indirect marker of recent neuronal activity, was detected in cleared brain tissue with utmost precision, allowing for the exact localization of activated neurons. Using light-sheet microscopy, we obtained 3D images of the entire brain, enabling the identification of distinct neuronal populations and circuits across multiple brain regions, including the central amygdala (CeA), a critical structure involved in motivation and reward processing. We demonstrated that this novel method provides an opportunity to visualize functional subdivisions in brain regions, revealing the neuronal correlates of specific behaviours. This method provided an opportunity to visualise functional subdivisions in brain regions, revealing the neural correlates of behaviours related to social and food rewards. The combination of iDISCO and c-Fos mapping presents a novel approach to studying the spatial organization of activated brain circuits, offering insights into the mechanisms underlying complex behaviours. This technique also holds promise for exploring alterations in brain function in models of neurological and psychiatric disorders.

NEUROBIOLOGY SESSION

Taisiia Prosvirova
Aleksandra Bramorska, Wiktoria Podolecka, Mark Jeremy Hunt
University of Warsaw

Characterizing Oscillatory Activity in Rat Brain Regions During Locomotion, Slow-Wave Sleep, and After Ketamine

The study investigated oscillatory activity across different rat brain regions during locomotion (LMA), slow-wave sleep (SWS), and after ketamine. Local field potentials (olfactory bulb (OB), ventral striatum (VS) and prefrontal cortex (PFC)) and EEGs (frontal and parietal) were recorded in freely moving rats (N=12). Data was analyzed during locomotion, SWS and a subanesthetic dose of ketamine (25 mg/kg). Data were analyzed using Python libraries neo, pactools, and scipy. During SWS there was a relative increase in delta power across all brain regions, which in the EEG-P coupled particularly strongly to high gamma (60-100 Hz). In contrast, LMA was marked by a prominent theta peak in the power spectra and theta-gamma coupling in the OB and VS. Ketamine administration was associated with the presence of high-frequency oscillations (130-180 Hz, HFO) in the OB>VS>PFC>EEG-F, and which coupled to theta in all these regions. HFO after ketamine was not obvious in EEG-P. This study shows that distinct patterns of oscillatory activity and cross frequency coupling reflect different behavioral and pharmacological states. Coupling could reflect coordinated neuronal activity across different brain regions during these distinct states.

NEUROBIOLOGY SESSION

Adam Brosnan
Ewelina Knapska
Nencki Institute of Experimental Biology, Polish Academy of Sciences

Behavioral Hierarchies in Mice: Patterns, Causes, and Consequences

This study explores the possibility of modeling social hierarchies in mice within a fully automated, semi-naturalistic testing environment known as Eco-HAB. We aim to determine whether social hierarchies formed in this setting are stable over time and if they are flexibly established across different social contexts. Specifically, we investigate whether a group composed solely of socially dominant/middle/subordinate mice will organise themselves into a ranked order. Findings from this research will shed light on the mechanisms of social hierarchy formation and maintenance, providing valuable insights applicable to broader social and behavioral sciences. Using Ecohab, a system of four interconnected cages, in which chasing behaviour is messured. Chasing is a measure of social dominance in mice. Mice quickly form stable ranked hierachies. However, upon mixing animals, in which all the dominant animals are housed together, all of the middle animals are housed together, and all of the subordinate animals are housed together. The dominant group switched to a territorial way of establishing dominance, whereas middle and subordinate animals retained the ranked hierachy based on chasing behaviour. The study demonstrates that mice rapidly establish a ranked social hierarchy that remains stable over time. This stability is dependent on the presence of different phenotypes within the group, indicating that a diversity of behavioral or physiological traits is necessary for maintaining hierarchical structures. Furthermore, we observed that territoriality can emerge under social pressure, suggesting that environmental and social factors can induce territorial behaviors among mice. These findings enhance our understanding of how social hierarchies are formed and sustained, highlighting the interplay between individual differences and social dynamics in shaping group organization.

NEUROBIOLOGY SESSION

Kamelija Horvatović
Andrea Gelemanović
Faculty of Science, University of Zagreb

Endothelial gene expression modifications linked to periodontal microbes in Alzheimer's disease

