# IV International Conference

# Aspects of Neuroscience

## Abstract Book

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Dear Colleagues,

It is our great pleasure to welcome all of you to the International Conference "Aspects of Neuroscience". This is the fourth edition of our conference and the second one organized at the international level.

We gathered here, because of one, both common and obvious reason: neuroscience. This meeting between outstanding scientists and ambitious young researchers is a great opportunity to fulfill our curiosity.

Interdisciplinary character of this conference is a base for integration of diverse scientific environments in order to create a new quality in brain research. We would like to emphasize that lectures and discussions during our conference, beside undoubted scientific value, are also a perfect chance to establish new ideas and prospective cooperation.

Therefore, we warmly encourage you to participate actively in every part/aspect of this meeting. We believe that inspirations found during our conference could grow to a new way of thinking in the near future and lead to even greater acceleration in international brain research.

Kind regards,

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# CONFERENCE PROGRAM

## NOVEMBER 14, 2014 (FRIDAY)

16.00 Registration opens
18.00 Opening ceremony

### OPENING LECTURE (9B)
18.15–19.15
*Chemistry of vision and inherited retinal disease*
**Prof. Krzysztof Palczewski**
Department of Pharmacology, School of Medicine, Case Western Reserve University, USA

20.00 **Warsaw at night - sightseeing**

Enrollment available at registration point. Details to be given later.

## NOVEMBER 15, 2014 (SATURDAY)

09.00–11.05 <u>**I SESSION (Neurobiology)**</u> *(9B)*
09.00–10.00
*Cleavage that links brain and mind*
**Prof. Leszek Kaczmarek**
Laboratory of Neurobiology, Nencki Institute of Experimental Biology, Polish Academy of Sciences, Warsaw, Poland

10.05–11.05 <u>I SEMINAR SESSION</u>

**BASIC LEVEL** *(9B)*

**SI.B1** *The science behind homosexuality -
a general overview*
Dominika Korol

**SI.B2** *Dopamine, plasticity and working memory*
Anna Tokarska

**SI.B3** *Diverse patterns of behavioral deficits
in subjects being genetic mouse model
of Fragile X syndrome*
Alicja Puścian

**EXTENDED LEVEL** *(103B)*

**SI.E1** *Salivary catecholamines in psychology -
MHPG as a marker of central noradrenergic
activity*
Konrad Rudnicki

**SI.E2** *Acute restraint stress enhances
glutamatergic and attenuates gabaergic
transmission in the paraventricular nucleus
of the rat hypothalamus*
Magdalena Kusek

**SI.E3** *Anti–interleukin–1beta antibody prevents
the occurrence of restraint stress–induced effects
in the frontal cortex*
Joanna Sowa

11.05–11.30 **Coffee break** (*Main Hall*)

11.30–12.40 **POSTER SESSION I** (*Main Hall, 1st Floor*)

12.40–14.45 <u>**II SESSION (Neuroinformatics)**</u> *(9B)*

12.40–13.40

*Modelling the dynamics of information storage and recall in neural circuits*
**Prof. Bruce Graham**
Cognitive Computation Research Group, Computing Science and Mathematics, School of Natural Sciences, University of Stirling, Scotland

13.45–14.45 <u>II SEMINAR SESSION</u>

**BASIC LEVEL** *(9B)*

**SII.B1** *Modeling of seizure transitions with ion concentration dynamics*
Damiano Gentiletti

**SII.B2** *Analysis of mice behaviour in Python (programming language)*
Jakub Kowalski

**SII.B3** *SSVEP generation – simple superposition or internal neural oscillator?*
Paulina Anna Dąbrowska

**EXTENDED LEVEL** *(103B)*

**SII.E1** *Time evolution of SSVEP for different stimulation frequencies*
Maria Nowicka

**SII.E2** *Spatial properties of steady state visual evoked potentials (SSVEP)*
Dominik Krzemiński

**SII.E3** *Spontaneous and forced synchronization in Kuramoto model*
Aleksiej Khrabrov

14.45–16.30 **Lunch Break / POSTER SESSION II** (*Main Hall, 1st Floor*)

16.30–18.50 <u>**III SESSION (Clinical Neuroscience**</u>) *(9B)*

16.30–17.30

*Neuroinflammation and mood disorders; cause or coincidence*
**Prof. Brian Leonard**
National University of Ireland Galway, Ireland

17.35–18.55 <u>III SEMINAR SESSION</u>

**BASIC LEVEL** *(9B)*

**SIII.B1** *Neuropsychology of sleep and dreaming in borderline personality disorder*
Monika Słodka

**SIII.B2** *Neural integration in bipolar disorder*
Wojciech Sak

**EXTENDED LEVEL** *(103B)*

**SIII.E1** *Neuroradiological changes in the model of experimental acute hydrocephalus in rabbits*
Konstantin Senkevich

**SIII.E2** *Inflammation-driven neurodegeneration: can we stop this phenomenon with cell-based therapy?*
Bogna Badyra

**SIII.B3** *Deep Brain Stimulation – history, current and future clinical application*
Kamil Polok

**SIII.B4** *Comparative analysis of the progression of AD among patients with DM type 2 taking and not taking metformin*
Piotr Alster

**SIII.E3** *Does systemic inflammation induced in young rats change the seizure susceptibility in adulthood?*
Emilia Kosonowska

**18/21** – **EVENING POSTER SESSION** (Main Hall, 1$^{st}$ Floor)

**21/22** – **Integration meeting at Café Niespodzianka** (Marszałkowska 7 St.)

## NOVEMBER 16, 2014 (SUNDAY)

09.00–11.25 **IV SESSION (Cognitive Neuroscience)** *(9B)*

09.00–10.00
*Shared circuits, perception and empathy*
**Valeria Gazzola, PhD**
Netherlands Institute for Neuroscience, Amsterdam, Netherlands; Faculty of Medical Sciences, University of Groningen, Netherland

10.05–11.25 <u>IV SEMINAR SESSION</u>

**BASIC LEVEL** *(9B)*

**SIV.B1** *Impact of augmented reality training on cognitive functioning in schizophrenia*
Łukasz Okruszek

**SIV.B2** *The influence of working memory capacity on the speed and accuracy of insight*
Marta Ratomska

**SIV.B3** *What can event-related brain potentials tell us about semantic processing during language comprehension?*
Katarzyna Jankowiak

**SIV.B4** *The reader's brain*
Joanna Sowa

**EXTENDED LEVEL** *(103B)*

**SIV.E1** *Frontal alpha asymmetry as a leading factor in explaining cognitive changes in depression*
Aleksandra Kołodziej

**SIV.E2** *Nencki Affective Word List (NAWL) in neuroscientific research of emotional dimensions and basic emotions*
Monika Riegel

**SIV.E3** *Eye fixation-related potential (EFRP) studies: results, applications and challenges*
Agnieszka Fudali-Czyż

11.25–11.50 **Coffee break** *(Main Hall)*

11.50–13.55 **V SESSION (Borderlines of neuroscience)** *(9B)*

11.50–12.50
*Subjective truths – from colour to beauty*
**Prof. Semir Zeki**
University College London, United Kingdom

12.55–13.55 V SEMINAR SESSION

**ALL LEVELS** *(9B)*

**SV.1** *Dream-reading machine: from imagery to reality*
Dagna Skrzypińska

**SV.2** *Brain perspective on willpower: is self-control finite or unlimited?*
Wojciech Zajkowski

**SV.3** *Language under a microscope. Is experimental approach useful to development of language evolution as a field of research?*
Iwona Nowakowska

13.55–14.00  **Short break**

**CLOSING LECTURE** *(9B)*
14.00–15.00
*The human brain and its disorders illustrated by brain atlases*
**Prof. Wieslaw Nowinski**
Biomedical Imaging Lab, Agency for Science, Technology and Research, Singapore

15.05 **Awards ceremony**

15.15 **Closing remarks**

# LECTURE ABSTRACTS

### Chemistry of vision and inherited retinal disease

Prof. Krzysztof Palczewski

Department of Pharmacology, School of Medicine, Case Western Reserve University, USA

Retinal photoreceptor cells can respond to light throughout our lives because they continuously regenerate a light-sensitive chromophore and certain essential structures. Defects in many proteins involved in these processes cause photoreceptor degeneration. Our long-term goal is to elucidate the molecular mechanisms of phototransduction and retinal degeneration to discover therapeutics for inherited human blinding diseases caused by mutations in phototransduction genes.Mutations in the gene encoding opsin, the protein moiety of the light receptor rhodopsin, are among the main causes of these diseases. The interface between the retina and RPE is also especially important because it is part of the visual cycle that can change in response to external stress, genetic manipulations and therapeutics in live animals. To maintain vertebrate vision, the spent all-trans-retinal chromophore released from rhodopsin in photoreceptor cell outer segments must be converted back to 11-cis-retinal, a process largely accomplished in an adjacent layer of the retina called the retinal pigmented epithelium (RPE). The key enzymes involved in this process are ABCA4 transporter, retinoid isomerase (RPE65), esterifying enzyme call LRAT and retinol dehydrogenases. In addition, a number of retinol-binding proteins are involved in this process. Structural studies significantly increased our understanding of the retinoid cycle. Pharmacology combined with structural biology of these enzymes holds great promise for developing innovative therapies targeting retinal diseases.

### Cleavage that links brain and mind

Prof. Leszek Kaczmarek

Laboratory of Neurobiology, Nencki Institute of Experimental Biology, Polish Academy of Sciences, Warsaw, Poland

The Merriam-Webster Dictionary derives term "Mind" from Old English gemynd; akin to Old High German gimunt meaning memory. Over the last quarter of century we have followed molecular roots of the memory in a hope to identify also building blocks of the mind. Initially, we have identified increased c-fos mRNA levels in memory formation, thus discovering phenomenon of gene expression in learning. Following c-Fos protein function as transciptional regulator, we have focused on its gene targets: TIMP-1 and MMP-9 (tissue inhibitor of matrix metalloproteinases-1 and matrix metalloproteinase-9), composing extracellular proteolytic system that we and others have implicated as a major player in the synaptic plasticity, learning and memory. MMP-9 has been shown first to be activated in dendritic remodeling, accompanying epileptogenesis. Then, functional studies demonstrated MMP-9 role in learning and memory as well as their cellular models and finally epileptogenesis. At the subcellular level, MMP-9 localization and activity helps to explain this role, as the enzyme, its protein and mRNA are all available at the or near excitatory synapses located at the dendritic spines to allow for a rapid, local unleash of the

enzymatic activity in response to synaptic stimulation. Furthermore, MMP-9 was shown to directly affect the dendritic spine morphology and excitatory neurotransmitter receptor function and trafficking. In aggregate, the pivotal role of MMP-9 in the synaptic plasticity underlying brain physiology has been firmly established. The present research challenge is to explain possible contribution of the enzyme to such human neuropsychiatric conditions as epilepsy, drug addiction, schizophrenia and autism spectrum disorders to name just those for which such a link has been demonstrated. By these virtues, MMP-9 emerges indeed as a molecular link to the brain molecular underpinning of the mind.

### *Modelling the dynamics of information storage and recall in neural circuits*
Prof. Bruce Graham

Cognitive Computation Research Group, Computing Science and Mathematics, School of Natural Sciences, University of Stirling, Scotland

A subfield of Neuroinformatics, Computational Neuroscience uses mathematical modeling, analysis and computer simulation to study form and function in the nervous system. Modeling has become a vital tool in cellular biological research, particularly for the endeavour of trying to understand the operation of networks of neurons. Mathematical models are used to untangle the myriad intracellular signaling pathways, particularly those underlying plasticity, the electrical properties of neurons and how neural networks may learn and process information. In this talk I will describe models aimed at deconstructing information processing in cortical neural networks, focusing specifically on the hippocampus, a brain area which is vital to the formation of declarative and episodic memories. Cortical circuitry consists of a large population of excitatory neurons, typically pyramidal cells, which are contacted by smaller numbers of heterogeneous populations of inhibitory interneurons. Assuming the excitatory pyramidal cells (PCs) are the 'information processors', then the largely inhibitory microcircuit surrounding each PC forms a control system to modulate information throughput, involving PC spiking activity and synaptic plasticity. To explore this concept we have built a computational model based on the circuitry of the CA1 area of the mammalian hippocampus. With this model we demonstrate possible roles for four classes on inhibitory interneurons (IN) in controlling the storage and recall of patterns of information coded as PC spiking activity. The model is based on published experimental data showing that the PC and different IN populations show phasic activity profiles during the 5 Hz theta rhythm that is prominent in CA1 in rats that are actively exploring an environment. The phasic relationships between cell types can result in PC activity representing recalled information during one half of a theta cycle, while new information is stored by synaptic plasticity of excitatory inputs onto PCs during the opposite half cycle.

### Neuroinflammation and mood disorders; cause or coincidence

Prof. Brian Leonard

National University of Ireland Galway, Ireland

Inflammation is an important protective mechanism against invading microorganisms and oncogenes. It is also a component of the stress response. However, whereas inflammation may start as a time and site specific defence mechanism aimed at protecting the body against pathogens, it is also an important mechanism for removing damaged cellular debris by activating the peripheral ( macrophages and monocytes) and central ( microglia) scavenger cells.

Should the inflammatory process be prolonged as a result of a chronic infection, autoimmune reaction or chronic stress for example, then maladaptive changes may occur. These changes are associated with a sustained increase in pro-inflammatory cytokines and chemokines and can contribute to both physical ( for example, heart disease, diabetes and cancer) and major psychiatric disorders such as major depression and schizophrenia. Thus chronic low grade inflammation is a characteristic feature of many major psychiatric disorders and now forms the theoretical basis of psychoneuroimmunology. The conceptual importance of psychoneuroimmunology lies in emphasising the holistic link between malfunctioning immune, endocrine and neurotransmitter systems and psychopathology and raises questions regarding the potential importance of a novel class of psychotropic drugs which modulate the immune and endocrine axes.

### Shared circuits, perception and empathy

Valeria Gazzola, PhD

Netherlands Institute for Neuroscience, Amsterdam, Netherlands; Faculty of Medical Sciences, University of Groningen, Netherland

Humans are social animals. While it is of cardinal importance for us to understand what other people do and feel, we still lack an understanding of how our brain achieves this function. Research on social perception has focused so far on cognitive processes. I investigate an alternative account: 'shared circuits'. Shared circuits are brain areas involved when we ourselves do an action, feel an emotion or sense a sensation AND when we observe someone else perform the same actions, express the same emotions and experience the same sensations. Such shared circuits reflect an automatic transformation of what other people do and feel into the neural representation of our own actions, emotions and sensations. Using fMRI we investigate the role of brain regions involved in the execution of actions during the perception of the actions of others; the role of the somatosensory cortices during the perception of other people being touched; and the role of emotional structures (e.g. amygdala and insula) during the observation of the emotional stimuli. The emphasis of the work is to investigate the idea that a single mechanism – shared circuits – could give valuable insights into how we perceive the actions, sensations and emotions of others.

### *Subjective truths – from colour to beauty*

Prof. Semir Zeki
University College London, United Kingdom

In his book on Vision and Colours, the German philosopher Arthur Schopenhauer wrote that, "A better understanding and a firmer conviction of the wholly subjective nature of colour is a very good introduction to the Kantian doctrine of the likewise subjective and intellectual forms of all knowledge". The study of colour vision thus opens an enquiry into the more general question of knowledge, of how we acquire it and how certain we are of what we know.

In this lecture, I will start by describing how the brain has developed specialized systems for processing different attributes of the visual world, among them colour, and show that damage to specific parts of the visual brain can lead to specific loss of perceptive abilities, be they in colour, or form or motion. I will also show, by focusing on beauty and comparing it to our perception of colour, that the only truths that we can be sure of are subjective truths; the neural activity mediating these subjective states can now be identified and quantified and raise important issues about what truths these subjective states are pointers to and what, in more general terms, subjective experiences tell us about our brains and the world in which it has developed.

### *The human brain and its disorders illustrated by brain atlases*

Prof. Wieslaw Nowinski
Biomedical Imaging Lab, Agency for Science, Technology and Research, Singapore

This talk has two parts: the first part addressing brain (along with some head and neck) anatomy and the second part about neurologic disorders, both illustrated by brain atlases [1-2].

Brain anatomy covers the cerebrum (with the cortex parcellated into lobes, gyriand sulci), cerebellum, brainstem, spinal cord, (cerebral, posterior fossa and deep) white matter, deep gray nuclei, ventricles, intracranial arteries, intracranial veins, dural sinuses, white matter tracts, visual system, cranial nerves with nuclei, as well as some head and neck anatomy including extracranial arteries, extracranial veins, head muscles, glands, cervical vertebrae, skull, and skin.The presentation will be illustrated by a three-dimensional (3D) and interactive atlas of brain anatomy [1].The anatomic atlas has been constructed from in vivo imaging by employing multiple MR 3 and 7 Tesla, and high resolution CT scans of the same brain specimen. The virtual model of the brain, head and neck has been parcellated into about 3,000 3D components [3-7].

Understanding brain pathology along with underlying neuroanatomy and the resulting neurological deficits is central in medical education and clinical practice. To facilitate and expedite this understanding, we have created a 3D interactive atlas of neurologic disorders to provide the correspondence between a brain lesion and the resulting disorder(s) [2]. Thisatlas, bridging neuroanatomy, neuroradiology and neurology,

provides disorder-localization relationships along with neuroanatomy exploration. It presents focal and distributed brain lesions of cerebrovascular [8], cranial nerve-related [9], and regional anatomy-related [10] disorders. These 3D synthesized lesions are labeled with the resulting disorders and associated signs, symptoms and/or syndromes along with the surrounding neuroanatomy.

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# SESSION PRESENTATIONS - NEUROBIOLOGY

### SI.B1. *The science behind homosexuality-a general overview*
Dominika Korol
*Jagiellonian University, Cracow, Poland*

This lecture is an attempt to summarize some of the most important discoveries and research regarding the sexual orientation of human beings. Early studies, those carried out by Simon LeVay and Dick Swaab, mainly concentrated on identifying anatomical differences within the brain structure of a sample group of men and women, of both hetero- and homosexual orientation. The regions considered as potentially responsible for homosexuality were: bed nucleus of stria terminalis located in the amygdalar complex, sexually dimorphic nucleus of the hypothalamus as suggested by LeVay and the Superchiasmatic nucleus as suggested by Swaab.

A few years later Dean Hamer came up with a genetic hypothesis for homosexuality in men, proposing 3 different chromosomes, including the X chromosome. However, the result was not repeatable when using a genome-wide scan. Some more recent studies from the Karolinska Institute in Sweden have shown newly discovered anatomical differences, by analysing brain's asymmetry using an MRI and by measuring the bloodflow to the amygdala using a PET. With so many competing theories and approaches, each one arguably both true and false at some point in recent history, it is important to attempt to clarify contemporary positions on the issue.

It would seem that homosexuality has at least some biological basis, whether society wishes to accept it or not. The question should be whether a homosexual person can reason their behaviour and sexual orientation by claiming to be 'born that way'.

### SI.B2. *Dopamine, plasticity and working memory*
Anna Tokarska
*Jagiellonian University, Cracow, Poland*

The prefrontal cortex, which is playing a critical role in planning complex cognitive behavior, decision making, control of emotions and social behavior, is a dynamic region which undergoes many plastic changes. Neuroplasticity can occur on many different levels, from cellular changes of synaptic efficacy and its cytoarchitecture, to large-scale changes in neural networks. Long-term depression and long-term potentiation are the two most studied forms of long-term plasticity. Dopamine neurons from ventral tegmental area, which widely innervate prefrontal cortex, can modulate functioning of pyramidal neurons and interneurons in cortex. Many physiological studies have shown strong modulatory effect of dopamine on long-term depression and long-term potentiation. However, these plastic changes depend strongly on the enviroment of cells and basal concentration of dopamine. Thus, through modulation of the pyramidal neurons, dopamine can change the state of the prefrontal network and affect many executive and cognition functions, especially working memory.

### SI.B3. *Diverse patterns of behavioral deficits in subjects being genetic mouse model of Fragile X syndrome*
Alicja Puścian, Ksenia Meyza, Szymon Łęski, Maciej Winiarski, Ewelina Knapska
*Department of Neurophysiology, Nencki Institute of Experimental Biology, Warsaw, Poland*

Loss-of-function mutations in the fragile X mental retardation protein result in fragile X syndrome (FXS) characterized by intellectual disability and autistic behaviors. FXS is a

trinucleotide repeat disorder in which a CGG element located within the 5' untranslated region of fmr1 gene expands and becomes hypermethylated. Earlier studies reveal that individual capabilities of FXS patients are related to the FMRP expression and methylation level, but the observed variability is not fully explained by this factor.

In our studies we exploited a mouse model of FXS with identical, non-functional FMR1 genotype. Using fully automated IntelliCage tests we showed significant variability in cognitive and social functioning within the FMR1 knock-out population. We observed subgroups of knock-out mice differing in their performance in place preference learning, as well as in social approach behavior. Interestingly, the levels of cognitive and social performance were correlated only in some animals.

