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The organization of parietal-frontal sensorimotor networks in primate brains.

Abstract

Compared to other mammals, primates have a large number of visual areas in neocortex, as well as expanded posterior parietal cortex and premotor and prefrontal areas of cortex. Visual areas that directly or indirectly project to posterior parietal cortex are considered to be in the dorsal stream of cortical networks for selecting and producing complex behaviors. Our research in monkeys and prosimian galagos indicates that a large part of posterior parietal cortex is subdivided into eight or more small regions or domains where electrical stimulation evokes a specific but different action such as reaching, grasping, running, or looking. Each domain of posterior parietal cortex selectively activates functionally matched domains in motor and premotor cortex, where the motor domains are necessary components of the functional networks. We regard the three sets of interconnected domains as three levels of decision making, where sensory information, cognitive and memory components, and motor planning sources of information successfully influence the motor outcome. The nature of the fractured motor maps
in premotor and motor cortex suggest that their domains include a mixture of functionally different microcolumns that together reflect the functions of the domains.

Biography. Jon H. Kaas (b. September 13, 1937 in Fargo, ND, USA) received a B.A. from Northland College (Ashland, WI) in 1959 and Ph.D. in 1965 from Duke University (NC, USA) with Irving Diamond as his thesis advisor where he studied brain organization in a variety of mammalian species. From 1965 to 1968 Jon was a postdoctoral fellow with Clinton Woolsey at University of Wisconsin, Madison, where he studied the visual system in monkeys. He is currently Distinguished, Centennial Professor of Psychology at Vanderbilt University, where he has been since 1973.

Dr. Kaas was elected to the National Academy of Sciences in 2000, and the American Academy of Arts and Sciences in 2001. He received the Distinguished Scientific Contribution Award from the American Psychological Association, the Karl Spencer Lashley Award from the American Philosophical Society, the George A. Miller Prize in Cognitive Neuroscience from the Cognitive Neuroscience Society in 2014, Honorary Life Member, J. B. Johnson Club for Evolutionary Neuroscience in 2014, and the Palay Award from the Journal of Comparative Neurology, 2014. He has published over 540 papers and review articles, and edited many volumes including a four-volume series "The Evolution of Nervous Systems" in 2007 and 2017. In 2009 he received the Graduate Mentoring Award from Vanderbilt University. Two of Jon's PhD students have won the MacArthur "genius" award.

Current research includes investigations of the somatosensory, auditory and motor systems in a range of mammals including a number of species of prosimian and simian primates, as well as the study of brain material obtained after natural death from apes and humans. Researchers in the Kaas laboratory have published extensively on the organization of sensory and motor systems in primates, the plasticity of these systems in developing and mature brains, and the coding properties of neurons in these systems, especially somatosensory cortex. Many studies are concerned with how brains differ in organization across species in order to deduce how complex brains such as the human brain evolved. A relatively new focus of investigation focuses on how numbers of neurons scale with brain size and size of brain parts.
I am therefore I think

Abstract: This overview of the free energy principle offers an account of embodied exchange with the world that associates neuronal operations with actively inferring the causes of our sensations. Its agenda is to link formal (mathematical) descriptions of dynamical systems to a description of perception in terms of beliefs and goals. The argument has two parts: the first calls on the lawful dynamics of any (weakly mixing) ergodic system – from a single cell organism to a human brain. These lawful dynamics suggest that (internal) states can be interpreted as modelling or predicting the (external) causes of sensory fluctuations. In other words, if a system exists, its internal states must encode probabilistic beliefs about external states. Heuristically, this means that if I exist (am) then I must have beliefs (think). The second part of the argument is that the only tenable beliefs I can entertain about myself are that I exist. This may seem rather obvious; however, it transpires that this is equivalent to believing that the world – and the way it is sampled – will resolve uncertainty about the causes of sensations. We will consider the implications for functional anatomy, in terms of predictive coding and hierarchical architectures in the brain. We will conclude by looking at the epistemic behaviour that emerges using simulations of active inference, with a special focus on visual foraging.

