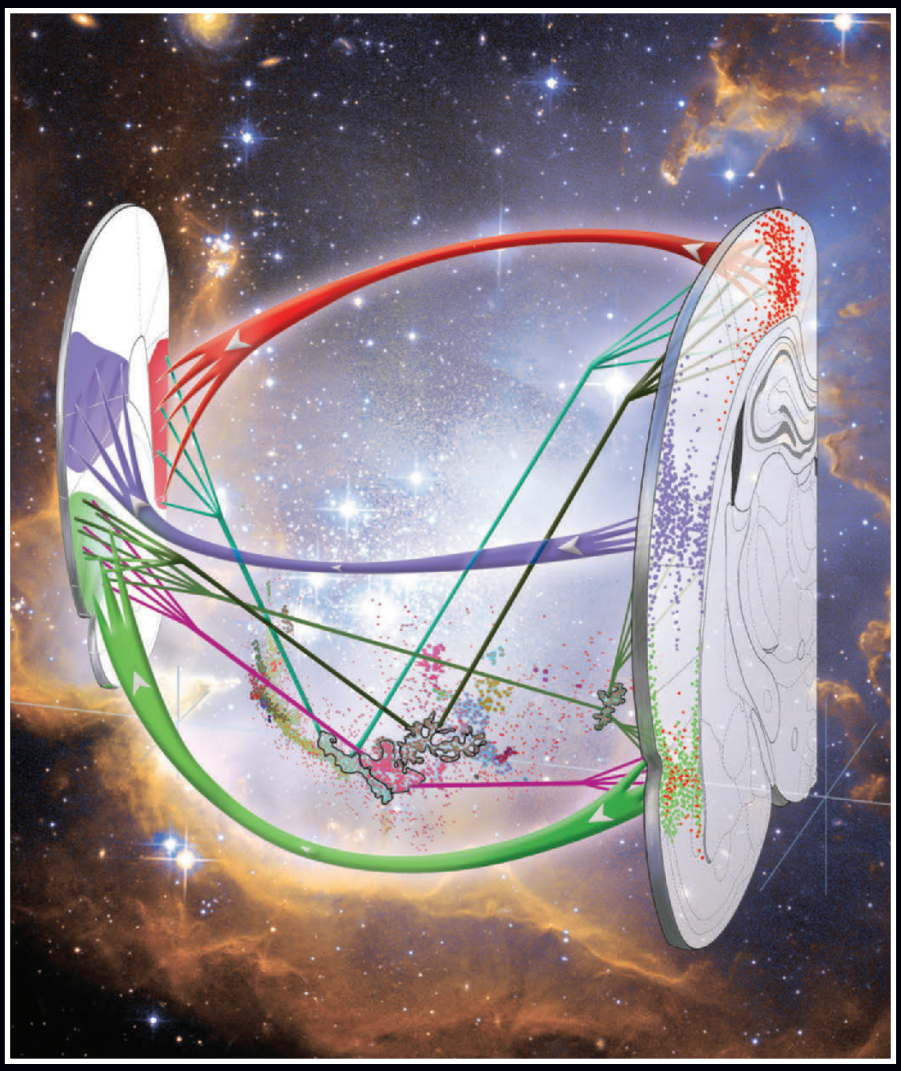
NETWORK ARCHITECTURE OF FOREBRAIN SYSTEMS: ANATOMY TO FUNCTION

A Symposium in Honor of LASZLO ZABORSZKY



September 27, 2014,

Balaton Limnological Institute, MTA Centre for Ecological Research, Hungarian Academy of Sciences, Tihany, Hungary

NETWORK ARCHITECTURE OF FOREBRAIN SYSTEMS: ANATOMY TO FUNCTION.

A Symposium in Honor of LASZLO ZABORSZKY

September 27, 2014, Balaton Limnological Institute, MTA Centre for Ecological Research, Hungarian Academy of Sciences, Tihany, Hungary

Organized by Károly Elekes PhD, DSc

9:00 AM	**Opening remarks**
9:05 AM	JAN BJAALIE, MD,PhD, *University of Oslo, Norway* Google maps of the brain: multi-level digital atlasing of the rodent brain
	Chair: M. GIELOW, PhD *Student, Rutgers University*
9:35 AM	CELESTE T. NAPIER, PhD, *Rush University Medical Center, Chicago, IL, USA* Basal Forebrain Anatomy to Function: 25 years of progress
10:00 AM	LASZLO DETARI, PhD, *Eotvos Lorand University, Budapest, Hungary* Continuing evolution in the functional assessment of cholinergic neurons
10:20 AM	KAZUE SEMBA, PhD, *Dalhousie University, Halifax, Canada* BF regulation of sleep and waking: cholinergic and non-cholinergic neurons
10:40 AM	ANGEL M NUNEZ, MD, PhD, *Universidad Autonoma, Madrid, Spain* Cholinergic modulation of the somatosenssory cortex: specific pathways and functions
11:00 AM	**Coffee break**
	Chair: M. ANTAL, MD,PhD,DSc, *Professor, University of Debrecen*
11:20 AM	JOSE L. CANTERO, PhD, *University Pablo de Olavide, Seville, Spain* Effects of early neurodegeneration on anatomo-functional brain networks
11:40 AM	LORETA MEDINA, PhD, *University of Lleida, Catalonia, Spain* Development and evolution of cholinergic corticopetal neurons of the basal forebrain
12:00 PM	LASZLO ZABORSZKY, MD,PhD, *Rutgers University, Newark, NJ, USA* New perspectives in the organization of the basal forebrain corti copetal system

12:30 PM **Lunch**

Chair: A. CSILLAG, MD,PhD,DSc, *Professor, Semmelweis University*

2:00 PM FLORIS WOUTERLOOD, PhD,
Free *University, Amsterdam, The Netherlands*
A new era in neuroanatomical tracing based on selective express ion of fluorescent proteins

2:15 PM WILLIAM CULLINAN, PhD, *Marquette University, Milwaukee, WI, USA*
Hierarchical organization of stress-related pathways

2:35 PM MARISELA MORALES, PhD, *NIDA, Baltimore, MD, USA*
Glutamatergic neurons in the A10 area

2:55 PM TIBOR KOOS, PhD, *Rutgers University, Newark, NJ, USA*
The organization of cholinergic and GABAergic neostriatal inter- neuron circuitry

3:15 PM JOSE L. LANCIEGO, PhD, *University of Navarra, Pamplona, Spain*
Loss of dendritic spines in striatofugal neurons following experi mental Parkinsonism

3:35 PM **Coffee break**

Chair: Z. KISVARDAY, MD,PhD,DSc, *Associate Professor, University of Debrecen*

3:50 PM HENK GROENEWEGEN, MD,PhD, *Free University, Amsterdam, The Neteherlands*
Orbitofrontal projections in rats

4:10 PM HELEN BARBAS, PhD, *Boston University, Boston, MA, USA*
Modulating prefrontal executive functions

4:30 PM SUSANNE HABER, PhD, *University of Rochester, Rochester, USA*
Circuits of reward and decision-making: what monkey tracing studies tell us about human connectivity

4:50 PM MENNO WITTER, PhD, *Kavli Institute for Systems Neuroscience, Trondheim, Norway*
Postnatal development of hippocampal projections to the septum

5:10 PM GABOR TAMAS, PhD, *University of Szeged, Szeged, Hungary*
Unprecedented connections of human and rodent interneurons

5:30 PM ZOLTAN NUSSER, PhD, KOKI, *Hungarian Academy of Sciences, Budapest, Hungary*
Structural, molecular and functional heterogeneity of hippocampal glutamatergic synapses

6:00 PM **Coffee break**

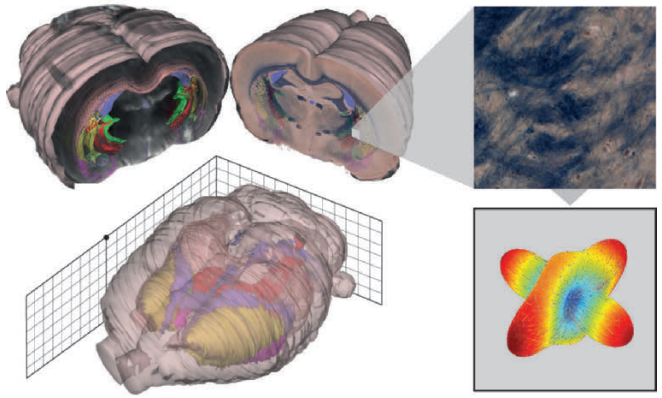
Chair: P. GOMBKOTO, PhD, *Rutgers University*

6:15 PM ALBERT-LÁSZLÓ BARABÁSI, PhD, *Boston University, Boston, MA, USA*
Controlling networks

Jan G. Bjaalie

Jan G. Bjaalie, MD, PhD
Professor and Head of Institute
Institute of Basic Medical Sciences
University of Oslo, Norway

Jan Bjaalie is Professor of anatomy, Head of the Neural Systems laboratory, and Head of the Institute of Basic Medical Sciences at the University of Oslo; he is also Chair of the Governing Board of the International Neuroinformatics Coordinating Facility at the Karolinska Institute. Dr. Bjaalie's research interests include principles of wiring patterns in the brain, map transformations in sensory systems, advanced imaging of brain architecture, and development of neuroinformatics tools and approaches for 3D visualization and atlasing of the brain. Recently, his work has focused on development of online resources for improved documentation of scientific results and interpretations, sharing of large amounts of multi-level data (from histology to functional imaging), and the use of new standardized frameworks facilitating comparison of data in 3D atlas space. He introduced the Rodent Brain WorkBench (rbwb.org), a portal to collections of data, tools, and services, developed through a large number of international collaborations. The portal delivers a new 3D digital rat brain atlas, atlases with interactive tools for the hippocampal area, atlases of cellular level expression of transgenic Tet-Off gene promotors, and atlases of barrel cortex connectivity. During his tenure as founding Director of the International Neuroinformatics Coordinating Facility, Dr. Bjaalie contributed to establishing several international programs and activities in neuroinformatics.



T. Celeste Napier

T. Celeste Napier, Ph.D.
Professor, Departments of Pharmacology and Psychiatry
Rush University Medical Center
Chicago, Illinois, USA

Dr. T. Celeste Napier is a Professor within the Departments of Pharmacology and Psychiatry at Rush University Medical Center. She also serves as the Director for the Center for Compulsive Behavior and Addiction at Rush University, and the Leader for the Drug Abuse and HIV Scientific Working Group for the Chicago Developmental Center for AIDS Research. Professor Napier's academic background includes a Ph.D. in Pharmacology from Texas Tech University Health Sciences Center, Lubbock, Texas USA, and post-doctoral training in Neurobiology at the University of North Carolina School of Medicine, Chapel Hill, North Carolina USA. She had research sabbaticals at Yale University School of Medicine, New Haven, Connecticut USA and the University of Washington Health Sciences Center, Seattle, Washington USA. Professor Napier has received continuous funding from the National Institutes of Health (NIH; USA) since 1990. Her extensive scientific service includes President of the Chicago Chapter of the Society for Neuroscience, membership in NIH scientific review committees, an organizer of international conferences, editor or reviewer for over 25 scientific journals and books, and also is an advisor/consultant for community-based treatment and education centers, and the biotech industry. She has provided expert testimony to the United States Congress, Committee on Science, Space and Technology Subcommittee on Research and Technology.

