11th Annual Conference Aspects of Neuroscience
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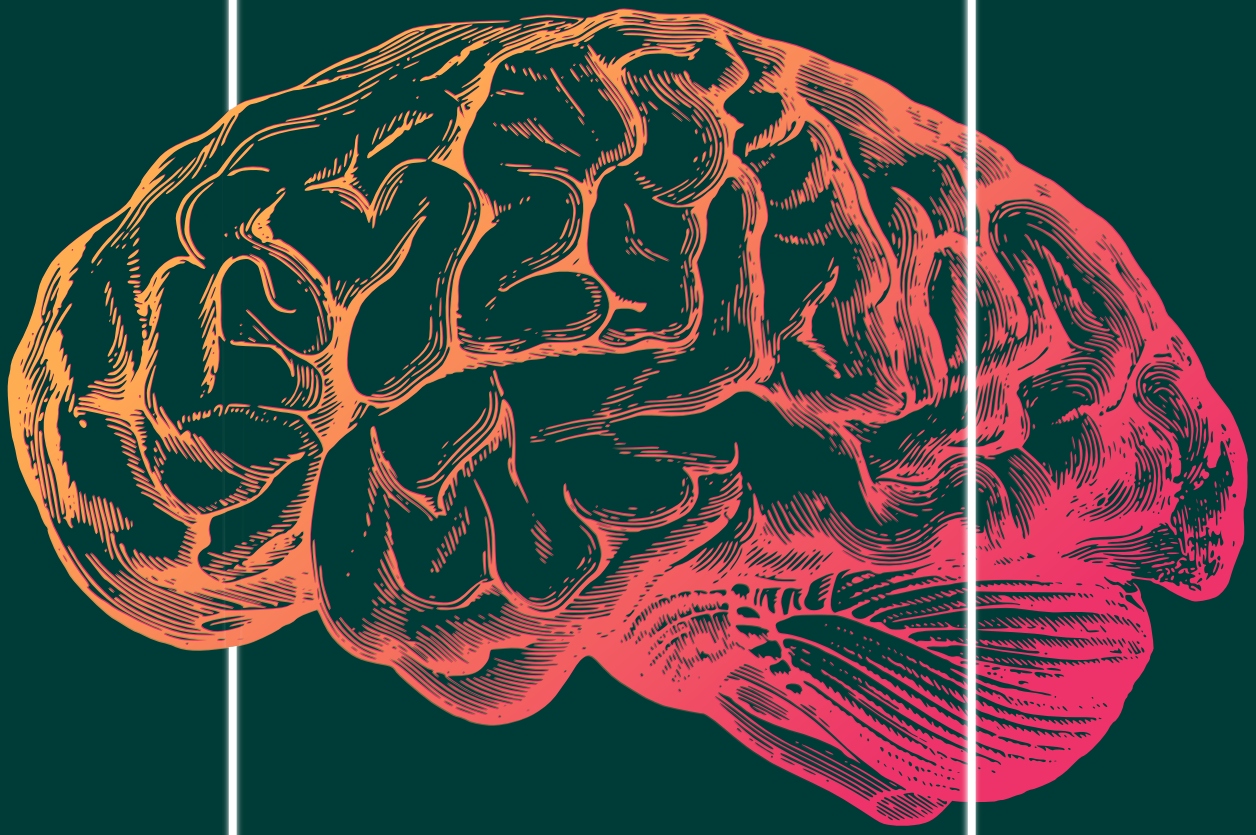

24-26 march 2023
Faculty of Physics
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11th ASPECTS OF NEUROSCIENCE

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Dear Colleagues,

Welcome to the 11th International Conference Aspects of Neuroscience! We, Aspects of Neuroscience Organizing Committee, 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 in order 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. Our aim is to give you opportunity to listen to some of the leading researchers of different aspects of neuroscience: Biological, Computational, Cognitive and Clinical. We firmly believe that cooperation above disciplines and integration of neuroscientists will result in new ideas and thinking outside of the box.

XI INTERNATIONAL CONFERENCE "ASPECTS OF NEUROSCIENCE"

During the Conference, we invite you to 7 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 sixty of interesting research and projects. In addition, there is also an opportunity to participate in a panel discussion with experts.

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 double-blinded peer review.

Conferences are also a great opportunity to do some networking in the world of science - find inspiration or promising collaborations!

The conference is organized by the members of Neuroinformatics Scientific Student Assocation at the University of Warsaw and by student volunteers from many polish universities

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EVENT PROGRAM DAY BY DAY

24th MARCH 2023 (FRIDAY)

10:00 – 18:00 Registration desk open!
18:00 – 18:30 Opening remarks
18:30 – 19:30 Plenary Lecture – Prof. Marianne Fyhn
OPENING LECTURE

EVENT PROGRAM DAY BY DAY

25th MARCH 2023 (SATURDAY)

10:00 – 11:00 Plenary Lecture – **David Belin, PhD**
There is more to drug addiction than the drug:
psychological and neural mechanisms of incentive habits

11:15 – 12:15 Seminar Session – neurobiology
• Aleksandra Nogaj – *The role of nucleus incertus originating inner vationand relaxin-3 RXFP3 signaling in modulating ventral hippocampus activity - anatomical, neurochemical and electrophysiological studies in rats*
• Katarzyna Hryniewiecka – *Validation of a new mouse model for autism spectrum disorder*
• Bernadeta Angelika Pietrzak – *Non-nuclear estrogen receptors targeting as a novel neuroprotective strategy against amyloid-β-induced neurotoxicity*

12:15 – 13:00 Coffee Break

13:00 – 14:00 Plenary Lecture – **Prof. Laura Andreae**
Activity and noise: wiring the brain

14:00 – 15:30 Lunch

15:30 – 16:30 Seminar Session – clinical
• Tomasz Kuliński – *Acute-phase electrocorticography in rats exposed to rotational traumatic brain injury*
• Piotr Buczkowicz – *EEG brain activity in ADHD children*
• Karolina Pendrasik – *Analysis of influence of prenatal exposition to testosterone and serum testosterone level in patients with multiple sclerosis treated with natalizumab and fingolimod.*

16:30 – 18:00 Poster session – clinical & neurobiology

18:00 – 19:00 Plenary Lecture – **Prof. Lisa Marshall**
Investigations on sleep-associated brain rhythms
using exogenous stimuli and optogentics

EVENT PROGRAM DAY BY DAY

26th MARCH 2023 (SUNDAY)

10:00 – 11:00 Plenary Lecture – **Christian Machens, PhD**
Coordinated Spike Coding in EI networks

11:15 – 12:15 Seminar Session – cognitive
• Alicja Olszewska – *Differential timecourses of functional brain reorganisation in novice pianists*
• Anna Lesniewska – *40Hz ASSR is sensitive to the level of arousal and awareness during natural sleep*
• Bernadeta Angelika Pietrzak – *Effects of Loneliness on Neurophysiological Correlates of Cognitive Reappraisal Use in Young Adults*

12:15 – 12:45 Coffee Break

12:45 – 13:45 Plenary Lecture – **Dirk Schubert, PhD**
From neurodevelopmental disorder gene to mechanism: generating & phenotyping human neuronal networks in the dish

13:45 – 15:15 Lunch

15:15 – 16:15 Seminar Session – computational
• Marta Lotka – *Functional connectivity estimation from fMRI data: correlation matrix estimation method matters*
• Ewelina Turczak – *Optimising the connectivity pattern within auditory cortex: An evolutionary approach*
• Agata Kozioł – *Motor overflow during reaching in infancy: quantification of limb movement using Inertial Motion Units*

16:15 – 17:30 Poster session – clinical & neurobiology

17:30 – 18:30 Plenary Lecture – **Daniel McNamee, PhD**
The neural microdynamics of cognition

18.30 – 19.00 Award Ceremony and closing remarks

KEYNOTE SPEAKERS

Prof. Marianne Fyhn

University of Oslo

Marianne Fyhn is Professor in Neuroscience at the University of Oslo, Norway. In her research, she uses an interdisciplinary approach to understand basic principles for brain plasticity, learning and memory in rodents. She applies a combination of in vivo electrophysiology, imaging and genetic tools to record from and perturb neural network functions. Fyhn was seminal for the discovery of grid cells which was awarded the Nobel Prize in Physiology or Medicine in 2014 to MB and E Moser. In her recent work, she has investigated the role of specialized extracellular matrix molecules for memory processing and the grid cell network. She will also present ongoing research on neural mechanisms of visual association learning in the parahippocampal network.

Dr David Belin

University of Cambridge

David Belin is Professor of Neuroscience at the Department of Psychology of the University of Cambridge and the Director of Studies in Psychological and Behavioural Sciences at Homerton College. Professor Belin was born in Blois, France in 1979. When he was ten he moved to Bordeaux where he graduated in 2005 in Neuroscience and Neuropharmacology at the University of Bordeaux 2. During his PhD he developed the first preclinical model of cocaine addiction based in the operationalization of multiple clinical criteria of the pathology as defined in humans. Professor Belin then moved to the laboratory of Professor Barry Everitt at the Department of Experimental Psychology of the University of Cambridge in January 2006. With his mentor he investigated the corticostriatal mechanisms of cocaine seeking habits and the relationships between impulsivity and compulsive cocaine self-administration, leading to a breakthrough in our understanding of the neurological and psychological mechanisms subserving individual vulnerability to cocaine addiction. In 2009 David Belin tenured at the INSERM in France and established his INSERM team in Poitiers which focused on the psychological, neural and cellular mechanisms of the individual vulnerability to develop compulsive disorders and their modulation by the environment. Soon it became apparent that Cambridge is where he wanted to carry out his research and he came back in October 2013, being appointed Lecturer at the Department of Pharmacology. He moved back to the Department of Psychology in October 2016, as the head of the CLIC Cambridge Laboratory for research Impulsive & Compulsive disorders. Professor Belin has published over 75 papers in peer-reviewed journals. He has received the Mémain-Pelletier Award from the French Academy of Science and the Young Investigator Award from the European Behavioural Pharmacology Society. He is an adjunct professor at Mount Sinai (New York, USA), an alumnus of the FENS/Kavli Network of Excellence, a former International Fellow of the Chinese Academy of Science and a former visiting scientist at NIDA.

There is more to drug addiction than the drug: psychological and neural mechanisms of incentive habits

There is increasing evidence that Substance Use Disorders stem from loss of control over maladaptive drug seeking habits. The psychological and neural basis of the maladaptive nature of these drug seeking habits remains unknown. The incentive habit hypothesis of addiction suggests that incentive habits, which are instrumental habits that develop under the motivational influence of the conditioned reinforcing properties of drug-paired cues, contribute to the persistence of drug seeking in the face of negative consequences and the high tendency to relapse that jointly characterise Substance Use Disorders. In longitudinal studies in rats, we used a combination of refined self-administration procedures, causal manipulations of the corticostriatal circuits, such as functional disconnections or pathway specific manipulations of the brain in rats seeking drugs, in vivo extracellular electrophysiological recordings and molecular biology to identify the neural and psychological basis of these incentive habits. We further demonstrated that incentive habits result in the aberrant engagement of excessive drug seeking behaviour despite past or future negative consequences, or following abstinence. During this talk I will present this novel psychobiological model of addiction and discuss its neural and cellular substrates. I will particularly focus on the notion that once incentive habits have developed, as a result of prolonged exposure to drug seeking under conditioned reinforcement, there is a shift in the goal of this persistent drug seeking from the drug to the response itself.

Prof. Lisa Marshall

University of Lübeck

Lisa Marshall studied biology and received her doctoral degree at the Institute of Physiology (Humboldt-University of Berlin, Charité, Peter Bartsch). At the Institute of Neuroendocrinology (University of Lübeck, Jan Born) she began her research on sleep. During a Habilitation scholarship in 2000 she was a research fellow at the Center for Molecular and Behavioral Neuroscience (NJ, USA, György Buzsáki). In 2009 Lisa Marshall became Professor for Behavioral Neurobiology at the Dept. of Neuroendocrinology, and in 2014 at the Institute of Experimental & Clinical Pharmacology & Toxicology (University of Lübeck, Markus Schwaninger). As head of the Research Group Neuroplasticity and Rhythms, her present research on mice and humans focuses on the factors and mechanisms through which sleep-associated memory consolidation is modulated.

Investigations on sleep-associated brain rhythms using exogenous stimuli and optogentics

Decades have past since arguments against brain rhythms as epiphenomenon emerged. One apparently straightforward way of investigating the causality of brain rhythms was not only to perturb, but to simulate them. Here, data of studies using electric, acoustic and optogenetic manipulations to modulate brain rhythms and learning and/or memory consolidation in humans and rodents will be presented. Furthermore, interindividual features contribute essentially to the efficiency of applied stimulation. Investigating interactions between cognitive ability and electrophysiological activity may help predict susceptibility to exogenous stimulation.

Prof. Laura Andreae

King's College London

Laura Andreae studied medicine at Cambridge and UCL, and practised as a doctor for a few years before seeing the light! She did her PhD with Andrew Lumsden in developmental neurobiology at King's College London followed by a postdoc with Tim Bliss working on LTP and plasticity at the NIMR in Mill Hill, UK and with Juan Burrone on synaptic vesicle cycling at King's. She set up her own lab at King's at the end of 2013. Her lab works on synapse and circuit development in health and in context of neurodevelopmental disorders.

Activity and noise: wiring the brain

The role of neuronal activity in the development of neurons and circuits remains controversial. Historically, activity has been seen to be critical for the sculpting of connectivity patterns after the period of synapse formation, often pruning unused synapses and helping to maintain or grow active ones. We now have evidence that a specific type of activity, spontaneous transmitter release, in the past often regarded as simply 'noise', plays a role in synapse formation and the development of dendritic morphology at early stages in the developmental period. Using both in vitro and in vivo approaches in mice to manipulate spontaneous transmitter release and the postsynaptic receptors that detect it, we show that these effects are connection specific in the developing hippocampal circuit. Many of the key synaptic proteins involved are known to be mutated in severe neurodevelopmental disorders, indicating how important these early roles may be in healthy brain development.

Dr Dirk Schubert

Radboud University Medical Center

Dirk Schubert is research group leader and principle lecturer at the Cognitive Neuroscience Dept. of the RadboudUMC in Nijmegen, Netherland. He obtained his PhD in biology at the HHU Düsseldorf (Germany). There, trained as electrophysiologist, he focused on understanding fundamental aspects of the structural and functional organisation of cortical Excitatory/Inhibitory (E/I) neuronal networks. After a research fellowship at the University of Szeged (Hungary) and a postdoctoral position at the HHU Medical Centre Düsseldorf, he moved to the RadboudUMC to start his lab for "Cellular Neurophysiology". He and his group currently combine translational research on rodent cortical network development with human stem cells derived neuronal models, the so-called "human brain in the dish" approach, for studying molecular and cellular mechanisms underlying altered E/I balance in monogenic neurodevelopmental disorders associated with intellectual disability, SZ, ASD and epilepsy.

From neurodevelopmental disorder gene to mechanism: generating phenotyping human neuronal networks in the dish

The possibility to produce human induced pluripotent stem cells (hIPSCs) and to let them differentiate into human neuronal-glial in vitro networks has opened doors for investigating the gene to function relation in neurological disorders with high translational power. In this presentation we will briefly discuss challenges involved in identifying risk genes for neurodevelopmental disorders and how selected genes can be tested for their impact on neuronal structural/functional connectivity in a human genetic background in-vitro. To this end we will discuss the steps involved in generating hIPSC derived neuronal in vitro models and how they can be assessed for gene or disorder specific molecular, structural and functional phenotyping, eventually aiming for identifying fundamental disease mechanisms. As an example, we will use a recent study on a rare monogenic de novo mutation associated with schizophrenia.

Dr Christian Machens

Champalimaud Centre for the Unknown

Christian Machens is a principal investigator at the Champalimaud Foundation in Lisbon, Portugal. He studied physics in Tubingen, Germany, and in Stony Brook, New York, and received a Ph.D. in computational neuroscience from the Humboldt University of Berlin, Germany, in 2002. He then worked as a postdoctoral fellow at the Cold Spring Harbor Laboratories, before taking a faculty position at the École Normale Supérieure in Paris in 2007. In 2011, he joined the newly formed Neuroscience Programme at the Champalimaud Foundation. In his research, he seeks to understand how networks of neurons communicate and process information. His work combines the statistical analysis of neural population activity with the computational modeling of spiking neural networks.

Coordinated Spike Coding in EI networks

Models of neural networks can be largely divided into two camps. On one end, mechanistic models such as balanced spiking networks resemble activity regimes observed in data, but are often limited to simple computations. On the other end, functional models like trained deep networks can perform a multitude of computations, but are far removed from experimental physiology. Here, I will introduce a new framework for excitatory-inhibitory spiking networks which retains key properties of both mechanistic and functional models. The key insight is to cast the problem of spiking dynamics in the low-dimensional space of population modes rather than in the original neural space. Neural thresholds then become convex boundaries in the population space, and population dynamics is either attracted (I population) or repelled (E population) by these boundaries. The combination of E and I populations results in balanced, inhibition-stabilized networks which are capable of universal function approximation. I will illustrate these insights with simple, geometric toy models, and I will argue that they force us to reconsider the very basics of how we think about neural networks.