Biography. Karl Friston is a theoretical neuroscientist and authority on brain imaging. He invented statistical parametric mapping (SPM), voxel-based morphometry (VBM) and dynamic causal modelling (DCM). These contributions were motivated by schizophrenia research and theoretical studies of value-learning, formulated as the dysconnection hypothesis of schizophrenia. Mathematical contributions include variational Laplacian procedures and generalized filtering for
hierarchical Bayesian model inversion. Friston currently works on models of functional integration in the human brain and the principles that underlie neuronal interactions. His main contribution to theoretical neurobiology is a free-energy principle for action and perception (active inference). Friston received the first Young Investigators Award in Human Brain Mapping (1996) and was elected a Fellow of the Academy of Medical Sciences (1999). In 2000 he was President of the international Organization of Human Brain Mapping. In 2003 he was awarded the Minerva Golden Brain Award and was elected a Fellow of the Royal Society in 2006. In 2008 he received a Medal, College de France and an Honorary Doctorate from the University of York in 2011. He became of Fellow of the Royal Society of Biology in 2012, received the Weldon Memorial prize and Medal in 2013 for contributions to mathematical biology and was elected as a member of EMBO (excellence in the life sciences) in 2014 and the Academia Europaea in (2015). He was the 2016 recipient of the Charles Branch Award for unparalleled breakthroughs in Brain Research and the Glass Brain Award, a lifetime achievement award in the field of human brain mapping. He holds Honorary Doctorates from the University of Zurich and Radboud University.
Brain connectomics: From Cajal to present

From the outset of Cajal’s studies in 1888 with the method of Golgi he provided support for his belief that dendrites and axons end freely in the nervous system and that they communicate by contact. This hypothesis contrasted with the most prevalent idea at the time that the elements of the nervous system formed a continuum. The existence of a continuous network would more readily explain the flow of currents, but how could this be possible through an infinitely interrupted and fragmented nervous system? Cajal proposed that neurons showed a morphological and functional polarization in such a way that neurons could be divided in general into three distinct regions: a receptor apparatus (dendrites and soma), the emission apparatus (the axon) and the distribution apparatus (terminal axonal arborisation). Cajal’s new ideas about the connections between neurons led to novel theories on the relationship between neuronal circuits and brain function. Indeed, this hypothesis gave rise to a new era in neuroscience and to the tracing of the first point-to-point connectivity maps. In the 1930s, it had been shown histologically that the terminal axonal bouton was separated by a “membranous synaptic barrier”. At the areas of contact between the axon terminal and the soma or dendrite, only one membrane was visible (the synaptic membrane), presumably since the membrane of the pre- and post-synaptic elements were so close together that only a single membrane could be distinguished. Thanks to the introduction of transmission electron microscopy (TEM) in the 1950s the nature of synapses was examined, confirming a critical aspect of the neuron theory: the pre- synaptic and the post-synaptic elements are physically separated by a space about 20 nm wide, the synaptic cleft. The recent development of automated EM techniques (e.g., FIB/SEM microscopy) will represent a true revolution in the examination of synaptic circuits.