Professor Napier's research is concerned with changes in the adult mammalian brain that alter motivational behaviors, including those associated with drug and behavioral addictions. This work involves addiction co-morbidity with other pathologies, such as HIV/AIDS and Parkinson's disease. Her scientific publications span molecular biology, biochemistry, neurophysiology and behavior often using rodent models of human brain disease. Evaluations of the brain limbic system are a theme of this research. Professor Napier pioneered studies of dopaminergic transmission within the ventral pallidum and the

neuroplasticity of this system during chronic drug exposure. In 1990, she spearheaded an international conference titled "The Basal Forebrain: Anatomy to Function", the proceedings of which were published in a book of the same title in 1991 (Editors: T.C. Napier, P.W. Kalivas and I. Hanin). These proceedings were the first compilation of reviews from the world's experts on the topic and helped forward decades of research. The current conference "Network Architecture of Forebrain Systems: Anatomy to Function" echoes this theme, illustrating the continued critical need to understand these systems in order to understand the complexities of normal and dysregulated behavior.

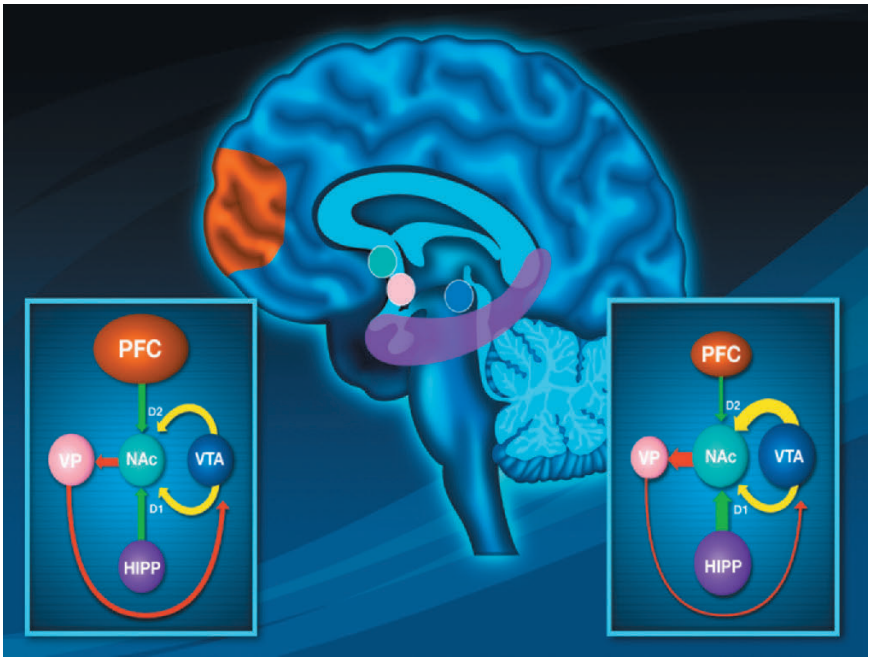


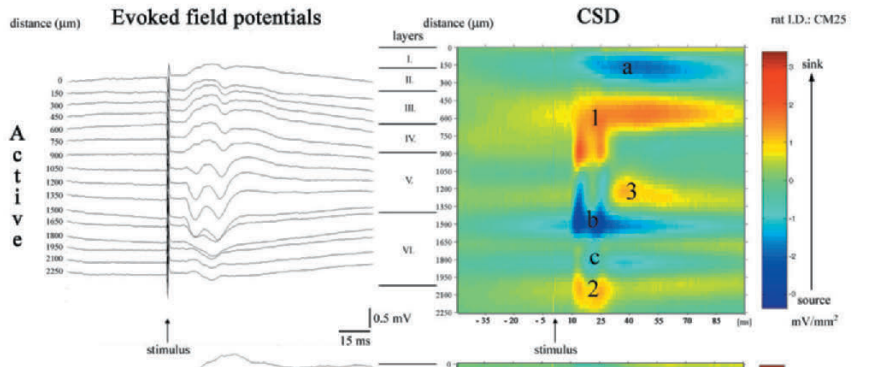
Illustration of limbic neuro-adaptations that involve the ventral pallidum (VP). Glutamatergic projections are green, GABAergic are red, and dopaminergic are yellow. Left, diagram of the normal system. In the adapted system (right) disruption of the gating balance between D1/D2 receptors in the nucleus accumbens (NAc) acts to enhance hippocampal (HIPP) drive. This promotes the NAc GABAergic inhibition of the VP, which attenuates the ability of the VP to reduce ventral tegmental area (VTA) neuronal activity. This scenario promotes HIPP-mediated attention focus and reduces prefrontal cortex (PFC) inhibitory control over reward-motivated behaviors.

Figure from: *Linking neuroscience with modern concepts of impulse control disorders in Parkinson's disease.* Napier, Grace et al.,
Mov. Disorders, in press, 2014.

László Détári

László Détári, PhD, DSc
Professor, Department Head of Physiology and Neurobiology
Eötvös Loránd University, Budapest

László Détári graduated from Eötvös Loránd University (ELTE) as a research biologist in 1975. He joined the staff of the Department of Comparative Physiology (now Department of Physiology and Neurobiology) in the same year. He received his "Doctor of University" title at ELTE in 1978, then the degrees awarded by the Hungarian Academy of Sciences (HAS): "Candidate of Sciences" in 1993, and the "Doctor of HAS" in 2006. László Détári is a full professor at ELTE, he is Department Head of Physiology and Neurobiology since 2000, and from this time he also leads the Master of Sciences program "Neuroscience and Human Biology" for biology students, and the PhD program with same name. He was a member of the Faculty Council from 1997 to 2007 and served as Vice Dean for Financial Affairs from 2005 to 2012 at the Faculty of Sciences of ELTE. He also was a member of the Executive Board of Hungarian Neuroscience Society from 2005 to 2013. Since his graduation, he was involved in sleep research. His research interest turned toward the basal forebrain in 1978 as a potential regulator of slow wave sleep. He published two, widely cited papers on neuronal activity of basal forebrain neurons during the sleep-wake cycle in cats in 1984 and 1987, and then moved to London, Ontario to work with Case Vanderwolf. The basal forebrain cholinergic system became a very hot topic at this time, as it was shown that the activating cholinergic innervation of the forebrain is provided almost exclusively from this area, and these neurons deteriorate in Alzheimer's disease. However, basal forebrain was also one of the best candidates for the sleep center role. László Détári and Case Vanderwolf proved that activity of cortically projecting neurons, at this time believed to be exclusively cholinergic, is strongly correlated with cortical activation. After a short stint in Leiden, The Netherlands, where he examined with Joke Meijer and Tom DeBoer the multiunit activity of neurons in the suprachiasmatic nucleus and its interaction with the sleep-wake cycle in freely-moving rats, he went to Halifax, Nova Scotia to examine the brainstem influence on basal forebrain cholinergic cells with Kazue Semba. Finally, he participated as the Hungarian PI in a consortial grant to László Záborszky, Newark, New Jersey, aimed to show the effects of circumscribed stimulation of neurons in the basal forebrain on cortical activity. His present research interest is the generation and function of the slow cortical rhythm.



Averaged evoked FPs (n=50; left) from the hindlimb area of the SI and their corresponding CSD profiles (right) in case of active state stimulation. Data presented here are derived from a representative rat. In the middle, cortical layers are marked with numbers while lines indicate the borders of the layers. Stimulus arrived at 0 ms. Sinks are marked by numbers (1–3) while sources marked by letters (a–c). (Tóth et al., Brain Res. 1226 (2008):99-110)

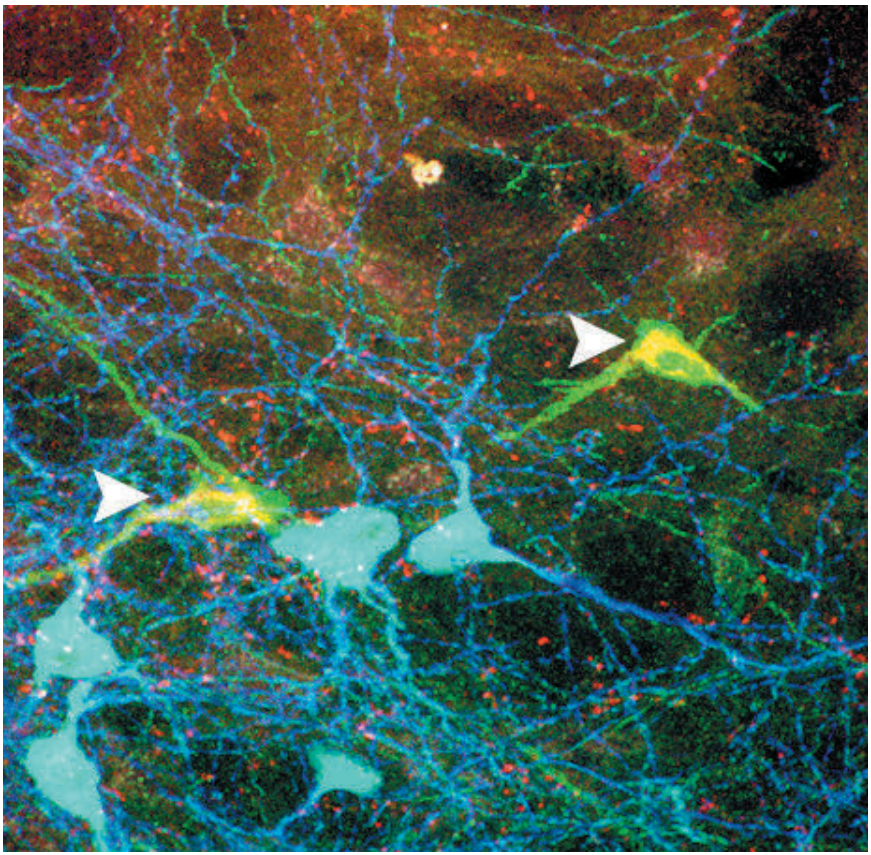
Kazue Semba, PhD
Professor of Medical Neuroscience, Psychology & Neuroscience, and Psychiatry at Dalhousie University, Halifax, Nova Scotia, Canada

After foundation years in Japan, she received her PhD in Psychobiology from Rutgers University (Institute of Animal Behavior) in Newark, NJ in 1979. Her lifelong research question has been how behaviours are generated by networks of neurons. Thus, her early work was on behavioural functions of neuronal synchronization, such as hippocampal theta rhythms.

After conducting some pioneering work on the central cholinergic system at the University of British Columbia in Vancouver, Dr. Semba moved in 1989 to Dalhousie University in Halifax, where she started her primary research on the neurobiology of sleep. Recognized as an

authority on the neuroanatomy of sleep/wake systems, Dr. Semba made important contributions to understanding the roles of cholinergic neurons in sleep and wake states, and to elucidating the anatomical link between the circadian and sleep/wake systems. Dr. Semba then turned her focus to chronic sleep loss, a common problem in modern societies, and her work using a novel rodent model of chronic sleep restriction has revealed a cascade of neurobehavioural and physiological responses, some with long-term consequences to health. Most recently, she started pioneering work on the role of astrocytes in the synaptic plasticity involved in sleep regulation.