Dr Daniel McNamee

Champalimaud Centre for the Unknown

Daniel McNamee leads the Natural Intelligence group at the Champalimaud Centre for the Unknown. He acquired his undergraduate degree in Mathematics at Trinity College Dublin, his PhD in Computation & Neural Systems at the California Institute of Technology, and held a postdoctoral fellowship jointly associated between the University of Cambridge and University College London.

The neural microdynamics of cognition

The entorhinal cortex and hippocampus form a recurrent circuit involved in many cognitive processes including memory, planning, navigation, and imagination. Neural recordings in these regions reveal multiplicitous constructions of latent spaces which subserve these computations. Disparate experiments demonstrate a surprising level of complexity and disorder in the intricate spatiotemporal dynamics of sequential hippocampal reactivations within such latent spaces and provide evidence of a modulatory role for entorhinal cortex. In this talk, I'll discuss a theoretical cognitive framework and proposed circuit mechanism to integrate and normatively characterize this neural microdynamical complexity and sketch current work on aligning these ideas with those emerging in the generative artificial intelligence literature.

SPEECHES

NEUROBIOLOGICAL SESSION

Aleksandra Nogaj
Kinga Przybylska, Aleksandra Trenk, Anna Guguła and Anna Błasiak
Faculty of Chronobiology and Neurophysiology, Jagiellonian University

The role of nucleus incertus originating innervation and relaxin-3/RXFP3 signaling in modulating ventral hippocampus activity - anatomical, neurochemical and electrophysiological studies in rats

Objectives: The stress-sensitive brainstem structure nucleus incertus (NI) is a primary source of neuropeptide relaxin-3 (RLN3) in the brain. NI provides extensive innervation to the ventral hippocampus (vHPC), an area critical for processing emotional information and involved in control of anxiety-related behaviors. The activation of RLN3 receptors (RXFP3) in vHPC increases anxiety and social avoidance. However, the neuronal mechanisms underlying interactions between NI and vHPC remain unclear.

Methods: Viral-based neural tract tracing was performed to map NI-originating fibers within the vHPC. Fluorescent multiplex in situ hybridization was used to characterize vHPC neurons expressing RXFP3 mRNA. Finally, we used ex vivo multielectrode array and patch-clamp recordings, to verify the effects of RXFP3 activation on vHPC network activity.

Results: Neural tract-tracing revealed a high density of NI fibers within the polymorphic and molecular layer of the dentate gyrus (DG), the majority being RLN3-positive. That indicates NI as a primary source of RLN3 in the vHPC. Multiplex in situ hybridization showed that all RXFP3-mRNA expressing vHPC DG cells are vGAT1 mRNA-positive, which indicates their GABAergic nature. Ex vivo multielectrode array and patch-clamp recordings demonstrated that RXFP3 activation exert both inhibitory and excitatory effects on vHPC neurons activity.

Conclusions: These results suggest that NI originating RLN3 innervation controls the activity of DG neurons and points to the NI-vHPC axis as an important component of the neural mechanism underlying stress processing. That influence may account for anxiety-related behaviors and social avoidance following chronic RXFP3 activation in the vHPC.

NEUROBIOLOGICAL SESSION

Katarzyna Hryniewiecka
Marcin Lipiec, Magdalena Majkowska, Suelen Baggio, Ewa Kublik, Marta Wiśniewska
University of Warsaw

Validation of a new mouse model for autism spectrum disorder

Objectives: Tcf7l2 is a high-confidence risk gene for autism spectrum disorder, but its exact role in its pathogenesis is unknown. Tcf7l2 is highly expressed in the thalamus, where it regulates genes governing neuronal excitability. The thalamus, as a relay of sensory signals from periphery, as well as a modulator of activity between associative, motivational, executive and motor cortical regions, is a candidate structure for ASD pathogenesis. To understand the role of thalamus-expressed Tcf7l2 in the information processing and development of ASD, we investigated functional consequences of its deficiency in the brain.

Methods: We hypothesize that Tcf7l2 deficiency in thalamic neurons impairs the activity of thalamo-cortical circuits, whose dysfunctions are common in psychiatric disorders such as ASD.

Results: A mouse strain with the postnatal knockout of Tcf7l2 in the thalamus was used for in vivo and in vitro electrophysiological experiments. Neuropixels probes inserted to somatosensory thalamus and cortex of anesthetised mouse were used to measure field evoked potential responses to single and paired whisker stimulations. The strength of the prepulse inhibition effect (PPI, a measure of sensory gating mechanisms) was estimated from their amplitudes. In vitro, a patch-clamp recordings were conducted to investigate the excitability of thalamic neurons in their standard firing modes – tonic, burst and rebound-burst.

Conclusions: Our results indicate that male knockout mice show impairments in the prepulse inhibition mechanism compared to control mice ($t(18) = -3.26$, p 0.01). Preliminary patch-clamp results show a decrease in general excitability and a dysfunction in burst mode firing in thalamic neurons.

NEUROBIOLOGICAL SESSION

Bernadeta Angelika Pietrzak
Bernadeta Angelika Pietrzak, Agnieszka Wnuk, Karolina Przepiórska, Andrzej Łach, Małgorzata Kajta
Maj Institute of Pharmacology, PAS

Non-nuclear estrogen receptors targeting as a novel neuroprotective strategy against amyloid-β-induced neurotoxicity

Objectives: Alzheimer's disease (AD) is a neurodegenerative disorder characterized by amyloid-β deposition and tau hyperphosphorylation that result in progressive exacerbation of memory loss and cognitive decline. AD is accompanied by estrogen receptor (ER) signaling dysregulation, as evidenced by high incidence of AD among postmenopausal women. ERs are an important system for neuroprotection. However, activation of classical, nuclear ERs which mediate the vast majority of hormonal effects, in addition to neuroprotection may lead to carcinogenesis and cardiovascular problems. On the contrary, selective activation of non-nuclear i.e., membrane-associated ERs (mERα and mERβ) has been shown a safer alternative that does not induce tumorigenesis and thromboembolism. Therefore, in this study, we assessed the neuroprotective capacity of Pathway Preferential Estrogen-1 (PaPE-1), which selectively activates mERα and mERβ against amyloid-β-induced toxicity.

Methods: To model Alzheimer's disease, we utilized mouse primary neocortical cell cultures that were treated with amyloid-β oligomers 1-42 (10 μM). PaPE-1 was applied in the posttreatment paradigm. The mechanisms of PaPE-1-attributed neuroprotection were assessed in respect to apoptosis, cell viability, the degree of neurodegeneration and neurite outgrowth.

Results: We observed that primary neocortical cell cultures treated with amyloid-β showed increased caspase -3, -8, and -9 activities. Since caspases are known not only for their pathological role in cell death but also in neurite outgrowth and dendrite branching, we evaluated the effects of amyloid-β and posttreatment with PaPE-1 on cell viability (Calcein AM), the degree of cell neurodegeneration (Fluoro-Jade C), apoptosis-related chromatin condensation (Hoechst 33342) and neurite outgrowth. According to our results, PaPE-1 attenuated the abovementioned amyloid-β-induced changes, thus supporting the neuroprotective capacity of PaPE-1 against AD-related pathologies.

Conclusions: Our original data provide evidence that selective activation of mERα and mERβ by PaPE-1 is a promising neuroprotective strategy against amyloid-β-induced neurotoxicity. This research was funded by the National Science Centre of Poland, grant number 2020/39/NZ7/00974.

CLINICAL SESSION

Tomasz Kuliński
Johan Davidsson, Mechanics and Maritime Sciences Division
Jagiellonian University, Kraków, Poland; Chalmers University of Technology, Gothenburg, Sweden

Acute-phase electrocorticography in rats exposed to rotational traumatic brain injury

Objectives: The aim of this animal pilot study was to test whether rotational traumatic brain injury causes measurable alterations in resting state electrocorticography in the acute postinjury phase and, if so, what alterations may be found. Our primary hypothesis was that power spectral densities between pre- and postinjury states will differ.

Methods: 5 male Sprague-Dawley rats (including 1 sham) were sacrificed. Animals were anaesthetized with midazolam-medetomidine-fentanyl mixture injection. Rats with exposed crania were glued to a test rig imparting rotational acceleration-deceleration analogous to car crash-related head injury in humans. Brain activity was measured with 3 epidural screw electrodes and a Biopac MP150 system. Recording lasted for at least 10 minutes before trauma and from immediately after injury until up to 3 hours. Data determined as artefact-free had power spectral density (PSD) estimated with Welch's modified periodogram over the whole of preinjury and postinjury recordings, and separately for the first and last 300 s of the postinjury recording (early and late postinjury phases).

Results: Our preliminary results indicate that rats exposed to rotational brain injury show suppressed spectral power relative to preinjury in the early postinjury phase for frequencies up to 40 Hz. The spectral power partially returns to or even exceeds preinjury values at the late postinjury phase. We also encountered numerous unexpected episodes of signal loss, both in injured and uninjured animals, which occurred suddenly or gradually over the course of minutes.

Conclusions: We have concluded that resting state cortical activity after trauma does show alterations in spectral power, which vary over time. Our two main speculations on the causes of observed signal loss events are that they may be either (1) "electrode pop" artefacts of a physical or chemical nature, or may be related to (2) spreading depression. We argue for this distinction by noting the differences in the time courses of these events.

CLINICAL SESSION

Piotr Buczkowicz

Jagiellonian University

EEG brain activity in ADHD children

Objectives: Attention deficit hyperactivity disorder (ADHD) is characterised by persistent inattention and/or hyperactivity symptoms interfering with or reducing social, academic or occupational aspects of functioning. [1] It is estimated that ADHD occurs in 7 to 10 percent of population. [1, 2]

Methods: ADHD is recognised by a primary care provider or a mental health professional, based on the interviews with the parents or the child. The interviews are relatively subjective, they often have poor specificity and are inconsistent between i.e. parent and teachers versions. [5, 6] Use of psychometric assessment, like Conners-3 test is often recommended. [3] However, it might be sometimes insufficient, or even create a risk of gender bias. [7] These problems implicate a growing need of alternative, objective methods of diagnosis.

Results: Therefore, attempts have been made to find a biomarker for ADHD. In case of structural neuroimaging, they turned out to be mostly unsuccessful, but the literature is inconsistent. [1, 10] Generally there is no biomarkers for ADHD [9] and yet the closest to that seems to be EEG, especially changes in the theta-beta ratio (TBR). [4] The latter is being used as FDA-approved Neuropsychiatric EEG-Based Assessment Aid System NEBA. [8] Although not entirely consistent, research on the EEG characteristics in ADHD is a promising thread that may help to better understand the neural basis and the possibility of more accurate diagnosis in this disorder.

Conclusions: This work aims to present the current scientific findings on the characteristics of EEG recordings in children with ADHD during the resting recording, but also during the cognitive task. At the end, a research plan (with the description of preliminary results, if possible) will be presented, aiming at creating new EEG-ADHD markers in combination with eye-tracking. The hypothetical results of the planned experiment that I will describe could have crucial meaning on understanding of neural basis of ADHD and diagnosis possibilities.

CLINICAL SESSION

Karolina Pendrasik
Dominika Świerczewska, Kacper Mazurkiewicz, Michalina Wiwatowska-Ligęza
Medical University of Lodz

Analysis of influence of prenatal exposition to testosterone and serum testosterone level in patients with multiple sclerosis treated with natalizumab and fingolimod.

Objectives: Multiple sclerosis (MS) is a chronic inflammatory demyelinating disease of the CNS. Exposition to low levels of testosterone (T) during the prenatal period represent risk factors for developing MS. High serum T levels in adult patients can be a protective factor in MS. T plays also a role in formation and repair of myelin in the CNS suggesting its neuroprotective role. In this work we studied a link between T levels and clinical progression of patients treated for relapsing-remitting form of MS (RRMS).

Methods: We enrolled 33 patients with RRMS treated with natalizumab and fingolimod.

Results: Digit Ratio (DR) was measured. Serum T concentration was measured with electrochemiluminescence. Neurological outcome was determined using EDSS. For assessment of cognitive functions we used SDMT, MoCA, FSMC and MFIS. Since patients suffering from MS frequently cope with depression. We measured its severity with BDI.

Conclusions: We found a correlation in female patients between serum T level and progression in MFIS and a correlation in female patients between DR and FSMC . In male patients we observed an association between serum T level and progression in SDMT and between T and progression in MFIS . There is a relation in all male patients between DR and progression in BDI.

COMPUTATIONAL SESSION

Marta Lotka
Anna Ceglarek, Magdalena Fąfrowicz, Koryna Lewandowska, Tadeusz Marek, Jeremi Ochab, Barbara Sikora-Wachowicz
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Functional connectivity estimation from fMRI data: correlation matrix estimation method matters.

Objectives: Accurate estimation of the correlation matrix from functional magnetic resonance (fMRI) data is crucial to functional integration research. The Pearson correlation matrix is commonly used. However, in the fMRI data setting the number of variables – locations from which the signal is sampled – is of the same or greater order as the number of samples. In such a setting the Pearson correlation coefficient becomes very sensitive to any noise present in the data. Moreover, the Pearson correlation coefficient does not account for the non-stationarity of fMRI data. Therefore, it is of interest to explore other methods of correlation matrix estimation and, in particular, the effects of method choice on detection of statistically significant differences between experimental conditions.

Methods: Method comparison is conducted using data from an fMRI experiment investigating the effects of diurnal changes of working memory performance. Three methods of correlation matrix estimation are compared: the Pearson correlation coefficient, the detrended cross-correlation coefficient and a coefficient based on the resting BOLD event triggered average (rBeta) method. Each method is also considered after application of Ledoit-Wolf shrinkage – a procedure reducing the effects of noise present in the data.

Results: All correlation matrix estimation methods besides the rBeta-based method detected statistically significant differences between information encoding and retrieval phases of the experiment. However, differences between experimental tasks were generally not stable with respect to the correlation matrix estimation method used.

Conclusions: To ensure meaningful results, it is necessary to further investigate correlation matrix estimation methods in the context of different data analysis pipelines.

COMPUTATIONAL SESSION

Ewelina Turczak
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Optimising the connectivity pattern within auditory cortex: An evolutionary approach

Objectives: To investigate signal processing in the auditory cortex (AC), May and colleagues created an advanced computational model based on the anatomy of the AC. It has successfully been applied to describe event-related fields (ERFs) acquired with magnetoencephalography (MEG). In the past, the values of the connection weights between the basic computational units of the model were set manually, with the aim of roughly replicating the morphology of real ERFs. To obtain better parameter values, we fitted simulated ERFs to experimental ERFs using an advanced optimisation approach.

Methods: To solve this optimisation problem, we applied evolutionary algorithms (EAs). We utilised a simplified AC architecture with only one cortical column as the basic unit in each of the 14 fields of the model. We have also employed the full architecture of the model with 16 columns per field.

Results: Both approaches provided high-quality fits of the synthetic MEG signal to the real MEG waveform. Our results for both architectures revealed an asymmetry between feedforward and feedback connection strengths, with stronger values for feedback connections. This finding deviates from the originally assumed symmetry of respective weight values.

Conclusions: Our results shed new light on the organisation of the human AC, but more MEG data from different subjects must be examined. Due to the computational burden of EAs, this requires finding new ways for reducing the computational complexity. Our work demonstrates the potential of parameter optimisation methods in the context of the improvement of computational models simulating biological systems.

COMPUTATIONAL SESSION

Agata Kozioł
David López Pérez, Zuzanna Laudańska, Anna Malinowska-Korczak, Karolina Babis, Oleksandra Mykhailova, Hana D'Souza, Przemysław Tomalski
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Motor overflow during reaching in infancy: quantification of limb movement using Inertial Motion Units

Objectives: Early in life infants exhibit motor overflow, which can be defined as the generation of involuntary movements accompanying purposeful actions (Addamo et al., 2009). Although this phenomenon has already been explored in infancy (e.g., D'Souza et al., 2017), previous studies relied on manual coding and the exact mechanism of motor overflow is still debated. Here we present the results of the first study quantifying motor overflow with high accuracy and precision provided by wearable motion trackers.

Methods: In this study we used Inertial Motion Units to quantify motor overflow in 4-month-old infants. The purpose of the research was to investigate the motor activity across the non-acting limbs during goal-directed action. To this end, we used wearable motion trackers to measure infant motor activity during a baby-gym task designed to capture overflow during reaching movements. The analysis was conducted on the subsample of participants (n = 20), who performed at least four reaches during the task.

Results: A series of Granger causality tests revealed differences in activation patterns depending on the type of the reaching movement and the non-acting limb. Importantly, on average, the non-acting arm preceded the activation of the acting arm. In contrast, the acting arm activity was followed by the activation of the legs.