Among the various known etiological factors of Alzheimer's disease (AD), periodontitis has recently emerged as a potential contributor to the onset of this disorder. This in silico study aims to determine whether transcriptomic alterations in endothelial cells (EC) triggered by common periodontal pathogens like Fusobacterium nucleatum (FN) or Porphyromonas gingivalis (PG) align with changes observed in the EC of AD patients. RNA-seq datasets GSE222136 and GSE125050 were obtained from the NCBI GEO database. Differentially expressed genes (DEGs) across different conditions (FN, PG, or AD) were identified using the DESeq2 pipeline. The changes detected in Endothelial cells (ECs) infected with FN and PG in vitro were overlapped with transcriptomic hallmarks identified in the brain-derived ECs of AD patients in comparison to healthy controls. The weighted gene co-expression network analysis (WGCNA) pipeline was applied to detect highly correlated gene modules. Functional enrichment analysis was conducted on DEGs and relevant gene modules. A total of 15 gene modules were identified, of which six modules containing 89 key genes were significantly correlated with PG treatment, and four modules with 352 key genes were linked to FN treatment, with the most notable change involving interferon signaling. In PG- and FN-treated ECs, 553 and 834 DEGs were identified, respectively, while 1,384 DEGs were significantly altered in ECs of AD patients. Upon comparison, MIRHG1, SLC24A40, and ABHD13 were found to be commonly upregulated DEGs across all three pathologies, suggesting disrupted RNA interference mechanisms, altered ion channels, and impacted cell adhesion. This comprehensive study uncovered multiple potential gene candidates underlying microbe-driven pathological changes in EC physiology, which could serve as critical contributors to the initiation and/or progression of AD.

NEUROBIOLOGY SESSION

Ermis Ryakiotakis

Nencki Institute of Experimental Biology, Polish Academy of Sciences

Early life adversity and rearing conditions on reward-learning, hierarchical stability and reward system activation on rats

Disruption of mother-child interactions can negatively affect the behavioral and neurological development of the offspring and can act as a potent early-life stressor. Although many studies have reported social and learning deficiencies following early-life stress (ELS), most reports focus on individual animal tasks reared in homogenous groups, disregarding the potential cumulative effects of social instability that characterize ELS animals. We hypothesized that different post-weaning rearing conditions can affect previously reported group reward-learning tasks negatively impacted by ELS. Additionally, we investigated brain activation in areas correlated with poor performance of ELS animals in these tasks. We used a Denial of Expected Reward (DER) early-life manipulation that accurately mimics maternal neglect. To assess the rearing effects on animals undergone ELS we created mixed animal groups with control (CTR) and DER animals immediately after weaning. We designed a grouped 2-phase food anticipation learning task (FA) composed of a context-dependent (CoP) and a cue-dependent learning period (CuP). We assessed the learning rate and hierarchical stability of the animals during these tasks. Finally, we assessed nucleus accumbens (NAc) and ventral Prefrontal cortex (vPFC) activation brain activation by measuring pCREB levels. Mixed rearing with normal animals ameliorated the negative effects of the DER experience on reward association learning, hierarchical instability and abnormal brain activation. Conversely, mixed rearing with DER animals affected negatively reward learning and social status in the CTR animals. We showed that rearing conditions can play an important role on the manifestation of ELS long-term social and cognitive effects. Although resocializing in a normal social environment following weaning can nullify the adverse effects of ELS, animals that have undergone adversity during early age can destabilize the members of their social group. Importantly, we provide evidence that rearing conditions can provide positive or negative feedback loops on the progression of ELS pathology.

CLINICAL SESSION

Emrullah Ecer
Agata Gasiorowska
SWPS University

The Relationship Between Adult Attachment Insecurities and Working Memory Capacity is Mediated by Borderline Personality Traits

People with attachment insecurities may experience impairments in executive functions and be at risk for borderline personality traits. However, until now, no studies have examined the role of borderline personality traits in the relationship between adult attachment insecurities and the risk of working memory deficits, particularly using non-emotional or non-attachment-related stimuli in a non-clinical sample. We used the 2-back task to measure working memory capacity in a Polish sample, while controlling for social desirability bias. We found an indirect effect of attachment anxiety and avoidance on the risk of working memory deficits via borderline personality. We also found that borderline personality traits mediated the relationship between attachment insecurities and the number of correctly matched items. Attachment anxiety was marginally related to the number of correctly matched items, while attachment avoidance was not. Our studies suggest the importance of borderline personality traits as a potential mechanism linking attachment insecurities to working memory capacity regardless of cultural differences and gender.