Our findings suggest that, in addition to CGG repetitions, there exist different mechanisms leading to altered cognitive and social functioning in animals lacking a functional fmr1 gene. The designed behavioral paradigm enables us to investigate characteristics which can be observed only in a continuous, long-lasting study and holds promise of revealing mechanisms underlying the observed phenomenon.

### SI.E1. *Salivary catecholamines in psychology - MHPG as a marker of central noradrenergic activity*

Konrad Rudnicki
*University of Lodz, Lodz, Poland*

Origin and significance of neutoransmitters and their metabolites in saliva remains an open question due to conflicting research results. To investigate whether salivary 3-methoxy-4hydroxyphenylglycol (sMHPG) can be used as a marker of central noradrenergic activity, 30 students participated in two experiments consisting of effortful, cognitive tasks, while 31 others were subjects for examinational stress. On the first meeting Go/Nogo paradigm and Attentional Network Task were conducted. The second one consisted of Lexical Decision Test, Dot Judgement Test and Pattern Comparison Test. Saliva samples from the first group were taken before and 3 times after experiments. From the second group samples were collected 15 minutes before the exam and on an ordinary day. Changes in sMHPG and noradrenaline levels were examined by high-performance liquid chromatography with electrochemical detection. No differences in sMHPG as a result of examinational stress were found. However in both experiments involving cognitive effort, significant elevation in sMHPG after effort was observed. What is more, people with higher sMHPG excretion performed significantly better in cognitive tasks while performance of those with higher noradrenaline excretion was poorer. Lack of relationship between levels of sMHPG and noradrenaline also suggests its central origin. Thus the data indicate that sMHPG is rather a marker of central noradrenergic activity than physiological arousal and peripheral noradrenaline turnover.

### SI.E2. *The Acute restraint stress enhances glutamatergic and attenuates gabaergic transmission in the paraventricular nucleus of the rat hypothalamus*

Magdalena Kusek, Krzysztof Tokarski, Grzegorz Hess
*Institute of Pharmacology, Polish Academy of Science, Cracow, Poland*

Parvocellular neuroendocrine neurons of the hypothalamic paraventricular nucleus (PVN) play a key role in the activation of the hypothalamic-pituitary-adrenal axis (HPA). Parvocellular PVN neurosecretory neurons synthesizing corticotropin releasing hormone (CRH)

release CRH in the anterior pituitary gland to stimulate the production of corticotropin (ACTH), which stimulates the adrenal cortex to produce glucocorticoid hormones. It is known that excitatory and inhibitory inputs that regulate the activity of these neurons may undergo stress-related modifications; however, the effect of acute restraint stress on the function of glutamatergic and GABAergic synapses in PVN parvocellular neuroendocrine neurons is not fully understood. Adolescent male Wistar rats were subjected to acute restraint lasting 10 min and were decapitated rapidly after stress session. Brains were cut into coronal slices. Whole-cell patch-clamping was used to record spontaneous and miniature excitatory and inhibitory postsynaptic currents (sEPSCs, sIPSCs and mEPSCs, mEPSCs) from parvocellular neuroendocrine neurons of the PVN ex vivo. Acute restraint resulted in an increase in the frequency of sEPSCs and mEPSCs. Also a decrease in the frequency of sIPSC and mIPSC was observed. There was no change in the basal electrophysiological properties of the neurosecretory parvocellular neurons. The kinetic of the currents remained unchanged. In conclusion, acute immobilization stress results in an enhancement of the glutamatergic and an attenuation of GABAergic input to neurosecretory parvocellular neurons in the PVN of the rat hypothalamus.

### SI.E3. *Anti–interleukin–1beta antibody prevents the occurrence of restraint stress–induced effects in the frontal cortex*

Joanna Sowa, Bartosz Bobula, Grzegorz Hess
Department of Physiology, Institute of Pharmacology Polish Academy of Science, Cracow, Poland

Introduction. Behavioral stress has been implicated in the pathophysiology of several disorders e.g., depression. It has been shown that stress increases the amount of the proinflammatory cytokine IL–1beta in brain and exogenous IL–1beta could imitate behavioral effects of stress. It has been proposed that activation of the hypothalamic–pituitary–adrenal (HPA) axis and secretion of glucocorticoids in response to stress can be regulated by IL–1beta. Enhanced secretion of glucocorticoids influences the glutamatergic transmission in various structures of the brain, however, mechanisms of the influence of stress on glutamatergic transmission and synaptic plasticity in the cerebral cortex remain poorly understood.

The aim of this study was to determine an involvement of IL–1beta in the effects of repeated restraint stress on excitatory synaptic transmission and long–term potentiation (LTP) in the rat frontal cortex.

Methods. Wistar male rats were subjected to restraint lasting 10 minutes and repeated twice daily for 3 days. In one experimental group, rats received intraperitoneal injections of the anti–interleukin–1beta antibody, 15 minutes before each restraint session.
In a separate group, rats received only injections of IL–1beta. Frontal cortex slices were prepared 24 hours after the last restraint session and studied ex vivo. Field potentials were recorded in the cortical layer II/III.

Results. In slices originating from stressed animals the amplitude of field potentials was increased, compared with slices obtained from control animals. Restraint stress resulted in attenuation of LTP, which is consistent with previous studies. Similar effects were observed after the administration of IL–1beta. Anti–interleukin–1beta antibody, administered fifteen minutes before restraint session, prevented stress–induced modifications of the glutamatergic transmission and synaptic plasticity.

Conclusions. These data point to an involvement of peripherally produced IL–1beta in mediating the influence of repeated restraint stress on the functions of the frontal cortex.

# SESSION PRESENTATIONS - NEUROINFORMATICS

### SII.B1. *Modeling of seizure transitions with ion concentration dynamics*

Damiano Gentiletti, Piotr Suffczynski
University of Warsaw, Warsaw, Poland

Traditionally it is considered that neuronal synchronization in epilepsy is caused by a chain reaction of synaptic excitation. However, it has been shown that synaptic transmission is not necessary for epileptiform synchronization (Jefferys and Haas, Nature, 1982). In order to investigate the respective roles of synaptic and non-synaptic neuronal coupling in seizure transitions, we developed a computational model of hippocampal network, involving extracellular space, realistic dynamics of Na+ and K+ ions, the glial uptake and diffusion mechanism. We show that network behavior under synaptic coupling conditions may be quite different from the neurons' activities when specific non-synaptic components are included. In particular, we show that in the extended model, strong discharge of inhibitory interneurons may result in long lasting accumulation of extracellular K+, which sustains depolarization of principal cells and causes their pathological discharges. This effect is not present in a reduced, purely synaptic network. These results point to a possible role of non-synaptic mechanisms in a transition to seizure.

### SII.B2. *Analysis of mice behaviour in Python (programming language)*

Jakub Kowalski, Alicja Puścian, S. Łęski
Nencki Institute of Experimental Biology, Polish Academy of Science, Warsaw, Poland

Automated systems for long-time monitoring of behaviour of a group of animals (like IntelliCage) produce abundant behavioural data. Manual analysis of such data is extremally unefficient and error-prone. Since a computer is far better than a human in terms of computation speed, precision and robustness, it is tempting to let the computer do the work by designing an automated data analysis workflow. Another advantage of such approach is reproducibility of data analysis. To facilitate programming of such workflow we are developing a dedicated, object-oriented Python library for easy accessing recorded behavioural data which I present in my talk.

### SII.B3. *SSVEP generation – simple superposition or internal neural oscillator?*

Paulina Anna Dąbrowska, Rafał Kuś
Faculty of Physics, University of Warsaw, Warsaw, Poland

Even though electroencephalography exists for almost 100 years, the mechanism of generation of Steady State Evoked Potentials (SSEP) is still not clear. Nowadays two main theories are usually considered. According to the first of them, SSEP is a linear superposition of single Evoked Potentials (EP), which means individual response to each stimulus in a series. The second theory speaks about specific group of neurons, generating internal oscillations as a reaction to a stimulation. To the group of SSEP belongs Steady State Visual Evoked Potential (SSVEP). Analysis of decay of SSVEP just after stimulation offset may bring us closer to decision, which explanation is more likely. Examination of signals of 7 participants gave ambiguous results. Inspection of time evolution of power and phase shown, that amplitude decreases immediately when no more stimuli are present and that the synchronization of EEG signal can remain stable even up to six periods after stimulation offset. Such an effect suggests, that both theories are at least partially true and superposition as well as neural oscillation take part in generation of SSVEP

**SII.E1.** *Time evolution of SSVEP for different stimulation frequencies*

Maria Nowicka, Maciej Łabęcki, Anna Chabuda, Piotr Suffczyński
*Faculty of Physics, University of Warsaw, Warsaw, Poland*

Steady State Visual Evoked Potentials (SSVEP) are the steady state responses elicited in EEG signal by flicker stimulation. Frequency of oscillation of these responses corresponds to the stimulus frequency and its harmonics. In an earlier study we showed, using single stimulation frequency, that in majority of subjects instantaneous power of SSVEP decreased in time. The aim of this study was to investigate time evolution of SSVEP for different stimulation frequencies. The analysis was done using EEG signals recorded during series of 60-seconds long stimulation periods interleaved with 30-seconds rest periods. We used four stimulation frequencies, i.e, 5, 10, 20 and 40 Hz, which were randomly changed between the trials. For each subject 5 hours of EEG signal were collected – 50 trials for each frequency. The analysis shows that time evolution of SSVEP varies between stimulation frequencies. For low frequencies (5 Hz) the power of response increases in time while for higher frequencies the habituation of power is observed. The possible explanation of these results is that SSVEP propagate by two different visual streams, which may have different, frequency dependent properties.

**SII.E2.** *Spatial properties of Steady State Visual Evoked Potentials*

Dominik Krzemiński, Maciej Łabęcki, Piotr Suffczyński
*Faculty of Physics, University of Warsaw, Warsaw, Poland*

Steady State Visually Evoked Potentials are the steady-state responses registered in the EEG signal when visual system is stimulated by a flickering light. It was shown that the strongest response is observed in the area of visual cortex (V1). Aim of this study was to investigate whether SSVEP signal measured in different parts of the scalp propagates from V1 along neural pathways, or rather by volume conduction. Differentiating true brain interactions from noisy EEG signal is highly non-trivial task. It has been argued (Nolte et al. 2004) that the imaginary part of coherency is insensitive to volume conduction effects, hence it may reliably detect information flow in the brain. In this study we analyzed imaginary part of coherency applied to SSVEP multichannel recordings. Obtained results were compared with phase distribution maps of these signals. An ubiquitous feature of these maps is sharp 180 degrees phase change between frontal and parietal regions. Coherency analysis did not provide evidence for SSVEP poropagation along the specific pathways. Taken together, these results point out rather to the existence of a driven tangential dipole being a source of SSVEP signals and volume conduction effects being responsible for their spatial distribution.

**SII.E1.** *Spontaneous and forced synchronization in Kuramoto model*

Aleksiej Khrabrov
*Faculty of Physics, University of Warsaw, Warsaw, Poland*

This talk will cover the phenomena of spontaneous and forced synchronization in Kuramoto model, which is a generic framework used to study the behavior of coupled limit cycle oscillators. Such oscillator systems can be used for modelling of neuronal synchronization. Classical Kuramoto model as well as its subsequent extensions can be easily investigated using numerical simulations. Selected extensions can correspond to phenomena occurring in biological neural systems. Behaviors such as phase transitions between the state of complete disorder and

the total synchronization, and clustering of the oscillators can be observed in such oscillator systems. Also it can be shown that oscillators in extended Kuramoto model can synchronize with an external force, which corresponds to the phenomenon of SSVEP. Classical Kuramoto model assumes constant natural frequencies, fixed coupling constants and all-to-all connectivity. By relaxing these assumptions and modulating previously fixed parameters entirely new collective behaviors can be achieved. Newly introduced parameters provide a more realistic picture of synchronization of the neurons in the brain by incorporating the properties of single neurons and neural systems into Kuramoto model.

# SESSION PRESENTATIONS - CLINICAL NEUROSCIENCE

### SIII.B1. *Neuropsychology of sleep and dreaming in borderline personality disorder*

Monika Słodka, Dagna Skrzypińska
*Jagiellonia University, Cracow, Poland*

The aim of this presentation is to explore and describe the complexity of the image of sleep and dreaming in subjects with borderline personality disorder (BPD). Sleep disorders are one of the most common symptoms experienced by people with BPD. The cross-sectional studies show that they vary in the range of 15-95,5% (Hafizi, 2013). Research on the attributes of sleep and dreaming in the course of borderline personality disorder showed that problems with sleep continuity occur in this population, along with altered regulation of REM sleep and nightmares (Asaad et al., 2002; Plante et al., 2009; Sansone et al., 2010; Semiz et al., 2008). So far, only a few polysomnographic studies were conducted in order to explore sleep architecture in patients with BPD. La Fuente and colleagues (2001) revealed shorter sleep duration, longer sleep latency and more awakenings in BPD group and depressive patients compared with non-clinical population. Sleep stages 2, 3 and 4 were shorter, slow-wave sleep percentage was lower, and REM sleep latency was longer in the BPD group compared with the depressive and non-clinical groups. In later studies shorter sleep duration and more awakenings in BPD and depressive group than in non-clinical group were replicated (La Fuente et al., 2004). Moreover, patients with BPD had less slow-wave sleep and longer REM sleep latency than other groups of subjects. Philipsen and colleagues (2005) compared BPD group with nonclinical group. It turned out that the BPD group displayed shorter sleep stage 2, increased amplitude of delta waves in NREM sleep and increased amplitude of delta and theta waves in REM sleep. The data on the sleep architecture and sleep disorders in BPD obtained using PSG are inconsistent and require further empirical verification. The proposition of research with polish population will be shown during the presentation.

### SIII.B2. *Neural integration in bipolar disorder*

Wojciech Sak
*Nicolaus Copernicus University, Torun, Poland*

Mental health can be interpreted as neural integration according to Louis Cozolino and Daniel J. Siegel who deal with neuroscience and psychotherapy. In this presentation will be showed what does it mean in case of bipolar disorder, which is characterized by periods of elated mood (mania or hypomania) alternately with episodes of depression, from which suffers 2.4% of population worldwide. Often patients with this disease are left without any profound explanations what and why really has happened to them and how besides taking medications they can help themselves to keep balanced mood. Scientific discoveries showing trends of changes in functioning of neural substrate of bipolar disorder, like mechanism of excitotoxicity, dysfunctional activity of limbic system and hypothalamic–pituitary–adrenal axis, dysregulation between executive function network and default mode network or lower density of neurons in nnterior cingulate cortex, gives important information what one can do to cope with this disease. New kind of therapies like Mindfulness-Based Cognitive Therapy are able to meet those changes and effectively treat bipolar disorder, which will be showed on a specific example of Mind-Body Bridging.

**SIII.B3.** *Deep Brain Stimulation – history, current and future clinical application*

Kamil Polok

*Medical College Jagiellonian University, Cracow, Poland*

Movement disorders like essential tremor or Parkinson`s Disease are debilitating and affect the quality of the patient`s life . They require pharmacological therapy that is often associated with unpleasant side effects. This prompted the beginning of research on invasive treatment methods in 1950s. Ablative brain surgeries turned out to be effective therapy for movement disorders but bilateral ablation which was necessary in some patients was associated with high risk of persistent dysarthria and dysphagia. However, during these procedures surgeons observed that high-frequency stimulation suppressed tremor in the patient. French neurosurgeon, Alim-Louis Benabid implanted a wire into the patient`s brain, connected it to external battery and programmed it. Thus the history of Deep Brain Stimulation begun. In 1987 Deep Brain Stimulation was used for the first time as a therapy for Parkinson`s Disease and it was the beginning of new era in interventional neurology. In the course of research on DBS it also turned out to be effective in some psychiatric disorders e.g. depression, obsessive-compulsive disorder and Tourette syndrome. Further research allowed to achieve better adjustment of electrodes placement and stimulation`s frequency which led to an impressive improvement in the patient's outcome. It`s side effects are related to surgery, hardware and stimulation and the most frequent are hemorrhage, infection and electrodes misplacement. Generally, DBS seems to be effective and relatively safe intervention in some otherwise treatment-resistant neurological diseases. So far, DBS is approved by FDA as a treatment for essential tremor, Parkinson`s Disease, primary dystonia and obsessive compulsive disorder. It is investigated as a therapeutic method for numerous neurological and psychiatric disorders. Moreover, DBS efficacy will further improve with the equipment modernization and growing experience of clinicians thus improving quality of life of many patients suffering from various diseases.

**SIII.B4.** *Comparative analysis of the progression of AD among patients with DM type 2 taking and not taking metformin*

Piotr Alster

*Medical University of Warsaw, Warsaw, Poland*

Metformin is a popular oral antidiabetic drug, used mainly among patients diagnosed with DM type 2. It is satisfactorily tolerated during pharmacotherapy of obese patients and causes a relatively low number of side effects (e.g. lactic acidosis and decrease of the level of vitamin B12) In terms of biochemistry, vitamin B12 is a metabolic cofactor, which prevents DNA defects. In neurology, standard level of vitamin B12 provides correct formation of the myelin sheath. B12 deficit is, however, also relevant in inducing cognitive impairments such as progression of dementia. The aim of this work is to analyze the impact of the decrease of vitamin B12 induced by metformin, on the evolution of cognitive impairments in patients diagnosed with AD. The research project carried out at the Medical University of Warsaw assumes examining groups of patients with AD, DM type 2 using different doses of metformin, to analyze the relation between the results of Mini Mental State Examination, Clock Drawing Test and the level of vitamin B12 in the blood. It is expected that all patients will be examined twice in order to analyze the progression of cognitive impairments during the metformin treatment of DM type 2. Preliminary results show that the decrease of vitamin B12 in the blood of patients using metformin, without any protective supplementation, has resulted in obtaining results mainly in the lower 20% of the normal range. Cognitive tests taken by AD/DM t.2/ metformin patients

show increased deterioration of concentration, praxis and recalling. The differences in the results of MMSE tasks assessing remembering skills demonstrated insignificant changes compared to patients without any diagnosed cognitive impairments.

### SIII.E1. *Neuroradiological changes in the model of experimental acute hydrocephalus in rabbits*

Konstantin Senkevich[1], Olga I. Smirnova[4], Maxim A. Shevtsov[1,2,3]
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Hydrocephalus is medical condition in which there is an abnormal accumulation of cerebrospinal fluid in the ventricles. We investigated the correlation between the changes in the neuroradiological and morphological parameters in an animal model of acute obstructive hydrocephalus. Hydrocephalus was induced in New Zealand rabbits (n=10) by stereotactic injection of kaolin into the lateral ventricles. Control animals received saline in place of kaolin (n=10). The progression of hydrocephalus was estimated using magnetic resonance imaging. Regional fractional anisotropy (FA) and apparent diffusion coefficient (ADC) were measured in several white matter (WM) regions before and after the infusion of kaolin. Following 1 month, the animals were sacrificed and analyzed for the changes of WM. The brain sections were stained routinely with hematoxylin-eosin and Kluver-Barrera methods. Furthermore, the morphology of myelinated nerve fibers as well as blood-brain barrier were studied with the help of transmission electron microscopy (TEM). Compared to control animals kaolin injection into the ventricles resulted in dramatic increase in ventricular volume with compression of basal cisterns, brain shift and periventricular edema (as observed on MRI). The values of ADC in the periventricular and periaqueductal areas were significantly increased in the experimental group ($P<0.05$). Fractional anisotropy 2-fold decreased in the zones of periventricular, periaqueductal white matter and corpus collosum. Follow-up histological-based analysis demonstrated the deterioration of the WM and necrobiotic changes in the cortex. Microstructural alterations of the myelin fibers were further proved with the help of TEM. Blood-brain barrier ultrastructure assessment showed the loss of its integrity. The study demonstrated the correlation of the neuroradiological parameters with morphological changes in the white matter and blood-brain barrier. These parameters have significant implication for the diagnostics and management of hydrocephalus in patients.

### SIII.E2. *Inflammation-driven neurodegeneration: can we stop this phenomenon with cell-based therapy?*

Bogna Badyra, Olga Milczarek, Marcin Majka
Department of Transplantation, Medical College Jagiellonian University, Cracow, Poland

Brain tissue injury results in activation of microglia, which gain macrophages capabilities, including phagocytosis, cytokine and chemokine production. Such inflammation state is a physiological process, which facilitates damaged tissue removal. However, excessive or prolonged inflammation can weaken blood-brain barrier and enable peripheral leukocytes to infiltrate into the brain, leading to intensify inflammation and as effect more severe injuries of neural tissue. Mesenchymal stem cells (MSCs) are gaining increased interest of regenerative medicine as a tool in cellular therapies of pathological processes driven by excessive inflammation. MSC, which originally populate adult bone marrow, adipose tissue and also neonatal Wharton jelly, have anti-inflammatory and immunomodulatory properties, what make them perfect candidate as a transplantation material. There are growing numbers of clinical

studies, concerning myocardial infarction, graft-versus-host disease, stroke or traumatic brain injury (TBI), which not only prove unique properties of MSCs, but also show better regeneration and less severe tissue damage as a result of transplantation. Here, we would like to present our remarks about potential cell-based therapy in neonatal encephalopathy, caused by perinatal brain hipoxia and ischemia. Taking into consideration the mechanisms underlying pathology in this disease, we would like to mark the potential role of autologous MSCs and medial ganglioma eminence (MGE) differentiated from induced pluripotent stem (iPS) cells in ameliorating the neonatal encephalopathy.