When she is not working in the lab, Dr. Semba enjoys playing violin in string quartets and orchestras.

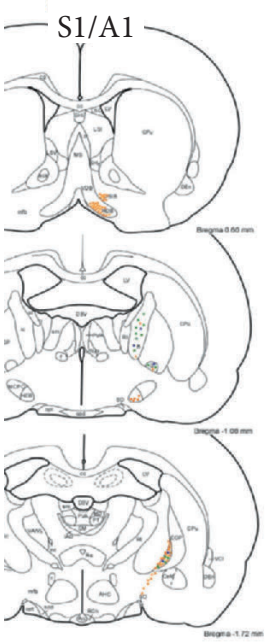


Some cholinergic neurons (green) in the basal forebrain contain vesicular glutamate transporter-3 (VGLUT3, red) [arrowheads, yellow]. Many of these neurons project to the basolateral amygdala, and are distinguished by the absence of low affinity p75 nerve growth factor receptors (blue), which is present in most cholinergic neurons [light blue]. (Adapted from: Nickerson Poulin et al. J Comp Neurol 498:690, 2006)

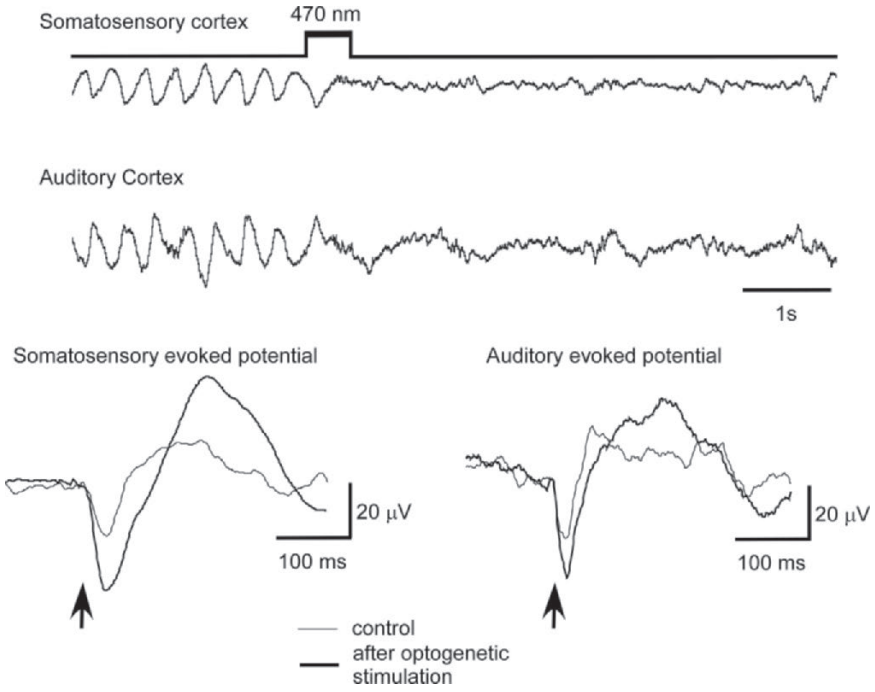
Angel Nuñez

Angel Nuñez, MD, PhD
Professor of Cell Biology,
Universidad Autonoma de Madrid, Director of the Anatomy, Histology and Neuroscience Department, Universidad Autonoma de Madrid

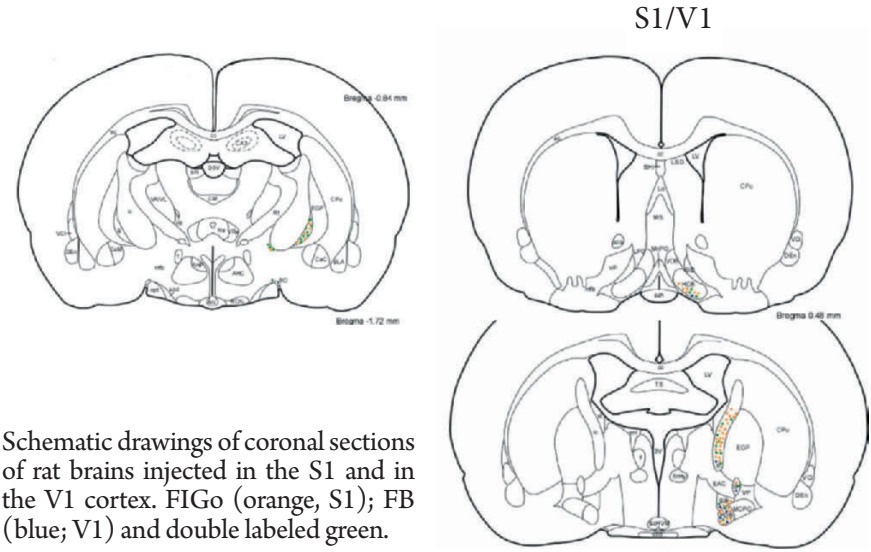
His research interests include the sensory processing in the somatosensory pathway and its modulation by attentional processes and the grow factor IGF-I. His work with Professor Steriade and colleagues has contributed to our understanding of the thalamo-cortical networks that underlie the generation of delta waves in the EEG. At present, his work focuses on the cholinergic mechanisms that modulate cortical responses by cholinergic projections from the basal forebrain in anesthetized rats. The main goal of this project is to deeply understand the anatomo-electrophysiological relationships between the basal forebrain and the prefrontal cortex. He hypothesizes that neurons located in the basal forebrain and in the prefrontal cortex might be interconnected according to specific anatomical pathways in order to increase cortical responses to relevant stimuli; these specific pathways would facilitate specific sensory stimuli but not for all the others. This fact would be essential for sensory processing and selective attention. In addition, he and his colleagues study in vitro the mechanisms of cholinergic modulation of cortical responses. They have demonstrated that ACh modifies the balance excitation/inhibition inducing a switch in the synaptic responses from a single spike to a bursting output mode, which causes a potent and sustained response enhancement with possible consequences for plastic properties and sensory processing in the cortex.



Distribution of retrogradely labeled cells in the BF following injections of FIGo (orange) into the S1 cortex) and FB (blue) into the A1 cortex.



Optogenetic stimulation of the horizontal limb of the diagonal band of Broca induces EEG desynchronization (upper records) and an increase of the sensory evoked potential (lower records) in transgenic mice. Note that the increase is larger in the somatosensory evoked potent

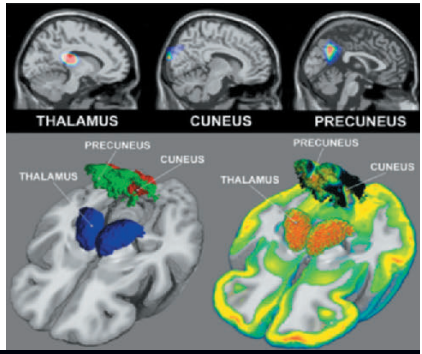


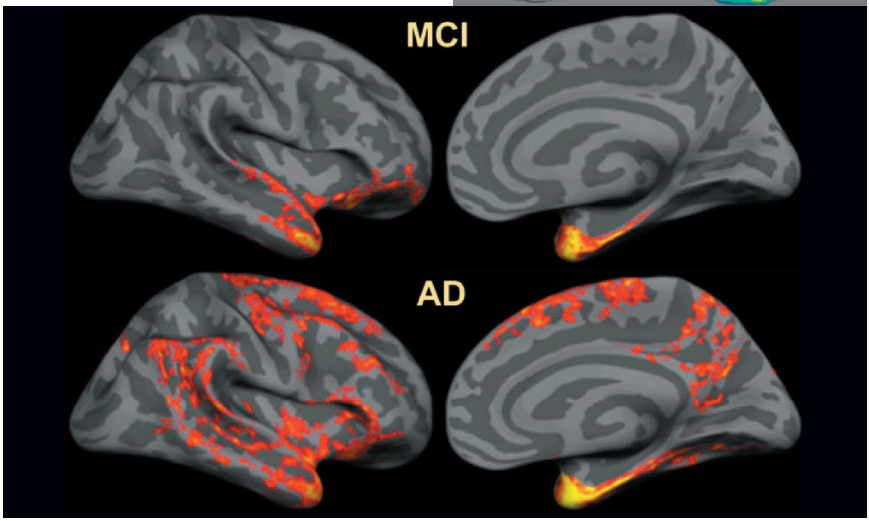
Schematic drawings of coronal sections of rat brains injected in the S1 and in the V1 cortex. FIGo (orange, S1); FB (blue; V1) and double labeled green.

Jose L. Cantero

Jose L. Cantero, PhD
Associate Professor of Physiology
Pablo de Olavide University
Seville, Spain

Jose Luis Cantero is Associate Professor of Physiology at the Pablo de Olavide University (Seville, Spain). Dr. Cantero earned his PhD in Neuroscience from the University of Seville in 1999, and was a research scientist the Laboratory of Neurophysiology, Department of Psychiatry, Harvard Medical School (2000-2002). In 2003, he moved to Pablo de Olavide University in Seville, and founded the Laboratory of Functional Neuroscience (2006) where his work has focused on understanding brain changes occurring during the decade before diagnosis of Alzheimer's disease. His research interests include the study of brain organization during aging and incipient neurodegeneration by exploring anatomical and functional changes, connectivity patterns, and temporal dynamics of neural circuits.