Biography I began my research career in 1976 at the Cajal Institute, under the supervision of Dr. J. Rodrigo, experimentally and morphologically studying the sympathetic and parasympathetic innervation of the mammalian oesophagus. Having presented my doctoral thesis in 1980, I joined the laboratory of Drs F. Valverde and A. Fairén at the same Institute. It was in this period that I began to study the microorganization of the cerebral cortex, using the combined method of Golgi-electron microscopy, a subject that has remained the focal point for my research since then. During this period, we developed a very simple and effective method for correlative light and electron microscopic studies to analysis the connections between identified neurons at the electron microscopy level. This method allowed us to identify unequivocally every part of the axon and the dendrites of the cell under
study. In 1983, I obtained a Fogarty Fellowship (NIH) to work with Dr. Edward Jones at the Washington University School of Medicine, St. Louis (USA). This allowed me to extend my studies on cortical organization through the use of additional methods, such as high resolution immunocytochemistry and the use of anatomical tracers. One of the most important scientific achievements was the demonstration of the coexistence of neuropeptides (somatostatin, neuropeptide Y and cholecystokinin) with a classical neurotransmitter (GABA) in the cerebral cortex. From 1984 to 1985 I was appointed as a Visiting Scientist, in the laboratory of Dr. Jones at the University of California (Irvine). After this period in the laboratory of the Dr. Jones (1983-1986), I obtained a Tenured in Neuroscience at the Cajal Institute to continue my research on the cerebral cortex. Between 1989 and 1991, I returned to Dr. Jones’ laboratory to study the microorganization of the monkey cerebral cortex. In 1991 I returned to the Cajal Institute to establish a research group that principally focuses on the microorganization of the normal cerebral cortex (including hippocampus) in various species (particularly humans) and on the alterations of cortical circuits in epilepsy and Alzheimer disease. In 2000, I was appointed as Research Scientist, and in 2004 as Full Professor in the same institution. I was the Spanish Project leader for the NASA Neurolab project (1998) and the Director of the Cajal Blue Brain Project (2009-actual). In addition, I am the leader of Subproject 1 *Mouse Brain Organization and Interspecies Comparisons* and member of the *Science and Infrastructure Board* of the Human Brain Project (2013-2023. Finally, another of my principal interest is the study of the history of our current understanding of cortical organization and function. In particular, I am interested in the roots of cortical histology and circuitry.
Title: Insoluble proteins and neurodegeneration: deposition and transmission

Abstract: Neuropathological hallmarks of neurodegenerative disorders are depositions of insoluble proteins such as Abeta and tau in Alzheimer disease, alpha-synuclein in Parkinson disease, and polyglutamine in Huntington disease (HD). p62 is important regulatory proteins for selective autophagy, by which aggregated proteins are degraded, and is associated with several inclusions of neurodegenerative disorders including nuclear inclusions of HD. We have been focusing on the protein quality control system and its role on clearance of polyglutamine aggregates. In this talk, I will introduce those works and also the effect of p62 depletion on the polyglutamine mouse models. The results suggest that the genetic ablation of p62 in HD mice models enhanced cytoplasmic inclusion formation due to affected autophagic clearance of polyQ inclusions, decreased their nuclear influx and ameliorates paradoxically the disease phenotypes by decreasing toxic nuclear inclusions.

Because the autophagic clearance system works in cytoplasm, this system should work more in other neurodegenerative disorders with cytoplasmic inclusions. To detect the effect of factors on the protein deposition, we established prion-like transmission experiments using alpha-synuclein seeds in vivo. Unexpectedly, the seeds disseminated very rapidly in vivo. I will discuss about the significance of this phenomenon.

Biography Dr. Nobuyuki Nukina is currently a professor of Laboratory of Structural Neuropathology, Doshisha University Graduate School of Brain Science, and also visiting senior researcher of RIKEN and a visiting professor of Juntendo University. He graduate University of Tokyo on 1977 and got PhD on discovery of tau protein as a main component of Alzheimer neurofibrillary tangles. He was an associate professor of the Department of Neurology in University of Tokyo until 1997 and moved to RIKEN Brain Science Institute as a head of lab for Structural Neuropathology and group director of Molecular Neuropathology Group. Since 2015, he is working in the current position. His main interest is insoluble proteins in the neurodegenerative disorders including polyglutamine disorders and protein quality control mechanism for clearing those abnormal proteins.
Ioan Opris

Associate Professor, University of Miami, Milller School of Medicine, Miami Project to Cure Paralysis, Center for Neuroengineering, and Department of Biomedical Engineering, Miami, Florida, USA; Professor, USAMV, School of Veterinary Medicine, Bucharest, Romania