### SIII.E3. *Does systemic inflammation induced in young rats change the seizure susceptibility in adulthood?*

Emilia Kosonowska, Zuzanna Setkowicz
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Epilepsy is one of the most common chronic disorders of the brain. It is defined as a tendency to unprovoked, recurrent seizures. According to the Epilepsy Foundation of America it affects about 65 million people in the world and more than a half of them suffer from seizures without any known cause (idiopathic epilepsy). Medical treatment of these patients is much more complicated or even impossible (drug resistant epilepsy). Therefore, numerous contemporary research efforts are aimed to detect factors triggering epileptogenesis in such clinical cases. Actually, some research groups claim that inflammatory processes could be good candidates for these epilepsy-inducing factors. However, it is also suggested that early age inflammation acting as a preconditioning factor may also have neuroprotective effects in case of epilepsy. I would like to present main theses of the research project I am involved in and to show some preliminary results. The main issue of this research is the influence of inflammation on the subsequent brain susceptibility to seizures. We are planning to look for postinflammatory changes and check if they could be factors contributing to epileptogenesis. To examine the relation we used LPS injections to induce systemic inflammation in six-day- and thirty-day-old rats. Then, on postnatal day 60, the rats were injected with pilocarpine to evoke status epilepticus and the intensity, and duration of seizure behaviour were observed. Three days after seizure induction the rats were sacrificed. We expect that results of our immunohistochemical examinations, further data obtained from MRI studies of rat brains and EEG recordings of cortical activity in those rats will make us able to detect possible causal relations between early age inflammatory status and susceptibility to seizures induced in adulthood.

## SESSION PRESENTATIONS - COGNITIVE NEUROSCIENCE

### SIV.B1. *Impact of augmented reality training on cognitive functioning in schizophrenia*

Łukasz Okruszek[1], Anna Schudy[1], Michał Jarkiewicz[2], Mateusz Kruszyński[1], Magdalena Linke[2], Marek Jarema[2], Emilia Łojek[1], Adam Wichniak[2]
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Recent studies have shown that psychomotor slowing may be a basic deficit which underlies other cognitive dysfunctions in schizophrenia. However, cognitive remediation (CR) therapies are rarely aimed at improving this domain of cognitive functioning in schizophrenia. Thus, training which simultaneously address psychomotor and cognitive abilities may be more beneficial than standard CR therapies in schizophrenia. The aim of our research program is to analyze the impact of training with new generation augmented reality (AR) software on cognitive functioning in schizophrenia. During the pilot study five patients diagnosed with schizophrenia according to ICD- 10 criteria completed twelve one-hour sessions, during which executive control and verbal working memory were trained with Neuroforma software. Additionally patients have undergone neuropsychological examination with a MATRICS Consensus Cognitive Battery at the baseline and upon the completion of the training. Test-retest differences were observed in measures of psychomotor speed (Wilcoxon signed-rank test for Trail Making Test-A results: $p$=0,04) and verbal learning (Hopkins Verbal Learning Test: $p$=0,04), moreover a trend toward differences in verbal working memory task emerged (Letter Number Span: $p$=0,06). A trend toward improvement of MCCB Composite Score was also observed, however it did not reach the statistical significance ($p$=0,07). This results shows that AR training may lead to improvement in both psychomotor speed and in other cognitive domains in patients with schizophrenia, however further studies are needed to assess its efficiency and compare it with other CR methods in schizophrenia.

### SIV.B2. *The influence of working memory capacity on the speed and accuracy of insight*

Marta Ratomska
The John Paul II Catholic University of Lublin, Lublin, Poland

The purpose of the study was to find the relationship between working memory capacity and efficiency of solving insight problems. The insight is treated here as a result of implicit learning interacting with explicit learning. Working memory is a part of the cognitive system responsible for temporary information storage processing. It determines the efficiency of higher order cognitive functions, including reasoning and problem solving. This is why we hypothesized that people with higher level of working memory capacity would solve an insight task better than those with lower level of working memory. There were 35 subjects aged from 20 to 32, who gained the lowest (N = 19) and the highest scores (N = 16) in the O-span task during selection tests. Both groups solved the insight task similarly. The analysis of differences in reaction times revealed that the process of implicit learning did not occur. However, amongst subjects classified as "nonsolvers" of the insight task there were those who found the hidden rule but did not apply it. Although the results of the conducted research did not confirm our hypothesis, it is worth noting that further research should take into consideration the possibility of dividing people into three groups (solvers, nonsolvers and quasi-solvers) instead of two groups (solvers vs. nonsolvers). This enlarged number of categories of dependent variable could better permit to find what exactly distinguishes solvers from quasi-solvers, leading to answer the

question: 'What enables people to solve problems more efficiently?'. This was the preliminary study before the EEG assessment aiming to find neural correlates of insight.

## SIV.B3. *What can event-related brain potentials tell us about semantic processing during language comprehension?*

Katarzyna Jankowiak
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Event-related potentials (ERPs) have been frequently used in neurolinguistic research [1, 2]. Due to the fact that ERPs offer a great temporal resolution, they make it possible to determine the specific stage of processing influenced by a particular linguistic stimulus. ERPs are therefore commonly employed with a view to investigating almost every aspect of language comprehension.Studies devoted to ERPs in semantic processing usually focus on two language-related ERP components: the N400 and the LPC (late positive component). The N400 is a negative-going brainwave peaking in amplitude at around 400 ms after stimulus onset, and is sensitive to a stimulus' congruity and plausibility. Importantly, the component turns out to be very informative when investigating the nature of semantic memory representation in the brain, as different types of meaning-related information (e.g., concrete vs. abstract words) elicit different N400 amplitudes.Yet, the precise cognitive operations behind the N400 remain under discussion. The LPC, on the other hand, is a positive brain activity, usually evoked 500-800 ms after stimulus onset. Although the LPC was traditionally ascribed to reflect syntactic violations, recent findings [3] have suggested that the component also reflects additional meaning re-analyses, as well as memory processes engaged in meaning integration and the formation of new semantic associations. Interestingly, both the N400 and LPC are also frequently examined when investigating figurative meaning comprehension [4, 5], as well as bilingual language processing [6, 7].The talk will explain the neural basis of ERPs, and point out the advantages of employing electrophysiological methods in studies on language. Furthermore, the presentation will be devoted to discussing the aforementioned aspects of semantic processing reflected by the N400 and LPC, together with theories accounting for them, in order to shed more light on cognitive operations engaged during language processing.

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## SIV.B4. *The reader's brain*

Joanna Sowa
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At this very moment, your brain is accomplishing an amazing feat- reading. Your eyes scan the page in saccades and every 4-5 per second your gaze stops to recognize some words. But how can a few black marks on white paper projected onto your retina evoke a process in which we are aware of only meaning and sounds? And why does our primate brain have an inclination for reading despite the fact that this cultural activity was only invented a few thousand years ago? The reader's brain contains a complicated set of mechanisms admirably attuned to the recognition of written words. More surprisingly, the same mechanisms, in all humans, are systematically housed in the identical brain region, the visual word form area (VWFA), as if it was a cerebral organ for reading. Human brain architecture obeys strong genetic constraints, but

some circuits have evolved to tolerate a fringe of variability and remains open to changes in the environment. According to this approach, our neuronal networks are literally "recycled" for reading. Moreover, we are able to identify words regardless of how they appear, whether in print or handwritten, in upper- or lowercase, and regardless of their size or font. The VWFA, through reading experience, becomes specialized for detecting particular line contour configurations. It also appears to be feature-tolerant so that we can read word forms consisting of dots which carry word information by spatially varying dot luminance or dot motion direction. The ongoing research indicates vast possibilities for the future, as the results could profoundly alter our view on education and learning.

### SIV.E1. *Frontal alpha asymmetry as a leading factor in explaining cognitive changes in depression*

Aleksandra Kołodziej
*University of Social Sciences and Humanities, Warsaw, Poland*

Depression is usually characterized as a disorder accompanied by persistent negative mood, intrusive thoughts, low self-confidence, reduced self-esteem and lack of energy. Depression is also a disorder characterized by specific deficits in cognitive functioning, especially when integration of information is required. Changes in cognitive functioning are now widely recognized as a very important aspect of depression and mood disorders. In addition to traditional behavioral indicators of cognitive skills psychophysiological methods (including electrophysiological measures) are used more often to verify and explain cognitive changes in groups of people with low mood. The main objective of my presentation is to review the cognitive changes characteristic for depression - cognitive impairment: attentional, memory, analysis and reasoning – and how they related to the asymmetry in the alpha band activity in the frontal cortex. Some studies suggest that cognitive disorders manifest in depression because of the disruption of normal prefrontal alpha power lateralization. People suffering from depression usually show significantly higher activity in the alpha band in the left hemisphere compared to the right. Moreover, in the presentation I'm going to talk about my future project concerning this topic funded by Ministry of Science and Higher Education.

### SIV.E2. *Nencki Affective Word List (NAWL) in neuroscientific research of emotional dimensions and basic emotions*

Monika Riegel, Małgorzata Wierzba, Marek Wypych, Łukasz Żurawski, Katarzyna Jednoróg, Anna Grabowska, Artur Marchewka
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In the behavioural and neuroimaging studies of emotion, the crucial challenge for a researcher is choosing the appropriate and controlled stimuli to evoke emotional states. So far, the standardized databases of verbal stimuli have been created in certain languages, yet not in Polish. Nencki Affective Word List (NAWL) is the cultural adaptation of the German database Berlin Affective Word List-Reloaded (BAWL-R) (Võ et al., 2009). It consists of 2902 emotional and neutral words with the controlled psycholinguistic parameters, such as: frequency of use, number of letters and grammatical form. All the words have been standardized in line with two theoretical frameworks used in research of emotions: first, on the dimensions of emotions (valence, arousal, imageability); second, along with discrete emotion categories (happiness, anger, sadness, fear, and disgust). The obtained ratings of emotional arousal and emotional valence formed the

boomerang-shaped affective space, in which emotionally valenced words are characterized by higher arousal. Additionally, we explored the affective space and described it in terms of basic emotion categories, as identified with several methods of classification. There are numerous potential applications of the NAWL dataset, both in behavioral and neuroimaging studies. In order to verify its usefulness to investigate the neural correlates of verbal material processing, we decided to conduct a preliminary fMRI study. We used one of the most popular paradigms in this field of research, namely the Lexical Decision Task. We compared recognizing real words expressing particular basic emotions, neutral words, and pseudowords. We found the basic emotion effects in the reaction times, as well as brain activations consistent with the previous studies. As demonstrated in this experiment, the standardized NAWL database may be useful in studying emotions from both perspectives, dimensional and discrete, both on the Polish population and in the cross-cultural studies.

## SIV.E2. *Eye fixation-related potential (EFRP) studies: results, applications and challenges*

Agnieszka Fudali-Czyż

*Psycho-Neuro-Physiological Laboratory, Department of Experimental Psychology, The John Paul II Catholic University of Lublin, Lublin, Poland*

Perception is a dynamic process, which is inherently associated with eye movements. However, most studies of the neural correlates of cognitive processes are conducted in situations in which the subject passively fixates while simple objects are presented at the fovea (Dandekar et al., 2012). A solution can be an eye-fixation related potential (EFRP) method. EFRP allows to investigate neural correlates of cognitive processes during exploration of complex visual stimuli (eg., visual scenes or three-dimensional images) in natural viewing conditions (Dimigen et al., 2011). EFRP method combines the EEG measurement with eye tracking. EFRPs are extracted from the EEG by means of signal averaging in a temporal window commencing from the onset of eye fixation (Fudali-Czyż et al., 2014). So far, this method was used to study such complex cognitive tasks as reading, visual search, change detection, object identification, decision-making in information seeking or exploration of simulated environment (Baccino, 2011; Dimigen et al., 2011; Frey i in., 2013; Fudali-Czyż et al., 2014; Rämä i Baccino, 2010; Körner et al., 2014; Takeda et al., 2014). In my presentation I am going to introduce the most interesting findings of EFRP studies and their potential applications as well as their main challenges.

## SESSION PRESENTATIONS - BORDERLINES OF NEUROSCIENCE

### SV.1. *Dream-reading machine: from imagery to reality*

Dagna Skrzypińska, Monika Słodka
Jagiellonian University, Cracow, Poland

Dreaming is a subjective experience while sleeping with the predominance of visual images. The content of dreams has been private and its objective measuring has not been possible for very long time. The main aim of the talk is to present a neural decoding approach to visual imagery during sleep. It is focused on visual imagery experienced during the sleep-onset period, not REM one, because it allowed to collect many observations by repeating awakenings and recording subjects' verbal reports of visual experience. On the basis of links between fMRI patterns and verbal reports with reference to lexical and image databases, the content of visual imagery was revealed. Decoding machine learning models are created when the specific task- and stimulus-induced brain activity patterns in visual cortex are present. It was proved that the specific visual experience during sleep is represented by the same neural substrate as observed during waking perception. The similarity between REM and sleep-onset reports and the visual cortical activation during the REM sleep suggest that the same decoders could be used to decode REM imagery. This approach may lead us to the objective measurement of dream content.

### SV.2. *Brain perspective on willpower: is self-Control finite or unlimited?*

Wojciech Zajkowski
University of Social Sciences and Humanities, Poland

Over the last two decades the predominant view on the mechanisms of willpower was grounded in the limited resource model. Social psychology studies have shown consistently, that engaging in an effortful self-control task diminishes self-control in subsequent tasks. Those findings lead many researchers to believe that volitional exertion of self-control relies on renewable but finite resources. The most prominent framework of Ego Depletion (Baumeister, 1998) draws a comparison between muscle and brain function proposing that willpower is bounded by physiological mechanisms involving measurable drops in blood glucose after effortful self-control (Muraven and Baumeister, 2000). However, recent findings from psychological and neuroimaging studies cast doubt on this framework, providing converging evidence that such a mechanism is highly imrobable from a physiological and psychological perspective. McGuire and Botvinick (2009) showed that metabolic consumption across the brain did not change in response to increasing mental workload. Addtionally, Ego Depletion framework cannot explain many behavioral results, when participants were able to almost instantaneously replenish their willpower resources by watching TV or smoking cigarettes. The behavioral phenomenon of decreasing willpower can be explained in the light of exploration-exploitation motivational switch, suggested by many contemporary researchers (Cohen, McLure and Yu, 2007; Inzlicht, 2014). This model assumes a evolutionary motivated balance between the need to exploit currently available resources and explore the surrounding environment, in search of more profitable possibilities to exploit. Deployment of such strategy is believed to be guided by the frontal pole of the Prefrontal Cortex. The exploration/expoitation trade-off model explains the psychological data that does not fit the depletion framework and provides a testable brain model ready for further exploration.

### SV.3. Language under a microscope. Is experimental approach useful to development of language evolution as a field of research?

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Language evolution - as a field of cognitive science - is a young, dynamic and interdisciplinary field of research. The main question - how did language evolve throughout thousands of years - is believed by some scientists to be the hardest problem to be solved in science in general. They used several experimental methods to examine language and its development. One of these methods is observing how an artificial language evolves in laboratory. The presentation aims to present the process and outcomes of selected experiments on language evolution conveyed in laboratory: embodied communication game and tacit communication game (T. C. Scott-Phillips, S. Kirby), "alien language" experiments (S. Kirby, H. Cornish, K. Smith), Pictionary-like tasks (S. Garrod, N. Fay, T. M. Ellison). The material presented bases directly on original research reports. In the presentation I would like to outline the outcomes of these experiments, analyse the impact they had on language evolution as an area of research and examine the limitations of the methods used as well as the main controversies connected with them. The listeners will get to know main ideas and trends in contemporary language evolution.

# THEORETICAL POSTER ABSTRACTS

### TP1. *Neurobiology of time*

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Psychology of time is very important and interesting, but underestimated field of research. Nowadays this state is changing: we can observe an increasing number of research projects, aimed at explaining human thinking about time. One of the more interesting theories was developed by Philip Zimbardo, who described five temporal perspectives, which are related to the emotional and cognitive processes. Depending on the dominant time perspective, people can focus on the past, present or future - in positive or negative affective dimension. As a consequence, the way of thinking about the world always occurs in the temporal context. This theory became basis of study, which is part of doctoral research about the children's perception of time, conducted at the Faculty of Education, University of Warsaw. Previous research reports in this area allow to conclude that the perception of time changes with age. Study of the temporal perspectives of youth and adolescents, conducted in Warsaw high schools, colleges and universities and described in this material, seems to confirm this thesis. The main conclusion from this research is that future time perspective (FTP) increases with age of the subject. This effect is mainly related to the maturation of the brain structures responsible for abstract thinking, planning, or delaying gratification. This material is a discussion of the results of the study in the neurobiological context.

### TP2. *Whether anorexia nervosa is or is not undiagnosed autism spectrum disorder?*

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Anorexia Nervosa (AN) is a psychiatric disease and one of the eating disorders. According to DSM-5 criteria, Anorexia Nervosa is characterized by restrictive reduction in food intake, profound underweight with obsessive weight control and deformed image of body. It has a high mortality rates (Arcelus et al., 2011) and it concerns increasingly younger people (Serpell et al., 1999; Halmi, 2009). In turn, Asperger Syndrome (AS) is a neurodevelopmental disorder or, as it has been modified in DSM-5, belongs to spectrum of disorders, in which all difficulties lie in the two major areas: A. difficulties with social interactions, B. restrictive, repetitive behaviours. Individuals with AN have similar dysfunctions to these with AS, e.g., focus on self, repetitive behaviours and weak central coherence (Southgate et.al., 2007; Lang et al., 2014) . Baron-Cohen as the first claimed that males with AS represent extreme male brain - the cognitive style in which social interaction and ability to empathising have a lower influence than tendency to categorization and systematization (e.g. Baron-Cohen, 2002; Baron-Cohen et al., 2010; 2011; Auyeung et al., 2013). In the general population women have better social skills than men. Although results from the past few years has shown that women with AN have some autistic traits (e.g. Baron-Cohen et al., 2013; Tchanturia et al., 2013) and get lower than women without diagnosis of AN values of the empathy scales and ToM, comparable to women with AS.

**TP3.** *Gamma band neurofeedback training – a powerful tool joining science and clinical applications*

Katarzyna Dyl

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Gamma band oscillations (30-100 Hz) have been implicated in a variety of cognitive processes, such as perception, learning and memory. Unlike lower frequency bands, which communicate distant brain areas, the synchronization in gamma range is mainly associated with communication in neighboring areas and local integration. Impaired neural synchrony may contribute to cognitive deficits in several neuropsychiatric disorders. The evidence suggests a relationship between abnormal gamma oscillations and pathophysiological processes in schizophrenia and autism spectrum disorders [1]. Neurofeedback is a noninvasive method used to teach subjects how to modulate one's brain activity. Numerous studies have used neuronal oscillations as a feedback signal, mostly obtained along the scalp from different cortical areas in EEG recordings. This method offers the opportunity to investigate whether neural synchrony is relevant for cognitive functions, due to the fact that synchronization is treated as an independent, instead of a dependent variable. It delivers causal evidence to explore more direct links between oscillatory brain states and behavior [2].

Moreover, EEG-neurofeedback methods hold the promise of applying as a simple and cheap treatment for several brain disorders, or even as a new paradigm for communication with locked-in patients [3]. This poster summarizes gamma-band based neurofeedback studies, with an emphasis on practical applications of these methods.

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**TP4. The role of gangliosides and sialic acid in maternal diet in fetal neurodevelopment**

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Gangliosides are a group of cell membrane glycosphingolipids that have at least one sialic acid residua. They are mostly present in neurolemma where their constitute 6% of all phospholipids. Brain development is associated with an increase in gangliosides level, with peak during prenatal and early postnatal period. Thus, between 16 and 22 weeks of gestation, their content in the cortex of the frontal lobe double and in the hippocampus increase by 30%. Gangliosides play various regulatory roles in processes occurs in neural cell, including proliferation and differentiation, myelination, neuro-, axono- and synaptogenesis, which are basis of the fetal brain development. The main source of gangliosides in human diet are egg yolks, meat, milk and milk products as plant food does not contain them. Currently, there is no studies either on the average consumption of ganglioside by human, or on the optimal intake levels. So far there is limited number of an animal studies, and non human studies, where the effects of prenatal ganglioside supplementation on fetal brain development are evaluated. This studies have shown increased brain weight without long-term effects on behavior or cognition. Also, prenatal supplementation of sialic acid in n-3 fatty acid deficiency diet can be beneficial for the learning abilities in pups. It is known that maternal supplementation in human would depends on the transfer of dietary gangliosides across the placenta to support

the brain development of the fetus in utero. This study was confirmed by ex vivo model. The precise functional role of gangliosides is still poorly understood and more research is needed to evaluate the role of supplementation of this compound during pregnancy in prenatal brain and cognitive development.