Conclusions: The registered differences in motor activity may be a reflection of distinct purposes of the non-acting limbs in supporting postural stability and efficiency of movement execution. Finally, our findings demonstrate the utility of wearable motion trackers for precise measurement of infant movement dynamics.

COGNITIVE SESSION

Alicja Olszewska
Maciej Gaca, Dawid Droździel, Agnieszka Widlarz, Aleksandra Herman, Artur Marchewka
Nencki Institute of Experimental Biology

Differential timecourses of functional brain reorganisation in novice pianists

Objectives: Learning to play the piano is a complex task, integrating multiple sensory modalities and higher-order cognitive functions. Longitudinal neuroimaging studies on adult novice musicians show training-related functional changes, primarily in music perception tasks. However, these findings are not uniform and are obtained at varying time-scales from minutes to weeks to months. It is possible that the observed diversity of results reflects different stages of complex neuroplastic process. Moreover, the reorganisation of brain activity while actually playing an instrument has been rarely studied. Thus, our aim was to investigate the dynamic complexity of functional brain reorganisation within the first half year of musical training.

Methods: We scanned twenty-four novice learners (female, 18-23yo) using fMRI while they played increasingly complex musical pieces after 1, 6, 13 and 26 weeks of training.

Results: In line with previous studies, playing music evoked responses mainly in the auditory and left sensorimotor regions and supplementary motor cortex. The training, however, invoked changes in the right sensorimotor cortex, cerebellum, superior parietal cortex, anterior cingulate, anterior insula, putamen and hippocampus, among others. Post-hoc analysis revealed region-specific time-courses for independent auditory, motor and inferior frontal regions of interest.

Conclusions: These results suggest that while the primary sensory, motor and frontal regions are involved in playing music, the training affects higher-order cognitive control and integrative regions, and basal ganglia. When designing longitudinal experiments, caution should be taken not to limit the analysis only to task-related regions. Moreover, training might affect different brain regions in a sequential manner, providing evidence in favour of the dynamic, complex and nonlinear nature of brain plasticity.

COGNITIVE SESSION

Anna Lesniewska
Urszula Górska Ph.D., Marek Binder Ph.D., Małgorzata Hołda Ph.D.
Jagiellonian Univeristy

40Hz ASSR is sensitive to the level of arousal and awareness during natural sleep.

Objectives: When we fall asleep, we seem to not detect most of incoming auditory stimuli, while some of them could still be detected. Auditory steady-state responses (ASSRs) have been proven to be sensitive in fluctuations in arousal – they tend to reduce in the states where conscious processing is markedly diminished. However, it is unclear whether those effects are caused by fluctuations in arousal or consciousness. We attempted to answer this question in our study by using neuroimaging techniques and sleep questionnaires.

Methods: ASSRs are oscillatory responses elicited by periodic auditory stimulation Here, a series of two chirp stimuli, varying in duration and frequency, was presented to 22 healthy volunteers. We analysed the intertrial phase clustering (ITPC) response from the nine frontocentral channels on the EEG data for each stimulus. From 14 of the participants, 42 sleep and dream reports were collected.

Results: We found significant ($p<0.05$) effects of reduced ITPC values from wakefulness to N2 and N3 NREM conditions. For the wide-band type of chirp stimulation there was also significant effect between wakefulness and REM sleep, while it was not significant when narrow-band type of chirp stimulation was used. Interestingly, the comparison of subjective reports from serial awakenings paradigm reveals significant difference ($p<0.05$) of ITPC in 37-43 Hz band between no-dreaming vs dreaming reports in which auditory experience was present, but not when it was absent.

Conclusions:These results indicate that low gamma range ASSRs are sensitive to changes in both consciousness (which decreases during non-dreaming unconsciousness) and arousal (which decreases in NREM sleep). The current findings support the idea that ASSRs in the low gamma range can be used to reliably distinguish between levels of consciousness in clinical settings.

COGNITIVE SESSION

Marta Chrustowicz
prof. Łukasz Okruszek, mgr Szymon Mąka
Social Neuroscience Lab, Institute of Psychology, Polish Academy of Sciences

Effects of Loneliness on Neurophysiological Correlates of Cognitive Reappraisal Use in Young Adults

Objectives: According to the Evolutionary Theory of Loneliness, a prolonged feeling of loneliness may increase bottom-up processes associated with orienting towards social stimuli (e.g. hypervigilance to social threats) while decreasing top-down processes necessary for producing adequate emotional response towards it (mentalizing and emotion regulation). The study aimed to examine the impact of loneliness on ability to engage in cognitive reappraisal, in a group of participants from the general population.

Methods: 151 young adults from the whole spectrum of loneliness were asked to reappraise or watch negative three-second animations depicting two point-light agents that have been taken from Social Perception and Interaction Database (Okruszek Chrustowicz, 2020), while the electroencephalography (EEG), electrocardiography (ECG) and galvanic skin response (GSR) were recorded.

Results: The study found that altercations were perceived as more arousing and negative than neutral social interactions. Increased early and late Late Positive Potential (LPP) amplitude to altercations compared to neutral interactions were also found. However, the use of reappraisal strategy was found to reduce these effects. Moreover, the effect of condition was observed also in ECG and GSR signals. Interestingly, no correlation between loneliness levels and behavioural and neurophysiological markers observed during the task were found.

Conclusions:To summarize, the behavioral and neurophysiological data suggest that the participants were capable of comprehending the negative situations presented through point-light displays and employing cognitive reappraisal to decrease their level of arousal and negative assessment of the stimuli. Moreover, the participants' ability to engage in cognitive reappraisal was found to be unaffected by their level of loneliness.

POSTER SESSION

NEUROBIOLOGICAL SESSION

Andrzej Łach
Agnieszka Wnuk, Bernadeta Angelika Pietrzak, Karolina Przepiórska, Małgorzata Kajta
Maj Institute of Pharmacology, Polish Academy of Sciences

Prenatal exposure to benzophenone-3 induces neurotoxic and transgenerational effects on mouse brain tissues

Objectives: The chemical UV filter, benzophenone-3, is a component of many products present in everyday life. Despite numerous reports concerning its role in endocrine disruption, susceptibility to absorption via skin and ability to penetrate both blood-brain and blood-placental barriers, there is a relative shortage of research addressing its influence on nervous system, especially in terms of neurogenesis. This research is an attempt of identifying the effects of prenatal exposure to benzophenone-3 on mouse brain in F1 and F2 generations.

Methods: To establish a model of prenatal exposure, pregnant female mice were subcutaneously injected with benzophenone-3 in environmentally relevant dose of 50mg/kg. Tissues for analyses i.e., cerebral cortex and hippocampus, were obtained from two descendant generations, F1 and F2. To assess benzophenone-3-induced cell death, a variety of parameters were measured; LDH activity, caspase-3 and -8 activities and reactive oxidative stress (ROS). Since the neurotoxic effects of benzophenone-3 are mostly related to its ability to induce apoptotic processes, both on intrinsic and extrinsic pathways, we employed qPCR and western blot techniques, measuring expression fluctuations of genes/proteins associated with these processes i.e., FAS, FASL, BAX, BCL-2, GSK3β.

Results: We have observed statistically significant changes in LDH, caspase-3 and -8 activities in both F1 and F2 generations and alteration in ROS concentrations in F1 generation. Expression of genes and proteins associated with apoptosis was also disrupted by prenatal exposure to benzophenone-3. Changes were observed both in males and females from F1 and F2 generations.

Conclusions: This research confirmed that prenatal exposure to benzophenone-3 elicits proapoptotic and neurotoxic effects on mouse brain tissues. This research demonstrated for the first time the transgenerational effects of this compound, making it a valuable report on underrated threats associated with this continuous human exposure to benzophenone-3.

NEUROBIOLOGICAL SESSION

Maurycy Stempniewski

Uniwersytet Mikołaja Kopernika w Toruniu

The relationship between brain temperature and temperament traits from the Regulative Theory of Temperament

Objectives: The goal of this study was to find out if brain temperature was related to three temperament traits from Jan Strelau's The Regulative Theory of Temperament describing the energetic aspect of behaviour - Activity, Emotional reactivity, and Endurance. These traits are connected to brain structures underlying mechanisms responsible for regulation of acquiring and maintaining optimal level of arousal. The assumption was that the brain temperature and its changes (measured before and after a cognitive task) can indicate neural effectivity of regulation of resources used in the cognitive task. These resources are, for example, level of arousal/level of activation (stimulation of brain structures).

Methods: Every participant (volunteers, mainly students, N = 56, age mean = 28, SD = 5.5, 29 females) was tasked with n-back (n = 2) problem, during which their brain temperature was measured using magnetic resonance spectroscopic thermometry (MRS-t; before, and after the task completion). For the analyses both direct and absolute temperature differences were used. Temperament traits were measured with FCZ-KT(R).

Results: The results showed that neither of the measured temperament traits (on its own) was related to the brain temperature. However, Resposne Surface Analysis (RSA; method that allows to determine how much combinations of two predictive variables are related to an outcome variable and to visualize the result on a 3D graph) suggested, that in line with assumptions there was a relationship between combination of traits – Emotional reactivity and Endurance with direct brain temperature difference. There were also sex-moderated relationships between brain temperature and temperament (correlations and moderation). In women there was a relationship between absolute brain temperature difference and Endurance ($\rho = 0{,}466$; $p < 0{,}05$). In men on the other hand, there was a relationship between direct brain temperature difference and Activity ($\rho = 0{,}391$; $p < 0{,}05$).

Conclusions: The results show that in line with the assumptions, change in brain temperature can be an indication of effectiveness of regulation of brain structures stimulation.

NEUROBIOLOGICAL SESSION

Zuzanna Rauk
Wojciech Kosiek [1,2]; Małgorzata Duda [3]; Grzegorz Tylko [4]; Zuzanna Setkowicz-Janeczko [1]

1. Jagiellonian University, Institute of Zoology and Biomedical Research, Laboratory of Experimental Neuropathology, Krakow, Poland 2. Jagiellonian University, Doctoral School of Exact and Natural Sciences, Krakow, Poland 3. Jagiellonian University, Institute of Zoology and Biomedical Research, Department of Endocrinology, Krakow, Poland 4. Jagiellonian University, Institute of Zoology and Biomedical Research, Department of Cell Biology and Imaging, Krakow, Poland

Can keto diet save the brain? The effect of the ketogenic diet on injury related neuropathological changes.

Objectives: Traumatic brain injury (TBI) is a frequent cause of disability and a risk factor for the development of neurodegenerative diseases, as a result of a multidimensional tissue response to insult. Ketogenic diet (KD) is considered a potential therapy due to its neuroprotective and ani-inflammatory properties. The aim of my project is to evaluate KD influence on animals' state after TBI, inflammation, neurodegeneration and glial scar formation.

Methods: The in vivo part included induction of penetrating brain injury on postnatal day 30 (P30) in rats obtaining standard diet (SD) or KD. Body weight, blood level of glucose and ketone body β-hydroxybutyrate (BHB) were monitored. On P60 rats were perfused and brains dissected. In the in vitro part, BHB was supplemented for 7 days in primary hippocampal and cortical neural cultures, scratch injury was performed and cells' migration recorded for 24h.

Results: Injured KD-fed animals had a lower body mass on P60 compared to injured SD-fed group and uninjured KD controls. SD-fed injured rats had a similar body mass, but reduced brain mass compared to the uninjured SD-fed group. Interestingly, no brain mass differences were observed between injured and control KD-fed rats. An increased migration speed was observed in BHB supplemented hippocampal culture after scratch compared to untreated control. There were no significant differences between treated and untreated cortical cultures.

Conclusions: To conclude, KD, despite lowering rats' body mass, prevents brain weight decrease after TBI. In cell culture, BHB improves hippocampal but not cortical cells' migration abilities after injury. Further analyses will explain KD impact on scar development, perineuronal nets degeneration an injury-related markers expression.

NEUROBIOLOGICAL SESSION

Szymon Kantor [1,2]
Agnieszka Drzał [3]; Martyna Elas [3]; Krzysztof Janeczko [1]

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Activation profile of the rat brain nitrergic system in response to experimentally induced seizures

Objectives: Epilepsy should not be considered a simple disease, but rather a complex pathophysiological condition with a highly diverse phenotype. Therefore, understanding the brain mechanisms of seizures cannot be reduced to a conservative and simplistic model of the imbalance between the excitatory and inhibitory classical neurotransmitter systems. Nitric oxide (NO), a nonclassical, multifunctional gaseous neurotransmitter, may profoundly influence epileptic reactivity. This study aims to determine the temporal profile of changes in nitrergic system activation following experimentally induced seizures.

Methods: In two-month-old male Wistar rats, seizures were induced with one dose of chemoconvulsant: pilocarpine or homocysteine. During a 6 hour observation period, the intensity of seizure behavior was continuously assessed using the modified Racine's scale. 6, 12, 24, 48 or 96 hours after chemoconvulsant administration, in vivo NO spin trapping was performed with Fe(DETC)2. Electron paramagnetic resonance spectroscopy (EPR) was applied to measure the signal of the NO-Fe(DETC)2 complexes.

Results: The temporal profile of NO release after seizures showed that NO synthesis in the brain increased during the first 12 hours. Thereafter, it dropped sharply and became normal 96 hours after chemoconvulsant injection. There was no significant relation between NO levels and the intensity of seizures.

Conclusions: It appears that the brain nitrergic system is involved in the response to seizures in the earliest stage of epileptic activity. However, its activation does not depend on the seizure intensity and/or released NO does not affect seizure behavior.

NEUROBIOLOGICAL SESSION

Barbara Pijet-Binkiewicz
Agnieszka Kostrzewska-Księżyk, Maja Pijet-Kucicka, Leszek Kaczmarek, Magdalena Kania, Anna Krause
Nencki Institute of Experimental Biology PAN

Pharmacological inhibition of MMP-9 enzyme activity improves animal recovery and affects neuronal excitability after ischemic stroke

Objectives: Post-stroke epilepsy is one of the most common consequences of ischemic stroke occurring in patients over the age of 50. Importantly, cerebral ischemia is accompanied by an increased activity of an extracellular protease, matrix metalloproteinase 9 (MMP-9). In our previous studies we showed that MMP-9 plays an important role in the development of other types of epilepsies. Here we hypothesize that MMP-9 plays also an important role in pathology of ischemic stroke and is a potential therapeutic target for therapies to prevent the consequences of stroke, also epilepsy.

Methods: In the present study we used PKL-021, broad spectrum MMPs inhibitor, manufactured by Pikralida to examine its potential in post-stroke treatment. For cerebral ischemia we followed a focal middle cerebral artery occlusion (fMCAo) protocol in mice. We used animals with genetically modified MMP-9 level. Mice received 3 repeated doses of PKL-021 during first 24 hours after ischemia. During first 30 days of recovery, we monitored animal weight, neurological deficits and motor activity. 10 weeks post-ischemia animals were implanted with cortical and hippocampal electrodes and we performed PTZ-threshold test with video-EEG monitoring.

Results: We showed that PKL-021 delivered after ischemic stroke improves animal condition and reduces neurological deficits in wild type animals as well in MMP-9 overexpressing animals. We observed the significant effect of the treatment with the PKL-021 on neuronal excitability, use of the drug significantly decreased epileptiform discharges in EEG recordings during 1 hours after PTZ injection in comparison to group that received placebo.

Conclusions: The current study indicates that the use of the drug affects post-stroke recovery process and neuronal excitability, which implicates use of the PKL-021 in the post-stroke epilepsy treatment therapies.

NEUROBIOLOGICAL SESSION

Agnieszka Kostrzewska-Księżyk
Barbara Pijet, Maja Pijet-Kucicka, Emilia Rejmak, Magdalena Kania, Anna Krause, Leszek Kaczmarek
Nencki Institute of Experimental Biology PAN

Pharmacokinetics and molecular mechanism of action of MMP-9 inhibitor PKL-021 in ischemic stroke model

Objectives: Cerebral ischemia is one of the most common causes of mortality worldwide. Ischemic brain displays enhanced activity of an extracellularly acting protease, matrix metalloproteinase-9 (MMP-9). The results presented herein support preclinical and clinical phase I studies aimed at developing and characterizing a drug that inhibits the activity of the MMP-9 (PKL-021 aka marimastat). The aim of the present study was to describe the pharmacokinetics and molecular mechanism of action of PKL-021 after ischemic stroke.

Methods: In the experiments we used PKL-021, broad spectrum MMPs inhibitor, a drug manufactured by Pikralida. For cerebral ischemia we followed focal middle cerebral artery occlusion (fMCAo) protocol in C57BL6/J mice. In each experiments mice received single dose of PKL-021 immediately after reperfusion. Drug pharmacokinetics was analyzed using mass spectrometry. The minimum effective dose of the drug and inhibitory effect of PKL-021 was determined using immunoblot detecting cleavage of MMP-9 substrate nectin-3. mRNA mmp-9 gene expression and cellular source of the enzyme was evaluated with in situ hybridization method.