Loreta Medina

Loreta Medina, PhD
Professor of Anatomy & Embryology
Institute of Biomedical Research of Lleida (IRB-Lleida)
University of Lleida
Lleida, Catalonia, Spain

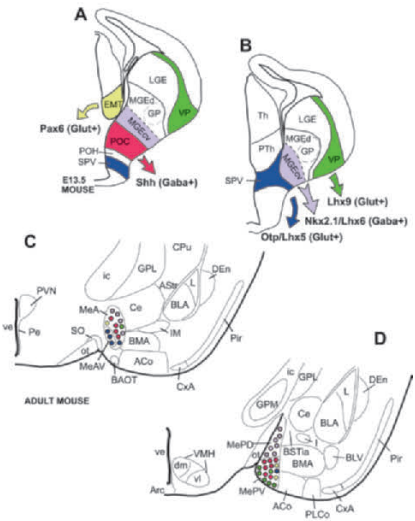
Loreta Medina is a Professor of Anatomy and Embryology at the Department of Experimental Medicine of the University Lleida in Catalonia, Spain. Dr. Medina received her PhD in 1991 (February 2) at the Faculty of Biological Sciences of the University of La Laguna, Tenerife. Her thesis, on the development of the visual system in lizards, was co-supervised by Dr. Carmen M. Trujillo (from the Univ. of La Laguna) and Dr. Wilhelmus J.A.J Smeets (from the Free University of Amsterdam, where Medina did a predoctoral research stay for more than a year). This first period of her career was imprinted by two major facts that change her mind and conditioned her subsequent steps in research: 1) exposure to the ideas on the segmental (neuromeric) organization of the brain, at the time not very popular in the scientific community, by the hand of Dr. Trujillo, but especially Prof. Luis Puelles (from the University of Murcia, Spain), who later became one of the fathers of the prosomeric model (together with Prof. John Rubenstein, from the University of California at San Francisco, USA). This model is now considered mandatory for molecular embryologists around the world, as a framework for understanding the molecular mechanisms that govern forebrain development. 2) Initiation in the comparative neuroanatomy and evolutionary studies of the basal ganglia and related forebrain and midbrain structures, by the hand of Dr. Wilhelmus J.A.J Smeets, from the Free University of Amsterdam, at the time considered a world-wide reference for comparative neuroanatomy studies. The postdoctoral training was done, first at the Univ. of Murcia (eight months) with Prof. Puelles, and then at the Univ. of Tennessee at Memphis, in USA (five years: 1991-1996), with Prof. Anton Reiner, an expert in Basal Ganglia evolution and function. The last two years at the University of Tennessee, Loreta Medina was hired as a Research Associate. During this postdoctoral period, Loreta Medina studied the segmental organization of the cholinergic and catecholaminergic neuronal groups in lizards, chickens and pigeons, applying the neuromeric model for comparative and evolutionary studies. From these studies, it became evident that many of the cholinergic and catecholaminergic brain systems were highly conserved in evolution. Moreover, she carried out immunohistochemical and con-

nectivity studies in pigeons that implied major advances for understanding the anatomical and functional organization, as well as the evolution of the basal ganglia.

By the end of 1996, Loreta Medina went back to Spain and became an Associate Professor at the University of Murcia, at the Department of Human Anatomy and Psychobiology, headed by Prof. Luis Puelles. She also returned to the studies of brain development, now using the recently formulated prosomeric model, and applied this model for understanding brain evolution. She started to analyze the expression and function of developmental regulatory genes in the brain of several vertebrates (the mouse, the chicken, the frog Xenopus laevis), and this was the beginning of her application of an evolutionary developmental biology approach for trying to understand the mechanisms behind the developmental and evolutionary origins of brain complexity. With the time, she became interested in the amygdala, a telencephalic structure essential for emotions and social behavior, which organization and evolution are still largely unknown. This has become a major topic in her research.

From 2000 until 2004, she was part of a Thinktank group that led the discussions for revising the names of many nuclei and areas of the avian brain, and participated in the Avian Brain Nomenclature Forum that took place at Duke University (Durham, NC, USA) in July 2002, and in the highly-cited publications that followed this event. A major outcome was the change in the names of a large part of the avian telencephalon, previously considered part of the basal ganglia (and having the suffix "striatum" in the name), but based on research conducted from the '70s are now considered part of the pallium (cortical-like).

At the end of 2006, she became a Full Professor at the University of Lleida, in north Spain. Here she develops her research at the IRB-Lleida, one of the reference centers in Spain for Health Research, where she is head of a lab of brain development and evolution. In combination with her academical tasks in high education (including teaching in the fields of human anatomy and embryology, and in neuroscience), she has continued her studies on the development and evolution of the amygdala, including the extended amygdala. Her studies have led to a change of paradigm for understanding the origin and organization of different amygdalar neurons, which is helping to understand its implication in so many, multifaceted functions. These studies also provide the basis for a better understanding of amygdalar alteration and dysfunction in many neuropsychiatric disorders.



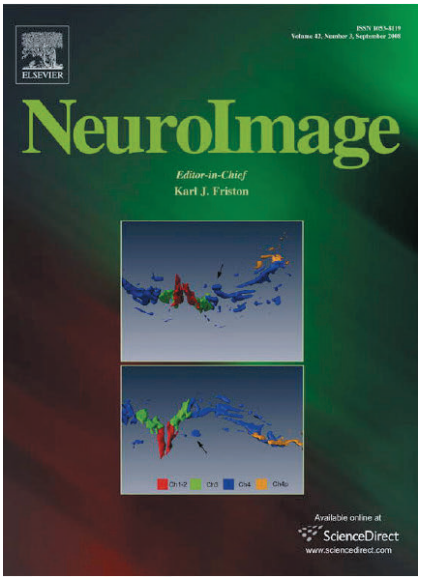
Laszlo Zaborszky

Laszlo Zaborszky, MD, PhD,DSc
Distinguished Professor of Neuroscience
Rutgers University, Newark, NJ., USA
http://zlab.rutgers.edu/

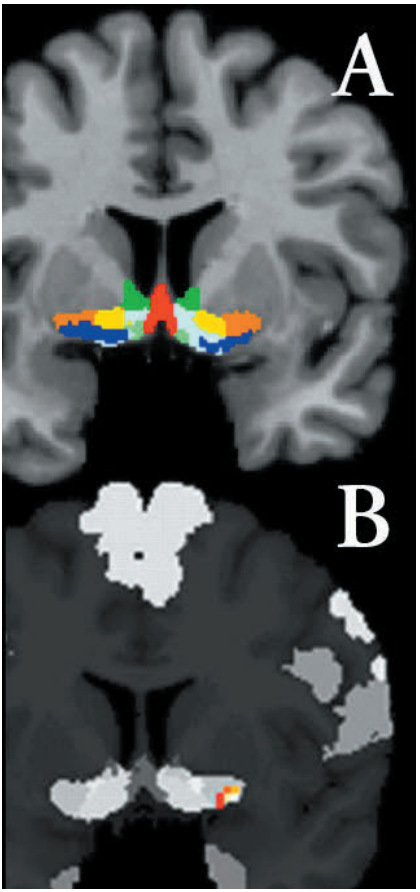
He received his MD at Semmelweis University with Sub Auspicis Rei Publicae Popularis (1970), and earned his PhD (1981) and Doctor of Science from the Hungarian Academy of Sciences (2000). He joined the faculty of the Department of Anatomy, Semmelweis University headed by J. Szentagothai in 1969 where he worked until 1981. He was also Assistant Professor in the Department of Anatomy at the University of Wurzburg, Germany (1973-1974). In 1981 he was invited to join the laboratory of Professor Heimer at the University of Virginia, Charlottesville, where he was appointed Associate Professor of Neurology, with a joint appointment in the Department of Neurosurgery in 1986. Later, he served there as Director of the Laboratory of Cellular and Molecular Neuroanatomy (1992). He moved to the Center for Molecular and Behavioral Neuroscience at Rutgers University in 1993, where he was promoted to Professor with tenure in 2004 and as Distinguished Professor in 2014. He spent short sabbaticals in the Max Planck Institute for Biophysical Chemistry in Gottingen, Germany (1976), in the Montreal General Hospital, Canada (1986), at the National Institute for Physiological Sciences, Okazaki, Japan (2000), in the Vogt Institute for Brain Research in Duesseldorf (2000) and in the Institute of Neuroscience and Biophysics, Research Center Juelich, Germany (2005).

Zaborszky has made important contribution through his pioneering efforts to understand the functional organization of one of the most complex brain areas, the basal forebrain, which contains the cholinergic, cortically-projecting neurons ("nucleus basalis") that deteriorate in Alzheimer's disease. Using a combination of electron microscopy and double immunolabeling techniques, he was the first to identify synaptic inputs to these cholinergic neurons, including catecholaminergic and GABAergic terminals, as well as projections from the cerebral cortex, nucleus accumbens, amygdala and hypothalamus. He developed –in collaboration with Zilles' group in Germany- a postmortem 3D mask of the cholinergic space that allows extracting the volume of the nucleus basalis from MRI scans of living persons to predict progression of Alzheimer's disease. With Dr. Cantero in Spain he provided evidence that neurodegeneration in the nucleus basalis can occur in patients with mild cognitive impairment. Using 3D reconstructions of basal forebrain projection neurons his team at Rutgers University (P. Gombkoto and M. Gielow) focuses on understanding the fundamental structural organization of the basalo-cortical network. In collaboration with several imaging groups he is interested to identify the various functional networks that

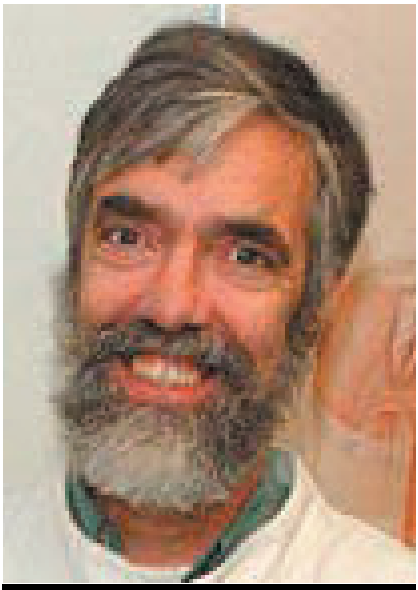
are linked to basal forebrain subcompartments.
Zaborszky also coined the term 'core and shell' to describe the subdivisions of the nucleus accumbens, a forebrain area



important in drug addiction and reward mechanism. His work has profound implications in the field of the neural basis of attention as well as for such disorders as Alzheimer's disease, Parkinson's disease and schizophrenia.
He is co-editor of the text books Neuroanatomical Tract-Tracing Methods 2 (Plenum, 1989 with L. Heimer) and Neuroanatomical Tract-Tracing 3: Molecules, Neurons, Systems (Springer, 2006 with F. Wouterlood and J. Lanciego). He is Founding Editor-in-Chief, Brain Structure and Function (www.springer.com/429). He advised more than 50 Undergraduate, Graduate Students and Postdoctoral Fellows.
His research is supported by the National Institute of Neurological Disorders and Stroke (NIH) since 1986. He was awarded Dr. Habil from Semmelweis University (2004) and was elected foreign member of the Hungarian Academy of Sciences (2007). In 2013 he received the "Arany Janos" award from the Hungarian Academy of Sciences and the "Knight's Cross, Order of Merit of the Republic of Hungary". He is President of the New York Hungarian Scientific Society (http://nymtt.org).



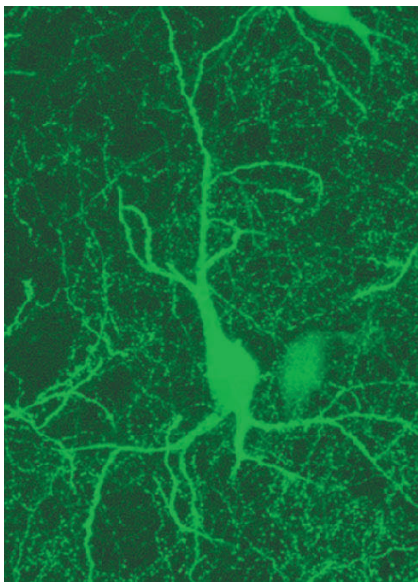
A: maximum probability maps of BF structures. Red: Ch1-2 cell group; dark blue: Ch4; green: bed n. of the stria terminalis; yellow: ventral pallidum; light blue: n. accumbens; orange: fundus.
B: BF activations in a rapid visual information processing task. Colored clusters show significant activation (T>3.92) within BF regions of interest (unpublished observation).