COMPUTATIONAL SESSION

Gabriela Puchała
Izabela Krejtz
SWPS University

Differences in the distribution of visual attention during the observation of canine silhouettes between experts and novices in cynology: An eye-tracking study

Numerous eye-tracking research has indicated differences in the distribution of visual attention between experts and novices during observing stimuli crucial for a certain field of knowledge (Gegenfurtner et al., 2011). These differences can be noticed in the parameters of various eye-tracking indicators. This study focused on comparing experts and novices in cynology – the science of dogs. 33 individuals participated in the presented study – 7 of them were experts and 26 were novices. The expert group included Judges and Cynological Assistants, as well as Breeders from the Cynological Association in Poland. The novice group included individuals without Judge or Assistant qualifications, whose experience with dogs was not meaningful. Every participant first watched 10 images depicting silhouettes and heads of dogs in a free manner, without any instruction, and then another 10 images of different dogs with a request to assess the dog. The results showed significant differences in the parameters of eye-tracking indicators depending on the level of experience in cynology and the condition of presenting the stimuli. Experts differed from novices, among others, in total viewing time of the stimulus, number of fixations per second and fixation duration. The condition of presenting the image had a significant impact on total viewing time of the stimulus, number of fixations per second, fixation duration and saccade amplitude. There were also significant differences found in the distribution of visual attention to various elements of the dog's head and silhouette depending on the level of experience in cynology and the presentation condition. Significant differences between experts and novices point to a conclusion that similar dependencies can be found in the field of cynology as in different fields of knowledge. This study also showed a major impact of the presenting condition on the parameters of the eye-tracking indicators. it is important to include the influence of the condition in the future research as it seems to be even more meaningful than the level of expertise.

COMPUTATIONAL SESSION

Ewelina Tomana
Nina Härtwich, Reinhard König, Patrick J. C. May, Cezary Sielużycki
Wrocław University of Science and Technology

Area-specific feedforward and feedback connectivity in the human auditory cortex

Despite advances in neuroscience, our knowledge of the human auditory cortex (AC) structure and related connectivity of it areas is constrained by the reliance on noninvasive techniques like magnetoencephalography (MEG). However, interpreting MEG data is challenging due to their complexity. Therefore, to enhance our knowledge, we leverage computational modelling as a complementary tool. We employ an established computational model proposed by May et al. (2015, doi.org/10.1111/ejn.12820) which simulates auditory processing in the human AC and outputs synthetic MEG signals mimicking those from real MEG experiments. Recently we optimised the model parameters using an evolutionary algorithm to improve the match of the synthesised MEG signals to their experimental counterparts (Tomana et al., 2023, doi.org/10.1016/j.heares.2023.108879). We found that feedback connections are on average somewhat stronger than feedforward connections. Now we explore area-specific contrasts in feedforward vs feedback connectivity between specific regions of AC, namely, core, belt, and parabelt. Using MEG data from ten healthy human subjects and employing the optimised model of AC, we have found that in the communication between core and belt, feedback connections are statistically significantly stronger than feedforward connections in both hemispheres, although the difference is more pronounced in the left hemisphere. Unravelling area-specific feedforward and feedback connection strengths should aid our efforts to understand the exact characteristics of the bottom-up and top-down processing of auditory information in humans. As the next step, we aim to conduct cross-validation analysis to make sure that the current results are robust. Additionally, implementing alternative optimisation methods could further improve the model's performance.

COMPUTATIONAL SESSION

Nina Kędziora

University of Warsaw

Advancing Understanding of Post-Stroke Impairments Through Advanced Imaging Techniques: A Focus on Hemispatial Neglect

A stroke, also known as a cerebrovascular accident (CVA), is an event that disrupts the brain's vascular system, typically due to a blockage in a blood vessel—referred to as an ischemic infarction. This blockage deprives brain cells of oxygen and nutrients, potentially leading to cell death and resulting in various physical, cognitive, or emotional impairments. The nature and severity of these impairments depend on the location and extent of the brain damage. This poster aims to demonstrate the value of advanced brain imaging techniques in elucidating the neurological basis of deficits following a CVA, with a specific focus on the neuropsychological deficit known as hemispatial neglect. Both structural and functional imaging methods are explored to capture the neural underpinnings of this condition. Advanced techniques, including topological voxel-wise lesion-symptom mapping and tractography-based hodological approaches, are compared. The key assumptions and methodological limitations of these approaches are examined and compared with conclusive research involving functional connectivity analysis. These research examples highlight that aspects of hemispatial neglect syndrome arise not only from structural damage but also from changes in functional connectivity, which can be studied using the described brain imaging techniques. Given that stroke is the second leading cause of death and the leading cause of adult disability worldwide, understanding these deficits is crucial. In Poland alone, the Polish National Health Fund recorded 74.7 thousand cases of ischemic stroke in 2023. As stroke incidence rises with an aging population, there is an urgent need for specialized care and improved clinical protocols to enhance the quality of life for stroke survivors. The research findings presented in this poster exemplify how methodological advancements can improve our understanding of the neural mechanisms underlying post-stroke deficits, potentially informing more effective rehabilitation strategies and contributing to better patient outcomes.