Title: The Emergence of the Mind

Abstract: The prefrontal cortex (PFC) of human and animal brain has been postulated to play critical roles in the executive control function, while the Hippocampus is instrumental in the formation of long-term memories and the Brainstem in the control of behavior. To gain insights into the neurobiological mechanism of such cognitive functions, one needs to understand the input-output transformational properties of the PFC, hippocampal and brainstem’s neuronal micro-circuits. This implies that spike trains of columnar neuronal ensembles of neurons are recorded with a biomorphic multi-electrode array from the prefrontal cortical layers of animals performing a cognitive task and then stimulated with appropriate patterns of electrical pulses. This modular approach provides clues about how the input spike trains are transformed into output spike trains by the PFC and hippocampal micro-circuitry. Recent results demonstrate the following integrative aspects: 1. Functional integration of perceptual and behavioral signals across cortical layers during executive control. The integrative effect of dlPFC minicolumns was shown by: (i) increased correlated firing on correct vs. error trials; (ii) decreased correlated firing when the number of non-matching images increased; and (iii) similar spatial firing preference across cortical-striatal cells during spatial-trials, and less on object-trials. 2. Causal relations to integration of cognitive signals by the minicolumnar turbo-engines. The inter-laminar integration between the perceptual and executive circuits was facilitated by stimulating the infra-granular layers with firing patterns obtained from supra-granular layers that enhanced spatial preference of percent correct performance on spatial trials. 3. Integration across hierarchical levels of the brain. This functional connectivity may have important implications for the understanding of functional integration within the PFC of the cognitive functions supporting the emergence of mind.

Biography. Dr. Ioan Opris is currently an Associate Professor of Biomedical Engineering at the University of Miami in the USA, and he is also a professor of preclinical sciences in Veterinary Medicine at USAMV Bucharest in Romania. He graduated from the University of Bucharest in 1982 and received his PhD in 1995 for the discovery of enhanced storage capacity for associative memory neural networks. Dr Opris has a broad interdisciplinary approach to neuroscience, including aspects of sensorimotor, cognitive and reward systems, addressing fundamental questions concerning the neuromodulation of cortical, striatal and brainstem microcircuits in animals (rodents, micropigs and primates) using minimally invasive (electrical microstimulation and optogenetics) and noninvasive (transcranial magnetic stimulation) approaches. Together with his interdisciplinary team in 2012, they demonstrated for the first-time facilitation and restoration of cognitive function by a neuroprosthesis that utilizes minicolumn-specific neural
firing in primate prefrontal cortex. These results were featured by NY Times in 2012. He is the recipient of several awards including the 2000 McDonnell Foundation Award and the 2017 Frontiers Spotlight Award. Since 2015, Dr. Opris is a Specialty Chief Editor for Neural Technology at the Frontiers in Neuroscience family of journals. Together with Prof. Manuel F. Casanova, in 2017 he edited the Springer Nature book entitled *The Physics of the Mind and Brain Disorders: Integrated Neural Circuits Supporting the Emergence of Mind*. 
Maria Sanchez-Vives

Research Professor ICREA, at the IDIBAPS
(Institut d'Investigacions Biomèdiques August Pi i Sunyer),
University of Barcelona, Spain

Title: Impact of Virtual Embodiment on Sensory and Motor Processing

Abstract: Our stable body representation can be challenged not only by neurological conditions but also by body transformation illusions such as the rubber hand illusion. In the last decade we have demonstrated that providing congruent sensorimotor correlations, we can induce the illusion that a virtual body in immersive virtual reality is our own body. The experience of "embodiment" of a virtual body has consequences that include physiological, behavioural, and psychological ones. Here I will discuss the impact of virtual embodiment on sensory processing including pain perception, concluding that virtual reality can be used to reduce chronic pain. Further, a virtual body can be used to better understand motor processing. I will explain the brain signals associated to motor errors and how controlling a virtual body through a brain computer interface can help us to understand the brain mechanisms of agency over movements. Virtual bodies become then a tool in neuroscience to study brain function and also a promising strategy in neurorehabilitation.