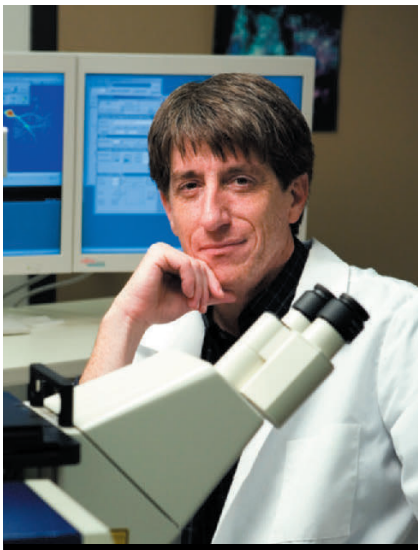


Floris G. Wouterlood

Floris G. Wouterlood, PhD
Associate Professor of Anatomy
Vrije Universiteit Medical Center
Amsterdam, the Netherlands

Floris Wouterlood is Associate Professor of Anatomy at the Department of Anatomy & Neurosciences, Vrije University Medical Center Amsterdam, The Netherlands. Dr. Wouterlood conducted research for his PhD thesis on the subject of craniofacial development in chick and duck embryos. After earning his PhD in 1977 he switched to Neuroscience, building up expertise in various neuroanatomical tracing techniques at the electron microscope level. These techniques, and various double staining procedures at the light and electron microscopic level, were implemented in work on neuronal network analysis in the parahippocampal-hippocampal system and, more recently, in work on striatonigral and mesostriatal connectivity. Most recently he started with fourth-generation tracing methods that exploit transgenic animals. The methodological and technical aspects of neuroscience have received his continuous interest. This has resulted in numerous papers in technical scientific journals. He co-authored one of the volumes of the Handbook of Chemical Neuroanatomy (Björklund, Hökfelt, eds) and later 'Neuroanatomical Tract Tracing III' (Zaborszky, Lanciego, Wouterlood, eds). Recently he edited ' Cellular Imaging techniques in Neuroscience and Beyond (2012). He has served in several editorial boards, and is currently member of the Editorial board of the Journal of Neuroscience Methods. The illustration is a confocal image of a large, GFP expressing cholinergic striatal interneuron in a transgenic mouse.

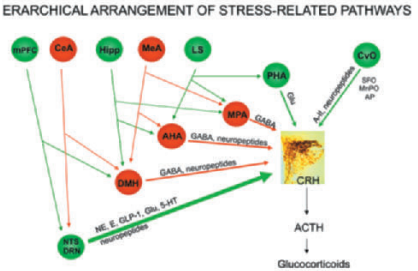




William E. Cullinan

William E. Cullinan, Ph.D.
Professor of Biomedical Sciences
Director, Integrative Neuroscience Research Center
Dean, College of Health Sciences
Marquette University

Bill Cullinan is a Professor of Biomedical Sciences and Dean of the College of Health Sciences at Marquette University in Milwaukee, WI. Dr. Cullinan received his Ph.D. in 1990 from the University of Virginia in the laboratory of the late Dr. Lennart Heimer, working under Dr. Laszlo Zaborszky. His thesis work helped to define the organization of afferents to basal forebrain cholinergic projection neurons. He subsequently did postdoctoral research with Drs. Stanley J. Watson and Huda Akil at the University of Michigan from 1990-95, focusing on regulation of the hypothalamic-pituitary-adrenocortical axis in response to acute and chronic stressors. In 1995 he took a faculty position at Marquette University, where he developed a research lab focusing on neurotransmitter-specific inputs to hypophysiotropic CRH neurons, including pathways mediating corticosteroid feedback inhibition of the stress response. This work also disclosed a local hypothalamic GABAergic network that is engaged following multiple classes of stressors. His laboratory utilizes integrated technical approaches, including combinations of anterograde and retrograde neuroanatomical tract-tracing methods, immunocytochemical and hybridization histochemical techniques, in vivo pharmacology, as well as biochemical, behavioral, molecular biological, and molecular surgical approaches. The focus of this work has been to better understand the link between stress and neuropsychiatric illness, and has included characterization of the chronic variable stress model of depression. More recently his laboratory team has explored the use of deep brain stimulation in an animal model of depressive illness.



In 2001 Dr. Cullinan established the Integrative Neuroscience Research Center (INRC), an affiliation of over 30 university faculty members that serves to promote the exchange of ideas among neuroscientists, increasing opportunities for collaborative research, acquisition of resources, attraction of high quality faculty and students, and strengthening of educational offerings. Dr. Cullinan also teaches courses in anatomy, neuroanatomy and neuroscience to undergraduate and graduate students,

as well as to medical and dental students and medical residents. He received the university's Faculty Award for Teaching Excellence in 2002, and the John P. Raynor Professorship in 2006. In 2007 he assumed the role of dean of the College of Health Sciences. For nearly 20 years, he has directed a three-day summer neuroanatomical dissection course that features the blunt dissection technique popularized by Lennart Heimer in the 1980's.

Marisela Morales

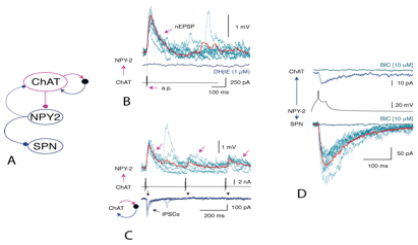
Marisela Morales, MS, PhD
Chief of the Integrative Neuroscience Research Branch
Chief of the Neuronal Networks Section in the National Institute on Drug Abuse

Marisela Morales is a Senior Investigator in the Intramural Research Program at the National Institute on Drug Abuse in the National Institutes of Health. As an undergraduate and graduate student she was trained in the fields of Biochemistry, Molecular and Cell biology, and she received her Ph. D. from the Institute of Experimental Biology in Guanajuato, Mexico. Her earlier research used high resolution imaging to investigate cytoskeletal proteins that participate in the dynamic changes of neurons. During these investigations she discovered that myosin and MAP-2 associate with actin in dendritic spines. More recently, she has been investigating the molecules, cells and neuronal pathways central to the neurobiology of drug addiction through use of anatomical, biochemical, cell biological and electrophysiological approaches. The primary questions to be addressed by her research include: (a) what is the brain circuitry through which addictive drugs have their habit-forming actions and (b) what neuro-adaptations of this circuitry accompany the transition from recreational to compulsive drug-taking. Clinical observations and results from animal models indicate that behaviors associated with intake of drugs of abuse are affected by stress. However, the neuronal pathways, neurons, and neurotransmitters that mediate interactions between stress and drugs of abuse are not well characterized. Recently, work from her laboratory has provided evidence indicating synaptic connectivity between the reward and the stress systems at the level of the ventral tegmental area (VTA), through glutamatergic innervations containing the CRF protein. In search for the origin of CRF afferents to the VTA, her group discovered glutamatergic signaling neurons in the VTA. In 2004, Dr. Morales received the Presidential Early Career Award for Scientists and Engineers (PECASE Award) and in 2008 the NIDA Director's Award of Merit.

Tibor Koos

Tibor Koos, PhD
Associate Professor
Rutgers University, Newark, NJ, USA

Currently I am concentrating on 2 main projects that address different aspects of the functioning of the basal ganglia. One of these concerns the mechanism of action of midbrain dopamine neurons in the neostriatum. Confirming and extending the findings of others, we demonstrated that those midbrain dopamine neurons also release glutamate in the nucleus accumbens. Our results indicate that the postsynaptic ionotropic glutamatergic responses are probably too small to control the firing rate of projection neurons, and therefore glutamatergic signaling is more likely to play pre- and/or postsynaptic modulatory roles. The second major project addresses the organization of striatal interneurons. Neostriatal interneurons have not been traditionally considered as important as the GABAergic neurons of cortical circuits and until recently it has been very difficult to determine even their basic electrophysiological and anatomical properties. With the advances of molecular biology it has become clear that the striatal circuit incorporates a large variety functionally distinct interneurons. Moreover, recent work by our lab and others clearly demonstrate that these neurons are important for the function of the striatum. For the first time we are able to analyze in detail the circuit organization, intrinsic properties and in vivo functional role of these neurons. We are employing both in vitro methods including simultaneous recording from genetically identified synaptically connected neurons, single cell RT-PCR characterization and optogenetics, as well as in vivo tetrode recordings from optogenetically identified interneurons in behaving mice.



In vitro characterization of a striatal microcircuit. Synaptic interactions of 3 simultaneously recorded striatal neurons, a cholinergic (ChAT) a neurogliaform (NPY-NGF) and a projection neuron (SPN, A). The ChAT interneuron elicited nicotinic EPSPs in the NGF neuron (B), an triggered recurrent IPSCs in itself through activation of as yet unidentified interneurons (C). The NGF elicits slow GABAergic IPSC in the SPN (D).

Jose L. Lanciego

José L. Lanciego, MD, PhD
Associate Professor of Neurosciences
Director, Basal Ganglia Neuroanatomy Laboratory
Center for Applied Medical Research
University of Navarra, Pamplona, Spain

José L. Lanciego is a Staff Scientist at the Center for Applied Medical Research, and an Associate Professor of Neurosciences at the University of Navarra, Pamplona, Spain. Originally trained as a Medical Doctor (University of Salamanca, June 1990), he received his PhD in Neurosciences with honors at the University of Salamanca in October 1994. Later on he joined the Department of Anatomy at the Amsterdam Vrije Universiteit, as a postdoctoral fellow under the supervision of Dr. Floris G. Wouterlood (1992 and 1996), with a main focus on neuroanatomical tract-tracing techniques. In February 1997 he moved to the University of Navarra to be engaged in different studies dealing with the neurobiology of Parkinson's disease. At present he is head of the Basal Ganglia Neuroanatomy Laboratory. His recent research interests include a number of projects dealing with the pathophysiology of Parkinson's disease using non-human primate models. Recently his work has focused on the screening of a number of G-protein-coupled receptor heteromeric complexes across the basal ganglia in macaques, as well as a number of gene therapies approaches for Parkinson's disease. He is co-editor of the third edition of Neuroanatomical Tract-Tracing Methods, Associate Editor of Frontiers in Neuroanatomy as well as a member of the Editorial Board of Brain Structure and Function. He is a member of the Society for Neuroscience and the Spanish Society for Neurosciences.