COMPUTATIONAL SESSION

Sylwia Adamus
Krzysztof Bielski, Iwona Szatkowska, Mateusz Gola, Małgorzata Draps
Faculty of Medicine, Medical University of Warsaw, Warsaw, Poland; Faculty of Physics, University of Warsaw, Warsaw, Poland; Institute of Psychology, Polish Academy of Sciences, Warsaw, Poland

Exploring the contribution of the amygdala resting-state functional connectivity to the severity of Compulsive Sexual Behavior Disorder

Compulsive Sexual Behavior Disorder (CSBD), which has been included in the 11th International Classification of Diseases, is an impulse control disorder characterized by the inability to stop engaging in various forms of sexual behavior. There are still many open questions regarding the neuronal correlates of CSBD and the amygdala has been suggested to play an important role in its pathogenesis. The aim of this study was to address this issue via a novel amygdala parcellation method based on Recurrence Quantification Analysis (RQA). The RQA-based pipeline was applied to resting-state fMRI data from 45 heterosexual males with CSBD. Psychological questionnaires such as the Sexual Addiction Screening Test-Revised (SAST-R), Brief Pornography Screening Test (BPS), and Hypersexual Behavior Inventory (HBI) were used to assess the severity of CSBD symptoms. Their scores were used as second-level covariates in a seed-to-voxel resting-state functional connectivity (rs-FC) analysis with obtained amygdala subdivisions as regions of interest. Each amygdala was divided into two subdivisions (the dorsomedial – DM and the ventrolateral – VL). The connectivity analysis revealed multiple :correlations between the rs-FC of the left amygdala and the severity of CSBD symptoms, especially for the left VL amygdala. The rs-FC between the left VL amygdala and cingulate cortex, hippocampus, and precuneus correlated positively with CSBD severity. On the other hand, the rs-FC between the left VL amygdala and middle temporal gyrus and supramarginal gyrus correlated negatively with CSBD severity. To the best of our knowledge, this is the first attempt to investigate the amygdala on the level of its subdivisions in CSBD patients. This study shows altered rs-FC of the left VL amygdala with several default mode network structures among individuals with CSBD and highlights the need for amygdala parcellation in research regarding this disorder. Funding: Data collection was supported by the Polish National Science Centre OPUS grant (2014/15/B/HS6/03792) to MG. Data analysis was supported by the Polish National Science Centre PRELUDIUM grant (2016/23/N/HS6/02906) to MD, also supported by the Foundation for Polish Science scholarship number START 014.2023.

COMPUTATIONAL SESSION

Łukasz Niedźwiedzki
Józef Ginter
University of Warsaw

Improving Physics-Informed Neural Networks for Modeling Molecular Transport in the Human Brain

This study focuses on enhancing the quality and efficiency of physics-informed neural networks (PINNs) for modeling molecular transport in the human brain, particularly for estimating diffusion coefficients from MRI data. While PINNs are effective in solving partial differential equations (PDEs), they struggle with noisy data. The goal is to refine the PINN approach to improve its reliability and consistency, making it a viable alternative to traditional methods like the finite element method (FEM) for solving inverse problems in medical imaging. Building on the work of Zapf et al. (2022), various enhancements to the standard physics-informed neural network (PINN) formulation are explored to improve performance with noisy data. This involves experimenting with different neural network architectures and incorporating operator learning to better capture complex dynamics. Techniques such as tuning the loss function and using adaptive refinement of training points are applied to enhance data fidelity and parameter estimation. Both synthetic and real life test cases, as well as comparisons with classical methods, are used to evaluate the impact of these improvements on the accuracy and efficiency of estimating diffusion coefficients from MRI data. Preliminary results indicate that the improved PINN approach, enhances quality and efficiency in estimating the diffusion coefficient from MRI data. Comparisons between different neural network architectures and classical methods, like the finite element method, show promise, but further tests are required to confirm these findings. While early findings suggest that the improved PINN method offers advantages in accuracy and efficiency over traditional approaches, decisive conclusions cannot yet be drawn. More extensive testing and validation are necessary to establish the robustness and general applicability of the proposed improvements in clinical settings.