Results: We found that PKL-021 penetrated blood brain barrier regardless of its damage. With use of hippocampal neuronal cultures we showed that PKL-021 inhibited MMP-9-dependent nectin-3 cleavage, already starting from 5 μM. Furthermore, we demonstrated that PKL-021 inhibited MMP-9-dependent nectin-3 cleavage in vivo in ipsi- but also contralateral cortex and hippocampus.

Conclusions: The results obtained, showing specific inhibition of MMP-9 activity in vitro and in vivo, as well as BBB penetration, by the drug PKL-021, provide the basis for testing the drug efficacy in a model of post-stroke epilepsy.

NEUROBIOLOGICAL SESSION

Gabriela Czerniak

Uniwersytet Jagielloński, Zakład Neurofizjologii i Chronobiologii

Ocean cells and their importance in specific-context encoding of episodic memory

Objectives: The hippocampal dentate gyrus, CA3 and entorhinal cortex are of great importance for forming distinct representations of episodic memories and providing contextual information. Layer II of the medial entorhinal cortex contains two main types of excitatory cells that are part of the entorhinal cortex - hippocampal network: ocean and island cells. Stellate Ocean cells project to the dentate gyrus and CA3 and are involved in a representation of a novel context and drive context-specific fear memory and context-specific activation of CA3 cells. Island cells, are pyramidal neurons that project into CA1, they are neutral for contextual encoding or memory.
Conclusions: Ocean cells rapidly create different representations of novel contexts and drive context-specific activations to CA3 and dentate gyrus. Despite Ocean and Island cells different provision of contextual and time-related information to the hippocampal-entorhinal cortical network, they help in the formation of episodic memory. Studying the function of these cells will provide a better understanding of memory based on multiple contexts and episodes.

NEUROBIOLOGICAL SESSION

Anna Ciejka

Jagiellonian University

Cerebellar Abnormalities in Autism Spectrum Disorder: Theoretical Review.

Objectives: Autism spectrum disorder (ASD) is pervasive neurodevelopmental disorders that encompasses a variety of forms and clinical phenotypes. It is characterized by deficits in social communication and interaction, as well as impaired motor function and the presence of repetitive and stereotyped movements and behaviours or interests. Although the aetiology of autism remains unclear, current research suggests that abnormalities of the cerebellum are associated with ASD. It is now believed that the cerebellum is not only involved in the motor control, but also in cognitive function and social behaviour.

Cerebellar neuroanatomical alterations are among the most replicated findings in post mortem and neuroimaging studies of autistic individuals. Cerebellum in autistic brains occurs to have a reduced volume, particularly in the area of VI and VII lobule. One of the contributing factors to this reduction could be a significant decrease in the number of Purkinje cells, which have become one of the most extensively studied types of brain cells in relation to ASD.
Conclusions: Given what is known about many of the functions of the cerebellum and its connections with cortical and subcortical regions of the cerebral hemispheres, it is likely that abnormalities of the cerebellum contribute significantly to many of the clinical features of the autism spectrum disorder. The aim of this theoretical poster is to explore the links between cerebellar pathology and symptom expression in autism. Also the specificity and the role of Purkinje cells disruption and its potential contribution to social and cognitive deficits in individuals with ASD will be discussed, as well as the techniques currently implemented in research on cerebellum and autism and potential therapeutic application of the results.

NEUROBIOLOGICAL SESSION

Wiktoria Podolecka
Jacek Wróbel, Mark Hunt
Instytut Biologii Doświadczalnej im. Marcelego Nenckiego

Ketamine-dependent HFO in the rat brain are driven by changes in nasal air pressure

Objectives: Subanesthetic doses of ketamine are used to model psychoses in humans and experimental animals. In rodents, ketamine produces complex changes in oscillatory activity recorded in a variety of brain regions. High-frequency oscillations (130-180 Hz) are enhanced by ketamine, most notably in the olfactory bulb. The olfactory bulb plays a prominent role in sensory odor processing and generation of the respiratory rhythm. Here, we tested whether HFO could be enhanced by odor presentation and/or changes in air pressure.

Methods: Rats were anesthetized using ketamine-xylazine and presented with 5 different odors (N=7). In a separate group of rats (N=9) air of varying pressure was presented to the nares.We further tested whether increases were due to the presence of specific gasses present in the air by selectively presenting O2, N2, and CO2 (N=8).

Results: Surprisingly, none of the odors affected the power of HFO recorded in the olfactory bulb. In contrast, air presentation even at low pressures significantly increased the power several-fold above baseline values. No changes to the power of HFO compared to baseline were observed after presenting O2, N2, and CO2.

Conclusions: Together, these findings suggest that ketamine-dependent HFO are caused by the movement of air across the nasal epithelia, rather than classical olfactory processing.

NEUROBIOLOGICAL SESSION

Joanna Roszkowska
Drwięga G, Walczak M, Pradel K, Gorkowska M, Błasiak T
Jagiellonian University

Innervation of midbrain dopaminergic neurons by the nucleus incertus of the brainstem – electrophysiological and anatomical studies in rats

Objectives: The nucleus incertus (NI) is a brainstem structure that is involved in many functions such as aversive stimuli processing and stress response generation. Based on our preliminary results, we have hypothesised that the NI might innervate and regulate activity of the midbrain dopaminergic system – the ventral tegmental area (VTA) and substantia nigra pars compacta (SNc). Therefore, our study was aimed at investigating the above neuronal pathway in male Sprague Dawley rats.

Methods: To determine the anatomy of the connection between the investigated structures, stereotactic injections of retrograde and anterograde viral vectors carrying genes for fluorescent proteins were performed, to the VTA and the NI, respectively. After three weeks, the animals were sacrificed, and the regions of interest were assessed under fluorescent microscope. Prior to the electrophysiological experiments, two viral vectors, one retrograde, carrying Cre recombinase gene, the other carrying Cre-dependent genes for the light-sensitive cationic channel, were injected into animals' VTA/SNc and NI, respectively. Then, extracellular recordings from the VTA/SNc of urethane-anesthetised rats were conducted, combined with NI optogenetic stimulation.

Results: The anatomical studies confirmed the existence of monosynaptic and lateralised input from the NI to the midbrain DA system with vertical gradient towards ventral part of the VTA. Moreover, the electrophysiological results showed, that 38% of the recorded neurons was significantly inhibited by the NI stimulation. These inhibited neurons were biochemically confirmed to be dopaminergic by juxtacellular labelling followed by immunostaining.

Conclusions: Our studies show that the NI-originating innervation of the midbrain DA system is inhibitory and reaches mainly the ventral VTA, which may suggest the involvement of this pathway with stimulus silence coding.

NEUROBIOLOGICAL SESSION

Liliana Kozłowska
Dr Justyna Nawrocka
Uniwersytet Łódzki

Neurobiological effects of ayahuasca and its potential for therapeutic use

Objectives: Ayahuasca is a psychoactive and entheogenic brewed drink, originally used in South America. Due to its neurobiological effects, it has been considered as a potential tool in the treatment of various diseases

It is most commonly made from the Banisteriopsis caapi vine and the Psychotria viridis or Diplopterys cabrerana shrub, a material derived from plants which grow in rainforests. It is used for ritual purposes by the indigenous people of Amazon. It is called "liana of the soul" or "plant teacher", because of its psychedelic properites, which include altered perceptions of reality.

The neurobiological effects of ayahuasca are caused by alkaloids, organic nitrogenous compounds such as N,N-Dimethyltryptamine (DMT) and harmala alkaloids as harmine, harmaline, and tetrahydro-harmine.DMT is responsible for visual hallucinations, whereas harmine and harmaline are monoamine oxidase inhibitors, which make DMT be active. Tetrahydro-harmine inhibits serotonin reuptake.

DMT acts as a non-selective agonist of serotonin receptors, particularly the 5-ht2a receptor. Researchers also point to a receptor called sigma-1, which activated may promote neuroprotection and trigger neurogenesis in hippocampus. Other findings prove harmala alkaloids also can cause hippocampal neurogenesis. These processes can be linked wih psychoplasticity, which may explain the antidepressant effects of ayahuasca.

Conclusions: Ayahuasca might be used in the treatment of depression, anxiety, post-traumatic disorder, various addictions or neurodegenerative diseases such as Aizheimer.

However, there are still a lot of questions about potential side effects. More research must be held to prove better knowledge, effectiveness, and safety.

NEUROBIOLOGICAL SESSION

Anna Świętek

SWPS University

Fecal Microbiota Transplantation as a way of treating neurological disorders

Objectives: Gut microbiota provides numerous beneficial functions for our organism like pathogen resistance, vitamin synthesis or drug metabolism. The opposite state is dysbiosis, an imbalance in gut microbiota composition caused by abnormal functioning of intestines. It can contribute to colorectal cancer, obesity or diabetes type 2. One of the way of changing human's gut microbiota is fecal microbiota transplantation (FMT). This method is based on samples from human's stool. After taking a sample of feces from a donor, it is mixed with saline and filtrated. Then it is ready to use as a medicine, it can be packed to a capsule or transplanted directed to the guts using colonoscopy. Beneficial outcomes for varied gut microbiota are also present in the brain. There is a nerve called vagus, which connects brain and guts. This is why an inflammatory processes in guts can influence neurons in the brain.

Conclusions: It has been proved that changing the composition of gut microbiota by FMT significantly improved cognitive functions in mice with Alzheimer's disease. There are also proofs that abnormal functioning of gut microbiota can contribute to cognitive dysfunctions in diabetic mice. FMT is a new method for treating neurological and psychological illnesses.

NEUROBIOLOGICAL SESSION

Magdalena Sobień
Marcin Barański, Monika Pawłowska, Leszek Kaczmarek, Marzena Stefaniuk
Nencki Institute of Experimental Biology

Challenges in brain imaging using light-sheet microscopy

Objectives: The most basic and at the same time common method of imaging preparations in molecular biology is a widefield microscopy. In this method, to have a good resolution and quality image, the imaged material must be prepared in advance in form of very thin slices. Such preparation is frequently associated with damage of tissue during slicing. Precision imaging and the ability to image all material in 3D are extremely important when studying the whole intact brain. Obtaining a 3D image is possible using light-sheet-based microscopy but this technique also raises challenges such as precise annotation of cells to brain areas in three dimensions.
Methods: We collected brain tissue from adult mice that underwent behavioral training. Each brain was optically cleared using iDisco+ protocol and immunostained for cFos, a marker of neuronal plasticity. Brains were imaged in toto using a light-sheet microscope (Ultramicroscope II) equipped with a 4× objective. The initial post-processing of hundreds of images generated included stitching using the BigStitcher plug-in in ImageJ. For segmentation and registration, we used three software tools: ClearMap, BrainGlobe/ CellFinder and SMART/wholebrain.
Results: In the first stage, we set the parameters of images for all three methods used. The detected c-Fos positive puncta were counted and assigned to one of the brain hemispheres. Here we present the results of data processing, annotation to brain atlas and cell detection, including artifacts detection and handling.
Conclusions: Our study shows how the quality of the preparation affects the further analysis of the results and potential solutions for encountered challenges. This work highlights how complex whole-brain imaging using fluorescent microscopy is.
This study was supported by NCN OPUS grant 2019/35/B/NZ4/04077

NEUROBIOLOGICAL SESSION

Karolina Przepiórska
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Maj Institute of Pharmacology of the Polish Academy of Sciences

Amorfrutin B evokes neuroprotection against hypoxia/ischemia through inhibition of apoptosis and oxidative stress

Objectives: Stroke is the second leading cause of death and the major source of disability worldwide. Due to short application time (up to 4.5 h) and many severe contraindications of current pharmacotherapy (rtPA), there is an urgent need to look for new and effective anti-stroke treatment. An interesting candidate for experimental research is a novel selective PPARγ modulator (SPPARγM) isolated from Amorpha fruticosa - amorfrutin B. In vitro and in vivo studies indicated that amorfrutin B activates a subset of genes under PPARγ control in a selective way, avoiding severe side effects typical of its full agonists.

Methods: The primary neurons were subjected to hypoxia/ischemia and amorfrutin B treatment occurred 6h after initiated damage. To determine the contribution of apoptotic signaling during hypoxia and ischemia, we used specific inhibitors of components of apoptosis pathway. Neuroprotective effects of amorfrutin B were estimated in terms of reactive oxygen species (ROS) activity, mitochondrial membrane potential (JC-10) and formation of apoptosis-associated heterochromatin foci (Hoechst 33342).

Results: The use of apoptosis-related inhibitors reduced the hypoxia- and ischemia-induced increase in LDH release, which proves the involvement of apoptosis in the two studied models of brain pathologies. Post-treatment with amorfrutin B enhanced mitochondrial membrane potential, decreased ROS activity and partially reduced heterochromatin foci formation induced by hypoxia/ischemia.

Conclusions:We recognized amorfrutin B as a SPPARγM that activates PPARγ in the neuronal cells undergoing hypoxia or ischemia and in this way evokes neuroprotection. Post-injury treatment of primary neurons with amorfrutin B inhibits apoptosis and attenuates oxidative stress. We postulate that multifactorial action against neurodegeneration and safe pharmacological profile of amorfrutin B may be the basis for the use of this substance in the future pharmacotherapy of stroke.

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NEUROBIOLOGICAL SESSION

Gabriela Burda
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Formation of α -synuclein inclusions in primary hippocampal neurons as a model for investigating pathways protecting against pathological protein aggregation

Objectives: One of main histopathological features of Parkinson's Disease (PD) are intercellular protein aggregates containing α-synuclein. Recently, modeling of α-synuclein aggregation became possible by utilizing prion form of α-synuclein created in laboratory – preformed fibrils (PFFs). Here we demonstrate workflow for in vitro model suitable for screening protective compounds – from formation of the fibrils, trough validation to application in primary neuronal cultures, image acquisition and image analysis.

Methods: Recombinant alpha-synuclein monomer was subjected to endotoxin removal, diluted to 5mg/mL and incubated at 1000 rpms for 7 days in 37°C. Formed PFFs were tested in Thioflavin T assay and sonicated. Hippocampal neurons were isolated from the E16.5 mice embryos and seeded on 96-well plates. On 7 day in vitro, PFFs were added to final concentration of 2.5µg/ml. Plates were fixed on 14th day in vitro stained , imaged and analyzed for α-synuclein aggregates formation with custom automatic CellProfiler workflow.

Results: After 7 days of incubation increased turbidity was seen in synuclein containing tube. Thioflavin T assay showed increased fluorescence intensity of PFFs compared to α-synuclein monomer (p0,01) or PBS (p0,01). In vitro, 7 days after PFF treatment 50% of neurons exhibited α-synuclein aggregates in form of elongated inclusions in soma which could be automatically analyzed from obtained images.

Conclusions: Produced synuclein fibrils demonstrate robust seeding of α-synuclein aggregates in primary neurons. Somatic aggregates can be easily quantified with high content image analysis workflows. We are currently utilizing PFF based α-synuclein aggregation model to investigate potentially protective effects of ghrelin receptor agonists.
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NEUROBIOLOGICAL SESSION

Izabela Łaska
Karolina Szklanny
Jagiellonian University

Sleep, obesity and how they are related

Objectives: Rates of obesity have been steadily increasing, along with disorders commonly associated with obesity, such as cardiovascular disease and type II diabetes. Simultaneously, average sleep time have progressively decreased. Sufficient sleep is essential for maintaining healthy physical, mental, and emotional functioning. A duration of 7–9 hours of sleep a night is considered appropriate to support good health in adults of 18–60 years of age, with an optimal average of 7.5 h. Sleep deprivation or sleep loss is multifactorial and has a variety of consequences. The National Health and Nutrition Examination Survey (NHANES) showed significantly higher rates of obesity in adults who reported an average of less than 7 h a night of sleep.

Conclusions: Sleep loss can be seen to have a negative impact on the process of thinking and on the learning, memory, and recall capacity, and thus on the ability to work efficiently and socialize freely. Epidemiological evidence supports a link between sleep loss and obesity. Based on MRI studies, the literature indicates that compared to one night of regular - Total sleep deprivation (TSD) was associated with greater activation of the anterior cingulate cortex in normal-weight men in response to food-related stimuli. The anterior cingulate cortex is a unique part of the frontal cortex and plays a key role in the evaluation of various perceptual representations of food. Against this background, the enhanced hedonic activity in response to food images may represent a mechanism subserving the brain's energy restoration after TSD. Which suggests that prolonged periods of staying awake leads to a greater reward response in anticipation of food.

NEUROBIOLOGICAL SESSION

Aleksander Wołek

Jagiellonian University

Salience network dysfunction in schizophrenia

Objectives: Abnormalities in salience network activity have been observed in many psychiatric disorders, schizophrenia being one of them. This poster focuses on examining various malfunctions in salience network action as well as its connectivity with other intrinsic brain networks in the context of schizophrenia, particularly when it comes to disordered language processing and psychosis. It also briefly inspects similarities in salience network dysfunction between schizophrenia and other conditions with comparable language processing and psychotic symptoms.