**TP5.** *Gangliosides and sialic acid in infant's diet: the role in neurodevelopment*

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Gangliosides, sialic acid-containing glycosphingolipids, are incorporate into cell membranes, especially neurolemma. They are involved in several cellular mechanisms, including cell proliferation and differentiation, modulation of ion channels, calcium influx, neurotransmitter release, trafficking of lipid raft components and myelination. These mechanisms are important for transmission of nervous impulses, modification of synaptic connectivity, neurogenesis, neural repair and memory formation, essential processes for postnatal neurodevelopment. The main dietary source of gangliosides and sialic acid for infants is human milk, because infant formula contains significantly lower amounts and different composition of these compounds. Therefore, breast-fed infants showed an increase concentrations of ganglioside and glycoprotein sialic acid in brain compared with formula-fed infants. Also, many studies have shown a better brain and cognitive development of breast-fed compared with formula-fed infants. Two recent papers have shown that fortification of infant formula with milk lipids to enhance gangliosides content have beneficial effects on cognitive development of healthy formula-fed infants, which was explained before in an animal model. Summarized, this results indicate on important dose-dependent role of dietary gangliosides and sialic acid on cognitive development of healthy infants.

**TP6**. *Animal models of anorexia-another perspective on the study of eating disorder*

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Anorexia nervosa (AN) is the most common eating disorder which is very difficult to treat and frequently has fatal consequences. It is estimated that over 7 million people in the world suffer from this disorder. The major clinical symptoms of AN include reduced body weight, obsessive preoccupation with food, an unreasonable fear of fatness, bradycardia, abnormal blood pressure and temperature, and often significant depression. There are three principal clinical types of AN: (1) restrictive, when patients restrict their food intake, (2) binge/purging, when people self-induce vomiting, misuse laxatives, diuretics etc., (3) activity type of anorexia which is common among patients showing excessive physical activity to reduce their body weight. Here, we would like to present animal models used for studies on anorexia. We will focus on four of the models: (1) Activity Based Anorexia (ABA), (2) Stress Model, (3) Diet Restriction (DR) and (4) Genetic Model. ABA is an animal model that recapitulates a subset of key characteristics of AN, especially hyperactivity and reduced food intake. Stress model is based on hormonal imbalance in the hypothalamus–pituitary–adrenal axis which influences food intake. DR is a very useful model in many disorders of the central nervous system. Researchers use food restriction of less than a half of daily ad libitum to induce excessive body weight loss in animals. The most commonly studied genetic model of

AN isanx/anx mice. Studies on hypothalamus in this model have shown abnormalities in the orexigenic and the anorexigenic pathways. Animal models of anorexia are very rarery applied research tools used to investigate mechanism of this eating disorder. The aim of this work is to present similarities between symptoms that occur in the models and those in patients that have been diagnosed with AN. Furthermore, we will describe current trends investigations of this eating disorder.

### TP7. *Curcumin as an effective therapeutical agent in major depressive disorder*

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Curcumin is an active ingredient of the plant tumeric (Curcuma longa) and widely known in Asia as a spice and herbal medicine. Recent studies have shown that curcumin is also a drug effectively ameliorating neurodegenerative disorders as serious as Alzheimer's and Parkinson's diseases or epilepsy. Moreover, the drug can support the treatment of major depressive disorder (MDD). It was confirmed by numerous experiments on animal models as well as clinical trials. Curcumin was combined with other factors, such as zinc or piperine, in order to check whether they may increase its activity and such multi-targeted therapy would be more effective than curcumin alone. This review aims to show curcumin as a commonly available agent alleviating depressive symptoms in patients not exhibiting suicidal intents or psychotic disorders. Comparative tests with various doses of this substance showed therapeutic effects at behavioral, molecular and histopathological levels. A growing number of studies on this topic indicates a very high efficacy and safety of the substance application without adverse side effects. Alternate and commonly available complementary medicines, such as curcumin, deserve serious experimental and clinical exploration because of a constant increase of the incidence of depressive symptoms in the rapidly growing modern world leading to simultaneous and inevitable cumulation of side effects of the commonly used antidepressants.

### TP8. *Can the impairments in the serotonergic system be connected with the symptoms of autism spectrum disorders (ASD)?*

Kacper Ptaszek, Paweł Polasik, Dorota Myślińska, Karolina Plucińska, Edyta Jurkowlaniec

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Autism spectrum disorders (ASD) became an clinical label when the new version of diagnostic and statistical manual of mental disorders (DSM-5, 2013) was published. ASD diagnosis is strictly connected with behavioral impairments in social situations, communication deficits as well as stereotyped and repetitive behaviors. The first signs of these impairments may be observed a few months after birth and many of them, despite therapeutic interventions, may be noticeable lifelong. Reports in the US in 2012, estimated the ASD prevalence to be 1 in 88 children. Serotonin (5-HT) is a monoamine neurotransmitter which is present in plants, invertebrates and vertebrates tissue. In humans, 5-HT is found in the brain (the raphe nuclei, pineal gland) where it is involved for example in the regulation of mood and social behavior, and in body where it affects mainly muscle tone and digestive processes. 5-HT is derived from tryptophan, which cannot be synthesized by humans. On the other hand, 5-HT neurons are first to be generated during brain development which is critical in very early

developmental stages, because it helps to establish the synapses and regulate development of other neurotransmitter systems. The serotonergic system impairments observed in people with ASD may be connected with an elevated 5-HT level in platelet in the blood observed in 30% of people with ASD, called hyperserotonemia. The mechanism underlying this condition is still unclear. Nevertheless some hypotheses suggest either increased synthesis of 5-HT in the intestine or uptake of 5-HT into platelets (Harrington et al., 2013). In adults, 5-HT does not cross the blood-brain barrier (BBB), yet some research indicates that children up to the age of two years have permeable BBB and 5-HT from the periphery could reach the brain and impair the serotonergic system (Whitaker-Azmitia, 2005).

### TP9. *Gender differences in auditory event-related potentials*

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Auditory event-related potentials (ERPs) are small voltage changes generated in brain in response to specific auditory stimuli and events. ERPs can be divided into two categories: early components (or sensory, exogenous) that depend on physical parameters of the stimulus; and late components (or cognitive, endogenous) that reflect information processing. Although auditory ERP is widely used in research and clinical evaluation of psychiatric and neurological patients as well as healthy individuals, it is still not clear whether there are any differences in ERP parameters (amplitude and latency) between males and females. This poster presents a literature review regarding gender differences in early and late components of auditory ERP. We performed a search in PubMed database for auditory P50, N100, MMN, N200, P200 and P300 potentials and gender differences and selected studies using non-verbal stimuli in healthy samples over 18 years of age (referred as 'normal' or 'control'). The amount of such literature is limited – 47 original research studies matching the selected criteria were found. And, the results are inconsistent: some studies show differences between males and females in certain ERPs, meanwhile others do not. It is not possible to fully confirm or discard gender effects; wider scale studies should be conducted taking into account gender as a factor.

### TP10. *Animal model of anorexia nervosa – does it give us better insight into the nature of eating disorders?*

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The purpose of this study is to critically present animal experimental models of eating disorders, especially a model of anorexia nervosa (AN), with pointing out of their advantages and limitations. Creation and validation of useful and adequate animal models of AN could be a challenge for scientists due to complexity of clinical nature and etiology of this disorder. What we can, what we want and what we should examine and observe using animal assays are the most important questions that should be answered by a model which imitates the disorder on different levels, i.e. molecular, genetic, biochemical, mental and/or behavioral. Chronic food refusal, reduction in amount of calories, type of meals, weight gain reinforced by fear, can lead to excessive decrease of body weight and other severe consequences involving

dysfunctions of gastrointestinal (dyspeptic, ulcers), immune, cardio-vascular (bradyarythmia), bone (osteopenia, osteoporosis) or central nervous systems. Using a large body of animal models, such as self-starvation (activity-based anorexia, ABA), models using various stress stimuli, genetic models or diet restriction, based on different factors causing and contributing to conditions similar to human anorexia, researchers try to explain and explore at least partially this complex disorder. Above animal models of AN do not fully illustrate the disorder, but the extensive exploration of the issue allows a better understanding of the causes and mechanisms of a disease development, what, at the same time, can help to find better methods of treatment. A particularly promising in this respect are genetic models.

**TP11**. *Mechanisms of parasites' influence on nervous system in behavior context.*

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Central nervous system is a great shelter from immune system for parasites. This neighborhood can be an opportunity for them to disturb work of neuronal systems or change it. Could we expect this influence in hosts behaviors? Or going even further – can parasites change human mind? I want to present some of parasite species which can control hosts behaviors for execute life cycle. I focused on non-exotic examples and chose parasites which occur in Poland. Firstly, I want to talk about trematoda, Leucochloridiumparadoxum which is having snail as a host. Later, I want to present Dicrocoeliumdendriticum where one of its vector is ant. As the closing matter I will discuss the Toxoplasma gondii which not only have influence on rats but in shed of later researches even on human behavior. Mechanisms of their work is not well-understood. In my poster I want to show studies of scientists like J. Webster, W. and T. Wesołowski and others who try to explain this problem. Also I would really want to show you that researches on neural parasites are needed.

**TP12.** *Electrophysiological and pharmacological methods of influence on animal behavior*

Łukasz Bijoch

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Rapid development of neuroethology in the last fifty years gave us a new view on neural system physiology. Studies on parasites which use plenty of refined methods to subordinate their hosts gave us new ways to control animals' behaviors. The ability of controlling invertebrates and vertebrates cause to rethink our view of free will. These researches can provide proofs of neural correlates of consciousness or lead us to conclusion that a nervous system is only a complex machine which can be controlled, if only we could understand how it works. In this poster I want to explain some of studies of Spanish scientist, Josie Delgado. He was a pioneer in implantations electrodes within a brain to stimulate it. He used that way to suppress aggressive behavior in bulls and monkeys. Continuing this topic I want to tell about Dr. John Chapin's studies on a remotely guided rat. I have prepared also a part about "prosocial" influence of oxytocin in researches on rhesus monkeys. The end of my presentation includes studies about controlling cockroaches by their cerci and an example of Polymorphusparadoxus which manipulates Gammarus by its serotonic system.

### TP13. *Exciting GABA! Depolarizing effects of the neurotransmitter*

Anna Chrzanowska

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Gamma-aminobutyric acid (GABA) is a commonly known neurotransmitter causing the inhibition in adult neurons. However, many studies have shown, that the important role of GABA is connected with its depolarizing activity. The most significant role of this phenomenon refers to prenatal and neonatal developement of nervous sistem. Its physiology is connected with higher intracellular concentration of chloride and with more positive equilibrium potential of Cl- than membrane potential. The change of this effects is regulated during the embrional development. It is caused by gradually increasing importance of glutaminergic transmission and dynamical changes of chloride transporters. Expression of NKCC1 transporter, which is responsible for maintainig the high intracellular Cl- concetration is decrasing, while KCC2 transporter, which pumps out chloride appears. Depolarizing activity of GABA in adult brains is a controversial subject, but some research shows its necessity during integration of newly-born neurons with existing curcuits. Non-hyperpolarizing function of GABA has a key role during early neurogenesis, migration of neuronal stem cells, their proliferation and maturation. Alteration of these proceses results in a number of pathologies.

### TP14. *Influence of isotretinoin on a brain.*

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Isotretinoin is a chemical substance from the retinoid family, which is commonly used by dermatologists for treatment of the most severe acne. Unfortunately, the treatment can cause side effects, like degeneration of neurons, which is still being researched. One of the most well-known side effects is depression. Long- term intake of isotretinoin can decrease level of aggression. Furthermore, high dose can disengage connection between nuclei raphes and hippocampus, what is direct cause of depression. More side effects strike on learning and memory. Striatum and hippocampus are structures being involved in covert and overt memory processes. Rats treated with high doses of isotretinoin can't remember the arm of maze were the award was located, whereas low doses of isotretinoin reveal neuroprotective influence, based on preventing activity of beta amyloid in hippocampus. This leads to the assumption, that applying isotretinoin into the treatment does not only cause undesirable side effects.

### TP15. *Chronotype and resting state activity of the brain – fMRI study*

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Chronotype is an individual attribute of human beeing emerging from inner circadian clock and refering to what time of day person is cognitively and physicaly effective. Resting

state is a method used in functional Magnetic Resonance Imaging that is usefull for estimation interactions between cortical regions when subject is not performing any distinct task.

Case of this study is to examine differences between late (LC) and early (EC) chronotype resting state activity in different times of the day. We will investigate 30 participants (15 LC and 15 EC) using functional Magnetic Reasonance Imaging. For each participant we will perform two sessions of fMRI. We are expecting significant differences that varies on whether subject will be tested in his/her normal operative hours depending on his/her chronotype or in hours that he/she is not fully effective.

We want to recruit 30 healthy, both-gender, right - handed students. Age from 18 to 30 years. Handedness will be measured with the Edinburgh Inventory (Oldfield, 1971). Chronotype will be measured with Krad (Kwestionariusz Rytmu Aktywności Dobowej – polish adaptation of Morningness-Eveningness Questionnaire by J.A. Horne and O. Oestberg). Every participant will be scanned two times. In one session - day we will perform morning scan (at 10.00 am) and evening scan( at 8.00 pm) and there will be only one scan( morning or evening) for one participant during one day. We will record 10 minutes of resting state activity in each session. Collected images will be exported for further analysis using FSL.

Refering to preceding studies we are anticipating differences patterns on resting state activity depend on differences between EC's and LC's groups (Blautzik, 2013) and also different patterns in each group depending on in what hours scans will be performed.

### TP16. *Core Functional Brain Networks in Cognition*

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Network perspective is becoming increasingly popular in the analysis and interpretation of cognitive brain functions. The network approach is grounded in system analysis and graph theory. In contrast to the modular framework which describes brain structures as discrete, independent and highly specialized processors (Necka et al., 2004), the network paradigm views complex cognitive operations as a function of many dynamic and interrelated processes, without clear anatomical boundaries (Bressler and Menon, 2011). To date, neuroimaging studies have identified three core large-scale functional networks, mediating all cognitive functions. These include the default mode network (DMN), central executive network (CEN) and salience network (SN). The DMN activity mostly dominates during cognitive leisure and self-monitoring functions. The main structural nodes of the DMN include the posterior cingulate cortex (PCC), ventromedial prefrontal cortex (VMPFC) and the precuneus. CEN activity is strongest during task engagement and directed attention. The CEN is anchored in the dorsolateral frontal cortex (DLPFC) - posterior pariental cortex (PPC) loop. Finally, the SN plays a crucial role of a dynamic 'switch' between DMN and CEN in accordance to cognitive demand. SN relates to activity in the anterior insula (AI) and anterior cingulate circuit (ACC). This lecture presents a basic overview of the network/system paradigm as applied to large-scale neural data, new methods necessary for analysing such data and the current findings illustrating the involvement of core large-scale networks in cognition.

**TP17.** *Songbirds as a model for human speech acquisition and disorder*

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Songbirds are used as a model system for vocal lerning and production due to strong similarities to mammalian brain pathways responsible for advanced vocal behavior. Birdsong resembles human speech – both of them depend on the ability to rearrange basic vocal elements in new layout. Studies on songbirds shed light on evolution of spoken language and anthropogenesis. The researchers hope to understand how brain structure andfunctioning affects vocal behavior. Numerous studies on vocal-learning capacity of songbirds are performed in order to explain the parallels between birdsong and human language. They focus on the function of auditory feedback (as both birdsong and speech play crucial role in social communication), gene expression (mutations associated with speech disorders), neurogenesis and cortico-basal ganglia circuitry. It should be emphasized, that the transcription factors FoxP1, FoxP2 show similar expression patterns in in humans and songbirds (zebra finches). Mutations in either gene cause severe language disorders in humans and song learning in birds. Although theregulatory mechanism of FoxP1 and Foxp2 in remains unclear, the data suggest that both genes play important roles in nervous system development.

Poster highlights contributions of songbirds to understanding crucial aspects of vocal lerning and speech acquisition, including the possibility to treat disorders in the future.

**TP18.** Cura*tion of big data in neuroscience*

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The increasing volume of neurobiological data presents both a major opportunity for a research as well as a formidable challenge. Moreover, the types of data collected are diverse, including genetic, image, physiological and behavioural data as well as descriptions of experimental design. Equally important is management of metadata, which are rarely available in a structured, comprehensive, and machine-readable form. Curation enables researchers to retrieve and re-discover data, maintain its quality, add value and provide for reuse over time. Currently, the process of biocuration, which establishes links between data embedded in the literature and databases relies mainly on manual labour and makes it time-consuming and expensive task. To optimize collection, tagging, filtering and analysing of biological concepts from journals could be facilitated by automated procedures based on Data Mining, Natural Language Processing and Machine Learning algorithms. There are some issues associated with data storing and sharing, especially locking away information in closed-access journal articles coupled with possibility of violating the rights of a third party. Neuroscience community must therefore counter this with adopting a culture of data sharing and open access, along with enforcing legal protection for the data creator and the subjects included in the data. Databases will need to be interoperable and federated to utilize available data. Existing data sets, however, are typically neither integrated nor interchangeable, resulting in a barrier to answering complex neuroscience research questions. Efficient integration and processing of heterogeneous neurobiological data has become a necessity due to the large quantity of information that are fast becoming available. The process of data curation remains a subject of

intense research, which hopefully will soon enable us to keep up with the flow of publications, increase value and reduce extensive repetition of research and integrate complex experimental data in order to understand brain function in health and diseases.

## TP19. *Syntax processing in music: an ERP evidence*

Marta Jaśkiewicz

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Musical syntax is a term commonly used in psychological studies of music. This term does not just indicate that musical syntax is just a language syntax relative to musical terms. It suggest that music is organised according to complex rules similarly to language. ERP studies indicates event related potentials elicited while musical rules are violated: ERAN (Early Right Anterior Negativity) and P600. ERAN is an early negative wave which means the difference in ERP between harmonically expected and harmonically unexpected musical events. Peak amplitude for ERAN is observed at about 200 ms after the onset of the event. This potential is observed at right anterior sites. Musical syntax in studies of ERAN refers to the collocation of chord functions and to harmonic relations within a major–minor tonal context. ERAN is compared to ELAN (Early Left Anterior Negativity) which has been observed in response to words with unexpected syntactic properties in sentences. The P600 was initially tested only in the experiments relating to rule violations in language syntax. However, P600 is not only language-relevant ERP. This effect was also observed in music perception studies. P600 can be elicited by errors in musical harmony (when a chord is played out of key with the rest of a musical phrase). The aim of the presentation is a critical description of previous results about event related potentials connected with processing of musical syntax. Additionally, relations between music and language with respect to ERAN and P600 will be described. Finally, I will try to answer the question if ERAN and P600 can be used as a measures for another music studies, not only connected to music-language relations.

## TP20. *Phasic activity of dopaminergic neurons in reward-seeking behavior*

Kamil Pradel

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Dopamine is a monoamine neurotransmitter which plays a crucial role in many central nervous system functions, including motivation, reward, associative learning and movement. The role of dopamine in nucleus accumbens (NAc) is to integrate reward-related inputs from various brain regions, such as amygdala, prefrontal cortex (PFC) and hippocampus. Dopaminergic neurons projecting from ventral tagmental area (VTA) to NAc generate both tonic and phasic activity. Tonic activity acts mainly through high-affinity D2 receptors selectively attenuating inputs to NAc from PFC. Phasic activity of dopaminergic neurons (which leads to high quantity of dopamine release) occurs in response to both reward and reward-predicting stimuli, resulting in potentiation of limbic inputs to NAc through low-affinity D1 receptors. In addition, it is thought that NMDA receptors located on dopaminergic neurons are responsible for this phasic, burst activity. NMDA receptors play a crucial role in long term potentiation (LTP) – a component of cellular plasticity and learning. That is why NMDA receptors located on dopaminergic neurons may be responsible for coding the validity of

external stimuli into neuronal patterns. Importantly, dopaminergic neurons code so-called reward-predicting error (not reward itself), which stands for the degree to which a reward is surprising. That is why dopamine activity is strongly associated with the evaluation of the importance of external stimuli, generating reward prediction through associative conditioning and producing appropriate behaviour.

### TP21. *Brain decoding - is it a way to reading the brain?*

Daniel Borek

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The past decade witnessed development of increasingly sophisticated techniques for analyzing the information represented in BOLD activity . One of popular techiques is linear classifcation, a techique for decoding the information about experimental stimuli or task from brain's activity patern. Another another approach, encoding model, refers to modeling of how single voxels respond to stimuli. Encoding and  decoding are complementary operations. These two opproaches can both be used to investigate how information is represented in the brain. Especially decoding approach, which relies on the development of sophisticated computational models, can be viewed as novel method to to mapping and modeling the brain activity under naturalistic conditions from fMRI data. These techniques also allow to reconstruction what a person represents a different aspect of the external and internal worlds, which could be described as mind/brain reading. I will try to present general overview about decoding techiques, including discriminative and generative approaches to decoding neural responses and feature-based models, which provide more explicit accounts of stimulus-response mappings.