COMPUTATIONAL SESSION

Magdalena Szponar
Bartłomiej Gmaj, Jan Kamiński
Nencki Institute of Experimental Biology, Polish Academy of Sciences

Towards Improved Machine Learning Models for Psychiatric Disorder Classification using resting-state EEG

Machine learning (ML) classification of psychiatric disorders using biomarkers, such as electroencephalography (EEG), is gaining popularity and has the potential to revolutionize psychiatric diagnosis. Current approaches employ a variety of classification algorithms, feature extraction methods, and selection techniques. However, the diversity in sample sizes, cross-validation protocols, and targeted psychiatric disorders make it challenging to identify the best strategies for enhancing this crucial tool. In this poster, I would like to present a systematic review summarizing the findings of 195 studies that utilize resting-state EEG for psychiatric disorders classification, to identify the most effective approaches. I systematically searched relevant papers in Scopus, Pubmed and PsycInfo databases, following PRISMA guidelines. From 195 eligible papers, I extracted data about machine learning methodology, including EEG feature extraction, selection, classification model used, and type of validation. The analysis reveals a significant interaction between the EEG features used for classification and the chosen ML algorithms. Notably, neural networks outperform traditional ML methods, especially when applied to raw data or without feature selection. Relying solely on linear features can undermine model performance, while employing complex feature sets, such as combined feature types, leads to higher accuracies. Additionally, preprocessing data with a notch filter can enhance model performance. Our findings highlight the importance of obtaining sufficient sample sizes and using subject-wise validation to mitigate potential overfitting. These insights synthesize the most effective current approaches and provide valuable guidance for developing new tools in this field.

COMPUTATIONAL SESSION

Anna Buchwald

AI Trackable Biochemistry Beneath Cognitive Decline

Cognitive decline represents a progressive deterioration in mental faculties, including memory, attention, and reasoning abilities. This gradual loss of cognitive function significantly impairs an individual's quality of life and is closely associated with various neurodegenerative disorders. To develop effective interventions and treatments, it is crucial to understand the complex biochemical mechanisms underlying this decline. Key factors include the misfolding and accumulation of proteolytic fragments of the Amyloid-beta precursor protein (APP) — Amyloid-beta-peptide (Aβ) —and the microtubule-associated protein Tau. Aβ forms clumps and plaques between neurons, while Tau forms neurofibrillary tangles within neurons, disrupting brain function and leading to neuronal death. Traditional research methods, such as histopathological examinations, biochemical assays, and animal model studies, are slow and labor-intensive. Artificial Intelligence (AI) offers a revolutionary solution by rapidly analyzing multi-sourced data to identify, segment, and characterize protein assemblies and their morphological features. AI algorithms can identify and track protein clumps at the nanometer scale in microscopy images, categorizing them by shape and size while monitoring their development over time. These aggregates play a significant role in the progression of neurodegenerative diseases. AI-driven analysis provides insights into how their formation affects cellular functions and contributes to cognitive decline. AI facilitates the study of protein interactions and signaling pathways, revealing the influence of biochemical processes on disease progression. By analyzing protein interactions and integrating multi-omics (genomics, proteomics, metabolomics) data, AI offers a comprehensive view of disease-related cellular changes. AI models predict potential therapeutic targets, accelerating drug discovery and personalized medicine.

COGNITIVE SESSION

Klaudia Krystecka
Magdalena Stanczyk, Aneta Szymaszek
Nencki Institute of Experimental Biology, Polish Academy of Sciences

Divergent neuronal patterns determined in the inhibitory control Go/No-Go task in individuals with high and low temporal efficiency

A growing body of research suggests that temporal and inhibitory processes are closely interconnected and share the same set of attentional resources. The objective of this study was to examine whether individuals of different temporal efficiency exhibit distinct patterns of neural activity in the inhibitory control Go/No-Go task. Two groups of participants were selected based on their performance in the Temporal-Order Judgment task, which is used to assess their temporal efficiency: the High Temporal Efficiency group (HTE, n = 33) and the Low Temporal Efficiency group (LTE, n = 30). Subsequently, both groups performed an electrophysiological visual Go/No-Go task. A cluster-based permutation analysis revealed a difference between HTE and LTE in the time range from 310 to 500 ms following stimulus onset. This was evidenced by a positive cluster with p = .031. The HTE demonstrated a significantly higher P300 amplitude in response to No-Go stimuli when compared to the LTE, with the difference being observed in the fronto-central region. Due to the behavioural differences in task performance between the two groups (lower number of omissions, higher d-prime value in the HTE), we calculated different waves (No-Go minus Go) to compare the difference in neural responses to Go and No-Go stimuli between the two groups. The results demonstrated that the HTE exhibited a significantly greater difference wave in comparison to the LTE in the frontal regions. The findings showed that individuals of high and low temporal efficiency displayed different behavioural and neural patterns while performing an inhibitory Go/No-Go task. The higher P300 amplitude and greater difference wave in the HTE group may be indicative of better cognitive functioning, particularly in the context of attention and information processing. The present study demonstrated that individual differences in temporal processing are reflected in P300 amplitude dynamics during inhibitory processes in young adults.