Conclusions: Salience network dysfunction seems to be particularly relevant in disrupting normal communication and language processing, not only in schizophrenia, but also in other psychiatric and neurodevelopmental conditions characterised by the occurrence of symptoms of disordered language processing, such as autism spectrum disorder or dyslexia. Research shows its role in the occurrence of psychosis and psychotic symptoms as well, especially regarding its atypical connectivity with other intrinsic brain networks; however, as for the exact nature and cause of this disrupted functional communication, it is not yet conclusive.

NEUROBIOLOGICAL SESSION

Karolina Nowalińska

Department of Neurophysiology and Chronobiology, Institute of Zoology and Biomedical Research, Jagiellonian University, Krakow, Poland

New findings on the reward's role in alleviating depressive-like behaviors – projections from the substantia innominata to the lateral habenula

Objectives: In recent years there has been a huge increase in interest in the lateral habenula (LHb), a part of the epithalamus, due to discoveries showing its critical role in affective behaviors. It is referred to as the brain's "antireward center" and it encodes negative reward-prediction error. Moreover, LHb has been shown to be associated with psychiatric disorders, in particular with major depression. It has been shown that reduction of its hyperactivity alleviates depressive-like behaviors. LHb also acts as a relay station which, by receiving signals from the limbic forebrain and conveying them to the midbrain, affects the dopaminergic and serotoninergic systems.
Conclusions: In particular, Cui et. al. in their 2022 Science paper, reported the results of studies conducted on mice, using research techniques ranging from in vivo and ex vivo electrophysiology, through fiber photometry, to behavioral testing, showing that substantia innominate (SI) – part of the basal forebrain – is an important source of information about aversiveness for LHb. Chronic activation of SI to LHb pathway is sufficient for the onset of depressive- like behaviors, and reward intake or chemogenetic manipulation of LHb postsynaptic neurons can reduce or modulate this phenomenon, respectively. In my poster, I summarize and discuss those fascinating recent findings, as they may be of crucial importance for the direction of further research into the treatment of depressive disorders.

NEUROBIOLOGICAL SESSION

Emilia Goszczyńska

Jagiellonian University

Hippocampal organoids and limitations to research on human brain organoids

Objectives: Numerous studies on human brain organoids are conducted on cerebral organoids that are not region-specific. Scientists have been working on creating three-dimensional (3D) neural cultures that recapitulate the organization and function of hippocampus. In order to create a model for cell-based research into hippocampus-related diseases certain obstacles need to be overcome. The lack of vasculatures is a major unresolved limitation that impedes the long-term culture of organoids. The size of brain organoids is limited by poor exchange of oxygen and nutrients between their environment and inner parts of the tissue. The problem could be solved by transplantation of vascularized organoids into a host organism, or by applying fluidic devices to induce a controlled flow of nutrient factors.

Conclusions: Morphogens WNT and BMP are reported to regulate the development of medial pallium, which goes on to form a hippocampus. Ciarpella et al. induced specific hippocampal region identity in murine cerebral organoids by the morphogen WNT3a. Development of the hippocampal formation with its spatial organization and circuit establishment requires a long term culture and protection of cells that are located at the inner region of the model. In order to grow complex 3D models and study their electrophysiology, Xiang et al. constructed a functional vascular-like system in cortical organoids. They expressed human ETV2, a transcription factor essential for vascular development. Shi et al. transplanted vascularized organoids into mice, which resulted in the construction of functional blood vessels that promoted cell survival. A fully functional vascular system is yet to be developed.

NEUROBIOLOGICAL SESSION

Joanna Doliwa

Jagiellonian University

SARS-CoV-2 on the Clock. The Interplays Between Circadian Rhytmicity and Viral Infections.

Objectives: Circadian clock is an endogenous biochemical oscillator that cycles with a stable phase, is synchronised by solar light, and runs with a period of approximately 24 hours. It is known for playing an play an important role in regulating various aspects of viral infections such as viral replication and host responses. Not so long after the COVID-19 pandemic, one may wonder what the specific interplays between the SARS-CoV-2 infection and the human circadian clock are. I review the role of circadian clock proteins in SARS-CoV-2 entry and replication, as well as the possibility of perturbation of host circadian rythms due to the infection. Based on this information, I evaluate possible candidates for antiviral drugs. I then look at how timing of SARS-CoV-2 vaccination and drug dosing may affect their efficacy and explain the effect of circadian disruption on the severity of developed COVID-19 symptoms.

Conclusions: To this moment, it has been reported that the circadian clock may control the susceptibility to viral infections, transcription rates of certain viruses, and adjusting the strength of the immune response. Its disruption by irregular sleeping patterns, varying time of food intake, or shift work may lead to disturbing these processes. Moreover, the circadian rhythmicity has also been found to dictate the most effective time of intake of antiviral drugs with short half-lifes, and vaccinations.

NEUROBIOLOGICAL SESSION

Karolina Bogaj
Joanna Urban-Ciećko
Nencki Institute of Experimental Biology, PAS

Modulation of VIP-expressing interneurons via GABAbRs in layer 2/3 of rodent primary somatosensory cortex

Methods: Here, we focused on metabotropic GABA receptors (GABAbRs) and their effect on regulation of VIP-INs. We utilized in vitro whole-cell patch-clamp technique to investigate cell responses to external pharmacological agents of GABARs. Intrinsic properties, spontaneous firing activity, excitatory and inhibitory postsynaptic currents were recorded and analyzed in layer 2/3 VIP-INs of the mouse somatosensory (barrel) cortex.
Objectives: Vasoactive intestinal polypeptide-expressing interneurons (VIP-INs) are a subpopulation of cortical the 5-hydroxytryptamine 3a (5HT3a) receptor-expressing interneurons, comprising one of three major cortical GABAergic (Gamma-aminobutyric acid) neurons, alongside parvalbumin (PV)- and somatostatin (SOM)-expressing interneurons. A major role of VIP-INs in neuronal circuitry is disinhibition of excitatory cells, targeting other interneurons - predominantly SOM-expressing interneurons. Despite our vast knowledge of VIP-INs morphology and electrophysiological properties, their physiological functions remain mostly uncovered.
Results: Moreover, based on previously reported classifications of VIP-INs and unsupervised clustering method, we aimed to establish whether this heterogeneous neuronal group differs in respective to GABAbR modulation.
Conclusions: Collectively, our electrophysiological data suggest that GABAbRs modulate intrinsic excitability and spontaneous firing activity of VIP-INs in a presynaptic- as well as postsynaptic-manner.

NEUROBIOLOGICAL SESSION

Karolina Przyborowicz
Marta Klimczak, Klaudia Misiołek, Magdalena Chrószcz, Łukasz Szumiec, Maria Kaczmarczyk-Jarosz, Barbara Ziółkowska, Julia Netczuk, Rafał Ryguła, Jan Rodriguez Parkitna , Zofia Harda
Maj Institute of Pharmacology Polish Academy of Sciences, Department of Molecular Neuropharmacology

Changes in the rewarding effects of social interactions with familiar kin during adolescence and their neural correlates

Objectives: In humans, adolescence is a time of rapid behavioral and neural changes, including a transient decrease in affect associated with being among family members. We described changes in the rewarding effects of interactions with siblings in adolescent male and female mice and we asked if the development of prefrontal GABAergic system corresponds to the observed behavioral changes.

Methods: Male and female mice of C57BL/6 strain were used. Five developmental time points were studied: pre- (around post-natal day), early, middle and late adolescence, as well as adulthood. Rewarding effects of interactions with siblings were tested we used the social conditioned place preference test. We studied changes in the prefrontal GABAergic system using immunofluorescent staining for parvalbumin and calretinin.

Results: The rewarding effects of interactions with siblings in adolescent male mice followed a similar course as in humans: high in pre-adolescence, decrease in mid-adolescence and return to the initial level in late adolescence. In female mice a similar U-shaped relationship between social reward and age was discovered. However, the lowest level of social reward was observed in late adolescence.

Conclusions: These data show clear similarities in the developmental changes of sensitivity to social reward in humans and mice. Hence, we conclude that mice are a suitable model to study developmental changes in social interactions in normal and pathological conditions.

NEUROBIOLOGICAL SESSION

Joanna Jędrusik

Jagiellonian University

The gut-brain-microbiota axis in obesity and weight control

Objectives: The gut-brain axis (GBA) is a bidirectional communication system between the brain and the gut. This network includes nervous system pathways, in particular the enteric nervous system and vagus nerve, the neuroendocrine system and the immune system. Especially important in this connection is gut microbiota activity. Microbiota is a collection of microorganisms, mainly bacteria, which are involved in digestive and metabolic processes. They influence the secretion of appetite-regulating hormones such as glucagon-like peptide-1, ghrelin, peptide YY and leptin. Therefore, the activity of the GBA axis may be involved in the maintenance of normal body weight and in the pathophysiology of metabolic diseases or obesity. Obesity is a chronic disease associated with excessive fat accumulation affecting more than 1 billion people worldwide and leading to the development of other conditions such as cardiovascular disease and type II diabetes. Among other things obese people experience dysbiosis, altered levels of short-chain fatty acids and gut barrier dysfunction. All this leads to a disruption of the body's energy metabolism which increases energy intake from food and its storage as adipose tissue.
Conclusions: Role of the gut-brain axis in the pathophysiology of obesity provides an opportunity to develop new therapies for this disease. Use of probiotics, prebiotics or synbiotics positively affected the composition of the microbiota and thus increased intestinal barrier integrity, insulin sensitivity, reduced inflammation and ultimately weight loss. Similar changes in the microbiota profile are observed after following appropriate diet and physical activity which also promote weight loss.

NEUROBIOLOGICAL SESSION

Karolina Warzecha
Martyna Paleczna, Justyna Kadłuczka, Dominika Biała, Paweł Żarkowski, Joanna Osika, Barbara Kosmowska, Tomasz Lenda, Joanna Kula, Katarzyna Kuter
Mai Institute of Pharmacology Polish Academy of Science

Running Rat Early PD Model

Objectives: Parkinson's disease (PD) affecting mostly motor functions. A severe loss of the dopaminergic projection lead to the resting tremor, slowness of movements, muscle rigidity and postural imbalance. Regular physical activity can partially overcome such deficits and improve patients functioning but mechanisms underlying such compensation are still unknown.
Methods: Running Rat Early PD Model was performed by unilateral 6-OHDA injection to the medial forebrain bundle causing medium size degeneration of nigrostriatal system progressing up to 2 weeks post-injection. Such lesion reflects early stage symptomatic, clinical PD. Adaptation to treadmill, learning to run and regular activity started 4 weeks before the brain operation and were performed daily, 5 days/week. Exercise was continued for additional 4 weeks, post lesion. We performed behavioral tests: spontaneous and apomorphine-induced rotations, asymmetric paw use in cylinder test, locomotor activity. All analyzed in different time-points along the degeneration and treatment process.
Results: We observed effect of lesion and a difference in behavioral test results between running and sedentary animals. This may indicate a positive effect of physical activity on the neuroregeneration of dopaminergic neurons partially damaged by lesion and on postsynaptic functional adaptations.
Conclusions:Clinical and epidemiological studies have shown that exercise alleviates PD patients' dysfunction and has a therapeutic as confirmed also by our research. This validated 'Running Rat Early PD Model' will be used to discover cellular mechanisms involved in the neuroregeneration and compensation of early deficits.
Funding: National Science Centre grant 2019/35/B/NZ7/02862 and statutory funds of IP PAS.

NEUROBIOLOGICAL SESSION

Magdalena Kapała, Piotr Wiśniowski
Nikodem Hryniewicz, Marcin Sińczuk, Anna Duszyk-Bogorodzka, Ewa Piątkowska-Janko, Piotr Bogorodzki, Kamila Jankowiak-Siuda
SWPS Uniwersytet Humanistycznospołeczny

The role of interoceptive awareness in the empathic reaction to pain

Objectives: Pain empathy is the most popular paradigm in empathy research. When observing others in pain, the same structures are activated in the brain of the observer as they are in the person suffering from pain. However, it is not clear how interoceptive awareness impacts this process. The goal of this study is to examine whether individual interoceptive awareness of the observer has a direct influence on their empathetic reaction to pain.
Methods: 18 participants were involved in completing the questionnaires assessing interoceptive awareness (MAIA) and took part in the fMRI study. Short movies depicting dynamic pain reactions in natural, everyday situations were presented to the participants. The stimuli consisted of 64 videos (8 scenes with 4 levels of pain intensity (no pain, low, medium and high). Graphic Rating Scale was used to evaluate the intensity of pain experienced by the actor in the movie.
Results: The analysis of Pearson's correlation showed positive associations between intensity of pain and interoceptive awareness and moderate negative associations between the activation of Caudate nucleus (CAU) and Middle frontal gyrus (MFG) and aspects of interoceptive awareness as Noticing and Emotional Awareness.
Conclusions: This study showed that interoceptive awareness (noticing and emotional awareness) affects the empathy reaction to pain (cognitive aspects) at the level of brain activity. The activation of CAU, as MFG, plays an important role in the suppression of pain and in reorienting attention from exogenous to endogenous attentional control which may be impaired in persons with higher interoceptive awareness.

NEUROBIOLOGICAL SESSION

Kornel Szypulski
Milena Damulewicz
Jagiellonian University

Effects of blue light on immune system activation in the brain of Drosophila melanogaster Parkinson's disease model

Objectives: Due to the growing evidence that blue light emitted by screens can affect functioning of the human nervous system the new question arises: can this type of radiation be potentially harmful? Research conducted on Drosophila melanogaster has proven that exposure to blue light can cause both physiological and morphological disruptions in insect nervous tissue, including degeneration. The aim of our research was to determine the effect of blue light on fruit fly Parkinson's disease (PD) model. Here we focused on activation of certain type of immune response.

Methods: Two strains of Drosophila melanogaster were used in our experiments: wild type Canton-S and park mutant, a PD model. Flies were kept in LD12:12 conditions (12h of light : 12h of darkness). Experimental flies were additionally exposed to one hour of low-intensity blue light a day in the evening. Heads were collected at the age of 7 and 40 days, respectively to assess antimicrobial peptides (AMP) gene expression levels. Using qPCR method transcript levels of following genes were checked: CecA1 (Cecropin A1), CecB (Cecropin B), Dro (Drosocin) and DptA (Diptericin A).

Results: We showed that expression of AMPs genes increases with age. In addition, young park mutant flies exposed to blue light have increased AMPs expression level. This effect was observed only in PD model, AMPs expression of wild type flies was not changed after blue light exposure.

Conclusions: Obtained results show that blue light affects not only nervous, but also immune system in Drosophila melanogaster. In a given age group changes are present only in PD model strain which may suggest that this particular neurodegenerative disorder can make one more prone to effects of light pollution.

NEUROBIOLOGICAL SESSION

Olga Mierniczek
Gniewosz Drwięga, Martyna Gorkowska, Joanna Roszkowska, Gabriela Izowit, Wojciech Solecki, Tomasz Błasiak
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Nucleus incertus responses to an aversive stimulus - electrophysiological and immediate early gene expression studies in the rat

Objectives: Since aversive environmental stimuli can lead to the development of stress-related diseases, it is necessary to study how such stimuli affect the brain circuits. Among many brain structures involved in generating stress response, the brainstem nucleus incertus (NI) plays an important role. Recent studies showed an indirect involvement of NI in controlling the response to aversive stimulation. However, the mechanism behind this remains unclear. Therefore, the study aimed to investigate the NI neurons' responses to aversive stimuli.
Methods: A series of experiments have been conducted to determine the responses of NI neurons to an aversive stimulus (an electric foot shock delivered to the animal's hind paw). During the in vivo electrophysiological experiments, both baseline activity of NI neurons and responses to the aversive stimulus were extracellularly recorded from urethane-anesthetized male rats using microelectrode arrays. Simultaneously, local field potential was recorded from the hippocampus to monitor spontaneously occurring and stimulus-evoked brain state alternations. In a separate series of experiments, the expression of an immediate early gene (c-Fos) was analyzed in NI of animals previously subjected to an aversion-inducing behavioral protocol.
Results: In vivo electrophysiological experiments showed that the most frequent response of NI neurons to the aversive stimulus was an increase and, much less often, a decrease in electrical activity. Interestingly, a small group of NI neurons has been observed to change the direction of its response (i.e., from excitation to inhibition) with alternations of the brain state. Accordingly, the observed expression of c-Fos confirmed that the activity of NI neurons was increased in animals that experienced aversive stimulation in an operant chamber.
Conclusions: Data from this study show how the NI, one of the brainstem nuclei involved in generating the stress reaction, responds to aversive stimuli. The observed phenomenon may be part of the mechanism by which aversive environmental stimuli can cause stress.

