Neurizons2016

speak your mind.

31st May - 3rd June 2016 · Göttingen, Germany

7th Biennial Neuroscience Conference

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Content
NEURIZONS 2016 Organizing Committee

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Welcome to Neurizons 2016

Message from the Organizing Committee

Neurizons 2016 is an endeavor to bring brilliant minds, young and experienced, together to create an enriched environment for thought provoking scientific exchange. We believe in providing the young aspiring minds an opportunity to glean knowledge from the experts and hence foster the scientific growth of the new generation of neuroscientists and visionaries. This year we bring to the stage various fields in neuroscience: synaptic physiology and plasticity, higher brain functions, sensory systems, system neuroscience, glia and neurodegeneration, and emerging techniques.

We resolve to bring forth the cutting edge advancements in the field and give a chance to all participants to have active discussions through personal interaction with erudite speakers. Students can also put their research up for discussion through the poster sessions, where they can get first hand feedback and stimulating ideas for their project.

This is your chance!
The Neurizons 2016 Organizing Team

Message from the Program Coordinator

Since the start of Neurizons in the year 2004 the meeting is now held in Göttingen for the 7^{th} time in 2016. Despite its growing size the meeting is still entirely organized by the PhD students of the International MSc/PhD/MD-PhD Program and Max Planck Research School for Neuroscience Göttingen. Over the years, Neurizons has preserved its unique character as a small meeting encouraging direct personal interactions between participants and bringing especially young PhD students at the beginning of their scientific career in contact with renowned neuroscientists. More and more Neurizons integrates the alumnae and alumni who contribute both by their scientific contributions and also by their personal engagement by interacting with our Master and young PhD students for instance in career-related workshops. This years conference is special not only due to its again unique speakers but also since it integrates a symposium on the occasion of the 15^{th} anniversary of the European Neuroscience Institute Göttingen (ENI-G) which is the home of the Neuroscience Program since the new ENI building was erected.

The Neurizons 2016 organizing team has again been very successful to compose an attractive program with internationally renowned speakers, who together with all other participants-will provide the scientific input to the meeting by communicating their newest findings. Consequently, the conference has again attracted participants not only from Göttingen or Germany but also from worldwide locations underlining the degree of internationalization reached on the Göttingen Campus.

In this respect, we especially welcome our guests from the Weizmann Institute in Rehovot/Israel and participants from the European Neuroscience Campus representing our joint Master and PhD training network with Amsterdam, Bordeaux, Coimbra and Zurich.

We are very happy that Neurizons again is sponsored by several companies and it is important to mention here, that a meeting like this would not be possible without our sponsors whose generous and continued support is very much appreciated and will contribute to make Neurizons 2016 a success.

Prof. Dr. Michael Hörner
Coordinator of MSc/PhD/MD-PhD Program and
International Max Planck Research School Neuroscience Göttingen.

Contents

Göttingen, City of Science

Göttingen belongs to the oldest university towns in Germany. Its population amounts to over 121,000, about 20% of which are students. The history of the town starts in 10^{th} century. Since the foundation between 1150 and 1200, Göttingen has played a remarkable role in the history of German science. The University of Göttingen (Georg-August-Universität) was founded in 1737 by King George II August. 100 years later, seven professors of the University, known later as the Göttingen Seven, protested against the absolute sovereignty of the King of Hannover, which cost them their positions. Some of the most famous mathemati-

cians in history, Carl Friedrich Gauss, Bernhard Riemann and David Hilbert as well as the great chemist Friedrich Wöhler were professors at Georg-August-Universität. Among the alumni of the university are 42 Nobel Prize winners. Other important personalities, Otto von Bismarck and Gerhard Schröder, studied law there. In addition to the University, there are several research institutes located in Göttingen:

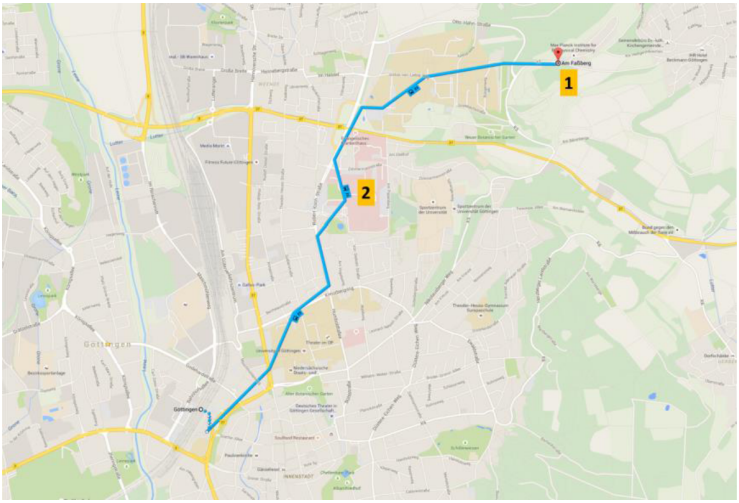
- German Aerospace Center.
- Private University of Applied Sciences.
- University of Applied Sciences and Arts.
- Max Planck Institute for Biophysical Chemistry.
- Max Planck Institute for Experimental Medicine.
- Max Planck Institute for History.
- Max Planck Institute for Dynamics and Self-Organization.
- Max Planck Institute for Solar System Research.
- German Primate Center.

During the World War II like Oxford and Cambridge, Göttingen was not bombed because of its academic value. The well-preserved old town is now an attractive place for tourists. The half-timber houses with precipitous roofs, which are typical for German architecture, create a unique atmosphere in the inner city. In front of the Old Town Hall you will find the landmark of the town the Gänseliesel Fountain. The sculpture on top of the fountain depicts a little goose girl, that is the most kissed girl in the world. According to the tradition, each student after receiving the doctoral degree climbs the fountain to kiss her cheek. Other interesting places in Göttingen include the Old Botanic Garden, the Jacobikirche (St. James' Church) and the Old Town Hall. The night life in Göttingen focuses within the old town. Multiple

restaurants, cafes and clubs offer a range of possibilities to spend time in the environment of international students. A number of clubs offer a wide range of parties: latin (Sausalitos), pop, hip hop and electro (Savoy, JT-Keller), rock and metal (Exil), as well as jazz and live music (Nörgelbuff). The restaurants offer various kinds of cuisine from traditional German (Zum Szultenburger) through international (Zak, Meyers, Kartoffelhaus), Italian (Nudelhaus, Fellini, VaPiano), Greek (Hellas) to African (Sambesi). To those who admire classical music, the churches of Göttingen offer concerts or choirs and orchestras. You can find further information about Göttingen on www.goettingen-tourismus.de. Scan the following QR code to get directions to the venues and other recommended places.

Practical Information

Venue: Max Planck Institute for Biophysical Chemistry

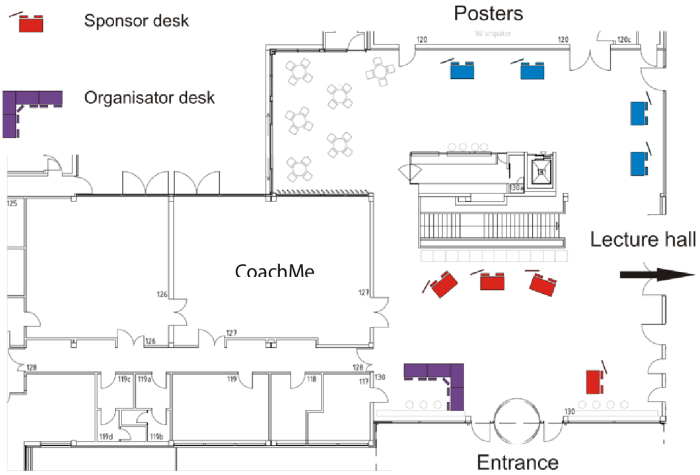


1. From the train station to the Max Planck Institute for Biophysical Chemistry, take the bus No. 23 or 21/22 that depart from the sidewalk D, direction Faßberg or Nikolausberg respectively. You should get off at the bus stop Faßberg. From there, it is a minute walk to the first administration building on the left side of the street.

2. From the Max Planck Institute for Biophysical Chemistry

to the Klinik für Klinische Neurophysiologie, University Medical Center Göttingen, take the bus No. 23 or 21/22 direction Bahnhof and get off at the bus stop Klinikum.