### TP22. *Methods of analysing neurophysiological sygnals*

Krystyna Karbarczyk, Agnieszka Porowska

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Nowadays collecting experimental data is more often easier than its analysis. There are many different mathematical methods, which are suitable only to very specific data. The choice of the appropriate method to analysis of the electrophysiology experiments is even more important because none of the programming tools is perfect. In our poster are presented the most common technics. The advantages and drawbacks of these methods are shown and compared. Chosen techniques are the Fourier and wavelet transform and Matching Pursuit. We show how estimations of spectral densities obtained by all of these methods vary from averaged Wigner's transform and each other.

### TP23. *Neuroscience and Evolutionary Psychology: a survey into social implications*

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Steven Pinker in his "The Blank Slate. The Modern Denial of Human Nature" described and abolished four fears associated with the biological model of human being: fear

of inequality, fear of imperfection, fear of determinism and fear of nihilism. His arguments against these fears are rooted both in evolutionary psychology and neuroscience. In our poster we'll compile his arguments with those taken from other sources and thus present a complex survey concerning social implications of the biological model of human life. Our sources will be drawn both from neuroscience and from anthropology and sociology to offer a more interdisciplinary approach.

## TP24. *EEG feature extraction with matching pursuit*

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Feature extraction is a vital part of the biomedical signal analysis. Many phenomena in brain activity can be identified by presence or absence of well-defined time-frequency structures in EEG signal. High resolution selective detection and identification of these structures can be achieved with Matching Pursuit algorithm. Several variations of Matching Pursuit (MP) algorithm will be presented, together with an analysis of accuracy and computational performance. Technical details of the algorithm, including (but not limited to) dictionary construction, will be presented. Finally, comparison between MP and alternative methods will be briefly discussed.

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## TP25. *Is autism a neuroplasticity disorder? Short view on genetics and neurobiology of ASD.*

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Autism spectrum disorders (ASDs) are a continuum of neurodevelopmental disorders, connected with severe impairments in communication skills and social interactions, often accompanied by repetitive and stereotyped behaviors. It is estimated that 1 in 68 children in the US are diagnosed with ASDs by the age of eight, with the advantage of boys (1:42) over the girls (1:189). Despite many years of research, the etiology of autism as well as its molecular basis remain unknown. So far, many genes have been indicated as important for genesis and development of ASDs. Growing evidence suggest, that some of them can be simultaneously connected with neuronal plasticity and maintenance of synapses. Impairment of these genes can strongly affect brain development and cause changes on functional and structural level of its architecture. Therefore, ASDs should be considered not only as a neurodevelopmental condition but also as a neuronal plasticity's disorder, that opens new possibilities for treatment and therapeutic options. The aim of this poster is to present the current view on genetics and neurobiology of autism, with special focus on the role of neuroplasticity in ASDs etiology.

**TP26.** *Smell the memory*

Tomasz Burzyński

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Until recently, the sense of smell was seen as one of minor importance. Researchers often dismiss it for the sight and hearing. The sense of smell plays a very large role in mammals modifying emotional reactions and behavior. As much as 3% of all genes are genes encoding olfactory receptor proteins and thus people are able to recognize about 10,000 different odors. Information about olfactory stimulus is passed through the olfactory pad. In olfactory pad are micro-regions, so-called glomeruli receiving a call from one type of olfactory receptor cells. Relay from the glomerulus is the mitral cell sending a pulse of only one glomerulus, which allows the behavior of the functional segregation of olfactory information. The spatial segregation of the same type of receptor cell is maintained until the level of the olfactory cortex. The transmission of information about the olfactory stimulus takes place without the mediation of the thalamus, which is an exceptional situation, not occurring in other sensory systems. The signal reaching the primary olfactory cortex is sent further include the thalamus, the amygdala and the hippocampus team through the entorhinal cortex. The uniqueness of smell is associated just with direct connection to the limbic system, which can cause severe and rapid changes in the emotional state of a human. For the storage and use of information scent responsibility is very specific olfactory memory, and remembered experience fragrances evoke memories of the experience earlier events. The aim of the author is a detailed analysis of the anatomical sense of smell which is the backdrop for the presentation and discuss the results of a study published in Science 13 December 2013 as regards the appearance of the memory trace already on the road olfactory stimulus - in the olfactory bulb. The results of this study are important for this reason that undermine the classical theory of memory and knowledge of the memory engrams and place of their formation in the nervous system.

**TP27.** *How to get to the Nobel Prize without a map? Hippocampal place code, navigation and grid cells*

Wioletta Tarasek

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A lot of elements concur to process of creating a map in our brain which will allow us to move. The whole process is placed mostly in the hippocampus especially in CA1 field and in the medial entorhinal cortex (MEC). There exist a lot of functionally specific cell types which are involved in making representation of local space and later in the process of movement. The composite elements of the system are grid cells, place cells, border cells and the head direction cells. During the development of a whole system, different types of cells exhibit a different activity and rhythmic organization of firing. The representation of space and our navigation is based on the connections between grid and place cells and on the temporal organization known as "theta phase precession". Big role has the network mechanism of grid cells and their functional organization.

## TP28. *Neurobiological correlates of intelligence*

Katarzyna Zuchowska

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Perceived intelligence as the ability to reason, plan, solve complex problems and abstractly thinking is a trait that undoubtedly distinguishes humans to other animals. The essence of human intelligence for centuries was the subject of interest to scientists and philosophers, but only relatively recent, we have appropriately advanced techniques, like fMRI or DTI, that have enabled us to more fully explore this topic and answer the question of what exactly constitutes a biological substrate of intelligence. Currently, the best factors correlating with the level of intelligence is considered to be the thickness of the cerebral cortex, the number of neurons and connections between themselves and the integrity of the white matter, which are responsible for the efficient processing of information and enable a rapid response. A good model of the anatomical structure of the brain showing the various intelligence is associated with the fronto-parietal integration theory of intelligence, which has been proposed based on the analysis of several dozen different studies using neuroimaging techniques. The scientists are looking for the genes that affect intelligence. From among the potential candidates four genes appear to be particularly interesting and are the genes encoding: ApoE4, CHRM2, cathepsin D, and COMT.

## TP29. *Psychophysiological correlates of religious conviction*

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Religious conviction in neuropsychological studies is usually evaluated either by complex questionnaires or by simple 'grade your belief in God in 1-7 scale'. Both approaches, have advantages and disadvantages, however they display one common weakness - assessment of religious conviction is entirely subjective and therefore can be influenced by respondents willingness to disclose their beliefs, comprehension of assignment and ability to accurately evaluate themselves. What could be an objective method for one's beliefs appraisal? Here we discuss possible alternative measures of religious conviction, summarizes to date discoveries in the area and present our idea of other ways it could be measured - using neuroimaging and psychophysiological methods. We suspect that differences in evoked potentials like N400 or LLP could be reflection of man beliefs.

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# EXPERIMENTAL POSTER ABSTRACTS

**EP1.** *Neuropeptide Y and POMC expression in the amygdala of rats chronically treated with olanzapine*

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Neuropeptides play an important role in the various neural pathways being able to control the wide spectrum of physiological responses. Neuropeptide Y (NPY) and proopiomelanocortin (POMC) functions are quite well studied, however little is known about their action at the level of amygdaloid complex. The present work was focused on the expression of the aforementioned peptides in this brain structure of rats treated with olanzapine, a second generation neuroleptic drug. The detailed purpose of this experiment was the evaluation of potential relationships between the long-term olanzapine administration and NPY/ POMC mRNA expression in the amygdalae. The studies were carried out on adult, male Sprague-Dawley rats that were divided into 2 groups: control and experimental animals treated with olanzapine (one month-long intraperitoneal injection). All individuals were sacrificed under anaesthesia, their whole brains were removed, then the amygdaloid complexes were precisely excised. Total mRNA was isolated from homogenized samples of amygdalae and then RT-PCR method was used for estimation of NPY, POMC and GAPDH gene expression. The results were expressed as means ± SEM and all data were analyzed statistically using Microsoft Excell 2007. Experimental results suggest, that chronic olanzapine administration is reflected in qualitatively different changes in expression of NPY and POMC mRNA in the rat amygdaloid complex. Interestingly enough, olanzapine mildly decreased NPY expression while increased the POMC level. One can conclude, that olanzapine may affect amygdalar neuronal populations by the modulation of the neuropeptide activity. Undoubtedly this hypothetic regulatory mechanism requires further pharmacological and neurostructural studies.

**EP2.** *Caffeine modifies aggressive behaviour of workers of the red wood ant Formica polyctenaduring dyadic aggression tests with workers of Formica rufibarbis*

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Caffeine, a common central nervous system stimulant, is known to influence physiology and behaviour of both invertebrates and vertebrates. In vertebrates (rodents and humans) caffeine administration was found to exert both stimulatory and inhibitory effects on specific patterns of aggressive behaviour. The effects of caffeine administration on physiology and behaviour of social insects are still very little known. We investigated the effects of chronic oral caffeine treatment on behaviour of workers of the red wood ant *Formica polyctena* during dyadic aggression tests involving confrontations with allospecific ants (*Formica rufibarbis*). Intranidal workers of F. polyctena were fed 0 ppm, 7 ppm, 25 ppm, 100 ppm and 200 ppm caffeine (diluted in aqueous sugar solution) during 14 days prior to the tests. Aggression tests (40-45 dyads per group) took place in sets of two joined test tubes. Ant behaviour was video recorded and analyzed using the software BehaView. The highest dose of caffeine (200 ppm)

significantly enhanced several patterns of overt aggressive behaviour (charges, dragging the opponent and fights), antennal contacts with the opponent and locomotory activity close to the opponent. Lower doses of caffeine also enhanced some features of overt aggressive behaviour of F. polyctena (100 ppm: rate of occurrence of fights; 25 ppm: rate of occurrence of biting, number of episodes and total duration of dragging; 7 ppm: total duration of dragging). However, the highest dose of caffeine (200 ppm) reduced the number of episodes and the total duration of open mandible threats. These findings imply that chronic oral caffeine administration enhances overt aggression, but reduces ritualized aggression in workers of F. polyctena paired with allospecific ants (F. rufibarbis).

**EP3.** *Dictinct 2-dRibose-induced apoptosis regulation in lymphoblasts from sporadic and familial Alzheimer's disease patients*

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Objectives. We previously reported that control of cell cycle progression distinguishes lymphocytes from sporadic (SAD) or familial Alzheimer's disease (FAD) patients. In particular, it was found significant differences in p21 levels SAD cells compared with lymphoblasts control or FAD individuals. We reported that FAD cells are more resistant to 2d-ribose-induced cell death than control or sporadic SAD. FAD cells showed lower accumulation of hypodiploid nuclei, and lower dissipation of mitochondrial membrane potential (MMP) than control or SAD lymphoblasts following 2-dRibose administration. Since it is known that p21, besides controlling cell cycle, can regulate apoptosis, we checked whether p21 levels play a role in the cellular response of FAD and SAD cells to oxidative stress evoked by 2d-ribose (2dRib).

Methods. Cell viability after 2dRib and pifitrin (PFT–a) treatment were measured using MTT assay, mRNA levels were evaluated using real-time PCR and protein levels by immunoblotting. p21 levels in nuclear and cytosolic fractions were visualized using confocal laser scanning microscopy. Results: FAD lymphocytes were more resistant to 2dRib-induced cell death than control or SAD cells. In response to 2dRib FAD cells showed significantly increased p21 mRNA and protein levels and preferentially cytoplasmic location of p21 as compared to SAD cells. Transcriptional activation of p21 was shown to be dependent on p53, as it can be blocked by PFT-a.

Conclusions. The increase in p21 transcription in FAD lymphoblasts and its cytoplasmic localization confer these cells a survival advantage, since PFT-a sensitized FAD cells to 2dRib-induced apoptosis. Thus, as some cellular mechanisms seem to be different in FAD and SAD cells, our data suggest a possibility for differential diagnosis of FAD and SAD based on p21 and p53, and individualized therapeutic approach for SAD and FAD.

**EP4.** *Present SELF, Past SELF and Close-other: EEG study of face and name recognition*

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The fundamental features of human conscious experience is a sense of self that persists across time. A growing body of evidence indicates that people distance themselves from their past self when they perceive self-change, even regarding their past self as 'another

person' [1]. However, present self is believed to be coherent and does not include other people into the self-concept [2]. In the present ERP study, we investigated neural correlates associated with processing of information related to the SELF - it's physical and non-physical aspects. Past and present images of faces, family and marital names were presented to participants (married women who had adopted their husband's name). Faces and names of the close-other, famous person and unfamiliar person were used as control conditions. We hypothesized that the past self and close-other condition would be associated with similar ERP responses. The present self was associated with higher amplitudes of P300 than close-other, famous and unfamiliar conditions for both names and faces but did not differ from the past self. Processing of the past self, in turn, resulted in enhanced P300 in comparison to famous and unfamiliar names and faces. Crucially, P300 amplitudes in the past self and close-other conditions did not differ. Thus our results indicated that: (i) the past self is processed similarly to the close-other, and (ii) ERP correlates of the physical and non-physical self are stable in time.

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**EP5.***Face recognition in a case of Asperger's syndrome associated with developmental prosopagnosia*

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No other visual stimulus is as ecologically important for human observers as the human face. Ability to "read" information about facial identity and expressed emotions or intentions is crucial in the social non-verbal interaction. fMRI and clinical studies consequently link face perception with the activity of fusiform gyrus (FG) and occipital face areas (OFA). However, more specific tasks, e.g. recognition of personally relevant faces or emotional expression, are associated with temporal areas like superior temporal sulcus (Fusar-Poli et al., 2012; Nasr and Tootell, 2012; Garrido, 2009; Haxby, 2000). Here, we report results of an fMRI study focused on face processing, performed with participation of a young male adult with diagnosis of Asperger's syndrome (AS) and developmental prosopagnosia (DP). Both disorders, present in one patient's case, have significant impact on face perception and recognition thus creating unique neurodevelopmental condition. We investigated BOLD signal changes during performance of familiarity recognition task of faces and inverted faces in 'AS and DP' patient in comparison to 12 control subjects. Results revealed typical pattern of brain activations in the FG and OFA. However, significant difference was found in the left anterior superior temporal sulcus/middle temporal gyrus. The lack of activity in this area observed in the case of clinical subject, combined with the behavioral, eye-tracking and neuropsychological results, suggest that the impairment of cognitive mechanism of face recognition involves higher level processing. It seems to be related to insufficient access to semantic knowledge about the person when prompt by face stimuli (Brambati et al., 2010).

**EP6.** *The influence of genes associated with stress response and the risk of depression and bipolar disorder*

Alicja Bejger, Aleksandra Szczepankiewicz

The significant participation of the HPA axis in response to stress, the intermediaries in the regulation of HPA axis are the main candidate genes in association studies of stress-related disorders characterized by a high incidence and heritability called mood disorders (depression and bipolar disorder). However, in case of bipolar disorder (BD) morbidity was estimated to be about 2% in general population in Europe, whereas for unipolar disorder (major depressive disorder, depression) (MDD) morbidity was estimated for about 17% in general population. In twin studies, heritability was estimated between 80-90% in case of BD and between 33-44% for MDD.

The aim of the experiment was the analysis of genes associated with the regulation of stress axis in bipolar and unipolar disorders (including differential clinical subtype). The analysis was intended to search for intergenic interactions of selected gene polymorphisms that possibly influences altered susceptibility to these disorders through changes in the function or biological activity of glucocorticoid receptor complex that further influences cortisol levels thus affecting the regulation of HPA axis.

Determination of genetic polymorphisms of selected genes was made using molecular and statistical analysis and techniques. The association analysis was included polymorphisms within the genes influencing the regulation of HPA axis through the activity of glucocorticoid receptor complex. The analysis was performed in the group of 700 unrelated patients diagnosed with bipolar and unipolar disorder in accordance with the diagnostic criteria for DSM-IV and in a group of 500 unrelated healthy people from a control group. Molecular analysis was included polymorphisms of gene STIP1 and comparing the results of the analysis of genes FKBP4, FKBP5.

Research have shown an important role studied genes in the pathogenesis of mood disorders such as depression and bipolar disorder.

**EP7.** *Relationship between heat rate variability and heartbeat evokedpPotentials*

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Growing evidence of heart influence on brain activity enhances our understanding bi-directional brain and heart communication. Heartbeat evoked potentials (HEP) – an electrocortical potential reflecting afferent cardiac information – has lower amplitude in populations, that demonstrate lower heart rate variability (HRV). This pilot study examined relationship between HEP amplitude and HRV parameters in 36 healthy volunteers (age range 19-32 years). Electroencephalogram (EEG) at and electrocardiogram (ECG) recorded simultaneously for five minutes at rest. Mean HEP amplitude in 180-240 ms interval after R-wave was calculated for F3, Fz, F4, C3, Cz, C4, P3, Pz, P4 scalp sites. We calculated HRV time-domain parameters SDNN, RMSSD, pNN50; frequency domain parameters – power spectrum in very low frequency (VLF; 0-0.04 Hz), low frequency (LF; 0.04-0.15 Hz), high frequency (HF; 0.15-0.4 Hz) bands; non-linear parameter approximate entropy (ApEn). Our study revealed, that at rest HEP mean amplitude significantly correlate with HRV parameters, especially with pNN50 and RMSSD. Most prominent relationship with HRV was found for HEP from central and parietal brain areas.

**EP8.***Auditory steady state response induced with chirp stimuli: read, count or relax?*
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Auditory steady-state response (ASSR) is an electrophysiological response recorded to periodically presented auditory stimuli: the frequency of the ASSR is close to the frequency of stimulation and reflects the ability of neural networks to synchronize. Recently, ASSR was proposed to serve as a biomarker of schizophrenia. However, the optimal type of stimulation is not estimated. In this study we investigate 1-120 Hz reverse chirp elicited ASSRs. Experiment consisted of 3 tasks performed by 19 male subjects: counting stimuli, reading and sitting with closed eyes. Phase locking factor (PLF) was computed and compared. Between conditions PLF was larger in counting than during reading and it was largest in eyes closed condition as compared to other two conditions. Previously, the same modulation pattern was shown for ASSRs elicited by click stimulation at 40Hz. Our result points to the urge to use chirp stimuli in future studies that would allow observation of different response frequencies with shorter stimulation times.

**EP9.***Systemic inflammation evoked at different developmental stages affects brain reactivity to seizures evoked in adulthood*
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Over 65 million people in the world suffer from epilepsy. More than a half have seizures without any identified cause. Therefore, understanding the mechanisms underlying epileptogenesis is critical to discover new therapeutic targets for those patients. There is growing evidence that inflammation may trigger epileptogenesis but it could also exert a neuroprotective influence. It is also known that inflammatory processes can induce angiogenesis via a variety of angiogenic factors. Therefore, we focused our study on long-term changes in the blood vessel density within the hippocampal formation following systemic inflammation induced at two different stages of postnatal development. The changes were reflected by respective variations in tissue immunoreactivity for lectin. Systemic inflammation was induced with LPS injections to Wistar rats on postnatal days 6 or 30. Thereafter, two-month-old survivors of the inflammatory status were injected with pilocarpine to evoke status epilepticus and sacrificed 3 days later. Brain sections were processed for lectin immunohistochemistry to assess the area occupied by blood vessels (Area Fraction) using ImageJ software. No significant effect of LPS-induced inflammation alone was detected. In response to pilocarpine-induced seizures, the hippocampal formation in the control, untreated group showed a significant increase of the Area Fraction calculated for lectinimmunoreactivity. Interestingly, no such response to seizures was observed in the two LPS-treated groups still presenting lectinimmureactivity similar to that in naïve rats. It could therefore be hypothesized that inflammation evoked at early but also at later developmental stages might prevent the blood vessel system from the response to seizures induced in adulthood. There is, therefore, a reasonable need for further examinations of possible effects of inflammatory preconditioning against brain reactivity to seizures.

**EP10.** *The heart and the brain – attempts to reveal the neurodynamics of HRV biofeedback-induced coherence*

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Heart rate variability (HRV) reflects the interplay between the two branches of autonomic nervous system innervating the heart, the sympathetic and the parasympathetic nervous system. High HRV parallels healthy psychophysiological states. Naturally occurring cardiovascular resonance between the baroreflex and respiratory sinus arrhythmia (RSA) results in great increases in HRV, especially of parasympathetic origin mediated via the vagus (Xth cranial nerve). Information about the induced state of coherence travels back via vagal afferents, forming connections with several structures through the brain. Application of biofeedback and paced breathing allows to take advantage of the resonance phenomenon and intentionally increase HRV. The voluntarily evoked state of coherence results in significant improvements of health, mood, and performance. In an attempt to investigate the neurodynamics of coherent state a controlled study has been planned, testing the influence of HRV biofeedback on brain activity and performance upon rest, attention and creativity tasks. Participants' attention and creativity shall be measured before and after 10 intervention sessions on Lateralized Attention Network Test and Alternative Uses Task, respectively. Brain activity will be measured via EEG, focusing mostly on the gamma frequency of brain waves (>30 Hz). This part of the EEG spectrum has been suggested as the neuronal counterpart of short-range communication within the brain, necessary for local information processing. Since HRV biofeedback training improves neurodynamic balance, we hypothesize that this intervention improves the quenching of unwanted local background activity (neuronal noise) by the prefrontal cortex, recorded as a global decrease of power in the gamma band. An increase in signal-to-noise ratio for the leading neuronal processes allows for more effective control of brain activity (both inhibitory and excitatory). This translates into increased synchronization and amplitude of specific, dominant processes, both local and global. Improved neuronal control and communication should be reflected in better psychophysiological functioning.