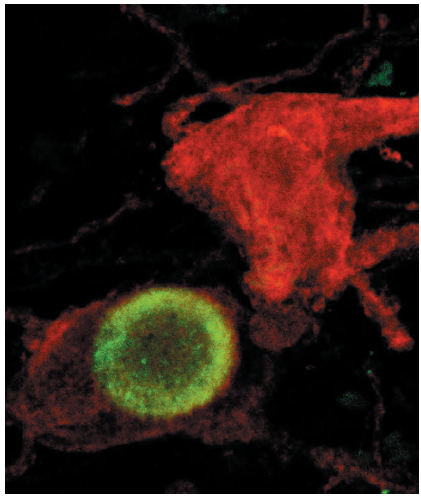
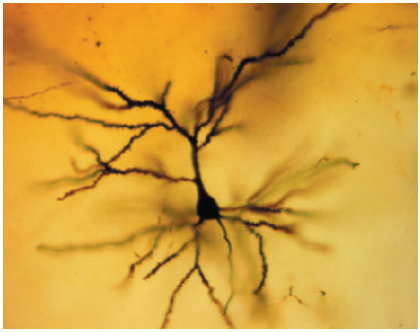
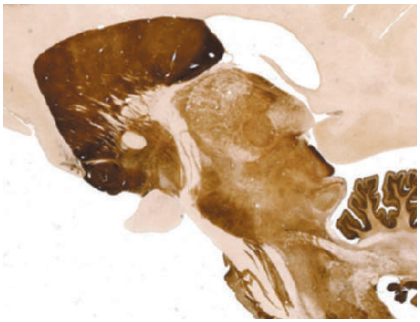


Figure "Lewy_Body": Human substantia nigra in Parkinson's disease. Dual immunofluorescent detection of tyrosine-positive dopaminergic neurons (red channel) and a-synuclein (green channel). The presence of a-synuclein intracellular aggregates known as Lewy bodies represents the neuropathological hallmark of Parkinson's disease.



"Golgi_LayerIII": Layer III pyramidal neuron from the rat auditory cortex stained with the Golgi-Colonnier method. (**Lanciego**)



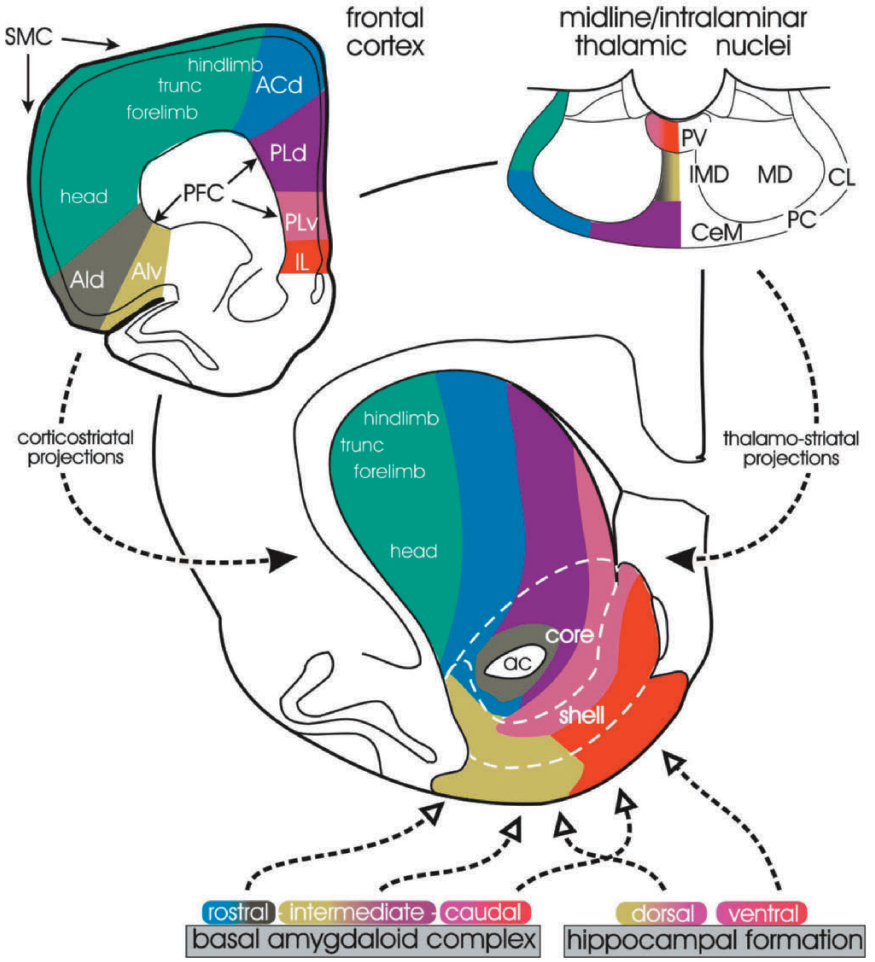
"AChE_sagittal": Sagittal section through the basal ganglia and thalamus of the macaque brain as stained with acetylcholinesterase.

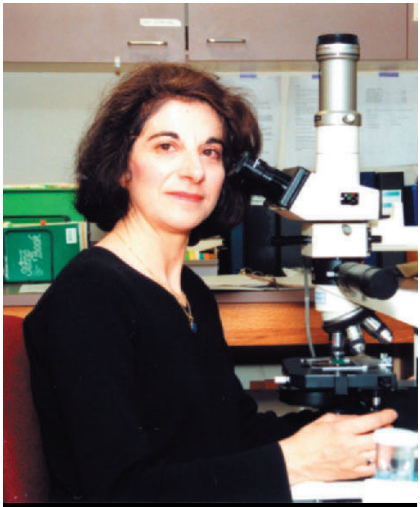
Henk J. Groenewegen

Henk J. Groenewegen MD, PhD
Professor of Anatomy
VU University Medical School
Amsterdam, The Netherlands

Henk Groenewegen is a Professor of Anatomy at the department of Anatomy and Neurosciences of the VU University Medical Center (VUmc) in Amsterdam. Dr. Groenewegen received his MD and PhD in 1978 at the faculty of Medicine of Leiden University. His thesis was on the olivocerebellar system in cats, using the at that time newly developed anterograde autoradiographic tract tracing technique. It showed for the first time experimentally that cerebellar climbing fibers originate from the inferior olive, although the fibers and terminals were still only visible as 'footprints' in the emulsion overlying the tissue. In the early '80s Henk Groenewegen spent a year as visiting scientist at MIT in the department of Psychology of Professor Walle J.H. Nauta where he studied, using anterograde and retrograde tracing techniques, the connections of different brain regions like the mediodorsal thalamus, the ventral striatopallidal system and the interpeduncular nucleus. Back at the VU University in Amsterdam he followed his main interest in unravelling the anatomical and functional organization of forebrain circuits involved in cogni-

tion, emotion and motivation. The focus of his research team has been on the prefrontal cortex – basal ganglia circuits in experimental animals and, in more recent years, also in humans using functional brain imaging techniques. The focus of the department has shifted from a purely functional-neuroanatomical approach to more translational approach in which neuropsychiatric diseases like Parkinson's disease and obsessive-compulsive disorder are the subject. From 1993 till 2013 Henk Groenewegen has been head of the department of Anatomy and Neurosciences VUmc and during the last 10-15 years research time has been rather sparse as a consequence of managerial tasks and teaching obligations. However, teaching in an academic environment with enthousiastic young people is highly motivating! The youth has the future and taking part in their education is very rewarding.



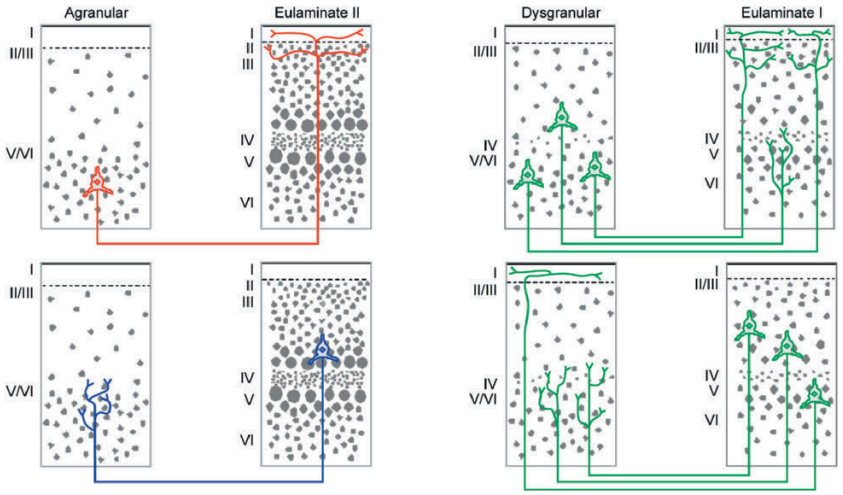


Helen Barbas

Helen Barbas, PhD
Professor Boston University
Boston, MA, USA
Lab website: http://www.bu.edu/neural/
e-mail: barbas@bu.edu

Helen Barbas studied neuroscience at McGill University (Ph.D, neurophysiology) and at Harvard Neurological Unit (postdoctoral, neuroanatomy), Beth Israel Hospital, before moving to Boston University and School of Medicine, where she is now Professor, and affiliated scientist at NEPRC, Harvard Medical School. She has established and directs the Neural Systems Laboratory at Boston University, funded by grants from the National Institutes of Health (NINDS and NIMH), the National Science Foundation, and Autism Speaks. Her research focuses on the prefrontal cortex and the pattern, organization and synaptology of cortical and subcortical pathways with excitatory and distinct classes of inhibitory neurons. Experiments are conducted within a conceptual framework – the structural model that helps predict patterns of connections. The goal is to understand the organization of prefrontal circuits associated with cognitive, mnemonic and emotional processes in primates and their disruption in psychiatric diseases.

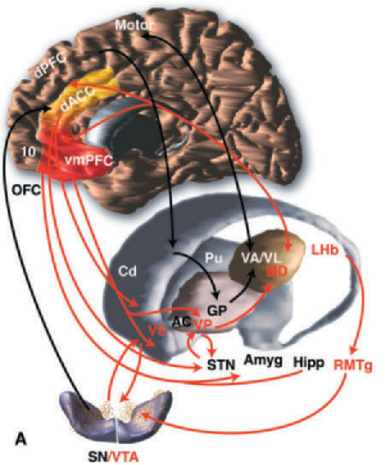
The structural model for connections

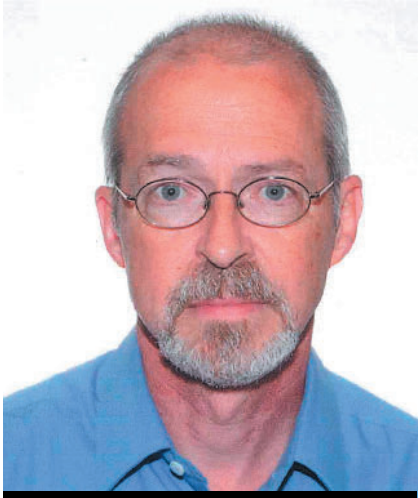


Susanne Haber

Suzanne Haber, PhD
Professor,
Department of Pharmacology and Physiology
University of Rochester School of Medicine and Dentistry, Rochester, NY

Dr. Haber grew up in Rochester NY. She went to College at Kent State University. She worked for several years before deciding to go back to school in Neuroscience. Following her Ph.D. from Stanford in 1978, Dr. Haber did her post-doctoral work, first in the laboratory of Dr. Bob Elde and then with Dr. Walle Nauta at MIT. Dr Haber's laboratory focuses on the neural network that underlies reward and decision-making leading to the development and execution of action plans. At the center of this network lies the cortico-basal ganglia (BG) circuit. Overall, cortico- basal ganglia circuits are traditionally thought to process information in parallel and segregated functional streams consisting of limbic (motivational), associative (cognitive), and motor control circuits. However, key learning, adapting, and optimizing goal-directed behaviors is the ability not only to evaluate different aspects of reward, but also to develop appropriate action plans and inhibit inappropriate choices on the basis of previous experience. This requires integrating different aspects of reward processing, and interaction of reward circuits and brain regions involved in cognition and motor control. Dr. Haber's work demonstrates the complexity of the cortico-basal ganglia network, showing a dual organizational system that permits both parallel and integrative processing. These results are particularly important for understanding the mechanism that underlies the effectiveness of innovative treatments such as deep brain stimulation for neurological and psychiatric disorders. Dr. Haber's laboratory combines state of the art anatomical techniques with computer modeling to render 3-D atlases of pathways and terminals fields from specific cortical and basal ganglia structures. In collaboration with several other groups, similar models are being developed for rodent, (rats and mice), and human brains. As part of our Conte Center, these models are being used to predict the pathways affected by deep brain stimulation, for psychiatric disorders at various stimulation sites. More recently, we have combined our anatomical studies with diffusion imaging in monkeys and humans to understand white matter abnormalities observed in psychiatric diseases.