Biography. Mavi Sanchez-Vives, MD, PhD in Neurosciences is ICREA Research Professor at the IDIBAPS (Institut d'Investigacions Biomèdiques August Pi i Sunyer), where she is Head of the Systems Neuroscience group. She is as well co-Director of the Event Lab (Experimental Virtual Environments in Neuroscience and Technology) and Adjunct Professor at the Dept. of Basic Physiology, University of Barcelona. Her main interests are cerebral cortex functional properties, neurotechnology for brain interfacing and the study of body representation. Part of the research of her group is currently carried out under the frame of the European Flagships Human Brain Project and Graphene Project. A pioneer in using virtual reality from a neuroscientific perspective, she is one of the founders of Virtual Bodyworks.
Prism adaptation test (PAT) - A new quantitative test of cerebellar motor learning -

Abstract: Spinocerebellar degeneration usually progress very slowly and changes of scores of clinical scales like SARA are quite small. Therefore, we need a practical test which can quantitatively evaluate subtle changes of cerebellar functions. Among various functions of the cerebellum, motor learning has a long history of extensive researches. We thought prism adaptation using finger reach movement may be a good task because adaptation time is fairly short during the task. An examinee wearing prism-equipped goggles touches the index finger to the target on a touchscreen in every trial. The whole test was composed of 3 consecutive sessions: 1) 50 trials with normal vision (BASELINE), 2) 100 trials with a prism shifting the visual field 25°rightward (PRISM) and 3) 50 trials without the prism (REMOVAL). In normal control, touched points deviated greatly with a prism but gradually returned to the correct target during repeated trials. The touched points deviated similarly to the opposite direction when the prism was removed and returned again to the correct target after repeated trials. Adaptation index (AI) was calculated by multiplying each probability of acquisition in the last 10 trials of PRISM, retention in the initial 5 trials of REMOVAL and extinction of in the last 10 trials of REMOVAL. AI clearly distinguished patients with cerebellar ataxia from normal controls and was significantly correlated with SARA and 9HPT scores. This system is compact and easy to use at outpatient clinics and useful to quantitatively evaluate the cerebellar function in clinical trials for cerebellar disorders.

Biography: Hidehiro Mizusawa is President of National Center of Neurology and Psychiatry since April 2016 after 2 years of Director General, National Center Hospital of the institute. He
graduated with MD in 1976 from Faculty of Medicine of Tokyo University, where he received PhD in 1983. He moved to Tsukuba University as Assistant Professor in 1984 and became Associate Professor of Department of Neurology in 1988. He has been Professor and Chair of Department of Neurology and Neurological Sciences, Graduate School of Medical and Dental Sciences, Tokyo Medical and Dental University since 1996 till 2014, where he has been Director of Center for Brain Integration Research, Director of School of Medicine, Vice Director of the Medical Hospital and Associate Managing Trustee for Research of the University. He has contributed particularly to researches on pathogeneses of ALS, Pure Akinesia/PSP, SCA, mitochondrial neuropathy, distal myopathy and Prion disease. He has long been Chairperson of Research Committees on Prion disease, Ministry of Health, Welfare and Labor, Japan since 2002 and a core member of the Research Committee on Neurodegenerative Diseases and that on Ataxic Disorders of which he was appointed as Chairperson since April 2014. He has been also a member of Advisory Board of National SCA/MSA Patients’ Association. Regarding the Initiative on Rare and Undiagnosed Disease, he has been the PI since 2015. He served as President of Japanese Society of Neurology since 2010 till 2014 and was President of Prion 2016 in Tokyo, President of WCN 2017 in Kyoto and Vice President of ICN 2018 in Tokyo. (Text: 256 words)
Abstract
The lecture will cover the major advances made in brain-machine interfaces (BMIs). BMIs link the brain to external devices, with an eventual goal of recovery of motor, sensory and cognitive functions to patients with neurological conditions. Over the past half-century, BMIs have advanced significantly from the early ideas that sounded like science fiction to the modern high-tech implementations. In particular, intracranial recordings using multichannel implants have enabled real-time control of artificial limbs by nonhuman primates and human subjects. BMIs can restore upper-limb and lower-limb functions. Furthermore, bidirectional BMIs can provide artificial sensory feedback, allowing users to perceive the movements of prosthetic limbs and their interaction with external objects. BMIs can also multitask, like simultaneously decoding orientation of spatial attention and motor goals. Recently, BMI approach was employed to build brain-nets that enable information exchange between individual brains and execution of cooperative tasks. Overall, BMIs appear to be an efficient approach to augmenting the brain function, with limitless perspectives.