COGNITIVE SESSION

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The Impact of Regular Aerobic Exercise on Cognitive Control: A Longitudinal Randomized Study

Recent studies have indicated that there is promising interaction between physical exercise and cognitive control, specifically inhibition. Inhibition may be defined as a crucial ability to suppress irrelevant thoughts and behaviors and maintain focus on task-relevant stimuli. The aim of this study was to investigate the impact of regular cycling training on behavioral and neuronal aspects of inhibition using the Flanker task. A total of 63 sedentary, young adult participants were randomly assigned to either the experimental group (EG, N=36) or the control group (CG, N=31). The EG group underwent supervised cycling training program, which lasted 6 weeks with three training sessions per week. At the same time the CG was asked to keep their usual level of activity. Before and after the intervention, participants completed the Flanker task with concurrent EEG recordings for ERP assessment. The task required identifying the central arrow's direction while ignoring surrounding distractor arrows, in both congruent (e.g.) and incongruent (e.g. >) conditions. Comparing pre- and post-intervention results, the EG exhibited significant behavioral improvements in response to incongruent stimuli, including a reduction in reaction time (p.01) and decreased standard deviations of reaction time (p.01). Furthermore, neural measures revealed that the CG, compared to the EG, exhibited increase in conflict between congruent and incongruent stimuli pre- to post-intervention. This was indicated by the neural marker of inhibition, the N2 component, and suggests that regular cycling might prevent from negative neural changes related to resolving tasks that demand inhibition. Collectively, the findings suggest that regular aerobic exercise improves both behavioral and neural indices of cognitive control and might be recommend for to benefit cognition of sedentary individuals.

COGNITIVE SESSION

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Role of substantia nigra in working memory

The aim of the current study is to verify this theory by using single neuron recordings in Substantia Nigra (SN) during a task engaging working memory. The study was conducted on patients with Parkinson's disease undergoing deep brain stimulation (DBS) procedure. During the procedure, the patients are asked to remember and then recall a position of one of the two arrows that are shown in sequence on a screen. Depending on a condition, they either have to recall the first arrow's position and ignore the later ('ignore' condition) or to provide the second arrow's position ('update' condition). Apart from the recording conducted throughout the procedure, during half of the trials patients' SN was electrically stimulated. The obtained results show that the patients' reaction time is significantly longer when the stimulation of SN is applied. However, this difference is only observed in an 'update' condition. Moreover, in some patients a significant difference in a single neurons' activity has been observed during the task after the SN stimulation. These results show that the neuronal activity in SN can be disrupted by applying electric stimulation and that it can influence patients' reaction time in the memory task. Moreover, a significant difference in the neuronal activity in SN can be observed after stimulation.

COGNITIVE SESSION

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Is pupillometry a new measure of spatial attentional bias: a replication failure

Attention can modify the pupillary light reflex (PLR), making pupillometry a valuable tool for assessing covert orienting of spatial attention. This principle underpins the „split-screen" method, a novel procedure designed to examine attentional bias. This method posits that stronger PLR to one of the visual hemifields indicates bias to orient attention towards that direction. Recognizing the clinical potential of this method we conducted a pilot study to verify its validity, We hypothesized that we will observe pseudoneglect — bias towards the left side of space — manifested as greater PLR to stimuli on the left. Furthermore, we anticipated that the PLR asymmetry would correlate with the behavioral measure of pseudoneglect, assessed via the greyscale task. Additionally, we expected to observe contraction anisocoria – an asymmetry in PLR depending on hemiretina being stimulated, which overlaps with the effect of attention. 63 participants were tested using the Eyelink 1000 eye-tracker. In the main procedure we manipulated the location of bright surface on the screen while subjects fixated their eyes at the central fixation cross. For exploratory purposes we assessed eye dominance. We used the contraction amplitude from segments surrounding experimental events as the dependent variable. We fitted linear mixed model to the data and run correlation analysis to check our hypotheses. The main hypotheses were not confirmed. However, we observed contraction anisocoria. Nevertheless, the pseudoneglect was present in our sample as evidenced by the greyscale task results with mean scores significantly deviating from the center. Eye dominance had no significant effect on pupil size. These findings suggest that the split-screen method may have low reliability but the pseudoneglect may be a subtle effect itself. They also demonstrate that pseudoneglect studies should take into account low-level visual hemifield asymmetries. Further research involving clinical populations is essential to evaluate the method's efficacy in neuropsychological assessment.