**EP11.** *Comparison of visual responses in subcortical and cortical structures of rat visual system after visual training*

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Neuronal plasticity is a basic mechanism of visual recovery after brain injuries. One of the methods to evoke plastic changes in the visual system is visual training in the form of repetitive visual stimulation. The aim of this study was to evaluate the influence of visual training on the magnitude of responses in chosen structures of the rat visual system. Neuronal activity was recorded from anesthetized (with urethane) rats using multichannel electrodes located in the lateral geniculate nucleus (LGN), the superior colliculus (SC) of contralateral hemisphere to stimulated eye and the primary visual cortex (VCx) of both hemispheres. Visual stimulation consisted of series of 300 repetitions of light flashes (2 s intervals), presented every 15 minutes through three hours to the left eye. The effect of visual stimulation on the magnitude of visual evoked potential (VEP) was compared in respective visual structures. Our

data show increase of magnitude of visual responses following visual stimulation in all considered structures. Visual responses stronger increased in the cortex than in subcortical structures.Increase of VEPs amplitudes was higher in the LGN than in the SC. Stronger alterations of VEPs in the geniculo-cortical pathway than in extrageniculate pathway can result from specificity of the thalamo-cortical loops.

## EP12. Factors supporting spatial memory in the elderly (age 65 +). The cognitive reserve hypothesis

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Commonly accepted criterion of belonging to the population of elderly people is the age of 65. Aging processes however are highly individual. Those who chronological age is similar, don't necessarily have same quality of cognitive function. According to the Cognitive reserve hypothesis (Stern, 2002), there are individual differences in strategies of information processing and coping with cognitive tasks. These differences might be caused by external factors, which are supporting more efficient and compensatory strategies of cognitive functioning. The aim of this study is verification of the relationship between selected factors that might be associated with cognitive reserve and the functioning of spatial memory in the elderly (65+). Relationship between (1) age, (2) education, (3) depression level, (4) strength of social bonds, (5) style of leisure activity and functioning of spatial memory in the elderly were tested. 30 healthy individuals (83% women) aged 65 to 87 were involved. In the study standard computer tasks (CANTAB eclipse) and non -standard (ecological) measuring spatial memory were used. Results of study showed that lower age, higher level of education and mental activity, are associated with higher scores on spatial memory task(standard and non-standard) in the elderly.

## EP13. Neuroprotective effects of KU55933, an inhibitor of ATM (Ataxia-Telangiectasia Mutated) kinase, against hydrogen peroxide- and rotenone-induced cell death in human neuroblastoma SH-SY5Y cells

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The ATM kinase is well-known from its involvement in DNA repair system. Recently, a non-nuclear functions for ATM has been suggested namely its participation in regulation of cellular response to oxidative stress and in preservation of mitochondrial homeostasis. In order to widen the knowledge about the role of ATM kinase in models of neuronal cell damage in the present study we tested the effect of ATM specific inhibitor, KU55933 against hydrogen peroxide- and rotenone-induced cell death of undifferentiated (UN-) and retinoic acid (RA)-differentiated human neuroblastoma SH-SY5Y cells.

The data showed that KU55933 (0.001-1 μM) when being not toxic when given alone to UN- and RA-SH-SY5Y cells it partially attenuated the cell death induced by hydrogen peroxide in both cell types as was confirmed by MTT reduction and LDH release assays. However, KU55933 (0.01 and 0.1 μM) was slightly neuroprotective against rotenone-induced toxicity only in UN-SH-SY5Y cells. Interestingly, in RA-SH-SY5Y cells KU55933 at concentration

of 1 μM increased the cell death induced by rotenone. Since the differences in neuroprotective effects of KU55933 against rotenone-induced cell death between UN- and RA-SH-SY5Y cells has been observed thus in next part of the study we compared the expression of Atm and Atm-related genes (Atmin and Dynll1) in UN- and RA-SH-SY5Y cells. The quantitative PCR data demonstrated a nearly two-fold increase in Atmin but without any significant changes in Atm and Dynll1 genes expression in RA-SH-SY5Y cells when compared to undifferentiated one. Altogether our data point to neuroprotective potential of ATM kinase inhibitor, KU55933 against hydrogen peroxide-induced cell damage in UN- and RA-SH-SY5Y cells. However, in the case of rotenone-evoked cell damage the protective effect of KU55933 depends on the cell differentiation stage.

### EP14. *Relationship between individual diffrences in heart rate variability and cognitive control in emotional and non-emotional flanker task: an ERP study*

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Heart rate variability (HRV) is an index of parasympathetic influences on the heart. The model of neurovisceral integration assumes that the vagal-mediated control of the heart is associated with emotion and cognitive control (Thayer and Lane, 2000; 2009). Previous research showed an association between HRV and performance in tasks that recruited executive functions, especially with emotional stimuli. The present study investigated whether individual differences in resting HRV are associated with performance changes in an emotional and non-emotional flanker task and with differences in event-related brain potentials (ERPs). Fifty-two participants took part in the experiment. Consistent with the hypothesis, participants with low HRV performed the emotional flanker task worse than those with high HRV, but there were no differences in the non-emotional flanker task. In contrast with the proposed hypothesis, we observed no differences between the low and the high HRV group regarding the P1 and LPP components elicited by the emotional faces. The low HRV group exhibited significantly greater N200 activity in all conditions of the emotional flanker task, which is consistent with the previous results and the assumption that the decreased N200 component reflects a highly functional cognitive control system. The above result partly supports the model of neurovisceral integration, but further research on this topic is needed.

### EP15. *The influence of task difficulty on proactive and reactive*

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Braver and colleagues (2007; Braver 2012) elaborated The Dual Mechanisms of Control (DMC). They suggested that the control and storage functions of working memory at least partially are carried out by analogous neural structures. Also, they described that cognitive control operates in two states: proactive control and reactive control. Proactive control is activated by the anticipation of upcoming interference. Moreover, it requires the presence of predictive contextual cues and it is metabolically costly. Also, it is less sensitive to changes in reward/punishment contingencies and it impedes the natural progression towards automatization. In contrast, reactive control is transiently activated as soon as a high

interference event is detected. Moreover, it is more susceptible to proactive interference and it is sub-optimal when stimulus-driven processing is insufficient. Czernochowski et al. (2010) noticed that the reactive control increases with increasing difficulty of the task using the explicit cue task-switching paradigm. At the same time the increase is greater in population of older people than in group of younger people. The aim of the study was to test whether the same relationship is also revealed in the paradigm of continuous performance test proposed by Braver and Cohen (2001). Moreover, the aim of the study was also examining the differences between the studies using this paradigm.

### EP16. *The impact of silver nanoparticles (AgNPs) on the survivin expression in Glioblastoma multiforme (GBM) cells cultured on in ovo model*

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Glioblastoma multiforme (GBM) is the most aggressive tumor of the central nervous system with high proliferation ratio and low apoptotic potential. Survivin is one of the protein, which is responsible for inhibiting both caspase dependent and independent apoptosis pathways and plays crucial role in the regulation of the cell cycle. Because of those properties, survivin is seen as a promising target in cancer therapy, including GBM. Nowadays, the growing interest of silver nanoparticles (AgNPs) as a potentially anticancer agents is observed. There are some data concerning the proapoptotic and antiproliferative properties of AgNPs in tumors, including GBM, but there is no information regarding the influence of AgNPs on survivin level in this cells. Thus, the aim of this study was to evaluate the impact of AgNPs administration on survivin level in GBM cells cultured on in ovo model. GBM cells (line U87) were placed on the chorioallantoic membrane of the chicken embryos at day 7th of development. At day 14th tumors were randomly divided into two groups: control (n=8) and group treated with colloidal AgNPs (n=8; 40 ppm). Four days later tumors were isolated, processed by common paraffin technique and stained immunohistochemically. The survivin index (SI) was estimated as the percentage of survivin positive cells in 1000 tumors cell, without marginal areas of tumors. Results have shown that SI of tumors treated with AgNPs ranged: 7,80%-24,84% (mean 11,95%±6,17) and was significantly lower than in control group: 15,00%-27,78% (mean 23,26%±4,83). In both group, the positive reaction was found in interphase and mitotic nuclei as well as, in some cases, also in cytoplasm. Our results indicate that AgNPs can modulate the level of survivin. Thus, this protein may pose the therapeutic target in GBM cells via AgNPs action, but this mechanism needs further investigation.

### EP17. *Immunohistochemical characterization of mutant mice with selective ablation of CREB in noradrenergic system.*

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Noradrenergic deficits in the central nervous system represent one of the crucial basis of the monoaminergic hypothesis of depression. The cyclic-AMP response element-binding protein (CREB) is a cellular transcription factor, activated in response to a vast array of physiological stimulants. CREB appears to be involved in both the mechanisms of action of antidepressants as well as the disease itself. It was reported that CREB is upregulated by

chronic antidepressant treatment and increasing CREB levels in animal models results in antidepressant-like behaviors. However, not all antidepressants increase CREB levels and activity. Reducing CREB in some brain regions also results in similar behaviors. Therefore, it remains open question to what extent CREB is involved in the pathophysiology of depression and the mechanisms of antidepressant treatment. The aim of this study is to evaluate the role of CREB exploiting novel transgenic mouse model characterized by the selective and functional ablation of CREB restricted only to the noradrenergic system which was achieved using the Cre/loxP system approach by crossing transgenic mice hosting Crerecombinase under the dopamine beta-hydroxylase (DBH) promoter with animals harboring the floxedCreb gene. To avoid adaptive effects of CREM, the conditional CREB mutant mice were maintained with CREM-deficient (Crem-/-) background (CrebDBHCreCrem-/-). Immunofluorescence (IHC/F) staining of brain and adrenal tissue sections (paraffin embedded) of CrebDBHCreCrem-/- mice was conducted using antibodies against CREB and other markers for assessment of glial activation, neurodegenerative processes, and neurothropic factor secretion. The IHC/F analysis confirmed selective lack of CREB in locus coeruleus and adrenal chromaffin cells. Changes of other markers were not detected, which indicates that introduced mutation seems not affect the noradrenergic system functioning. The CrebDBHCreCrem-/- mice may represent an interesting novel genetic model to study depression in context of noradrenergic system which represents one of the main targets of antidepressant therapies.

## EP18. Early emotion effects in visual cortical areas in response to facial stimuli (MEG study)

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Visual processing is considered to be a hierarchical process, highly specialized for pattern recognition, which culminates with the integration of particular features in a perceptual representation in higher order areas. However, effects specific to different stimulus categories have been found at latencies as early as 80-120ms in highly specialized cortical areas. Faces are one of the most biologically relevant stimuli in the context of social interaction. We presented 124 different identity faces posing either fearful, happy or neutral expressions twice to 15 volunteers (8 female, 7 male) while recording brain activity with magnetoencephalography (MEG). MEG provides an optimal balance between the temporal and spatial resolution needed to characterize early cortical processing non-invasively. Furthermore, our data were acquired with two different types of sensors - magnetometers and planar gradiometers - which are sensitive to activity of more or less deep neural generators, respectively. Data preprocessing for each event type involved applying a baseline correction (taking the -100 to 0ms time window) and a high pass filter of 1Hz. The event-related fields were then subjected to Montecarlo cluster based permutation statistics with 1000 randomizations to blindly test for differences between conditions. It was applied for magnetometer and gradiometer sensors separately. Magnetometer data revealed a greater response for fear (summed $F$-value = 2456, $p$=0.019) than happy and neutral faces, between 150-200ms at temporal electrodes highly lateralized to the right. By contrast, responses measured with gradiometers were larger for fearful vs. happy and neutral faces at occipital electrodes, between 130-180ms (summed $F$-value = 2230, $p$=0.009). It is expected that, by applying source localization techniques to these data, these two effects will be shown to originate from different cortical sources, possibly the fusiform gyrus and early visual areas respectively.

### EP19. *Neuronal circuits of socially transferred fear*

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Simple forms of empathy observed in rodents, such as emotional contagion play an important role in learning about external environment. Receiving signals of a potential danger may increase chance of survival. In our experimental model of between-subject transfer of fear, one rat (demonstrator) was subjected to fear conditioning. Afterwards, back in the home cage it was allowed to interact with its cagemate (observer). As previous research has shown such interaction activates the central amygdala (CeA) of the observers to the a higher level than observed in demonstrators. Therefore, we hypothesize that this structure is involved in social transfer of fear. The present study aimed at tracing of projections of the CeA neurons activated by social interaction with a fearful partner. To label activated neurons we used c-Fos immunohistochemistry and PSD-95:Venus fusion protein expressed under the control of c-fos promoter in recently developed transgenic rats. The neuronal projections were visualized with anterograde and retrograde axonal transport tracers. We discovered strong activation by social fear transfer in the following brain structures receiving projections from the CeA: dorsal raphe nuclei (serotoninergic neurons), substantia innominata and laterodorsal tegmental nucleus (cholinergic neurons), substantia nigra (dopaminergic neurons), caudate putamen (cholinergic and dopaminergic neurons). All neurotransmitters found in these structures are recognized to be involved in modulation of attention, learning and memory. We also observed highly activated neurons in the bed nucleus of the striaterminalis - structure rich in oxytocin receptors (implicated in maternal and nursing behavior in rats). Using retrograde tracing we have found active projections to the CeA originating in the basolateral amygdala, hippocampus, insular, prelimbic and infralimbic cortices. The map of afferent and efferent projections of neurons involved in the circuits underlying socially transferred fear can be a prelude to answer more detailed questions about molecular mechanism of social transfer of emotions.

### EP20. *Influence of stimulus contrast on the rat visual cortex visually evoked potentials to visual stimulus onset and offset*

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Luminance and duration are among the most important parameters of visual stimulus influencing response. It is known that increasing stimulus intensity causes shorter latency, faster rise time, higher amplitude and complexity of visual evoked potential (VEP). Stimulus onset and offset are important in coding of stimulus duration. Short light flashes (up to 10 ms), usually used in VEPs investigation, cause inseparable On and Off responses, moreover, in natural conditions stimulus duration usually is longer. Aim of our work was to investigate effect of stimulus intensity on the latency and amplitude of VEPs to stimulus onset and offset. Eighteen rats were used in this study. Under general urethane anesthesia one epidural electrode was implanted above rat visual cortex. Stimulus contrast ranged from -99% to 99 %, duration – from 50 ms to 500 ms. On and off of stimulus caused contrast change from negative values to positive and vice versa. Stimuli of each intensity were presented at each duration for 100 times, in total 54 combinations. After experiment animals were euthanized.

The main findings: 1)  Rat visual cortex visually evoked potentials to positive contrast changing are stronger and faster than to negative contrast changing independently of stimulus onset or

offset. 2) The most sensitive parameters of VEP to changing contrast are: a) Amplitude and latency of the first negative wave in both On and Off conditions. b) Amplitude of the second positive wave only in Off condition.

## EP21. *Emotion recognition in groups of different level of autistic behaviour*

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Emotion recognition and empathizing from an evolutionary and social point of view are significant, because thanks to them people can know others' attitude and respond to it. People with developmental disorders such as autism have problems with social functioning and communication. Many studies have been conducted for better understanding actions and way of functioning people with this kind of disorder. Continuum hypothesis of autism spectrum condition, concerning inference on the functioning of patients by studying healthy subjects, became the basis for the research formulation. The main aim of this study was to check whether there is a relationship between the level of autistic behaviour and correctness and model of recognising emotions based on facial expressions. The study included fifty healthy people (52% women). To measure the ratio of autistic behaviour, Polish adaptation of the questionnaire Autism-Spectrum Quotient (AQ) was used. Subjects were divided into groups with low or high coefficient of autistic spectrum. To explore strategies of emotion recognition and check the effectiveness of the recognition of six emotions (anger, fear, sadness, joy, disgust, surprise), unlimited-time test was used. It was created by using 70 images of basic emotions from the Karolinska Directed Emotional Faces. During solving a task by the subjects, the registration of eye movements using an eye tracker was made. Results show that all subjects had longer fixation times on the eyes than on the mouth. The relationship between score on the AQ and the response time of emotion recognition in the test ERT has been noticed. Comparison of the two groups showed no significant difference in the accuracy of identifying emotions. There was no preference of the mouth area in the group with higher AQ score. The obtained results of the study tend to look for another variable, which can explain deficits in emotion recognition.

## EP22. *CD44 silencing partially protects young hippocampal neurons from glutamate evoked reduction of dendritic outgrowth*

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CD44 is an adhesion molecule, receptor for hyaluronic acid, the main component of extracellular matrix in the brain. CD44 is expressed in neurons, but the function of this molecule herein is poorly understood. We have previously shown that CD44 can inhibit the proper development of dendritic tree. In this study, we have examined whether it is possible to protect neurons from injury by blocking the CD44 gene. We applied *in vitro* model of neuronal damage by treatment of young pyramidal neuronal cultures with low concentration of glutamate that had been shown to reduce the dendritic outgrowth without neuronal cell death. We have shown that silencing of CD44 expression exerts a protective effect on neurons by preventing dendritic shortening induced by glutamate exposure. Moreover, the protective effect of CD44shRNA was not observed when cells were co-transfected with constitutively active Src kinase, indicating that

Src acts downstream of CD44. Therefore CD44 might be a novel target for therapies of disorders involving dendritic pathology.

### EP23. *The neuroprotective role of PKCβII in brain ischemia-reperfusion injury*

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Protein kinase C β (PKCβ) is a member of the protein-serine/threonine kinase family. Its significance in neurons cells survival/ protection is being considered and needs further investigation. We previously showed the postischemic increase of PKCβ in mitochondria fraction but mainly in ischemia-resistant part of hippocampus. Therefore, here we set out to determine the role of PKCβisozymes, βI and βII in two models of brain ischemia: *in vitro* - rat organotypic hippocampal slice culture exposed to excitotoxic injury and *in vivo* - transient brain ischemia in gerbils. We studied: i) the effect of ischemic injury on the immunoreactivity of both PKCβisozymes and enzymatic activity of PKCβII in mitochondria isolated from ischemia-vulnerable and ischemia-resistant hippocampal regions, ii) the effect of PKCβisozymes inhibition in organotypic hippocampal cultures subjected to excitotoxicinjury,iii) identification of potential PKCβII-partners by pull-down chromatography followed by mass spectrometry. We have observed that transient ischemic episode induces significant elevation of PKCβII immunoreactivity and its activity in ischemia-resistant part of hippocampus in mitochondrial fraction. Moreover, we revealed that exclusive inhibition of PKCβI and βII by isozyme selective inhibitors enhanced cell death in organotypic hippocampal cultures.. Increase damage of neurons was observed with increasing concentration of inhibitors. Thus, this result might bespeak neuroprotective role of PKCβ. To explain the mechanisms of PKCβII-mediated neuroprotection its mitochondrial partners were identified. The pull-down method and LC-MS/MS analysis identified proteins belonging to mitochondrial inner and outer membrane as well as mitochondrial matrix. Other group of proteinsare involved in the regulation of different metabolic pathways. Using phophosite tool (http://www.phophosite.org) we verified that most of identified PKCβII-partners have putative PKC phosphorylation sites suggesting that regulation of these pathways by PKCβII phosphorylation may lead to PKCβII-mediated neuroprotection.

### EP24. *Electrical activity of the limbic structures in the rat during classical fear conditioning in NMDAR hypofunction model of schizophrenia*

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One of symptoms of schizophrenia is cognitive impairment. The rat NMDAR hypofunction model of schizophrenia has been experimentally validated. Thus, we decided to use it to verify how/whether the electrical activity of two limbic structures: nucleus accumbens (NAc) and basolateral complex of amygdala (BLA) is correlated with changes of rats' behavior during fear conditioning (a model of learning). The disturbances of cognitive functions were estimated on the basis of extinction of the conditioned response. Twenty male Wistar rats (280-320g) were chronically implanted with electrodes in right NAc and BLA. Guides were implanted bilaterally in BLA. Rats were randomly divided in groups: AMK group (NMDAR antagonist (MK801) infused

before acquisition sessions) and EMK group (MK801 infused before the first three extinction sessions). The animals were presented a tone associated with an electric shock (acquisition) or a tone alone (extinction). During each session local field potentials (LFPs) in NAc and BLA (band pass 0.1Hz-1 kHz) were recorded and saved on a PC. Behavior of rats was videotaped, number of fecal pellets was counted. After the experiment all animals were killed, the brains taken out and placement of guides and electrodes was verified using slices (Nissl staining).