Biography. Mikhail Lebedev, a Senior Research Scientist at Duke University, is an expert in Neurophysiology and Neuroprosthetics. He was trained as a physicist at Moscow Institute of Physics and Technology (MIPT or Phystech) (1980-1986) and received a PhD in Neurobiology from the University of Tennessee, Memphis. His research interest include motor control, Neurophysiology of sensory, motor and cognitive systems and brain-machine interfaces. He participated in the pioneering research on brain-machine interfaces that enable direct cortical control of assistive devices that reproduce limb movements, including BMIs for reaching and grasping, BMIs that enable bipedal locomotion pattern and whole-body movements in a wheelchair, and sensorized BMIs that both extract motor command from the brain and deliver feedback information using intracortical microstimulation applied to sensory areas of the brain.
Together with Ioan Opris and Manuel Casanova, Lebedev won Frontiers Spotlight Award for the research topic "Augmentation of Brain Function: Facts, Fiction and Controversy".
Using machine learning, phenotypic assays and biochemical profiling to identify drug targets and anti-targets to promote axonal sprouting and regeneration.

Phenotypic assays on live cells are efficient at finding compounds that produce desired cellular outcomes, but it is often impossible to identify the molecular targets of these compounds. Biochemical binding assays, in contrast, are effective at identifying compounds that bind to targets, but such compounds may not work in live cells or may cause undesirable “off target” effects. By using libraries of compounds that have been screened on hundreds of enzymes (for example kinases) in phenotypic assays, it is possible to link these two approaches. Machine learning can then be used to identify targets (kinases that when inhibited enhance the desired phenotypic outcome) and anti-targets (kinases that when inhibited antagonize the desired phenotypic outcome). This drug discovery pipeline also uncovers synergies among targets that can dramatically increase compound efficacy. We have used our pipeline to identify kinase targets that can be inhibited to promote axon initiation, axon extension and axon branching. Compounds that inhibit multiple molecular targets in vitro have proven effective at promoting regeneration in vivo.

Biography. Dr. Lemmon’s core research activities currently involve the use of phenotypic screening to identify genes and compounds that can be developed into therapeutics for nervous system repair. His lab uses automated microscopy and image analysis to measure how different treatments alter cell shape and the location and phosphorylation state of various proteins. (Moore et al., 2009; Hellal et al., 2011; Blackmore et al., 2012). The Lemmon group makes extensive use of the Center for Computational Science’s (CCS) High Performance Computing resources to analyze next generation sequencing data (Gao et al., 2017; Lerch et al., 2012; Zhu et al., 2017) and run support vector machine algorithms on data from kinase inhibitor experiments.
The Kinase Inhibitor Project is done in collaboration with major pharmaceutical companies and computer scientists in academia and industry. The Kinase Inhibitor Project has expanded from CNS injury to cancer with active collaborations at UM and internationally.

For the past, several years Dr. Lemmon has worked with Stephan Schürer to develop ontologies and informatics tools to allow interrogation of enormous chemical screening data sets. Most of these data are derived from studies of cancer cells. The first project produced the is the BioAssay Ontology (Vempati et al., 2012). Next came a project to create an ontology to describe nerve regeneration, the RegenBase Project (Lemmon et al., 2014b; Lemmon et al., 2014a; Callahan et al., 2016). This was followed by the LINCS Information FramEwork project and most recently an enormous multicenter project called the LINCS Big Data to Knowledge program. These NIH supported projects facilitate interrogation of massive and diverse data sets emerging from NIH and academic screening centers.
Valentin Dragoi

Levit Distinguished Professor of Neuroscience
Dept. of Neurobiology and Anatomy
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Population synchrony in cortical networks