Here is the site map of the Foyer of the Max Planck Institute for Biophysical Chemistry:



Name badges

Every participant of Neurizons receives a badge with his/her name. The badges should be worn during the conference, as they are required for admission to all the events.

Lunch and refreshments

Two lunches are included in the conference fee. On Wednesday and Thursday the meals will be served in the canteen located in the basement under the foyer. In order to receive lunch you need to present a valid voucher. Cold refreshments and coffee will be provided during the poster sessions.

Internet access

Free WiFi connection will be available during the conference. Please ask the registration desk for internet access. Additionally, in many areas across Göttingen you may find connection to the eduroam wireless network. Scientists and students from participating institutions can log in with their personal or institutional eduroam account.

Bus

Buses number 21, 22 and 23 connect the Max Planck Institute for Biophysical Chemistry with the city center and the railway station. To reach the venue, take the bus in the direction Nikolausberg and get off at the bus stop Fassberg. From there it is a minute walk to the first large administration building on the left side of the street. With the new and improved bus schedule, there are busses departing form Fassberg towards the city center every 15 minutes. The last bus departs at 23:21. Alternatively, you can also use the widely known service Google Maps, selecting the option of Public Transport.

Please take care of your personal belongings. The Organizing Committee takes no responsibility for accidents or damages to participant's private properties.

Feel free to approach the Neurizons Organizing Team if you need any further information or assistance. The organizers can be recognized by the Neurizons t-shirts.

Highlights

ENI-G's 15th anniversary symposium

The European Neuroscience Institute (ENI) was founded in 2001 to support young scientists in pursuit of independent research at the highest scientific level by providing necessary infrastructure and autonomy to carry out top-level research and training. As a joint event with Neurizons 2016, we are now celebrating ENI's 15th anniversary with a symposium on Synapses, Circuits and Sensory Systems that will take place at the Max Planck Institute for Biophysical Chemistry in Göttingen on May 31st, 2016.

Panel discussion: "Why we do what we do?"

As a new concept, this year, since our conference topic is speak your mind, we planned a special interest event to bring together a panel of researchers to discuss different topics regarding philosophy of neuroscience. Our goal with this panel discussion is to create a space for people to hear about and discuss ideas and concepts outside the traditional scientific framework. Bringing together the scientific and humanistic expertise, we would like the talks and discussion to revolve around the idea of human behavior at different levels.

Young Investigator Contest

After last year's success, we bring the second edition of the Young Investigator Contest. Through this contest, participants (PhD students and post-doctoral) have a great opportunity to give a 10 minute presentation of their research to the audience of Neurizons 2016. This means presenting your work to young enthusiastic minds and brilliant experts in the field. It provides a good exercise for giving a presentation to an audience you want to convince of your merit and your project's importance. It is a great practice for presenting at grant evaluations where one needs to impress and inspire the reviewers in very strict time constraints. It will take place on Friday, June 3, from 11:30 to 12:20. This is your chance to demonstrate the brilliance of your work and get great feedback. This year, the winner will be awarded with a Nikon camera, signed books and a Neurizons 2016 T-shirt!

Poster Sessions

There are two poster sessions on Wednesday from 18:00 to 19:00 and Thursday from 17:25 to 19:00. The abstracts with number from 1 to 20 will be presented on Wednesday, the abstracts with number from 21 onwards will be presented on Thursday. During the poster sessions a buffet of snacks and drinks will be provided.

CoachMe

During this event, we offer you an opportunity to individually discuss your career strategies with experienced senior scientists. Therefore the participants are kindly asked to prepare a short list of questions. In rounds of 10 minutes the participants will be put in individual face-to-face meetings during which the senior scientists will challenge the participants with critical questions concerning their future career plans. By this we hope to provide a constructive environment for the students, which will give them

a chance to get valuable insights and suggestions about important aims to focus on and maybe one or the other personal advice for planning a successful career in science.