NEUROBIOLOGICAL SESSION

Natalia Robak
Natalia Robak, Agnieszka Dębska PhD
University of Warsaw

Association between brain activity during word reading and socio-demographic measures in school-aged children.

Objectives: Cognitive, social and neurobiological factors that affect the development of reading are strictly interconnected (Noble et al., 2006), therefore identifying individual differences in early readers appears to be important in understanding the process of learning to read. This is why the aim of this study was to investigate relationships between brain activity during word reading, socio-demographic measures and non-verbal intelligence in school-aged children. This study was conducted as a part of Sonata NCN project, realized in the Nencki Institute of Experimental Biology PAS in Warsaw.
Methods: The brain activity during word-related task was compared with the use of functional magnetic resonance in 103 of Polish school-aged children. The stimuli presented visually to each person during the fMRI task were either pairs of words that were identical, or pairs of different words, or pairs of homophones - words that sound the same despite different meaning or spelling. A comparison between such conditions allows for an examination of the selectivity of the orthographic and phonological neural representations.
Results: Multiple regression analysis was performed to assess the impact of parental and familial socioeconomic status, as well as Raven's Matrix Standard IQ score on brain activity in response to words.
Conclusions: Our preliminary findings are negative associations between socioeconomic status and brian activity during reading identical (FWEc = 733, $p<0.05$) or different words (FWEc = 668, $p<0.05$) in cerebellum, right occipital areas, temporal areas and left fusiform.

NEUROBIOLOGICAL SESSION

Gabriela Rajtar

Jagiellonian University

Influence of gut microbiota dysbiosis on the induction and development of Alzheimer's disease

Objectives: Alzheimer's disease (AD) is the most commoncommonly detected neurodegenerative disease. Patients are typically diagnosed with memory decline, behavioral, and cognitive impairment when they are 65 years old. AD causes multiple disabilities which significantly reduce people well-being. The reason for these changes is impaired neuroplasticity driven by aggregation of amyloid beta plaques and hyperphosphorylated tau protein within the brain. It has been recently speculated that interacting inflammation and dysbiosis of the gut microbiota could be the cause of those pathologies.
Conclusions: Numerous literature data suggest that a notable disruption of gut microbiota homeostasis and progressive dysbiosis occurs in AD. Loss of commensal microbiota, pathobionts expansion, and diversity loss have been observed. This condition contributes to the development of an immune response, as well as a weakening of the intestinal barrier. Consequently, increased permeability to harmful bacterial metabolites and atopobiosis appear. These proteins induce and promote the development of an immune response and other pathological processes, for instance, molecular mimicry. At the same time, inflammatory aging and age-related dysbiosis contribute to a decrease in the number of probiotic and neuroprotection-related molecules, a change in neurotransmission, and a disruption of the production of proteins involved in modulating neuronal plasticity.
A better understanding of the mechanisms underlying these changes will allow the development of more effective methods for AD prevention, early diagnosis, and treatment of Alzheimer's disease such as effective diet programs, supplementation of probiotics and prebiotics, or even fecal microbiota transplantation in the most advanced cases.

NEUROBIOLOGICAL SESSION

Natalia Anna Roszkowska
Tomasz Nikołajew, MSc; dr Ksenia Meyza
Faculty of Biology, University of Warsaw

The Role of Somatostatin Interneurons in Emotional Contagion Regulation

Objectives: Impairments in empathy are a characteristic of many neuropsychiatric disorders. In order to gain further understanding of empathy, the lowest level of empathic processes, described as 'emotional contagion' (de Waal, 2008), can be studied in rodents. While somatostatin interneurons play a key role in the emotion recognition (Scheggia et al., 2020), as well as regulating active and passive defence reactions of fear (Yu et al., 2016), it is unclear what role they play in emotional contagion.
Methods: To study how negative emotions are transferred in mice, particularly in the amygdala and prefrontal cortex, the Remote Transfer of Fear behavioural paradigm was employed. This involved housing pairs of mice (Observer and Demonstrator) for three weeks before the Demonstrator was removed from the home cage and subjected to adverse stimuli (10 foot shocks - 1s long, 0.6mA).
Once the Demonstrator had been returned to the home cage, the first ten minutes of interaction were recorded. After another eighty minutes, the mice were sacrificed for immunohistochemical staining purposes. Sst-Ai14 mouse strains were used, as they expressed fluorescence marker (dTomato). Combined with immunochemistry against c-Fos (neuronal novelty marker), this enabled checking for somatostatin interneuron activity.
Results: The first ten minutes of interaction show higher levels of body sniffing (both control & experimental groups) and anogenital sniffing (experimental group).
Meanwhile rearing decreased for both Observers & Demonstrators (experimental groups) and digging behaviour increased (both groups). In the case of self-grooming behaviour, Observers show an increase (both groups), whereas only Demonstrators from the control group showed higher levels.
Conclusions: Altered behaviour within the Experimental group, combined with increased neuronal activation (higher c-Fos levels for both amygdala and prefrontal cortex), confirms that emotional contagion occurred. Changes in somatostatin cell activity within amygdala region (Observers; both groups) likewise indicate their role in the emotional contagion regulatory circuit.

CLINICAL SESSION

Jadwiga Irena Zymer

University of Warsaw

The role of GABAergic system disruption in ASD: Evidence and clinical implications

Objectives: Autism spectrum disorder (ASD) is a complex condition characterised above all by social communication deficits and repetitive behaviour. The neurobiology behind it remains unclear. It has been hypothesised that ASD may stem from an imbalance between excitation and inhibition in the brain [Rubenstein and Merzenich, 2003]. One possible cause of such an imbalance is a disruption of the GABAergic system, responsible for inhibition. In this review I will summarise different lines of evidence that support the importance of GABA in the aetiology of ASD and recent attempts to treat the condition with drugs influencing the GABAergic system.

Conclusions: Firstly, research based on non-invasive neuroimaging techniques such as magnetic resonance spectroscopy (MRS) showed altered levels of GABA metabolites in ASD subjects in comparison with controls [Zhao et al., 2022, Harada et al., 2011, Sapey-Triomphe et al., 2019, Fung et al., 2021]. Post-mortem studies reported decreased concentrations of GABA-B receptors in some brain regions of autistic subjects [Fatemi et al., 2009]. Several of the genetic mutations correlating with ASD occur in genes encoding subunits of the GABA receptors [Ma et al., 2005]. Mouse models carrying such mutations exhibit symptoms such as repetitive behaviour and decreased social interaction [Vien et al., 2015]. Epilepsy is a common comorbidity in ASD [Canitano, 2007], possibly because of disrupted inhibition. Finally, binocular rivalry, often associated with GABAergic action in the visual cortex, was found to be significantly weaker in autistic subjects [Robertson et al., 2016].

CLINICAL SESSION

Nina Niewińska

Nicolaus Copernicus University in Toruń

The Neuroprotective Potential of Hericium erinaceus: A Review of Current Research

Objectives: This theoretical poster aims to review the properties of Hericium erinaceus and its potential therapeutic applications for neurological disorders. In particular, mechanisms by which H. erinaceus affects the nervous system. The research questions are: What are the mechanisms by which Hericium erinaceus affects the nervous system?
Methods: What evidence exists for the neuroprotective properties of Hericium erinaceus in preclinical and clinical studies? What are the implications of these findings for the prevention and treatment of nervous system-related disorders?
Results: Hericium erinaceus has been found to stimulate the synthesis of nerve growth factor (NGF), which plays a critical role in the survival, growth, and maintenance of nerve cells in the brain and peripheral nervous system. Hericium erinaceus also modulates various neurotransmitter systems critical for regulating mood, learning, memory, and cognitive function, improving spatial and recognition memory in animals and humans. Furthermore, Hericium erinaceus has antioxidant and anti-inflammatory properties that can protect nerve cells from damage and promote the growth of new nerve cells.
Conclusions: In conclusion, Hericium erinaceus is a medicinal mushroom with promising neuroprotective properties. Its ability to stimulate NGF synthesis, modulate neurotransmitter systems, and exhibit antioxidant and anti-inflammatory properties make it a potential therapeutic option for the prevention and treatment of nervous system-related disorders. The neuroprotective effects of Hericium erinaceus may have implications for the prevention and treatment of nervous system-related disorders, such as Alzheimer's and Parkinson's disease.

CLINICAL SESSION

mgr Rozalia Żak
mgr Aleksandra Stawska, dr hab. Anna Przekoracka Krawczyk, prof UAM
Adam Mickiewicz University in Poznań

Sensory - motor fusion and vergence exercises using the virtual reality head mounted display

Objectives: Virtual Reality (VR) technology has previously been widely used in the gaming and entertainment industries, and later in psychotherapy and physiotherapy. Due to the growing interest in VR technology, applications using VR head-mounted displays have started to appear in optometric vision therapy (VT). There are several visual disorders that can be improved through optometric VT, including sensory-motor fusion problems, eye alignment control impairments, and hidden strabismus (phoria). These disorders are associated with many troublesome symptoms such as double or blurred vision, headache, concentration problems, and sleepiness, which can significantly hinder or prevent daily functioning. Adding VR to traditional therapy may make it more interesting, and additionally the immersion effect can potentially increase the effectiveness of the therapy.
Methods: In this pilot study, we aimed to determine the effectiveness of sensory-motor therapy on fusion, vergence ranges, and facility using VR goggles compared to Wheatstone stereoscope training and a placebo group with monocular VR therapy.
Results: Thirty subjects (20 - 29 y. o.) without binocular vision disorders participated in the study, conducting a four-week VT at home, with 10 people in each group. Before and after visual training, near point of convergence (NPC), horizontal heterophoria, vergence facility, and fusion vergence ranges were measured.
Conclusions:The study showed that NPC, vergence facility, and vergence ranges improved in the VR group, while phoria did not change. However, the effects in the stereoscope group were better than in the VR group. In the placebo group, the parameters did not change, and the result of the fusion vergence ranges was worse than before the start of the training. Our study suggests that VR can be a useful tool for sensory-motor fusion therapy in the office and at home, especially for children who may get bored with traditional methods. However, further research is needed to determine the effectiveness of VR therapy on patients with binocular vision disorders and to evaluate the optimal duration of therapy.

CLINICAL SESSION

Dominika Świerczewska
Karolina Pendrasik, Michalina Wiwatowska-Ligęza
Medical University of Lodz

Importance of psychiatric manifestation - case series of autoimmune encephalitis with anti-LGI-1 antibodies.

Objectives: Autoimmune encephalitis (AE) with anti-leucine-rich glioma inactivated-1 (LGI-1) antibodies is rare, not a fully known group of inflammatory diseases of the CNS. LGI-1 is a neural protein associated with potassium channels and it plays an important role in synaptic transmission.
Results: CASE REPORTS:
1: A 73-year-old man with rapidly progressive cognitive impairment, psychiatric symptoms and epilepsy. He had hyponatremia. The serological examination revealed anti - LGI-1 antibodies. MRI showed signal abnormalities in both insulas. The same lesion demonstrated restricted diffusion with low signal intensity on an ADC map. He was treated with anticonvulsants and steroids.
2: A 68-year-old woman with rapidly progressive dementia, positive psychiatric symptoms and epilepsy. Laboratory blood tests showed hyponatremia. Serological tests revealed anti-LGI-1 antibodies. Brain MRI revealed restricted diffusion in subcortical white matter with low signal intensity on ADC map. EEG showed diffuse slow theta waves. She was treated with immunotherapy as well as anticonvulsants and antipsychotics.
3: A 61-year-old man with progressive cognitive impairment and epileptic attack. Laboratory tests showed hyponatremia. MRI revealed hyperintensity of the medial temporal lobe on FLAIR. CSF analysis revealed the presence of anti-LGI-1 antibodies. EEG showed generalized seizure activity. Oncological screening revealed gastrointestinal stromal tumor.
Conclusions: Cognitive decline with productive symptoms may occur and dominate in the AE, consequently it can be misdiagnosed as a psychiatric disorder. Typical features of epilepsy are faciobrachial dystonic seizures. Oncological screening is crucial due to common paraneoplastic syndromes. AEs respond well to immunotherapy. The better recognition will be principal for the early treatment.

COGNITIVE SESSION

Jan Skorupski
dr Jacek Rogala, dr Urszula Malinowska
University of Warsaw

Predictors of EEG Neurofeedback Efficacy: A Literature Review

Objectives: EEG neurofeedback has been proposed to be a clinical tool as well as a cognitive and athletic performance enhancer. Yet, there is a large variability in the effects of training between subjects with 10-50% of subjects not experiencing any improvement. As such, the discovery of factors which would account for this variability would be of great theoretical and practical significance. This literature review aims to summarize the current state of knowledge. It also focuses on some of the most prevalent issues surrounding this area of research.

Methods: For the purposes of the review, first a list of queries was specified to search for articles concerning EEG NF efficacy prediction and 293 abstracts were identified. After the exclusion of duplicates, 143 abstracts were screened, from which 29 studies were included.

Results: A wide variety of factors have been considered as potential predictors of NF efficacy. However, almost none of these have been studied in more than two experimental studies, with the exception of age (n=10), sex (n=11) and baseline target value (n=9). The results for these factors are inconclusive, with the most consistent results appearing for baseline target value.

Conclusions: Despite the importance of this research, the current body of research does not appear to yield conclusive results for or against the significance of any predictors. This may be partially explained by the wide variety of studied factors, irregularity of utilized NF training protocols as well as incongruence and suboptimal data transformations in statistical analyses.

COGNITIVE SESSION

Monika Malon, Katarzyna Gajos
Łukasz Okruszek
Institute of Psychology, Polish Academy of Sciences

Lonely and selfish? A meta-analysis of 32 studies with 42,353 participants.

Objectives: Although Hannah Arendt emphasized the relationship between loneliness and self-centeredness already in the 1950s, empirical evidence for this relationship remains inconclusive. According to the Evolutionary Theory of Loneliness (ETL), loneliness intensifies one's urge to approach others and, at the same time, focuses their attention on self-preservation in the face of potential social threats. The current meta-analysis aims to estimate the strength of the link between loneliness and prosociality, as well as the impact of potential influencing factors.
Methods: A systematic search of PsycINFO, PubMed and Scopus was conducted in line with PRISMA 2020 guidelines to identify studies investigating the link between loneliness and prosociality. Only peer-reviewed studies using quantitative methods were included into the final sample (k=32; n=42,353; 53.79% females, mean age=25.46). Random effects models and meta-regressions employing age, female ratio and type of the sample (WEIRD and non-WEIRD) as meta-regressors were included in the analysis.
Results: We have identified a significant albeit weak negative correlation between loneliness and prosociality [r=0.109, 95% CI: (-0.1833, -0.0343), p=0.004]. Only female ratio was found to be a significant predictor of the strength of link between loneliness and prosociality, with stronger effects found in the samples with higher male ratio.
Conclusions: Our findings support the hypothesis that loneliness is negatively correlated with prosociality. However, since this effect only accounts for a small portion of prosociality variance, additional research on other social functioning factors, such as social status and social cognitive bias, is necessary.

COGNITIVE SESSION

Anna Warchoł-Jakubowska

SWPS University

Comparison of the visual attention of novice and expert tram drivers. Eye-tracking analysis of eye movement during the observation of driving on a tram simulator.

Objectives: The present poster shows the resalt of the compariton the expert and nonexpert tram drivers' dynamics of visual attention. The described study is the first in a series of eye-tracking studies planned as part of the project. The aim of the study was to answer the question:
● Are there significant differences in the visual attention of novice and expert tram drivers?
Following hypotheses were formulated:
● there is a difference in the distribution of visual attention between novices and experts
● the total time spent on viewing key elements of the image crucial for road safety is different for both groups of respondents.
Methods: The study was conducted at the Warsaw Tram Training Centre. It consisted in the observation and evaluation of rides recorded using a tram driving simulator. Eye movements were recorded with Gazepoint GP3 HD, 150 Hz stationary eye-tracker while watching the rides.
Results: The computer screen was devided into 10 AOI areas relevant to the driver. The number of fixations in each AOI for each group was calculated. The eye-tracking analysis allowed to verify the differences in scanning the field of vision between the compared groups. We observed differences in number of fixation in important AOI: novices has more fixation on control panel than experts. Eksperts has more fixation on central windshield than novices.
Conclusions: Information collected with the eye tracker gives a new insight into the mental processes of drivers - equally important for training novices (developing important scanning skills) and experts (expanding knowledge about one's own behavior).
As expected, statistically significant differences in the distribution of visual attention and the time spent on viewing key elements for driving safety were observed between the compared groups.
We are currently conducting another eye-tracking test, this time carried out on a tram driving simulator.
Model attention paths implemented to peripherally direct the eyesight of novices during training rides may be a support for the driver training process and a milestone in shaping the safety culture of a public transport company.