COGNITIVE SESSION

Nina Kędziora

University of Warsaw

Effects of Psilocybin on Brain Functional Connectivity: Insights into the Default Mode Network and Ego Dissolution

Psilocybin is a naturally occurring psychedelic compound found in certain species of mushrooms, commonly referred to as "magic mushrooms." This compound induces rapid and profound shifts in perception and cognition. In recent years, psilocybin has garnered significant scientific interest for its potential therapeutic benefits. However, the brain changes underlying the effects of psilocybin remain largely unknown. Current research suggests that psilocybin's acute effects may result from altered communication patterns within the brain. Studies have revealed that psychedelics can cause well-coordinated brain regions, which are functionally coupled into networks, to become less synchronized. It is proposed that psychedelics increase connectivity between different networks while decreasing connectivity within individual networks. These differential effects on functional networks are currently under investigation. Researchers aim to identify specific connectivity changes that correlate with the self-reported intensity of the psychedelic experience or particular aspects, such as ego dissolution. Ego dissolution involves a reduction in self-referential awareness that defines normal waking consciousness, disrupting the boundaries between self and the external world, and fostering a heightened sense of unity with others and the environment. It has been linked with The Default Mode Network (DMN), a set of brain regions that show increased activity during "wakeful rest" when the brain is not engaged in a specific task, has received particular attention. The DMN is thought to play a key role in generating a person's sense of self, space, and time. This poster provides a comprehensive review of ongoing research on the effects of psilocybin on brain functional connectivity, focusing on the DMN and ego dissolution. Understanding the neural mechanisms underlying psilocybin's effects is vital, given its growing therapeutic potential for treating disorders characterized by distortions of self-experience, such as depression.

COGNITIVE SESSION

Monika Tutaj
Tomasz Zaleśkiewicz, Anna Duszyk-Bogorodzka, Jakub Traczyk, Agata Sobków, Joanna Śmieja, Kamila Jankowiak-Siuda
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Brain activity during spontaneous imagery of complex scenes

The same neural areas are activated during mental imagery as during visual perception. Such effects have been found in studies using both fMRI and EEG techniques based on very simple stimuli, i.e. apple, house, face. Nevertheless, research using more complex and ecologically valid stimuli has been conducted less frequently. Moreover, in the typical paradigm used in imagery studies, participants are explicitly instructed to imagine the object. Unlike instructed imagery, where individuals are aware that they visualize specific scenes, spontaneous imagery seems to occur automatically. The main goal of this project was to test if visual brain areas are activated during imagery of engaging scenes in two conditions: on request and spontaneously. 60 healthy adults participated in our EEG study. Each of them participated in 3 conditions: visual – they watched an stimulating activity and decided if they wanted to engage in it, instructed imagery – they were asked to imagine that activity and decide if they wanted to engage in it, and spontaneous imagery – they were only asked if they wanted to engage in the activity. During the whole experiment, brain activity was recorded via EEG. After pre-processing EEG data, activity for particular visual areas was assessed based on the beamformer model and compared statistically across those 3 conditions in the frequency domain. The power spectrum analysis for the activity of visual regions of the brain revealed differences in theta (4-7 Hz) and alpha (8-12 Hz) bands compared to baseline in visual, spontaneous, and imagery conditions. The PLV connectivity analysis also showed similarities between brain activity in spontaneous and requested imagery in alpha and theta frequency bands. The results may suggest that spontaneous and instructed imagery activate similar brain areas, as indicated by the differences in theta (4–7 Hz) and alpha (8–12 Hz) power compared to baseline. Brain connectivity analysis further supports this, showing consistent patterns of brain connectivity in both conditions, particularly in the alpha and theta bands. This research was funded by the National Science Centre grant number 2019/33/B/HS6/01920.

COGNITIVE SESSION

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Kinesthetic Motor Imagery in Congenitally Blind and Sighted Individuals. An fNIRS study

Previous neuroimaging studies indicate differences in movement execution, motor imagery (MI), and brain activity patterns between sighted individuals (SI) and congenitally blind (CB). However, these experiments don't consider perspectives (e.g. 1PP; 3PP), and strategies during MI performance. To address this problem, we designed an experiment that enables us to control evoking kinesthetic motor imagery (KMI), by 1-DoF haptic interface. Gender, education, handedness and age were matched for 24 participants (12 CB; 8 F), aged 22-49 (M = 34.05; SD = 8.15). Individuals performed a MI task both hands related to the mental recall of kinesthetic stimuli evoked by the interface. The hemodynamic signal was recorded using functional near-infrared spectroscopy (fNIRS) from 24 channels located in the left and right motor cortex (LMC/RMC), frontopolar cortex (FPC). ANOVA was performed for changes in oxygenated hemoglobin (HbO) concentration in two areas (FPC/LMC) with within-subject factors HAND, CHANNEL and between-subject factors GROUP. We observed for the FPC area, a main effect of GROUP $F(1, 11) = 5.028$; $p = 0.047$; $\eta^2 = 0.154$. CB (M = -0.008; SE = 0.008) showed less HbO concentration than SI (M = 0.017; SE = 0.008). For LMC we found a interaction between HAND*CHANNEL*GROUP $F(1.262, 14) = 9.754$, $p = 0.01$; $\eta^2 = 0.112$. The post-hoc tests showed a difference between CB and SI for right hand in S3D3 (M = -0.078; SE = 0.02) and S3D1 (M = -0.08; SE = 0.02) channel. FPC in CB is functionally connected with the visual cortex and it interacts with a working memory system. Lower HbO concentration in this area for CB compared to SI may indicate lower cognitive load during the KMI task. The lower activation of HbO in the LMC area in the CB compared to the SI may be related to a mechanism of functional reorganization.