Analysis of freezing duration showed that extinction was inhibited in group EMK in sessions with infusion of MK801. In sessions without infusion the process of extinction was undisturbed in both groups. The number of fecal pellets during first three extinction sessions was higher in group EMK (MK801 infused), than in group AMK (SAL infused). In following sessions (without infusions) the number of pellets decreased in both groups. - Analysis of LFPs (power spectra) revealed mostly differences in delta band (0.5-4 Hz) between groups AMK and EMK in both analyzed structures.

**EP25.** *Effect of unilateral NMDA injection into the pedunculopontine tegmental nucleus on feeding evoked by stimulation of the mesolimbic system in the contralateral hemisphere in rats after novelty test*

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Individual behavioral variability is frequently modeled using locomotor reactivity to novelty. When placed in a new environment, some individuals (as tested in rats) show vigorous and long-lasting exploratory activity (high responders, HR), whereas others become quiescent after a short period of exploration (low responders, LR). In the present study we investigated a possible involvement of the pedunculopontine tegmental nucleus (PPN) in feeding activity induced by electrical stimulation of the ventral tegmental area (VTA) in rats after novelty test. This effect was investigated by analizing the behavior induced by unilateral VTA-stimulation directly after the temporary glutamatergic activation (NMDA injection, dose 2.0µg dissolved in 0.5µl of distilled water) into the contralateral PPN (water injection as a control; 0.5µl) in HR (n=5) and LR (n=4) rats. A latency/stimulation frequency curve-shift paradigm which assesses the motor and motivational aspects of appetitive behavior was measured. We found that after contralateral NMDA injection to the PPN, we observed the significant elevation of the stimulation frequency threshold from preinjection baseline in two experimental groups. It was clear especially in the LR rats, where we observed significant impairment of behavior after this injection (about 27%; Anova test: $p<0.001$ in comparison to the baseline), while in HR rats the effect was not that distinct (about 12.28%; Anova test: $p<0.05$ in comparison to the baseline). The results indicate that PPN and VTA belong to the same glutaminergic circuitry involved in the regulation of motivational aspect of food intake, as well as in psychomotor activation which is manifested as exploratory behavior.

**EP26.** *Influence of NMDA injection into the pedunculopontine tegmental nucleus on feeding evoked by unilateral stimulation of the mesolimbic system depends on the stimulated hemisphere*

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The pedunculopontine tegmental nucleus (PPN) is anatomically connected with neurons in the ventral tegmental area (VTA), the initial structure of the mesolimbic dopaminergic system. In the present study, VTA-stimulation induced feeding response was tested after temporary glutamatergic activation (NMDA injection; dose 2.0 µg dissolved in 0.5 µl of distilled water) of the PPN in the ipsi- or contralateral hemisphere. Motor and motivation aspects of appetitive behavior were analyzed on the basis of the latency/stimulation frequency curve shift paradigm, in male Wistar rats (n=20). It was found that distilled water injected into the PPN (value of the 0.5 µl), as a control group (n=20), did not cause any effect in comparison with the preinjection baseline. NMDA injection into the contralateral PPN had more significant effects on behavioral response during VTA-stimulation than this injection into the ipsilateral PPN. In rats with contralateral injection of PPN, glutamate activation caused deterioration of feeding (about 15.41%; n=9) which was manifested as an increase in the reaction frequency threshold and a rightward shift of the latency to feed or locomotor/stimulation frequency curve in relation to the water injection baseline. In rats with ipsilateral injection of PPN during glutamate activation the percentage change in feeding threshold was insignificant, (about -3.49%; n=11), and the lack of changes in the stimulation frequency/reaction latency curve compared with water control baseline. The indistinct effects of glutamate receptors on the ipsilateral side suggest that the tonus of NMDA activation is relatively weak ipsilaterally and could be at least in part reduced through the activation of the different afferents of the VTA.

## EP27. *SPTLC1 and RAB7A mutation and polymorphism analysis in hereditary sensory neuropathies in Polish population*

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Hereditary sensory and autonomic neuropathies (HSAN) is a rare, heterogeneous group of neurodegenerative disorders with an estimated prevalence of about 1:500000. HSAN symptoms manifest in progressive loss of function that predominantly affects the peripheral sensory nerves. It results in distal sensory loss, chronic ulcerations in feet and hands or osteomyelitis leading to amputations of toes and fingers. Till now mutations in approximately 20 different loci were diagnosed as responsible for HSAN. Genes involved in HSAN pathology can be either dominant or recessive. In my studies a group of patients was screened for two dominant genes responsible for HSAN (SPTLC1 encoding serine palmitoyltransferase and RAB7A encoding an important regulator of vesicular transport). Mutations in SPTLC1 are the most common cause of HSAN. A group of 12 patients was screened for mutations and polymorphisms in SPTLC1 and a group of 14 patients was screened for mutations and polymorphisms in RAB7A. All the individuals were consulted in the Neuromuscular Unit of Mossakowski Medical Research Centre Polish Academy of Sciences(years 2008-2013)and had a clinical diagnosis of HSAN. One trinucleotide deletion, which has never been previously reported, was found in the UTR of RAB7A. However, no deletion was found in RAB7A of the patient's sister who presented the same symptoms. One polymorphism in the coding sequence of RAB7A was detected. Two polymorphisms in two

different patients were found in the coding sequence of SPTLC1. In some cases further studies including NGS and CGH will be performed in the near future.

## EP28. Effects of neurotoxin DSP-4 on anxiety-like behavior in mice

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The present study aimed to investigate the effects of DSP-4 on anxiety-like behavior in mice. DSP-4 is a highly selective neurotoxin of central and peripheral noradrenergic neurons. The compound displays a very sustained inhibitory action on the uptake of noradrenaline in mouse and rat brain slices. Although the central noradrenergic system has been shown to be involved in anxiety in humans and fear and anxiety-like behaviors in animal models, the relationship between the DSP-4-induced changes in the adrenergic system and behavior has not been elucidated. Available literature does not clearly define the final results of the neurotoxin effects on animal behavior. Male Swiss mice (6-7 weeks) were divided into two groups that were examined for 3 and 15 days after intraperitoneal (i.p.) administration of DSP-4. The first group was tested in open field (OF) and elevate plus maze (EPM) three days after a single injection of DSP-4 (50 mg/kg, 0.1 ml, i.p., n=4) or saline (0.1 ml, n=8). In the second group the same behavioral procedures were performed 15 days after a single injection of DSP-4 (50 mg/kg, 0.1 ml, i.p., n=4) or saline (0.1 ml, n=8). In the first group, there were no significant changes in mice behavior in OF and EPM. In the second group a significant effect of administration of DSP-4 on the behavior of mice was observed only in the OF, no differences were observed in the EPM. The results suggest that the reduced level of noradrenaline in brain that could have been produced administration of DSP-4 may increase anxiety-like behavior in mice.

## EP29. *Neural correlates of auditory working memory in aging: an ERP study*

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Working memory (WM) is an ability to store and manipulate information over short periods of time. WM impairment is one of the most pronounced symptom of cognitive aging. This study investigates neural correlates of auditory WM in healthy aging using the ERP method. Eighteen healthy volunteers (8 young , aged: 21-29 years; 11 elderly, aged: 65- 74 years) performed the auditory N-back task during the EEG recording session. The task was to press a button whenever the presented syllable was identical as the previously presented one (N1-back, easy condition) or as one before last (N2-back, difficult condition). A set of 30 syllables (e.g., la, ba, da, ga), equal in duration (300 ms) and loudness (80 dB SPL), was used as stimuli. Preliminary analysis of the psychophysical data revealed age-related differences in the number of correct answers (hits) in N2-back task. It was significantly lower ($p < .018$) in elderly than in young participants. Such result confirmed declined auditory WM in elderly people. On the other hand, ERP results showed differences in N100 topography between the two age-groups. The highest amplitude of N100 in elderly participants was registered over the left hemisphere, whereas, in the young group the highest amplitude was registered on central electrodes. Such result may

suggest that age-related differences in N-back task may be associated with differences at early stages of coding of incoming stimuli.

**EP30.** *Comparison of visual response characteristics of caudate nucleus neurons in anesthetized and awake, behaving animals*

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**T**his study focuses on an important question, whether the brain activities recorded from anesthetised, paralyzed animals are comparable to those recorded from awake, behaving animal models. In order to answer to the question raised above we compared the neuronal activities recorded during visual stimulation from the caudate nucleus (CN) in two halothane anaesthetized, paralyzed and two awake, behaving cats. Local field potentials (LFP) and single-cell activities (SUA) were recorded from the CN during static (random dot kinematograms) and dynamic (moving visual noise) visual stimulation. During the recording session the anaesthesia was maintained with a gaseous mixture of air and halothane (1.0%). In the behavioural paradigm the visual stimuli were presented when the trained animals maintained visual fixation. The power spectrum densities (PSD) of LFPs were compared firstly. In the case of anesthetised animals the PSD had maximal intensity in the delta range (2-3 Hz) while in awake animals it was in the theta and alpha range (6-15 Hz). SUA were then compared during different epochs of the visual paradigm. The background activities measured without visual stimulation was significantly higher in the CN of awake animals ($p<0.01$). Similarly the stimulated activities and the net firing rates to static and dynamic visual stimulation were also higher ($p<0.01$) in awake animals. Furthermore, in the case of anesthetised animals the majority of the recorded CN neurons possessed no visual responses, i.e their net discharge rate was close to zero. Our results demonstrated strong difference between the multiscale neuronal activities in the CN of anesthetized, paralyzed and awake, behaving cats. The halothane anaesthesia strongly suppressed the activities in the CN. We argue that despite of the difficulties during working with behaving animals we have to use those in visual electrophysiological experiments in order get closer insight into the realistic functioning of the mammalian brain.

**EP31. Influence of restraint stress on the expression of selected trimeric and monomeric GTP-binding proteins in the rat hippocampus.**

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Stress has been implicated in many psychiatric disorders. Animal model studies have shown that exposure to stress affects structure and function of hippocampus which is known to play critical role in structural plasticity involving neurogenesis, synaptogenesis and dendritic remodeling. Molecular mechanisms, responsible for hippocampal remodeling after stress are not clarified. G proteins (GP) are heterotrimeric GTP-binding proteins, composed of alpha, beta and gamma subunits. Alpha subunit is responsible for receptor binding and GTPase activity. GP are

crucial for cellular signaling from metabotropic receptors. G(q/11) activates phospholipase C and cooperates with G12 protein, which can regulate monomeric GTP-binding proteins from Rho family, such as Rac1 and RhoA. The aim of the study was to investigate levels of alpha subunits of G(12), G(q/11), and selected small GTPases from Rho family proteins in the rat hippocampus after single restraint stress. Male, adult Wistar rats were restrained in perforated plastic cylinders for 3 hours. Next day after stress rats were decapitated, their hippocampus was dissected and Western blot analysis of G alpha(q), G alpha(11), G alpha(12), RhoA, RhoB, RhoC, Rac1/2/3 protein levels were performed. Our results indicate that single stress does not affect the expression of Galpha(11) and Galpha(q). Nevertheless, Galpha(12) level was increased by 20% in stress group vs control. Among Rho family proteins stress augmented only the expression of Rac1/2/3 (by 60% vs control). The Rac1 GTPase is known to play a key regulatory function of cytoskeletal dynamics and thus it is crucial to axonal growth and stability, as well as dendrite and spine structural plasticity. Thus, our results suggest involvement of Rac1/2/3 in stress-induced, structural changes in the hippocampus. Moreover increased expression of Galpha(12) being an up-stream effector of Rho-family protein suggests that stress induced Rac1/2/3 expression may depend on signaling pathways that engage trimeric GTP-binding protein.

**EP32.** *Relationship between auditory event-related potentials and language comprehension in children with Specific Language Learning Impairment: preliminary data*

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The aim of the study was to examine the relationship between language comprehension and event-related potentials (ERPs) elicited by syllables in children with Specific Language Learning Impairment (SLI). SLI refers to deficit in which normal patterns of language acquisition are disturbed from the early stages of development. However, they are not directly attributable to neurological or environmental factors. In ERP study, the stimulus was syllable /to/ presented as a standard in an oddball paradigm. Language comprehension was assessed with behavioral tests i.e. Token-Test 36 and Phoneme Discrimination Test. We examined 11 children with SLI, 5 boys and 6 girls aged from 5,3 to 8,3 years. Results revealed that this syllable elicited P1, N2 and N4 waveforms, as usually observed at this age. The novel outcome was that N4 amplitude typical for linguistic processing was significantly correlated with both language comprehension ($r=-0,63$; $p<0,04$) and phonemic discrimination scores ($r=-0,77$; $p<0,01$). For the other waveforms: P1 and N2 such correlation was nonsignificant. This finding may suggest that problems in auditory language comprehension in SLI children may be related to less mature brain response to linguistic stimuli. Our future plans include testing more children with SLI. Moreover, we are going to explain if such relations may be typical only for SLI children or may be also observed in children with other problems in language comprehension. Supported by: INNOTECH-K1/IN1/30/159041/NCBR/12

**EP33.** *EEG response for periodic and aperiodic visual stimulation*

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In the past studies, difference between reaction of neural system to periodic and aperiodic visual stimulation has been investigated using blood oxygenation level-dependent (BOLD) response. It was found that the aperiodic stimulation induces stronger response. In this work we show results of EEG experiment where these two kinds of stimulation were used. For

periodic stimulation we used three frequencies: 12, 16 and 24 Hz. Aperiodic stimulation was composed of these three local frequencies and the number of flashes per unit of time was equal to 16 Hz. This sequence was generated randomly before the experiment and it was the same in each trial. For each type of stimulation the signal was averaged across trials. In this study we compare the local amplitude of response aperiodic and periodic stimulation. After closer investigation of experimental procedure the risk of close resemblance of aperiodic stimulation to periodic stimulation has been noted so that further studies are being performed.

### EP34. *Time evolution of functional connectivity based on EEG in movement imagery paradigm*

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Event related synchronization/desynchronization phenomenon is used in brain - computer interfaces based on movement imagery paradigm. Most reliable changes occur in two frequency bands ($\mu$): 7 – 13Hz and ($\beta$ band): 16 – 30Hz in EEG signal recorded from the electrodes above the motor cortex. Most of BCI classifiers use traditional features based on instantaneous power estimations. We investigate new type of features based on functional connectivity. One subject was examined in five training sessions. Time evolution of functional connectivity estimated by means of Directed Transfer Function was investigated. The results suggest that this approach might be applied in a BCI.

### EP35. *Relation between personality traits and eye-movements recorded during playing First-Person Shooter games for experienced and naive in computer action games*

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Aim of our research was to test relationship between personality traits and eye-movements recorded during playing First-Person Shooter games. We measured personality features and eye-movements and compared groups with and without action games experience. Previous studies suggested that there are differences in strategy of visual field exploration between experienced players and non-players. In first part of our research we compared eye-tracking data from players and non-players. Both groups have to complete one mission in First-Person Shooter "Call of Duty: Modern Warfare III". Before that they had a training of controlling the game. Other studies showed that personality traits correlate with preferences of video games. We examined relation between personality traits and strategy of visual field exploration. Finally, we found that people with higher scores in psychoticism have lower rate of blinks during playing computer games (both for training and for mission completion). Moreover experienced players have much lower rate of blinks compared to non-players.

### EP36. *MK-801 induces hyperlocomotion in mice with altered levels of matrix metalloproteinase-9*

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Schizophrenia is a mental disorder that affects around 1% of the population. It is characterised by positive symptoms which are predominately hallucinations and delusions as well

as negative symptoms such as abnormal social behaviour. Schizophrenic patients have higher serum levels of certain proteins, one of which is MMP-9, an extracellularly operating endopeptidase involved in synaptic plasticity, as well as TIMP-1, an endogenous inhibitor of MMP-9. Moreover, polymorphisms in the MMP-9 gene have been linked to schizophrenia. This evidence suggests that there is a link between MMP-9 and the disorder. In order to verify this hypothesis, we tested male and female mice from two lines, a MMP-9 knock out and a MMP-9 overexpressing.  Two experiments were conducted to verify the effect of varying MMP-9 levels on MK-801 induced locomotor hyperactivity in an open field environment. During the first experiment, the mice were injected with either 0.1mg/kg or 0.25mg/kg of MK-801. The results showed that the lower dose induced hyperlocomotion in the female overexpressing mice and the higher dose resulted in hyperlocomotion in the knockout, heterozygote and overexpressing mice. There were no differences in male mice. To test the relevance of this result to schizophrenia, in the second experiment we attempted alleviating the hyperactivity with pre-treating the mice with clozapine, an atypical antipsychotic drug. The results have shown that clozapine reduced the MK-801 induced hyperlocomotion in male MMP-9 knockout and MMP-9 overexpressing mice. This demonstrates that mice with altered MMP-9 levels are more sensitive to hyperlocomotion caused by MK-801. The effects were partially reversible by clozapine which supports the concept that MMP-9 is involved in the pathogenesis of schizophrenia.

### EP37. *P300 components and fluid intelligence*

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P300 components were extensively researched for few decades now, but the conclusions about its correlation with fluid intelligence are inconsistent throughout studies. It was assumed that extraction of P300a and P300b components, which are thought to be connected with functions of attention, would allow verifying the hypothesis of faster information processing in case of higher intelligence, both with automatic reaction to novel stimuli and conscious attention allocation and classification of its properties. Present study was conducted on 36 right-handed participants (17 women), aged 19 to 27. Their fluid intelligence was measured using Raven's Advanced Progressive Matrices (TMZ). Even-related potentials were recorded while participants were performing oddball task, which is based on di erentiation of tones. Three types of auditory stimuli were implemented: 1) frequent standard; 2) rare target – relevant to the task; 3) rare deviant – irrelevant to the task.  Based on the TMZ score, participants were divided into two groups: 1) of higher intelligence (WI); 2) of lower intelligence (NI). Both latency and amplitude of extracted P300a (200-350 ms time window), and P300b (400-800 ms time window) components were analyzed on signal from Cz and Pz electrodes. Significant diferences were found in amplitude of P300b between compared groups – WI group had higher amplitude than NI group. No significant di erences were found in amplitude of P300a component, as well as in latency of both components in comparison of groups.

Results suggests that in case of WI group in comparison to NI, quicker and more accurate stimulus meaning evaluation starts in the conscious attention allocation and in process of comparison event characteristics with prototype pattern. Therefore possible and apparent conclusion is that P300b is better predictor of fluid intelligence level than P300a.

**EP38.** *Genotoxic response of human umbilical cord blood neural stem cells (HUCB-NSC)*
*to methylmercury chloride treatment*

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Methylmecury chloride (MeHgCl) is one of six known up to date developmental neurotoxins. Our previous data indicated, that the degree of neurotoxic insult in Human Umbilical Cord Blood Neural Stem Cells (HUCB-NSC) caused by MeHgCl, depends upon their developmental stage, the duration of exposure and the accumulated dose. We have also shown, that the niche surrogate such as 3D collagen scaffold and low oxygen level conditions change the response of HUCB-NSC to MeHgCl observed in typical 2D *in vitro* culture. In this report we are testing whether the treatment with MeHgCl induce also genotoxic effect in HUCB-NSC. The obtained data revealed that upon high dose of neurotoxin the cells responded with chromosomal abnormalities like: micronucleus (MN), nucleoplsmic bridge (NPBs) and nuclear bud formation (NBuds). Such abnormalities are related with: chromosome break or loss (MN), chromosomal rearrangement (NPBs) and gene amplification (NBuds), accordingly. The presence of binucleated cells (BN) in the culture treated with high doses of MeHgCl suggest disorders in the process of cytokinesis. Thus the neural progenitors derived from umbilical cord blood responded to MeHgCl treatment with abnormalities typical for genotoxic insult.

**EP39.** *Action video game training effects on temporal processing of visual and auditory stimuli*

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Action video game training enhances selective attention (Green and Bavelier, 2003) and efficiency in visuospatial attention tasks (Green and Bavelier, 2006). In a study by Green (2010) for the first time it was showed that effects of training are not restricted to the visual modality, and may also concern auditory modality. Studies conducted by our colleagues (Finc et al. 2014) demonstrated an improvement in auditory processing in range of tens of milliseconds after video game training, but no significant effect in visual processing. These results were used to design an experiment focused on the influence of action video games on temporal processing of visual and auditory stimuli and on their integration. The experiment will be carried out according to 'pretest – training – posttest' scheme and will involve 10 hours of video game training. Participants will be assigned to three training groups – action game involving sound, action game without sound and non-action control game. We expect a significant improvement in the processing of auditory and visual cues in the experimental group involving sound, and a significant improvement in the processing of visual cues only in the group without sound.