COGNITIVE SESSION

Magdalena Stanczyk
Elzbieta Szelag, Klaudia Krystecka, Anna Bombinska, Aneta Szymaszek
Nencki Institute of Experimental Biology, Polish Academy of Sciences

Relationships between temporal information processing in tens and hundreds milliseconds

Objectives: Temporal Information Processing (TIP) constitutes a complex construct which underlies many cognitive functions and it operates in a few hierarchically ordered time domains. However, relations between these domains still remains unclear. This study aimed to verify whether participants classified as more (or less) efficient in TIP in some tens of millisecond domain are also characterised by better (or poorer) TIP efficiency in some hundreds of millisecond domain.

Methods: 64 subjects participated in this study (M age = 23 years). They underwent two tasks. First, the temporal order judgement task was applied in order to assess subjects' performance in some tens of millisecond domain. The participants were asked to reproduce the order of two successive sounds presented in rapid succession. Based on results of this task, the participants were classified into two groups characterised as more or less efficient timers. Second, the – finger tapping in the maximum tempo was used to evaluate the efficiency of performance in some hundreds of millisecond domain. In this task the participants were instructed to repetitively press on a button as fast as they could with the index finger.

Results: The results revealed that subjects classified as more efficient timers in some tens of milliseconds are consistently faster in the maximum tempo speed (M = 158 ms) than those less efficient ones (M = 187 ms).

Conclusions: This finding suggests the contribution of a common time keeping system controlling.

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COGNITIVE SESSION

Klaudia Krystecka
Magdalena Stanczyk, Elzbieta Szelag, Anna Bombinska, Aneta Szymaszek
Nencki Institute of Experimental Biology PAS

Relationships in temporal information processing between millisecond and second time domains: evidence from behavioural and electrophysiological tasks

Objectives: Temporal Information Processing (TIP) controls human behaviour and it operates across different time domains which are organised hierarchically. Two levels of TIP are thought to be essential for cognitive processing: (1) some tens of millisecond level related to perception of succession and identification of the temporal order of incoming events, and (2) a few second level which refers to the temporal integration process in the range of approximately 2–3 s. Nonetheless, the relationships between these two processing levels have been unexplored so far. The objective of this study was to determine whether individuals classified as more (or less) efficient in TIP on some tens of millisecond level, may also indicate the better (or worsed) TIP efficiency on the other level.

Methods: Sixty seven healthy participants (Mage = 25 years) completed two tasks. (1) Auditory Temporal-Order Judgement task (TOJ) which measured the efficiency of TIP on some tens of millisecond level. On a basis of performance on this task, participants were classified into two groups, characterised as more or less efficient timers. (2) Passive auditory oddball task which measured an automatic brain response (reflected in mismatch negativity, MMN), detecting the difference between incoming standard (80%) and deviant (20%) sound presented in sequences separated by inter-stimulus intervals (ISI) of 1.5, 3, or 4.5 s. MMNs were calculated by subtracting the standard potentials from the deviant potentials.

Results: The results revealed that subjects classified as more efficient timers exhibited significantly smaller ($p = .027$) MMN amplitudes compared to less efficient timers in response to a deviant 3s ISI. In case of the other intervals (1.5 and 4.5s) the difference between groups was nonsignificant.

Conclusions:As temporal integration in ca. 3 s time window is considered as the fundamental principle of the neurocognitive machinery, the between groups difference reported in our study indicates the important contribution of TIP in some tens of milliseconds into a few second domain. Supported by the National Science Centre, Poland, grant no. 2018/29/B/HS6/02038

COGNITIVE SESSION

Ibrahim Vefa Arslan, Khulkar Rashidova
Monika Tutaj, Przemysław Blimel, Natalia Jakubowska
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Role of VWM in Playing Real-Time Strategy Games

Objectives: Visual working memory (VWM) is an ability to maintain information over a short period of time and is commonly mentioned as one of the subsequent cognitive functions required by Video Games (VG) playing (Blacker et al., 2014; Hauck Lien, 2022). In our study, we investigated whether training in a Real-Time Strategy (RTS) video game StarCraft II (SC2) can influence participants' VWM. We also examined whether individual differences in psychophysiological indicators of VWM can predict the effectiveness of video game training.
Methods: Thirty-one non-players were randomly assigned to either an Experimental (Variable and Fixed) or Control group. As the presented results are preliminary, we included training consisting of 30 hours of playing the SC2 and two EEG sessions (pre- and after 30h of training) during which participants performed a VWM task. Collected data allowed us to extract both neurophysiological and behavioural indicators of VWM (CDA and Pashler's K), and telemetric variables, which reflect participants' in-game achievements, namely, Perception-Action Cycles (PACs) and Actions per Minute (APM).
Results: We confirmed that CDA amplitude is modulated by the number of items stored in memory. Furthermore, we confirmed training's influence, showing that only experimental groups were able to improve their performance in the VWM task in the post-training session on every load. Finally, CDA amplitude was predictive of three of the selected in-game variables. Interestingly, we observed interaction with groups on PACs and APMs, which may reflect differences resulting from various environments applied during the training.
Conclusions: Our results are not only in line with previous research (Jakubowska et al., 2021), but also show the significant impact of a better understanding of individual predisposition, environmental differences – resulting from applied training models – and the values of telemetric variables.

COGNITIVE SESSION

Weronika Nieciecka, Stanisław Adamczyk
Patryk Szczeciński, Natalia Jakubowska, Paulina Lewandowska
SWPS University of Social Sciences and Humanities

Neurophysiological components of visual search in video-game skill acquisition.

Objectives: Playing video Games (VG) requires a wide range of players' cognitive skills, among which is the ability to scan the visual field. This particular skill is most often examined by the Visual Search (VS) task, which was shown to elicit N2PC - an ERP component, reflecting either a target reinforcement or distractors' suppression (Li, et al., 2018; Zivony, et al., 2018). Moreover, spatio-visual attention is linked with structural integrity of white matter tracts, which constitute complex visual-motor and attentional networks (Safadi, et al. 2018; Bennet, et al., 2012; Madden, et al., 2007). The aim of our study was to identify functional and structural indicators of visual attention which may be reflected in better performance in StarCraft II (SCII).
Methods: In our study 20 non-gamers were recruited. Participants performed VS with simultaneous EEG recording, MRI session and subsequently went through 30 hours of supervised SCII training. From the extracted EEG and MRI data we computed ERP's and fractional anisotropy (FA). Furthermore, telemetric data obtained from training, containing various in-game achievements, allowed to create different variables, indicating the course of players' development.
Results: We found that N2PC amplitude is correlated with greater right anterior limb of the internal capsule and left external capsule FA. Further analyses revealed that aforementioned neurophysiological components were highly correlated with players' in-game performance, which finally allowed us to build models predicting players' in-game achievements.
Conclusions: Our results suggest that structural and functional correlates of visual attention are mutually involved in visual field scanning and translate into specific VG skill acquisition.

COGNITIVE SESSION

Agata Antoniak

SWPS University of Social Sciences and Humanities

How complex should e-commerce websites be? Usability and cognitive capabilities of users

Objectives: According to numerous reports, online shopping has been increasing in popularity year by year. In the development of e-commerce websites, usability is of vital importance, as it has a decisive impact on both user experience and the consumer decision-making process.

Due to the fierce market competition, many e-commerce platforms want to display their products to the best of their ability and to provide as much useful information as possible. The desired effect is, naturally, that the customer makes the purchase. But what amount of information is optimal for the customers?

Among the factors that should be taken into account are users' cognitive capabilities. Everybody has certain limitations and can absorb a finite amount of data. Ignoring this in the design stage can result in the user misunderstanding the presented content or missing key details. In some cases, cognitive overload can even lead to the user abandoning the given task (e.g., choosing the right product) and leaving the website altogether.

What is the best and most appropriate complexity level of a website? It is a question many researchers specializing in fields like neuroscience, cognitive psychology, and HCI (human-computer interaction) have been trying to answer. In their research on human cognitive skills and website usability (including website complexity), they used such methods as eye tracking, usability tests, and surveys. It became apparent that the complexity of a website should account not only for its length or the number of the different types of elements it provides but also for the specific task (easy/difficult) the user must perform. Other important aspects include customers' cognitive style, device category (desktop/mobile), generational and cultural differences, and personal preferences.

COGNITIVE SESSION

Daria Makurat
Martyna Olszewska
Nicolaus Copernicus University in Torun

The impact of the dynamism of painting images on the aesthetic experience of viewers- research proposal

Objectives: Aesthetic experience is a vast, yet new subject of scientific research. Studies consider how people react to art, what artistic preferences they have or is there a link between aesthetic perception and personality. The concept of aesthetic experience that I want to use in this study is that proposed by Csikszentmihalyi and Robinson, which states that aesthetic experience involves not only the reception of art but also the experience of flow. In this work, I want to further investigate this direction to see how the dynamism of the paintings influences the aesthetic experience appearing in the viewers. Also, I would like to examine how personality traits, creativity and aesthetic sensitivity are related to aesthetic experience.
Methods: The study will include two sessions. During the first session participants will fill a questionnaire about the usually emerging aesthetic experience and the state of flow-AEQ. After that, participants will display 12 selected paintings in random order on the laptop screen. They will then complete a shortened version of the AEQ for each painting. While viewing the images, the examined person will wear an HRV device in order to measure heart rate variability and eye-tracking device will collect data to explore patterns in static and dynamic paintings. The second meeting will consist in completing questionnaires regarding personality traits, creativity and aesthetic sensitivity.
Results: This study is an extension of research from last year which showed that the dynamism of painting influences viewers' aesthetic experience and flow state- static paintings caused a higher aesthetic experience in viewers. Also, the flow state was higher when viewing static paintings.
Conclusions: I predict that the dynamism of the artwork will have an impact on the aesthetic experience and HRV level. Furthermore, I assume that openness to experience and creativity will correlate with aesthetic experience and aesthetic sensitivity. I hope this research could be helpful in expanding studies in the field of psychology of art.

COGNITIVE SESSION

Martyna Olszewska
Ewa Ratajczak
Nicolaus Copernicus University in Torun

Neurocognitive correlates of the emotions - creativity link (research proposal)

Objectives: The link between emotions and creativity remains a popular topic of contemporary research. Several studies have attempted to explain when and why emotions influence creative processes, proposing theoretical models including the Dual Pathway to creativity Model. It assumes that two significant factors play a part in the relationship between emotions and creativity: activation (ie. arousal), and hedonic tone (which divides emotions into negative and positive). Research has confirmed the beneficial influence of activating emotions on creative processes and provided some evidence on the differential effect of negative and positive emotions. According to the Model, positive activating emotions lead to higher cognitive flexibility while under negative activating emotions, one can achieve creativity through enhanced cognitive persistence. The presented project aims at a deeper verification of the proposed model. Differential influence of both negative and positive emotions on creative processes will be analyzed and further investigated with respect to individual levels of creative skills.
Methods: During two experimental sessions, the subjects will watch compilations of emotional movie scenes selected from standardised databases. The two conditions will differ in the type of evoked emotions: activating negative emotion (anger) or activating positive emotion (happiness). The order of the sessions will be reversed for half of the subjects. After the presentation of the film stimuli, the subjects will perform The Alternative Uses Test. In order to objectively monitor physiological arousal and cognitive processes, we intend to measure brain activity via electroencephalography (EEG) during the whole procedure.
Results: We expect to replicate previous findings and predict a stronger effect to occur in more creative individuals.
Conclusions: We believe in the importance of the proposed project due to its improved methodology and the consideration of individual differences. Replication of previous studies with the use of objective measures of brain activity makes it innovative and can provide new directions among the research on creativity, emotions and cognitive processes.

COGNITIVE SESSION

Olgierd Borowiecki

Nicolaus Copernicus University in Toruń

Dopaminergic-based memory encoding in mammals.

Objectives: Dopamine is released by two midbrain nuclei in relatively independent way (Ilango et al., 2014). Nigrostriatal pathway denotes projections from Substantia Nigra (SN) to striatum (Deumens et al., 2002), whereas mesolimbic and mesocorticolimbic pathways denote projections from Ventral Tegmental Area (VTA) to Nucleus Accumbens (NAc) and Prefrontal Cortex (PFC), respectively (Pierce & Kumaresan, 2006). This theoretical works focus on dopaminergic input to the hippocampus – which appears to be necessary for a successful memory encoding in rodents (Wagatsuma et al., 2018) and humans (Kamiński et al., 2018). Surprisingly, in rodents the dopaminergic input into the hippocampus originates from noradrenaline structure - Locus Coeruleus (McNamara & Dupret, 2017). In humans, source of dopamine in the hippocampus is believed to be mesocorticolimbic pathway originating from the VTA (Marusak et al., 2017). Suprisingly, electrophysiological studies suggest that the successful memory encoding requires activity of neurons in the Substantia Nigra (Kamiński et al., 2018) which opens a theoretical and computational inquiry about the dopaminergic circuitry in the human medial temporal cortex.
Conclusions:Dopamine is one of the crucial neurotransmitters in the central nervous system linked to action execution, reinforcement learning, and memory formation. However, the release of this neurotransmitter seems to vary phylogenetically. These observations are crucial for recognizing that findings in rodents might not be directly translatable to humans, which in turn may lead to important insights regarding the dopaminergic/hippocampal disfunctions such as Parkinson’s Disease and Alzheimer’s Disease.

COGNITIVE SESSION

Patrycja Śmiechowska

Nicolaus Copernicus University in Toruń

Neuroaesthetics- the correlates of experiencing beauty

Objectives: This theoretical work reviews the neural basis of beauty perception exemplified as perception of art. Aesthetically pleasant stimuli is positively correlated with activity in numerous brain regions such as: orbito-frontal cortex (BA 11), Anterior cingulate (BA 32) and left parietal cortex (BA 39) as well as nucleus accumbens the caudate and amygdala , and negatively correlated with activity of Default Mode Network (Edward a, Vessel et al., 2013). Such negative correlation makes sense given that it indicates one's focus on a piece of art and thus silencing the Default Mode Network, and simultaneously eliciting activation of emotional circuits mediated by the shell of nucleus accumbens and the ventral pallidum (Berridge et al., 2009). As studies by Berridge and Kringelbach (2008) and Wyvell and Berridge (2000) have shown, the opioid and GABAerigic neurotransmitter systems appear to be especially relevant in processing aesthetic stimuli. Taken together, the objective of this work is to review brain networks underlying the elusive experience of beauty.
Conclusions: Aesthetic perception is closely related to disgust sensitivity, which in turn is suggested as a factor in obsessive-compulsive disorders. Given that aesthetically pleasing stimuli seems to be capable of having a profound impact on one's actions, understanding the neural basis of beauty perception can reveal fundamental mechanisms behind desires and intentions when executing sensorimotor actions.

COGNITIVE SESSION

Jakub Skałbania
Łukasz Tanajewski, Marcin Furtak, Marek Wypych
University of Warsaw/ Kozminski University

Pre-stimulus fluctuations in ventral tegmental area affect self-control performance

Objectives: Pre-existing brain activity affects motoric decisions. Recent studies have shown that pre-stimulus neural activity may also affect higher-order cognitive processes such as risky decision-making, cognitive flexibility, memory encoding, and aesthetic judgments. Some studies suggest that pre-stimulus activity may be also relevant to the mechanisms of value-based decision making, such as self-control. Specifically, a higher pre-trial ventral tegmental area (VTA) activity, usually observed in self-control decision making, predicted less risky decisions. The aim of this study was to check whether pre-stimulus activity fluctuations affect dietary self-control. Three regions of interest (ROI), i.e., VTA, putamen, and nucleus accumbens (NAc), were identified based on the previous fMRI experiments on self-control and on pre-stimulus brain activities.

Methods: 49 participants (24 males) rated the healthiness and tastiness of foods and - based on these ratings - we customized the food pairs for each participant. In the fMRI scanner, the participants made 60 choices between a healthier and a tastier food item twice: in the high (HL) and low memory load (LL) conditions. Pre-stimulus activity was modeled by the finite impulse response (FIR), a method not biased towards a particular hemodynamic shape, and so optimal for detecting pre-trial signals. ROI analysis was performed using the ANOVA test.

Results: Our analysis revealed a higher VTA activity prior to the successful compared to failed self-control trials. The VTA activity was also higher in HL compared to LL trials. Putamen and NAc activities did not differ between successful and failed self-control.

Conclusions: Our findings suggest that pre-stimulus VTA activity may bias value-based decisions, which results in better self-control performance. Spontaneous fluctuations in VTA activity may be one of the mechanisms underlying inconsistencies in human decisions.