Menno P. Witter

Menno P. Witter, PhD
Professor of Neuroscience, Kavli Institute, for Systems Neuroscience, Center for Neural Computation, Norwegian University of Science and Technology (NTNU), Trondheim, Norway

He received his Ph.D. at the VU University in Amsterdam, The Netherlands, where he subsequently started his independent research on the anatomical organization of the hippocampal region. He became full professor and served as director of The Institute for Clinical Neuroscience at the VU University Medical School in Amsterdam. In his early work, he postulated the existence of functional differentiations within both the hippocampus and the entorhinal cortex. He joined May-Britt and Edvard Moser as professor at the Kavli Institute for Systems Neuroscience in 2007, continuing a productive collaborative period leading to the discovery of grid cells in the entorhinal cortex in 2005. His current work focusses on the functional anatomy of the lateral and medial entorhinal cortex. His group also works on the mechanisms of Alzheimer's disease, using animal models. He was recently elected a boardmember of the Norwegian Health Association's Dementia Research Program. He is the initiator and director of the Norwegian Research School in Neuroscience and an elected member of the Royal Norwegian Society of Sciences and Letters, and The Norwegian Academy of Science. For more information go to http://www.ntnu.edu/employees/witter

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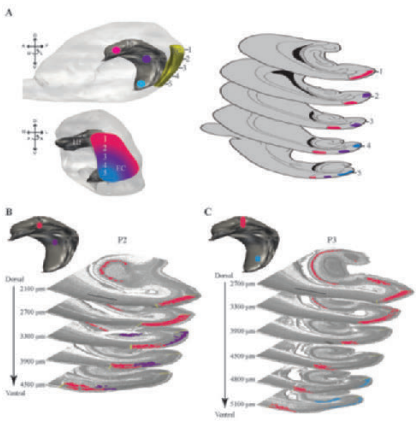
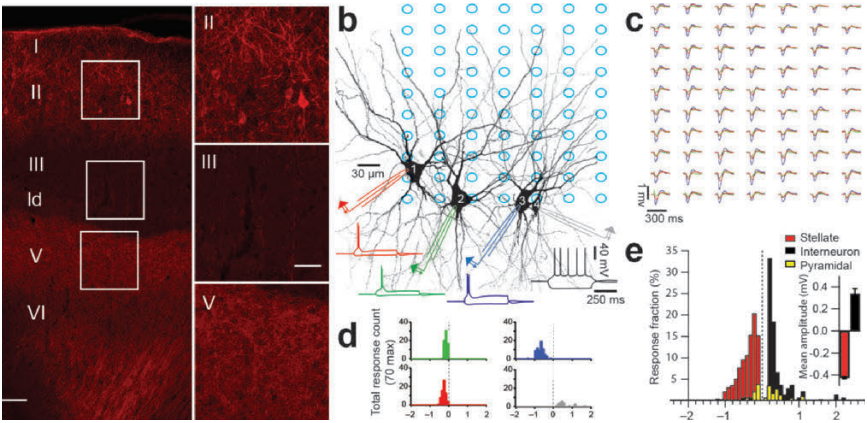
The topography of neonatal EC-to-HF projections is adult-like. In the adult brain projections from EC to HF are topographically organized. Bands of cells along a dorsolateral-to-ventromedial axis in the EC show a topographical projection pattern to dorsal, via intermediate and ventral levels of HF respectively. A) A cartoon representation of the location of hippocampal projection cells in EC in a P3 rat brain if the topography of the projections were similar to the adult connectivity. The three injection



illustrated in the figure on the top left would result in retrogradely labeled cells distributed in bands over the surface of the entorhinal cortex (bottom left). The right side figure displays five representative horizontal sections, numbered 1-5. B and C show examples of adult-like labeling pattern in EC resulting from injections into HF along the dorsal-ventral axis. B) A Neurolucida reconstruction of labeling in EC from a dorsal injection (FG) and an intermediate injection (FB) into ipsilateral HF in a P2 rat pup (see also Figure 3A). C) Neurolucida reconstruction of labeling in EC from ipsilateral injections of FG and FB into the dorsal and ventral HF, respectively, at P3 (O'Reilly et al 2014 Brain Struct Funct epub).



Recurrent inhibitory circuitry among entorhinal stellate cells. a. Injections of rAAV in the dorsal hippocampus resulted in a substantial number of neurons, dendrites and axons that express mCherry in layer II, while layer III is almost devoid of labeling. Anterogradely mCherry-labeled fibers are visible in layers V and VI. Scale bar: left panel equals 300 µm; right panels equals 60 µm. b. Stimulation protocol illustrating the 70 laser point stimulation foci (blue circles) for a cluster of layer II cells (posthoc biocytin filled). Whole cell responses to hyperpolarizing and depolarizing steps illustrate the clear firing properties of stellate (cells 1, 2 and 3; red, green, and blue respectively) and a non-stellate putative pyramidal cell (cell 4; grey). Scale bars: 40mV/250ms. c. Normalized mean responses recorded in the three stellate cells in response to the light pulses at each stimulation point (traces are color coded as in b. Scale bars: 1 mV/300 ms. d. Amplitudes for the four cells in b (same color code) showing absence of excitation in the three stellate cells (cells 1, 2, and 3; the pyramidal (cell 4) showed excitatory responses). e. Left panel. Excitatory amplitudes in all fast-spiking putative interneurons (black), responses in all pyramidal cells (yellow), and inhibitory amplitudes in all stellate cells (red; normalized distribution of the recorded responses; bin size = 0.25mV; zero fractions not shown: 22% FS, 2% Stellate, 80% pyramidal; dashed vertical line indicates zero.). Right panel. Responses in FS and stellate cells (Couey et al 2013, Nat Neurosci. 16:318-324).

Gábor Tamás

Gábor Tamás, PhD
Professor of Neuroscience,
University of Szeged, Hungary

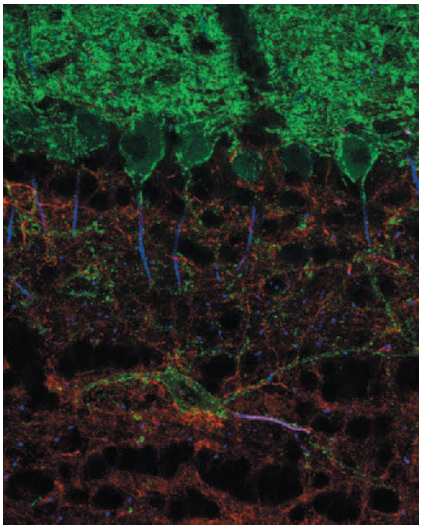
He started his neuroscience studies in the laboratory of Profs. Peter Somogyi and Eberhard Buhl at the University of Oxford and defined the effect, number and location of synapses between neocortical neurons.

This work also revealed that certain types of cortical neurons could control themselves by establishing autapses between their axons and the parent soma/dendrites. When establishing a laboratory in Szeged, he developed a combined electrophysiological and neuroanatomical approach to study the interactions between neurons of the cerebral cortex and identified an intercellular mechanism capable of synchronizing neurons at gamma frequency. He received training from Prof. Rafael Yuste at Columbia University in two photon and high speed confocal imaging and the collaboration revealed that dendrites of interneurons consist of Ca2+ microdomains separating individual synapses. He applied standardized procedures in his laboratory in order to develop a library of specimens currently containing >14000 functionally connected pairs of neocortical neurons recorded and archived for correlated light and electron microscopy. This unique dataset allows the analysis of rare cell types or connections in the cortex and was essential in discovering the first type of interneuron, the so-called neurogliaform cell, capable of eliciting slow, GABAB receptor mediated inhibition in the cerebral cortex. Moreover, his group demonstrated that axo-axonic cells, which were considered as the most specific inhibitory neurons, are not only inhibitory but also function as the most powerful excitatory neurons of the cerebral cortex. This was the first study for which the group successfully performed multiple patch clamp recordings in slices taken from the human cerebral cortex in collaboration with Prof. Pál Barzó (University of Szeged). The dataset concerning synaptic interactions of human neurons also showed that single neurons are capable of activating Hebbian networks in the human cerebral cortex. His group went on explaining the function of neurogliaform cells and revealed that this cell type uses GABA for a single cell driven form of nonsynaptic or volume transmission for the modulation of the surrounding microcircuit. The group recently found that insulin is expressed and released by neocortical neurogliaform cells linking GABAergic and insulinergic action in cortical microcircuits. Gabor Tamas is a member of the Academia Auropaea and the Hungarian Academy of Sciences.

Zoltán Nusser

Zoltán Nusser, PhD
Institute of Experimental Medicine, Hungarian Academy of Sciences, Budapest, Hungary

Zoltan Nusser was born on in Bonyhád, Hungary where he received his primary and secondary education. Following his graduation in 1992 from the Veterinary School in Budapest, he was admitted to the University of Oxford and enrolled to the Hertford College as a graduate student. His aim was to understand how nerve cells communicate with each other through chemical synapses. He developed a novel quantitative, electron microscopic immunogold localization technique to reveal the precise subcellular location of neurotransmitter receptors and to be able to tell how many of them are in certain synapses. He completed his thesis in 1995 with the title 'Localisation of amino acid neurotransmitter receptors in the hippocampus and cerebellum' and received the Doctor of Philosophy (D.Phil.) degree. In 1996, he spent a year in the laboratory of Prof. Stuart Cull-Candy, at the Department of Pharmacology, University College London where he received training in cellular neurophysiology. Between 1998 and 2000, he was a Wellcome Prize Travelling Research Fellow in the laboratory of Prof. Istvan Mody at the Department of Neurology, University of California Los Angeles. During these years, he furthered his understanding of synaptic communication by studying the brain with in vitro patch-clamp techniques and computer modeling. In 2000, Dr Nusser returned to Hungary to establish his independent research group in the Institute of Experimental Medicine, Hungarian Academy of Sciences, Budapest. His research interest focuses on how information is coded, processed, transmitted, and stored by synaptically interconnected nerve cells. He is primarily interested in understanding synaptic neurotransmission and signal integration in nerve cells.