**EP40.** *Eco-HAB - fully automated, ecologically-relevant assay for evaluation*
*of social deficits in mice*

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Impairments of social interactions are the key feature of many neurodevelopmental disorders, such as autism spectrum disorders (ASD) and socialanxiety disorders (SAD). Although there is a whole range of behavioral assays designed for evaluation of conspecific-related behavior in mousemodelsof these disorders, available behavioral tasks do not allow for longitudinal observations of spontaneous among-littermates interactions. Furthermore, they are usually carried out on socially isolated animals and require handling of mice by an experimenter. These factors may exert confounding, anxiety-related effects on the obtained data, as well as cause between-laboratory variability. For this reasons we aimed at designing Eco-HAB - a fully automated, controlled by a computer, stress-reducing tool for assessment of voluntary social interactions in group- housed mice. Eco-HAB asserts high reliability and enables multiple replications in standardized conditions imitating natural habitat. It takes into account specific features of mouse behavior, such as nocturnal activity, tendency for staying hidden and dominating role of the sense of smell during murine social interactions. The designed system enables individual recognition of every subject based on RFID technology. It also allows for continuous, even months-lasting data collection. Data analysis is performed with the customized software package written in Python programming language (Python 2.7 with NumPy and SciPy libraries). We standardized Eco-HAB by assessing social approach of valproate-treated BALB/c mice, that had been shown to display social interaction deficits (Yochum, 2008). Exposure to valproate in utero is one of the best established models of externally induced autistic phenotype in mice. Obtained results were also compared with social approach behavior measured in three chambered apparatus. Making use of the collected data we argue that Eco-HAB is a valuable and reliable tool for assessment of social interactionsa and gathering knowledge about functional relations within group of mice housed together.

### EP41. *Personality traits and its association with resting–state brain activity*

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Background. Number of studies have examined the relationship between personality traits and brain activity (in particular with alpha wave frequency) but the results lead to conflicting conclusions and interpretations. In the past years, many studies have found a positive association between EEG alpha activity and extraversion, on the other hand there are studies which show that this relationship is negative, furthermore there are even some indicating the correlation to not exist.

Aim. The aim of this study was to verify the hypothesis that the personality traits (Big Five) are reflected in the frequency of alpha wave of particular regions in the brain during resting-state.

Methods. 43 young, right-handed and healthy subjects (23 males) were recruited to the study. Personality traits were measured using a Revised NEO Personality Inventory. Subjects were asked to relax with their eyes closed while EEG signal was recorded from 64 electrodes. EEG data were converted in Matlab.

Results. The results of this studies show the existence of a relationship between selected personality traits and frequency of alpha waves.

Conclusions. We can conclude, Big Five personality traits are reflected in the brain's resting state activity (in particular with alpha wave).

**EP42.** *Increased anandamide levels enhance social memory via changes in c-fos and CREB*

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The endocannabinoid system (ECS) is composed by neuromodulatory lipids (anandamide and 2-AG), their pre-synaptic receptors (CB1 and CB2) and the synthesizing and degrading enzymes (FAAH, MAGL, DAGL). CB1 receptor is found widespread in the brain and its activation leads to reduced neuronal excitability. The ECS modulates learning and memory, anxiety, neurogenesis, development, feeding responses, pain sensation, neuroinflammation, clearance processes and mitochondrial activity. Several of these processes are impaired with aging and are involved in the progression of it. It was shown that animals with decrease ECS activation have accelerated age-related cognitive decline. We used FAAH (the enzyme that degrades anandamide) knockout animals to assess cognitive performance and changes in age-related synaptic plasticity and oxidative stress. We based on previous results showing enhanced performance of FAAH knockout mice in the partner recognition test and assessed c-fos and CREB, molecular markers of neuronal activation and memory. Moreover, we evaluated the effects of anxiety and acute anandamide increase in partner recognition. Finally, we assessed the conditioning and extinction of aversive memories in FAAH knockout mice. Our results showed that FAAH knockout animals have increased c-fos expression and CREB phosphorylation in hippocampus and amygdala after the partner recognition test. Moreover, changes in anxiety or acute increase in anandamide are not responsible for an improved performance in this recognition test. Additionally, FAAH knockout mice have enhanced amygdala-based extinction memory. Our results indicate that increased anandamide levels enhance recognition memory via changes in c-fos and CREB.

**EP43.** *Relationship between neuropsychological deficits observed in clinical examination and real-life skills in patients with schizophrenia*

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Multiple factors have been shown to be associated with the everyday functioning of patients with schizophrenia. However most of the studies in the field have been carried out with a non-standardized measures of cognitive and everyday functioning. The aim of this study was to investigate the relationship between the cognitive deficits observed during the clinical examination of patients and their real-life skills and cognitive abilities. Neuropsychological assessment was carried out with MATRICS Consensus Cognitive Battery (MCCB), a gold standard for assessment of cognitive functioning in schizophrenia, while the real life skills were screened with Personal and Social Performance Scale (PSP). Additionally clinical scales (Clinical Global Impression, Global Assessment of Functioning) were applied. Ten patients diagnosed with schizophrenia according to ICD-10 underwent the neuropsychological and clinical assessment in Institute of Psychiatry and Neurology in Warsaw. No relationship was observed between MCCB Composite Score and PSP, GAF or CGI scores. However, further examination of the results of stepwise linear regression analysis revealed that one of the seven MCCB cognitive domains (Verbal Learning) was strongly related with PSP score and explained over the half ($R^2=0{,}52$) of its variance. MCCB Verbal Learning was also a significant predictor of CGI score ($R^2=0{,}64$). Both

Verbal Learning and Speed of Processing explained 88% of GAF score variance. Overall, these results shows that verbal memory deficits and psychomotor slowing may be significantly associated both with everyday functioning and with clinical state of patients, thus should be the aim of special interest in cognitive remediation programs for patients with schizophrenia.

**EP44.** *Show me your VWFA- do we differ in terms of Visual Word Form Area activation when seeing words?*

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Visual Word Form Area (VWFA) is a functionally specific subregion of the fusiform gyrus known to be involved in reading and word recognition (e.g.,www.ncbi.nlm.nih.gov/pmc/articles/PMC2706007/). The activation of the left VWFA when word-stimuli is presented was observed regardless of the culture or subjects native language. Exact nature and function of this region are under special investigations. Interaction between meaningful string of letters exposition and VWFA activation is intensively studied, as the topic comprises both scientific and social issues. Here we present results from the functional Visual Word Form Area localizer, based on our previous research (which is a part of the greater experiment) in which we expected to find activation in VWFA accompanying words presentation. Our analysis of the contrast between words and non-words reveled a robust activation in the left ventrolateral occipital cortex, covering the region known as a Visual Word Form Area. This result refers to an experiment performed on a group level. Here, we decided to extend our investigation and focus on the individual level of research. How do people differ among each other considering the process of seeing words? Do we all need and use Visual Word Form Area equally? Eight adult (aged 20-26) subjects (both men and women) participated in the study. Our procedure comprised of short (2 min) block-designed scanning session. During the scanning participants were asked to look at the presented visual stimuli which were words and non words (23 strings per block, 6 block per condition). Images were acquired with 3T MRI Scanner (Magnetom Trio, Siemens, Healthcare Germany). SPM12 (http://www.fil.ion.ucl.ac.uk/spm/) was used for data preprocessing and analysis.

**EP45.** *Activation of top down attentional network during anticipation period of visual search task - an fMRI study*

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When expecting upcoming, demanding task, brain turns into attentive state in order to respond with better sensitivity to stimulation. This fact enables separate investigation of otherwise entangled attentional and task-specific processes. To study mechanisms of anticipatory attention a group of healthy volunteers (n=20) was examined in 3 Tesla MR scanner with a 12-channel head coil. Experimental task consisted of two contrasting types of trials. During attentional trials (1) participants were instructed to focus on the visual cue presented in the

central visual field for 2, 3, 4 or 5 sec while preparing for the following visual search task. In the control, motor condition (2) participants were presented with analogous visual cue of different color, which directly encoded proper response. The hemodynamic function for attentional and motor cue was estimated on the whole brain level using General Linear Model in SPM12. The group analysis revealed significant (FWE<0.05) activation within core structures of top-down attentional network, namely: frontal eye field (FEF), inferior parietal sulcus (IPS), anterior insula (AI), supplementary motor area (SMA) and within visual cortex. For these regions, complemented with suggested by others: inferior frontal gyrus (IFG) and temporal parietal junction (TPJ), mean HDR course was examined in details for trials of different type and durations. We observed that response during short trials was monotonically increasing and that it double-peaked during trials of longer duration. In attention-related regions amplitude evoked by attentional trials was coupled with negative response in motor cues. We observed correlated activity of bilaterally localized structures (e.g. IPS, AI, IFG) as well as coherent activation of IPS, AI and IFG specific for right hemisphere. Significant correlation between activations and behavioral results showed that engagement of AI (bilaterally) as well as left FEF and TPJ affected reaction times and accuracy.

**EP46.** *Impact of motivational enhancers on computer aided neurorehabilitation in multiple sclerosis*

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Multiple sclerosis is a chronic disease that affects large number of people, majority of whom are young individuals. The importance and effectiveness of physiotherapy in MS treatment is unquestionable. There is a growing trend to focus on neurological rehabilitation to improve patients' cognitive functioning. As technology develops, new computer programs dedicated for neurorehabilitation emerge. Parallel there is huge emergence of persuasive technology tools. The study's goal was to use one of existing computer-based rehabilitation tools, enhance its precedure with different types of reminders about exercises and to determine which type of reminder would be the most most effective one – SMS or reminder built into the program. The two types of reminder were also compared with control group, which did not get any reminders. Eleven subjects were included into the study. Their task was to perform one training session everyday for three weeks. Exercise frequency was monitored, depression level was controlled (BDI), also subjects opinion on the program was collected after the end of the study. Observed tendency in patients' behavior was different from expected, meaning no frequency increase was observed in subjects receiving enhancement. Moreover a tendency emerged, that the highest exercise frequency was obtained in control group. Both exercise frequency and amount ofadditional exercises were found to strongly correlate with perceived exercise-induced pleasure.

**EP47.** *Orexinergic theta rhythm in the hippocampal formation – studies on anesthetized rats*

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Orexin neuropeptides (hypocretins) are commonly known structures taking part in a numerous  processes like metabolic regulation, thermogenesis, stress response, epilepsy, memory processing, circadian rhythms and regulation of sleep. Hypocretins are represented by two neuropeptides – orexin A (ORXA) and orexin B (ORXB). They are widely distributed in a various  central nervous system structures including cerebral cortex, thalamus, hippocampal

formation and brain stem. The aim of the study was to prove that presence of two types of orexins is a sufficient factor of producing oscillations in theta band in the hippocampal formation. Effect of orexinergic projection was antagonized by selective blockers of orexin receptors – OX1R (SB) and OX2R (TCS). Studies were performed on 62 anesthetized Wistar rats. In the first step of experiments spontaneous theta rhythm was recorded from hippocampal formation and then blocked by intravenous injections of atropine. When theta disappeared, rats were subjected local injections of a) orexin A (0.4μg/0.5μl) or orexin B (0.2 μg/0.5 μl), b) orexin A or orexin B in a presence of SB (10 μg/1.0 μl) and TCS (10 μg/1.0 μl), c) orexin A or orexin B in a presence of SB (10 μg/1.0 μl) and d) orexin A or orexin B in a presence of TCS(10 μg/1.0 μl) in a separate experiments. Results of our study indicate the important evidence of orexinergic mechanism responsible for the generation of theta rhtyhm in the hippocampal formation. Moreover we established that induction of orexinergic-related theta rhythm has a reversible effect.

### EP48. *ERP correlates of information search process*
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Decision-making process often involves specific subtype of decisions: do we have enough information to choose the best alternative or should we search for more? The main aim of presented study was to determine if the event-related brain potentials differentiate between decisions to search for more cues and decisions to use them to make decision. 18 participants took part in EEG experiment and conducted probabilistic inference task, where they had to infer which of two options was better on the basis of sequential accumulation of cues. The results show that amplitude of P300 tracks changes in information search process.

### EP49. *Molecular dynamics simulations of FGF 2 – FGFR 2 complex and influence of FGF 2 on the brain cells*
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Fibroblast growth factor-2 (FGF2), also known as basic FGF (bFGF), is a multi-functional growth factor. FGF2 has pleiotropic effects in different tissues and organs, including potent angiogenic effects and an important role in the differentiation and function of the central nervous system (CNS). In the adult CNS, FGF2 is expressed in the neurogenic niches (the subventricular zone of the lateral ventricles - SVZ; and the subgranular zone of the hippocampal dentate gyrus - SGZ) and has been implicated in the control of adult neurogenesis based on changes in proliferation and differentiation of adult neural stem and progenitor cells. FGF2 regulates NSC (Neural Stem Cells) propagation both *in vitro* and *in vivo*. FGF 2 activates the mitogen-activated protein kinase (MEK/ERK) signaling and stimulates cells proliferation [1]. Several groups have accordingly shown the potential use of FGF2 as a therapeutic for neurodegenerative diseases such as Alzheimer's disease and Parkinson's disease. The transduction signal by Fibroblast Growth Factor Receptor 2 (FGFR 2) in the cells can be obscured by the presence of an electric field. The effect of external electric fields on the structural stability of FGF-FGFR complex has been studied by molecular dynamics (MD) simulations.
Reference.
[1] Mudò G., Bonomo A., Di Liberto V., Frinchi M., Fuxe K., Belluardo N. (2009) The FGF-2/FGFRs neurotrophic system promotes neurogenesis in the adult brain.J Neural Transm. 116(8):995-1005.

**EP50.** *Origin of the fundamental and harmonic components of SSVEP*

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Steady State Visual Evoked Potentials are the steady-state oscillatory potentials elicited in the EEG by flicker stimulation. Frequency of these responses corresponds to the stimulus frequency and its harmonics. In this study we investigated the nature and origin of harmonics, which are not well understood. It is conceivable that harmonics are caused by nonlinear, square shape of stimulation wave. Alternatively, they may be caused by nonlinearity of the visual system itself, since an output of the nonlinear system may contain harmonics and sub- harmonics of the sinusoidal input signal. In order to discern between these two hypotheses, we analyzed responses for square and sine stimulation waveforms. The analysis showed that both types of stimuli evoked harmonics in the response, ruling out the hypothesis that appearance of harmonics is solely caused by the square shape of the stimulation pattern.

**EP51.** *Neurocognitive functioning in older adults with HIV in New York City*

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Objective. The number of older adults living with HIV is increasing due to effective HIV treatment. Research shows that those individuals exhibit neurocognitive deficits related to both infection and aging or their interaction. This study examines elements of neurocognitive functioning in an HIV-infected older adult sample population in New York City, the North American epicenter of the epidemic with a well-matched (SES) control group. Participants and

Methods. Research was conducted by the AIDS Community Research Initiative of America (ACRIA). A total of 78 HIV-infected and 36 uninfected participants were recruited from New York City-based residents (mean age 49). Cognitive assessment included standardized tests of executive functions, abstract problem solving, verbal and visual memory, psychomotor speed and dexterity. A general score of neurocognitive functioning included all used measures.

Results. The general score of neurocognitive functioning showed HIV-infected individuals to have decreased neurocognitive functioning as compared to healthy SES matched controls. However, when analysing particular cognitive domains, significant differences ($p \leq 0.05$) between the groups were found only in motor speed and dexterity.

Conclusions. The study reveals that in HIV-infected older adults neurocognitive deficits occur in measures of motor speed and dexterity. The data underscores the need to assess changes in the large array of factors that contribute to cognitive function.

**EP52.** *Topographical and functional differences between FN400 and N400 event-related potentials*

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There is a growing debate as to whether frontally distributed FN400 potentials reflect familiarity-based recognition or are functionally identical to centro-parietal N400 reflecting semantic processing. We conducted two experiments in which event-related potentials (ERPs) associated with semantic priming and recognition were recorded, either when priming was

embedded within a recognition test (Experiment 1), or when these two phases were separated (Experiment 2). In Experiment 1, we found the N400 for priming only for old words, and ERP component of recognition only for primed words, but these two potentials did not differ topographically and both showed midline central maximum. In Experiment 2, the N400 for priming was recorded exclusively during encoding and again showed midline central distribution. ERP component of recognition was only found for unrelated words (not primed previously during encoding), and also showed midline central maximum, but, in addition, was present in left frontal region. This pattern of results indicate that FN400 and N400 potentials share similar neural generators, but when priming and recognition are not confounded, these potentials do not entirely overlap in terms of topographical distribution and presumably reflect functionally distinct processes.

**EP53.** *How neuropsychology can help us to understand the motives of helping, risk-taking and courage? Personality traits, which stand out Medical Rescue students*

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Completed study aimed to expose personality traits, that predispose emergency medical students to perform profession venture specifications and test personality profile of students that direction, unlike students in other fields of medical and directions, which neither related to the exercise of medical activities, nor help people in difficult situations, that threaten their health and life. A set of questionnaires containing an Elasticity Mental Questionnaire, Curiosity and Exploration Scale and Impulsivity Questionnaire was completed by 137 students from Lublin state universities, among which were: emergency medical students, students in other fields of medical and non-medical students. The results indicate that students, who going to be paramedics in the future have the highest level of resilience or psychological characteristics, which would result from the ability to adapt to the requirements of the scope of self-control situation.This personality trait plays a fundamental role in the process of effective coping. Analysis of the responses provided valuable information about the significantly higher level of risk taking in group of emergency medical students, while pointing to the lowest level of empathy in this group. In addition, prospective paramedics have the highest level of curiosity, which consists of a preference to seek new knowledge and experience and preference to novelty and uncertainty. Discussion of results, which also suggests further research neuropsychological aspects of the differences of personality will be presented on the poster.

# Conference centre – how to get there
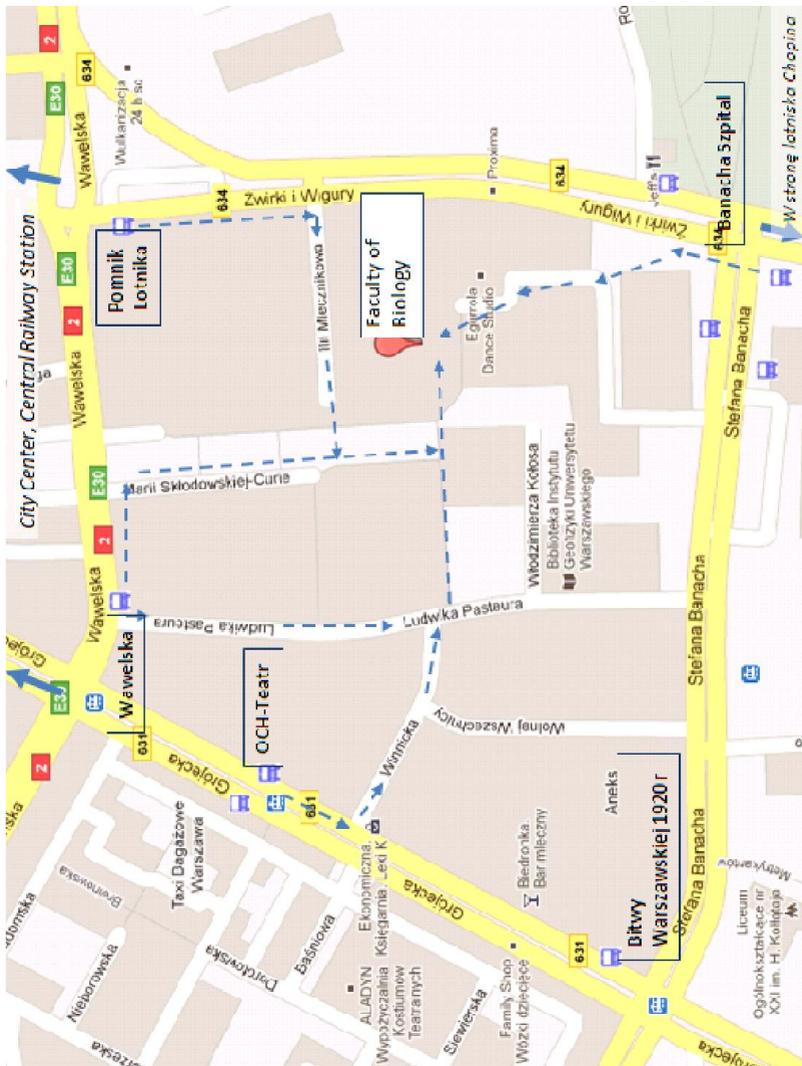
# Varia

**Big, International Neuroscience Projects**
Blue Brain Project http://bluebrain.epfl.ch/
Human Brain Project  http://www.humanbrainproject.eu/pl
The Whole Brain Project  http://www.wholebrainproject.org/
The Brain Activity Projects http://www.columbia.edu/cu/biology/faculty/yuste/bam.html

**Neuroscience Podcasts**
Nature Neuropod  http://www.nature.com/neurosci/neuropod/index.html
Neurology® Podcast http://www.aan.com/rss/index.cfm?event=feed.items&channel=1
Brain Science Podcast http://brainsciencpodcast.wordpress.com/
Naked Neuroscience http://www.thenakedscientists.com/HTML/podcasts/neuroscience/

**Online courses**
https://www.coursera.org/courses
https://class.stanford.edu//
http://ocw.mit.edu/courses/life-sciences/#biology
https://www.edx.org/course-list/allschools/allsubjects/allcourses

**Games**
Mouse Party  http://learn.genetics.utah.edu/content/addiction/drugs/mouse.html
Axon - Wellcome Collection  http://axon.wellcomeap