(Participation in CoachMe is possible only after prior registration for this event)

Career Fair

Neurizons 2016 kick starts on the 30th of May with Career Fair. Here you will have opportunities to witness and weigh all the diverse options you have at your disposal as a young scientist. Be it academia or industry, it is never an easy choice but with some guidance it can be simplified. With talks from leading scientists in academia and scientists who chose the path to industry or a combination of the two, we hope to give you a taste of what is out there. It is not only a great testing field but also a lucrative opportunity to establish networks. Come on board for one to one interaction with people who have gone through the same dilemma and help find out what career path suits you the best. Career fair is open to all and does not require prior registration.

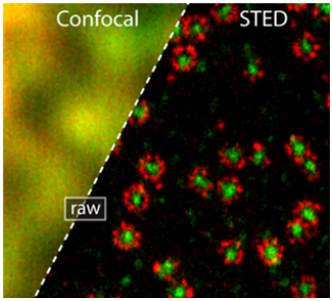
Career Fair Schedule

13:00-13:30	Transitioning from academia to engineering-type business and the choice outside pharma and consulting	**Dr. Marcin Barszczewski** Global Training and Education Director, Andor
13:30-14:00	Academic research on signposts, stumbling stones and joy	**Dr. Manuela Schmidt** Group Leader Emmy Noether Independent Junior Research Group "Somatosensory Signaling"
14:20-14:50	From the bench to labfolder: a Start(up) after the PhD	**Dr. Tomás Lopes da Fonseca** Community, Content and Account Manager at Labfolder GmbH
14:50-15:20	A journey through journalistic options	**Eva Eismann** Journalist
15:40-16:10	Research and teaching opportunities in India	**Dr. Zaved Khan** Assistant Professor at Adesh University, Punjab, India and Associate Professor at School of Biosciences and Technology at VIT University, Vellore, India

Methods Workshops

STED

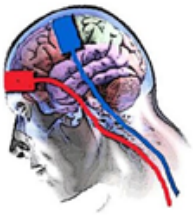
Department of NanoBiophotonics, Max Planck Institute for Biophysical Chemistry



Introduction to super-resolution imaging techniques e.g. STED, PALM, STORM, etc. Neuroscience specific applications and introduction to in vivo STED. Imaging demonstration using brain slices and cultures neurons.

Transcranial electrical stimulation in research and clinical practice

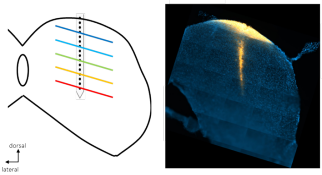
Klinik für Klinische Neurophysiologie, University Medical Centre Göttingen



Gain insights into the theory behind transcranial electrical stimulation paradigms (tDCS and tACS), developed at the Department of Clinical neurophysiology, Göttingen. Also, learn about applications including the use of tDCS as a tool to modulate cortical neuroplasticity in humans.

In vivo electrophysiology in the auditory system of mice

Cognitive Neurophysiology Lab, Max Planck Institute for Experimental Medicine



In this workshop we will perform acute electrophysiology in the mouse auditory midbrain: the inferior colliculus (IC). We will present sounds to the anaesthetized mouse in order to elicit spikes in different parts of the structure. The aim will be to show (1) that cells located progressively deeper in the central nucleus of the IC respond to progressively higher frequencies (tonotopy) and (2) differences between the responses in the central nucleus and the lateral cortex of the IC. The methods to isolate and analyze spikes offline will also be discussed.