Abstract. Brain activity during wakefulness is characterized by fluctuations in neuronal responses at different time scales. Whether these fluctuations play any role in modulating the coding of sensory information and the accuracy of behavioral responses is poorly understood. Using multiple-electrode recording techniques I will show that slow changes in local population synchrony in monkey visual cortex impair the coding of sensory information and perceptual performance. These changes also occur in executive areas, such as prefrontal cortex, while monkeys freely explore their environment during foraging. However, while population synchrony is detrimental for neural coding and behavior at long time scales, it plays a beneficial role at shorter time scales. Indeed, by simultaneously recording visual cortical populations in multiple areas we recently discovered that the precise temporal coordination between the spikes of three or more neurons carries information about perceptual reports in the absence of firing rate modulation. These results demonstrate an unexpected functional impact of synchrony in local cortical networks at slow and rapid time scales.

Biography. Valentin Dragoi is a systems and computational neuroscientist who examines how networks of cortical neurons encode information and how the population code influences behavioral decisions. His research combines electrophysiological (multi-electrode recording in restrained and freely moving animals, optical and electrical stimulation), behavioral, and computational methods. His goals are to understand the neuronal computations and coding principles of cortical circuits and develop new technologies for high-yield neuronal recording technologies for basic and clinical research. Valentin received rigorous training in experimental and theoretical neuroscience from Duke University (Ph.D. in 1997) and MIT (postdoctoral training between 1997-2003). He currently holds an endowed professorship at the McGovern Medical School, University of Texas, Houston, as Levit Distinguished Professor of Neuroscience. Valentin’s research on the principles of information coding in cerebral cortex has been published in numerous broad-audience journals, such as Science, Nature, Nature Neuroscience, Neuron, PNAS, Current Biology, eLife, and others. Over the years, Valentin received numerous awards for the results of his studies, including the BRAIN Initiative Award (2015), NIH Pioneer Award (2010), NIH EUREKA Award (2009), James S. McDonnell Award (2005), Pew Scholars Award (2004), etc.
Probing awareness using EEG reactivity measures

Recording the electrical activity of the brain by means of electroencephalography (EEG) can reliably distinguish wakefulness from sleep. Nevertheless, the distinction of awareness (content of consciousness) from arousal remains challenging using only spontaneous EEG recordings. Quantification of EEG changes to standardized stimulation paradigms is referred to as EEG reactivity. My lecture will review the EEG reactivity work carried out in the ComaEEG.RO consortium comprised of an increasing number of basic scientists, clinicians and industry partners. Our central hypothesis is that the brain activity, as reflected by its EEG signature, can be described as a sequence of task-oriented stimulus processing frames alternating with default mode frames devoid of task-demand. Such an alternating pattern can be directly observed in deep comatose states where the EEG shows large bursts of stimulus-evoked activity alternating with periods of flat EEG, consistent with the suppression of default frames commonly associated with consciousness. We developed a method to distinguish default activity frames in both burst-suppression and continuous EEG referred to as default EEG reactivity (DER, patent pending). In brief, we segmented the multi-channel EEG into consecutive classes with similar topographic frequency distribution and then identified the class with the largest decrease in occurrence probability during 1-minute stimulation epochs. To distinguish awareness, we focused on a particularly salient stimulus, the subjects own name, whereas the level of arousal was controlled by measures of heart rate variability. Our data suggest that DER can be used to derive measures of awareness with both clinical and experimental applications.

Biography. Associate professor Mihai Moldovan MD, PhD is a medically trained neuroscientist focused on developing translational neurophysiological techniques for quantifying excitability changes in the nervous system, such as “nerve threshold-tracking” and “EEG reactivity”. Although
based at the University of Copenhagen, Denmark, he kept an uninterrupted scientific collaboration with the “Carol Davila” University of Medicine and Pharmacy Bucharest, where he graduated from in 1999. He is actively involved with major international neuroscience organizations such as the Federation of European Neuroscience Societies, International Brain Research Organization and the European Dana Alliance for the Brain. In Romania, he currently serves as the president of the National Neuroscience Society as well as the scientific director of the Society of Electrodiagnostic Neurophysiology.