COGNITIVE SESSION

Marta Dębecka
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The relation between musical training and phonological awareness in children – fMRI study

Previous research has shown a link between musical training and phonological awareness in children, but the neural mechanisms behind this relationship are still not well understood. In this study, we aimed to investigate the neural basis of phonological awareness in children with and without musical training. A total of 42 children participated—21 with at least 2 months of musical training and 21 without. All children completed 3 phonological tests from a standardized battery, as well as 3 tasks in an fMRI scanner: pseudoword matching, rhyming, and first phoneme matching. There were no significant differences between the groups in terms of accuracy on either the behavioral tests or the fMRI tasks. However, during the pseudoword matching task, children with musical training showed greater activation in the left postcentral gyrus/inferior parietal gyrus (k = 286, -38 -30 28, T = 5.26, p 0.001, FWE-corrected p 0.05). Even though it is not very strong result, these regions are involved in both music and phonological processing, suggesting that training in one domain may influence the other. Overall, the results show that some differences in the neural basis of phonological awareness can be observed in children with musical training experience, even in the lack of behavioural difference, supposedly before these differences emerge.

COGNITIVE SESSION

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The Ageing Self: How Men and Women Reflect on Themselves and Others

Self-relevant stimuli, like one's name or face, are prioritized by the brain, resulting in faster responses and enhanced attention. These effects are linked to ERP components, particularly reduced N2 and enhanced LPP. However, most research has focused on young adults, with little attention to older adults. This study aimed to fill that gap by investigating age-related changes in self-perception and exploring potential gender differences. EEG data were collected from 56 participants over 60 years old. Before the experiment, participants completed psychological assessments and selected a close person (e.g. friend) and a preferred Polish celebrity (e.g. Lech Wałęsa). The experimental task consisted of three blocks (SELF, CLOSE, FAMOUS), where participants were viewing 150 adjectives (positive, negative, neutral) and judged whether each adjective applied to the assigned person. The analysis of reaction times and responses confirmed that participants reacted faster to self-related trials. The LPP component (electrodes F3, F1, AF3, AFz; 400-700 ms and 700-1200 ms) showed a higher positive response to self-related stimuli (early window: $F(45) = 3.807$, $p = 0.026$; late window: $F(45) = 3.770$, $p = 0.027$). Additionally, there was a difference in the N2 component (220-370 ms, electrode Fz) (condition: $F(45) = 6.37$, $p = 0.003$; condition*sex: $F(45) = 6.562$, $p = 0.005$). Sex differences were also analyzed. Results indicated the robust self-prioritization effect in older adults. Notably, elderly women exhibited higher LPP amplitudes and slightly lower N2 components compared to men. Enhanced LPP indicates deeper self-reflection which is linked to highest attention allocation for self-related personality traits. On the other hand, lower N2 suggest reduced engagement of executive control in visual encoding and response execution.

COGNITIVE SESSION

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Towards objective characterization and interpretation of cytoarchitectural properties of the primate cerebral cortex

Understanding the organization of the cerebral cortex requires both time and expert knowledge. Combining both, deep learning and explainable AI techniques, can provide observer-independent insights into the laminar structure, while unveiling the criteria used during the learning process. We propose a computational workflow for the cerebral cortex segmentation into layers. The solution combines (1) estimation of the neuronal density and size, (2) extraction of one-dimensional cortical profiles starting from the pial surface and ending at the white matter, (3) a deep-learning convolutional neural network that segments profiles into layers, and (4) explanation of estimated predictions with class activation maps. Our solution was evaluated on a dataset consisting of 18 selected cortical areas derived from a non-human primate – common marmoset monkey (Callithrix jacchus) brain. The model was trained to recognize layers in the areas of a diverse cytoarchitecture. The evaluation revealed that the model's performance increases when the neuronal density and size estimates contribute to the training process, compared to only using the image intensity. Furthermore, the model performs noticeably better when additional input with information about the area to which profiles belong is enabled. Apart from streamlining and automating cortex segmentation, our solution offers possibilities for valuable insights into the cytoarchitectonic properties of the primate cerebral cortex.