Events

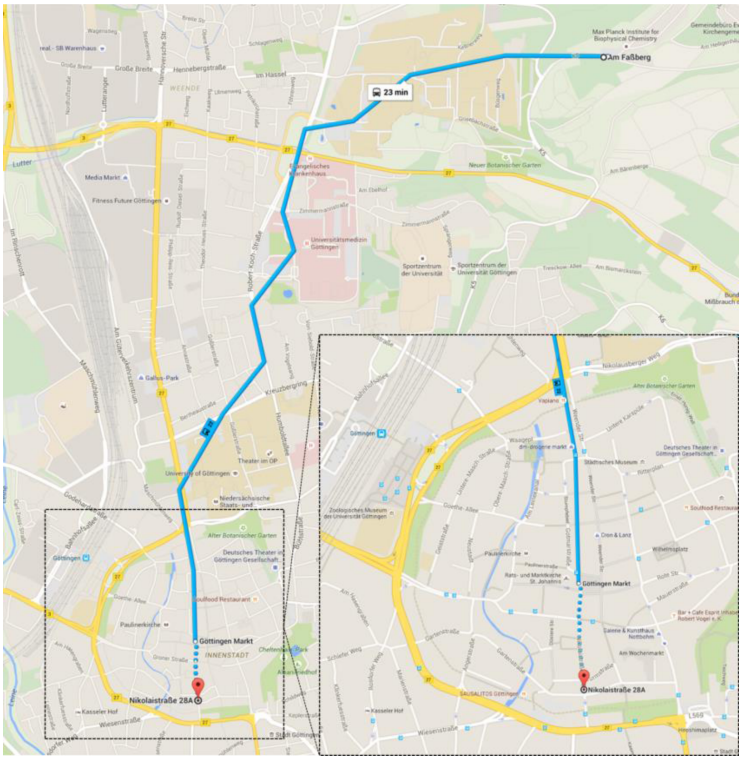
City Tour (1st May)

The city tour starts in the Old Town Hall, next to the Gänseliesel Fountain. A professional guide will show you the Götttingen's historical old town and its various attractions. This trip is an opporunity to learn about the history of the traditional university town.

Neurizons Party (2nd May)

After a long stimulating conference day, your brain needs to let loose or break free to process everything properly. Neurizons party offers you both! Whether you just want to have a drink and a nice conversation or want to dance and enjoy music, this

party is what you are looking for. The party starts at 21:30 in Club Freihafen, Nikolaistraße 1b, 37073 Göttingen. Entrance is only possible with the valid voucher/bracelet.



From the Max Planck Institute for Biophysical Chemistry to the party venue take the bus No. 22 direction Charlotenburger Straße, and get off at the bus stop Markt. From there it is a three minute walk along Bürgerstraße toward Freihafen in Nikolaistraße that will be at the left side of the street. Hope to see you there.

Acknowledgments

The organizers would like to thank the following supporters, whose assistance and ideas we could not have managed without. Firstly we thank the invited speakers, the students presenting talks and posters and the people organizing the workshops, for sharing their knowledge with the participants in this conference. We would also like to thank the previous organizers of the conference for the valuable inputs and guidance. Svea Viola Dettmer contributed with her profound experience in event organizing and was of irreplaceable help with venue and catering. We would also like to thank Christiane Becker for her consultation concerning legal and financial issues. We further thank the technical team at the MPI for Biophysical Chemistry for their support during the whole event. We would also like to thank the Medien Service of the MPI of Biophysical Chemistry for support with the generation of posters and banner. Last but definitely not least we would like to express our gratitude to Sandra Drube, Mirja Kristina Blötz and Prof. Michael Hörner for being the most important people for our program. Their support and advice are of utmost value for every IMPRS student and this event.

Thank you all,

The NEURIZONS 2016 Organizing Team

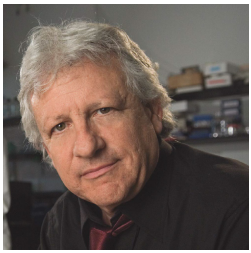
The organizing committee for Neurizons 2016 is a group of MSc/PhD students from the International Max Planck Research School for Neuroscience.

Plenary lectures

Keynote

Stuart Firestein

Department of Biological Sciences,
Fairchild Center for the Life Sciences,
Columbia University, NY, USA



Title of the talk

-How Biology Perceives Chemistry: the mammalian olfactory system
-Ignorance, Failure, Doubt, Uncertainty: Why Science Is So Successful

Research interest

Dr. Stuart Firestein is the former Chair of Columbia University's Department of Biological Sciences where his laboratory studies the vertebrate olfactory system, possibly the best chemical detector on the face of the planet. Aside from its molecular detection capabilities, the olfactory system serves as a model for investigating general principles and mechanisms of signaling and perception in the brain. His laboratory seeks to answer that fundamental human question: How do I smell? Dedicated to promoting the accessibility of science to a public audience, Firestein serves as an advisor for the Alfred P. Sloan Foundation's program for the Public Understanding of Science. Recently he was awarded the

2011 Lenfest Distinguished Columbia Faculty Award for excellence in scholarship and teaching. He is a Fellow of the AAAS, an Alfred Sloan Fellow and a Guggenheim Fellow. Besides the research, Dr. Firestein is interested in engaging the public into the scientific world. He has published books directed to a general audience, in which he adresses how ignorance and failure are driving forces of scientific research.