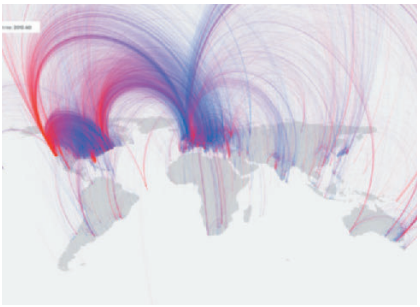
Immunofluorescent localization of the a1 subunit of the GABAA receptor (green), the Nav1.6 subunit of voltage-gated Na+ channels (blue) and the Kv1.1 subunit of voltage gated K+ channels (red) in the rat olfactory bulb.

Albert-László Barabási

Albert-László Barabási, PhD
Robert Gray Dodge Professor of Network Science
Distinguished University Professor
Northeastern University and Division of Network Medicine, Harvard University, Boston, MA. USA

Albert-László Barabási directs the Center for Complex Network Research at *Northeastern University* and he holds appointments in the Departments of Physics and College of Computer and Information Science, as well as in the Department of Medicine at Harvard Medical School and Brigham and Women Hospital in the Channing Division of Network Science, and is a member of the Center for Cancer Systems Biology at Dana Farber Cancer Institute. A Hungarian born native of Transylvania, Romania, he received his Masters in Theoretical Physics at the Eötvös University in Budapest, Hungary and was awarded a Ph.D. three years later at Boston University. Barabási latest book is "Bursts: The Hidden Pattern Behind Everything We Do" (Dutton, 2010) available in five languages. He has also authored "Linked: The New Science of Networks" (Perseus, 2002), currently available in eleven languages, and is the co-editor of "The Structure and Dynamics of Networks" (Princeton, 2005). His work lead to the discovery of scale-free networks in 1999, and proposed the Barabasi-Albert model to explain their widespread emergence in natural, technological and social systems, from the cellular telephone to the WWW or online communities.

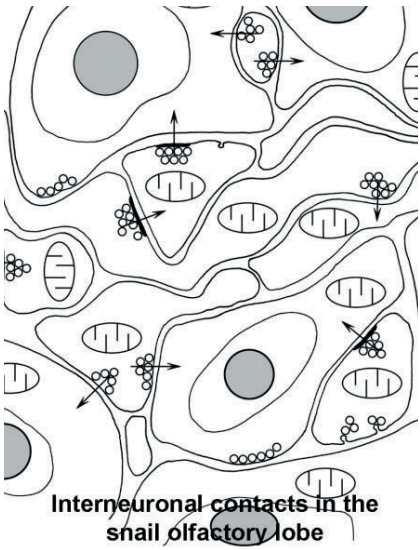
Barabási is a Fellow of the American Physical Society. In 2005 he was awarded the FEBS Anniversary Prize for Systems Biology and in 2006 the John von Neumann Medal by the John von Neumann Computer Society from Hungary, for outstanding achievements in computer-related science and technology. In 2004 he was elected into the Hungarian Academy of Sciences and in 2007 into the Academia Europaea. He received the C&C Prize from the NEC C&C Foundation in 2008. In 2009 APS chose him Outstanding Referee and the US National Academies of Sciences awarded him the 2009 Cozzarelli Prize. In 2011 Barabási was awarded the Lagrange Prize-CRT Foundation for his contributions to complex systems, awarded Doctor Honoris Causa from Universidad Politécnica de Madrid, became an elected fellow in AAAS (Physics) and is 2013 Fellow of the Massachusetts Academy of Sciences.



Károly Elekes

Károly Elekes, PhD, DSc
Professor
Department of Experimental Zoology
Balaton Limnological Institute
Centre for Ecological Research
Tihany, Hungary

Károly Elekes is Head of Department of Experimental Zoology and leader of the Research Group of Chemical Ecology and Neurobiology of the Balaton Limnological Institute of the Centre for Ecological Research in Tihany. At the same time, he is Professor at the Department of Experimental Zoology and Neurobiology at the Faculty of Natural Sciences of the University of Pécs, lecturing on „Model nervous systems". He has obtained his degrees at the Hungarian Academy of Sciences, PhD in 1981, DSc in 1995, the professorship in 1997. In Tihany, he has been keeping a position since 1969 where he also served as Deputy Director in 1990-2010. His and his team's research activity is focused on the functional morphology, synaptology and neurochemistry of invertebrates, with emphasis on the identification of networks underlying different behaviors, for the time being mainly chemical sensation of molluscs. He has spent about five years visiting different laboratories where he also worked on the nervous system of insects and crustaceans, as well as for a year in the 80ies, as an interesting detour, on the brain of weakly electric fish. As a Humboldt-Fellow he has spent 2 years in Germany, Constance, as a fellow of the European Science Foundation a year in France, Gif-sur-Yvette, and also longer times in Sweden, England and the USA. He has fulfilled a number of important positions in the research community, among others he was the president of the Hungarian Neuroscience Society, 2001-2005, the Neurobiology Committee of the Hungarian Academy of Sciences, 2002-2008, and the International Society for Invertebrate Neurobiology, 2003-2007.



Interneuronal contacts in the snail olfactory lobe

Tihany is a village on the northern shore of Lake Balaton on the Tihany Peninsula (Hungary, Veszprém County). The whole peninsula is a historical district. The center of the district is the Benedictine Tihany Abbey, which was founded in 1055 AD by András (Andrew) I, who is buried in the crypt. The founding charter of this abbey is the first extant record of Hungarian language, preserved in Pannonhalma Benedictine Archabbey. The church itself was rebuilt in baroque style in 1754. The still functioning abbey is a popular tourist attraction due to its historical and artistic significance. It also has the best view of Lake Balaton. The abbey also features as a footnote in Habsburg history - the last Habsburg Emperor of Austria, Charles I was briefly held prisoner here following his second attempt to regain the throne of Hungary.

The Hungarian Biological Research Institute, the forerunner of the current research institute, was opened on September 5, 1927 as part of a national program developed by Count Kuno Klebelsberg, then minister of education and religion.

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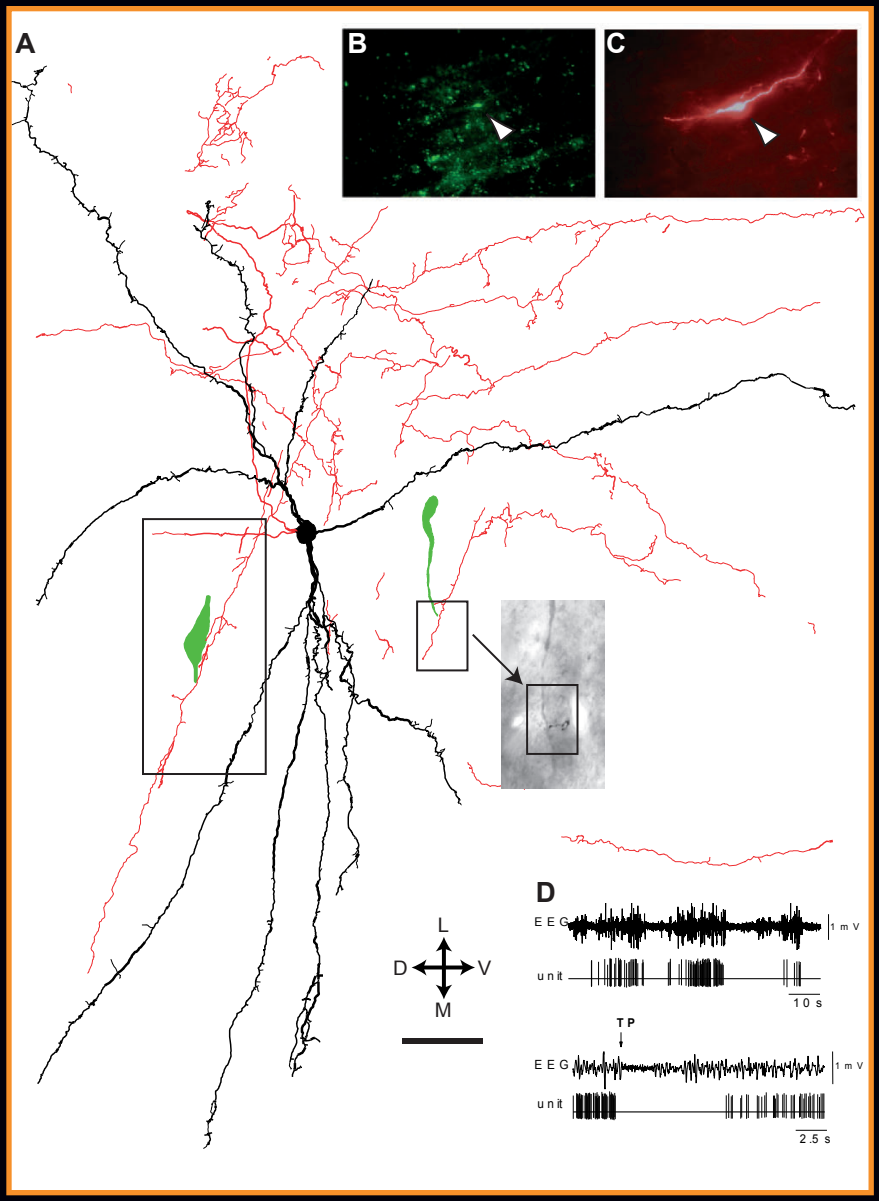
Front Cover:
Schematic display of our analysis suggesting that cholinergic and non-cholinergic neurons in the BF aggregate in cell clusters that project to interconnected cortical areas. From the two cortical slices, the left is about 3.7 mm rostral and the right one is about 2.7 mm caudal from the bregma viewing from lateral. In the space between the two brain slices BF cholinergic cells (reddish small dots) and their clusters are pasted from an actual analysis using the VRB cluster program (http://zlab.rutgers.edu/virtualratbrain/modules/Home/index.php). The individual clusters are color-coded. Those clusters that contain significant associations to specific cortical targets in the M2-posterior parietal-anterior cingulate cortex (red); in the S1-M1 cortex (purple) and in the perirhinal-insular cortex (green) are marked and their projection to the respective colored cortical areas are shown. These cortical locations are connected with thick arrows originating from their respective cortical columns as surmised from the gross distribution of posterior cortical projection neurons to various frontal/prefrontal sites. This analysis suggests that specific BF clusters project in a mosaic fashion to cortical association targets. Graphic design: **Lillian Erdy**.

Back Cover:
A:3D Reconstruction of a juxtacellularly labeled basal forebrain NPY neuron. The soma and dendrites are shown in black. The axon is shown in red. The green profiles represent cholinergic neurons in close proximity to the NPY axon-collaterals. Scale bar: 50 mm. B: The same neuron as in C stained for NPY (FITC). C: Biocytin filled neuron visualized with rhodamine. D: Unit and cortical EEG spontaneous and tail pinch (TP) induced activity. From the material of Duque et al., J. Neurophysiol., 84:1627-1635, 2000 and Duque et al., Brain Structure and Function, 212: 55-73, 2007.

Design: Zoltán Tardos


A
B
C
D
L
D
V
M
EEG
1 mV
unit
10 s
TP
EEG
1 mV
unit
2.5 s