COGNITIVE SESSION

Izabela Chałatkiewicz, Piotr Wiśniowski
Ekaterina Isakova, Magdalena Kozłowska, Jakub Schimmelpfennig, Anna Duszyk-Bogorodzka, Kamila Jankowiak-Siuda
SWPS University of Social Sciences and Humanities

Sex differences in empathic reaction to pain based on perspective taken by observer - ERP study

Objectives: Sex differences are commonly reported in self-report studies in empathic reaction to pain, although neurophysiological indicators do not show consistent results. Both early and late ERP components have been associated with the perspective taken by observers (specifically N2 and P3). Early components have shown to be sensitive to automatic processing of perceived pain, however late components have been found to be linked to top-down control on empathic processing. The aim of the study was to characterize the mechanism of empathic reaction to pain taking into account gender differences and the perspective taken.
Methods: 31 participants (K=21, M=10) took part in the study. The stimuli consisted of 14 different photographs of hands, in painful and neutral circumstances judged by participants from either: self-perspective or other-perspective. During the whole procedure EEG was registered. EEG data were analyzed using evoked potential technique (ERP).
Results: N2 showed larger amplitude in other-perspective, in comparison to self-perspective taken, regardless of stimuli type. Interestingly, P3 magnitude showed a significant interaction effect between sexes and perspective, where for women, P3 amplitude in self-perspective condition was larger than for other-perspective, regardless of stimuli type. However, in men an opposite pattern was observed only for painful stimuli.
Conclusions: P3 showed larger amplitude for painful vs. neutral stimuli. Differences between sexes and perspective might suggest opposed additional processing when taking self-perspective and other-perspective between genders, shedding new light on the role of top-down processing involved in empathic response for pain.

COGNITIVE SESSION

Joanna Wąsowicz
Robert Balas, PhD
Instutute of Psychology, Polish Academy of Sciences

Evaluative Conditioning: examining the nature of attitude acquisition and change.

Objectives: Evaluative Conditioning (EC) is a well-established psychological phenomenon in which the emotional value of a previously neutral stimulus is changed through repeated pairing with another positive or negative stimulus. Two single-process theories have been prominent in the ongoing debate about the underlying mechanisms of EC: associative theory and propositional theory. Associative theory suggests that evaluative change occurs through the formation of associations between the neutral and affective stimuli, while propositional theory proposes that this change involves the formation of propositional statements about the relationship between the stimuli. However, recent investigations have resulted in the emergence of a dual-process model that posits EC engages two relatively independent processes.
Conclusions: This theoretical poster provides a comprehensive review and critical evaluation of the single-process and dual-process models of EC, drawing on the latest empirical evidence from studies in the field. We examine the strengths and limitations of each theoretical framework and explore how they contribute to our understanding of the nature and mechanisms of EC. Finally, we propose future research directions to further investigate the nature of EC and deepen our understanding of this complex phenomenon.

COGNITIVE SESSION

Patrycja Ściślewska

University of Warsaw

Overall impact of chronotype on personal traits, brain function and anatomy

Objectives: The internal biological clock and the endogenous chronotype are key variables in neurobiological and psychological research. The aim of the presented analyses was to compare the characteristics of people with different chronotypes. It has been hypothesized that evening people are more likely to experience sleep deprivation and its long-term effects – changes in brain anatomy and a greater tendency to impulsive behavior.

Methods: To test the hypothesis, psychological questionnaires data (e.g., BIS-11, BFI, BADD) and MRI T1-anatomical scans from 86 people from The Stockholm Sleepy Brain Study (Nilsonne et al., 2020) were used. Chronotype and sleep characteristics were determined using the Karolinska Sleep Questionnaire. For each variable, Spearman and Person correlation coefficients were calculated. To compare the neuroanatomy of morning and evening people, the two sample t-test was used. VBM analysis was performed using MRIqc, FSL, SPM12, CAT12, and xjview.

Results: The results showed no direct relationship between chronotype and personality traits. However, a strong correlation between quality of the wake-up and attentional deficits ($r = 0.613$), moderate correlations between quality of the wake-up and occurrence of anxiety ($r = 0.522$), quality of sleep and the occurrence of insomnia ($r = 0.548$), duration of sleep and resistance to stress ($r = 0.501$) were observed. The average volume of examined brains was 1508.673 +/- 134.500 cm3, with no statistically significant differences in the brain volume of morning/evening people (1513.744 cm3 /1503.279 cm3, respectively). VBM analysis showed 3 enlarged areas in the morning people's brains (compared to those of the evening people) - Left Brodmann Area 19, Right Brodmann Area 27, and Left Cerebellum.

Conclusions: The results suggest significant differences between studied people, but a precise distinction between the effects of sleep quality disorders and the influence of chronotype is needed. It seems that these two factors can be difficult to separate and therefore are often confused.

COGNITIVE SESSION

Małgorzata Paczyńska
Łukasz Bola, Marta Urbaniak, Maria Kossowska
SWPS University

Decoding spoken words in the early visual cortex of congenitally blind and sighted individuals

Objectives: All over the world, language processing involves similar brain regions. Intriguingly, one population escapes this universal pattern - in blind individuals, linguistic stimuli activate not only the canonical language networks, but also the "visual" cortex. It is still unclear what properties of linguistic stimuli are captured by the visual areas in the blind, and consequently, what are the implications of this finding for our theories of brain plasticity. To contribute to this debate, we investigated whether the visual cortex activation in blind individuals represent differences between specific spoken words. Furthermore, we asked if some form of spoken word representation can be observed also in the visual cortex of sighted individuals. We studied 20 sighted and 17 congenitally blind participants, who listened to spoken words and made semantic decisions on word referents (animals and everyday objects). We found that specific spoken words can be decoded from early visual cortex activation in both blind and sighted participants. Furthermore, the searchlight analysis showed that brain networks representing differences between spoken words are overall very similar in both participant groups. We conclude that the overall shape of the spoken word comprehension network, as investigated with MVPA, is relatively robust to changes in visual experience. We also suggest that visual cortex responses to spoken words, observed in blind individuals, might originate from information that is represented in this region even in sighted individuals.

COMPUTATIONAL SESSION

Gabriela Puchała, Karol Krzemiński

SWPS Uniwersytet Humanistycznospołeczny

Visual strategies crucial for error detection in radiology

Objectives: Radiology takes place among the most important disciplines of medicine. It consists of various methods of imaging being used on daily basis in hospitals all around the world, some of which are X-ray, ultrasonography, magnetic resonance imaging, computer tomography or angiography. Statistics show that radiology is becoming a more and more popular specialization and being chosen more commonly by young doctors. Their education and therefore developing good diagnostic skills is crucial for making correct diagnoses, which can have a huge impact on patients' lives. There are studies that indicate that up to one third of missed pulmonary nodules in clinical practice are caused by inefficient visual search behaviors.

Conclusions: A wide range of eye-tracking research is focused on finding the differences between experienced experts in radiology and novices in this field. Scientists were able to identify profound differences in visual search patterns, time on task, eye movement characteristics and correctness of diagnoses of experts and novices. Experts showed a higher accuracy in their diagnoses, shorter general visual search, faster fixations on abnormalities and more global-focal search pattern. An idea occurred to apply these discoveries and create programs based on them, whose task would be to teach young doctors more effective visual search patterns and by that improve their analyzing skills. Unfortunately, most studies failed to find improvement in novices after using such programs.

COMPUTATIONAL SESSION

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How eye-tracking develops multimedia learning?

Objectives: Eye tracking is a technology that allows us to verify and improve multimedia learning methods. Thanks to this we can optimize techniques and enrich aesthetics that are supportive in the learning processes. Efficient and better multimedia learning can be possible through the adequate design of given materials.
Conclusions: Research conducted using eye-tracking enables the development of multimedia learning. They indicate how a person receives, processes, and remembers information. Results show that improvements such as appropriate interface design, cueing effects, or color coding are effective in the education process. Thanks to this, it is possible to modify, among others, school textbooks and modern forms of online education.

COMPUTATIONAL SESSION

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EEG-based Gender Recognition with Convolutional Neural Networks

Objectives: Convolutional neural networks (CNN) are becoming more widely used in various tasks of EEG classification. However, they haven't been studied extensively in the application for gender recognition, which could be helpful, e.g., in medical or psychological research. The main objective of this work was to assess the possibility of using CNNs in gender classification based on EEG signals recorded in experiments examining event-related potentials evoked by pseudowords and emotionally laden words. Secondary objectives involved comparing the effectiveness of different model architectures and input formats for models trained on data from experiments with various paradigms.

Methods: Data from 5 experiments were available for analysis: two Emotional Stroop Task (EST) experiments, one Lexical Decision Task (LDT) experiment, and two Emotional Categorization Task (ECT) experiments. EEG signals were filtered in the 0.1 - 30 Hz range and segmented into 1-second fragments, which were grouped according to the experiment paradigms, yielding three datasets of ~25000 samples, each with balanced classes. Four CNN architectures were developed: 2-layer shallow, 5-layer deep, 4-layer CWT and CWT-SF. The former two took the preprocessed segments as input, while in the latter the input was composed of time-frequency maps obtained using continuous wavelet transform with Morlet wavelets. Models were evaluated in a cross-validation procedure. Significance of the observed differences was tested using Kruskal-Wallis and Mann-Whitney tests with Bonferroni correction.

Results: All models were able to recognize gender at a level better than random classification. No significant differences were found between the models in cross-validation metrics. In the final evaluation, classification quality was the best for the LDT dataset in most models, where the highest accuracy was achieved by the deep network ((88.84±1.32)%) and CWT-SF ((86.99±0.71)%).

Conclusions:Results show that CNNs can achieve high accuracy in EEG-based gender recognition even with minimal signal preprocessing. The uniformity of experiment data and the training set size have a considerable influence on model performance. Further research should focus on explaining the deep and CWT-SF models to determine the most important EEG features for gender recognition.

COMPUTATIONAL SESSION

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Towards the observer-independent analyses of cytoarchitectural properties of the mammalian cerebral cortex

Objectives: The cerebral cortex is a laminar structure that can be divided into cytoarchitecturally defined areas. While it has been extensively investigated for over a century, there is still no broad consensus regarding its structural and functional parcellation. At the same time, delineating areas that are agreed upon is still time-consuming and depends on extensive neuroanatomical knowledge. Deep learning solutions that have emerged in recent years bring a chance of addressing both challenges: alleviate the burden of manual segmentation and provide broader, observer-independent insight into the structural properties of the cerebral cortex.

Methods: We propose a proof-of-concept U-Net deep learning network model for the segmentation of the cerebral cortex into cortical layers. We test this solution using artificially generated laminar profiles of neuronal density that imitate the distribution observed in cortical areas of a non-human primate, the common marmoset monkey (Callithrix jacchus). Specifically, we model and analyze examples of koniocortex, dysgranular, and agranular cortical areas that have diverse, though clear, and agreed-upon laminar composition.

Results: The model can distinguish between the cerebral cortex and the underlying white matter. Further, it was capable of classifying individual layers, although to a varying degree of accuracy.

Conclusions:This preliminary study showed that the U-Net deep learning network model is a good starting point towards streamlined analyses of the cytoarchitectonic properties of the primate cerebral cortex, in particular, automated identification of the individual cortical layers.

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COMPUTATIONAL SESSION

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Deep learning approaches to the identification of cortical areas in the mammalian brain

Objectives: The neuroanatomy of the cerebral cortex has not been completely studied. Such research is time-consuming and requires significant expertise. Similarly, delineating the cortex into areas according to neuroanatomical criteria is no less challenging. Hence a yearning need to automate both processes.
Methods: To address this challenge, we trained neural networks to automatically identify cortical areas based on laminar patterns derived from an open marmoset monkey brain template (https://www.marmosetbrain.org) that provides a delineation of the cortex into areas. A two-surface Laplacian-based method was used to compute curves extending from a pial surface to the white matter boundary. These profiles were then assigned with identifiers of corresponding cortical areas and constituted an input for the network. Two approaches were examined: one relying on segmentation into all 116 areas defined in the atlas. The other approach was to train 116 independent classifiers and apply winner-takes-all aggregation.

Results: The predictions are highly accurate (ca. 75%) when performed on the hold out dataset. Other performance metrics (recall, precision, and f1 score) also have similar values, however, they vary between areas. The results also demonstrate that the cytoarchitectonic profiles are a reliable source of training data for deep-learning solutions to identify cortical areas.

Conclusions:While the primary purpose of the pipeline is to automate the delineation of cortical areas, the close examination of the resulting neural networks might provide insight into cytoarchitectonic features that contribute the most to the identification of the cortical area.
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COMPUTATIONAL SESSION

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How can Big Data tools help Neuroscience? – a short review of opportunities and challenges related to using Big Data tools in Neuroscience

Objectives: The recent movement towards open science and data sharing enables neuroscientists to combine data from different sources and conduct more advanced analyses on existing datasets. The datasets often include additional information, from surveys filled out by participants, to details of the tasks they were asked to perform during the studies, to video recordings of their behaviour. However, these growing datasets might require new, more efficient methods of analysing and visualising, as well as more powerful machines to execute these operations. One way to combat these issues could be using and adjusting already existing Big Data tools, which although at first might seem to be more associated with business analytics, have already been found useful in some scientific fields, such as genomics and astronomy. In my poster, I am going to briefly review the opportunities and challenges related to using Big Data tools in Neuroscience, in order to investigate whether Neuroscience could benefit from applying these tools in the future and if so, how exactly would they improve the process of data analysis and how they could they be made more accessible and easier to use for researchers.

COMPUTATIONAL SESSION

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Exploring the potential of Recurrence Quantification Analysis in neuropsychiatric research

Objectives: Recurrence Quantification Analysis (RQA) is a tool used for the description of dynamical (nonlinear) systems and this method has caught the attention of neuroscientists. Recently it has been used to develop an amygdala parcellation pipeline based on the dynamics of the brain signal. The aim of this research is to further explore the potential of RQA in neuroscientific research through its application to data from patients with Compulsive Sexual Behavior Disorder (CSBD).

Methods:We examined resting-state fMRI data acquired from 50 CSBD patients and 28 healthy controls (HC) during a 12-minute resting-state session in a 3T MRI scanner. RQA measures have been computed for different estimations of the Radius value to explore which one could be best used for the description of the amygdala signal's dynamics in both datasets. Amygdala parcellations were performed according to the pipeline by Bielski et al. [1]..

Results: Best amygdala parcellations were obtained for the Radius values equal to 1.15 for the CSBD dataset and 1 for the HC. We managed to divide the amygdala into two subdivisions and the values of validation measures were comparable to those for the parcellation published in [1]. Differences in size and organization of the subdivisions were observed between patients and healthy controls.

Conclusions: Our results show that RQA has the potential to become a powerful method for neuropsychiatric research, but its limitations need to be further explored. The obtained parcellations are to be used as in-house amygdala masks to assess whether there are differences in resting-state functional connectivity of the amygdala subdivisions' between individuals with CSBD and HC.

COMPUTATIONAL SESSION

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EEG signal pathologies classification using NLP methods

Objectives: Electroencephalography is widely used in clinical applications and diagnosis. Despite that many methods for EEG analysis have already been developed, the occurrence of significant inter-individual differences in bioelectric signals might influence the reliability of the diagnosis obtained via existing tools. Moreover, it is believed that the EEG signal may contain a lot more information than has been discovered. Due to these reasons, in my master thesis, I plan to explore and expand the existing NLP-inspired model BENDR in order to create an automatic and, hopefully, more reliable EEG signal pathologies classifier.

Methods: The existing machine learning model BENDR is a transformer used for building the EEG model, analogical to the language model in NLP. In my research, I will focus on creating a general EEG model using freely available TUH EEG Corpus. The model will be fine-tuned on signals collected from subjects suffering from various neuropathologies, in order to create a classifier determining the probability of the occurrence of particular diseases for an examined subject. Additionally, different data representations for the autoencoder will be tested in terms of improving the model's performance.

Conclusions: If the results are promising, I will further develop the model in order to create a more reliable tool for neuropathologies diagnosis. Moreover, the appliance of explainable machine learning methods to this model may contribute to finding biomarkers distinctive for particular disorders.

COMPUTATIONAL SESSION

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A new look at the scanpaths

Objectives: There are numerous ways to analyze saccades in the oculographic methodology, however existing tools do not aggregate saccades for further analysis. Individual saccade analysis presents a difficulty in the context of the whole study and lack of aggregation introduces unnecessary visual chaos when visualizing the data. To prevent the aforementioned problems Edge Bundling was invented - a technique that simplifies complex transitional graphs (Lhuillier et al ., 2017, Peysakhovich and Hurter 2018). Unfortunately this technique was based on two-dimensional coordinates and omitted the time dimension.

Methods: The presented approach addresses the above gap by introducing a new scanpath aggregation technique, an entirely new procedure written in the Python programming language. It is based on Peysakhovich's main idea (2015), but proposes major changes to the entire analytical procedure.

Results: The main components of the procedure are fixation clustering, determination of Convex Hull to establish natural areas of interest, and optimization of natural breaks. The procedure also contains many machine learning based elements. The result of our research is a technique that allows the determination of aggregated scanpaths for both a single person and groups of people, in addition to the time domain, which is a novelty in this family of techniques.

Conclusions: This technique is important insofar as it allows comparing expert groups with non-experts in any field of life and work. Comparing scanpaths can be important to obtain differences and, based on them, prepare training programs to improve the way non-experts look. The implication might be critical in the case of, for example, public transport drivers.