Synaptic Physiology and Plasticity

Ole Paulsen

Department of Physiology,
Development and Neuroscience
Physiological Laboratory, Cambridge,
UK

Title of the talk

Circuit mechanisms of
hippocampus-dependent memory

Research interest

The primary interest of my group is the relationship between network oscillations and synaptic plasticity. Network oscillations naturally organise spike timing conducive to spike timing-dependent plasticity (STDP), a strong candidate for a mechanism involved in neural development as well as learning and memory processes. We aim to gain insight into how information can be stored and retrieved as changes of synaptic weights in neural networks displaying oscillatory activity. To this end, we use a combination of techniques, including whole-cell patch-clamp and planar multi-electrode recording, calcium imaging and light-

activated channels (channelrhodopsins).

Richard Tsien

NYU Neuroscience Institute, New York, NY, USA

Title of the talk

Neuromodulatory tuning of transmission fidelity in CNS circuit

Research interest

Our lab works in many areas of neuroscience, with multiple approaches, but there is a unifying question: how are neuronal networks attuned to meeting the demands of information processing in the brain? We have seen our share of controversial issues over the years. Do neurotransmitters work exclusively by opening ligand-gated channels or do they modulate voltage-gated channels as well? Do calcium channels exist? Are there multiple types, and if so, how many? Do ion channels switch between different patterns of opening and closing gating modes and is this switching central to how channels are modulated? Is activity-dependent control of neuronal gene expression more than a matter of raising calcium concentration in the nucleus? While these issues were once hotly debated, most neuroscientists would now regard them as settled long in the distant past. In our current work, we do not seek controversy, but are willing to deal with it in order to test unconventional ideas. With past progress in mind, we're tackling today's unresolved questions with the guiding principle that new tool development is paramount to successfully pushing science forward.

Arthur Konnerth

Friedrich Schiedel endowed chair of
neuroscience, Dept. of Medicine,
Technische Universität München,
Germany

Title of the talk

Neuronal circuit dysfunction in
Alzheimer's mouse models *In vivo*

Research interest

Arthur Konnerth's current research is concentrated on a better understanding of the mechanisms underlying brain function in health and disease. His lab studies different types of neurons and circuits in the cortex, cerebellum and hippocampus, and uses a variety of techniques, including electrophysiology, molecular biology, optogenetics, behavioral analyses and high-resolution optical imaging. A major focus of the work is directed towards an exploration of behavior-determined synaptic signaling and dendritic integration in neurons of defined circuits *in vivo*. Another focus of the lab is the exploration of the mechanisms underlying neuronal dysfunction in Alzheimer's disease. He and his team pioneered *in vivo* two-photon imaging of cortical circuits with single cell resolution. More recently, they developed the LOTOS method of high-resolution two-photon imaging and used it for the first time functional mapping of dendritic spines *in vivo*.

Hannah Monyer

Medical Faculty of the University and
the German Cancer Research Center
(DKFZ) Heidelberg, Germany

Title of the talk

Inhibition in the brain and its function for network synchronization and neurogenesis

Research interest

Hannah Monyer has studied GABAergic interneurons linking the molecular, cellular and behavioral level. She generated mice in which properties of selective GABAergic interneurons were altered in a cell-type specific fashion to reveal the functional implication for hippocampus-dependent learning and memory. Her current focus of research includes investigations on long-range GABAergic neurons in several forebrain regions, in particular in the context of network synchrony, spacial coding and memory. Ongoing projects address the question as to the cellular identity of neurons within microcircuits of the entorhinal cortex, and whether grid cells are the cellular substrate for path integration. Another focus of research regards the function of GABAergic signalling and its modulation for postnatal neurogenesis. Hannah Monyer and her colleagues identified DBI (Diazepam binding inhibitor) as a key modulator for stem cell and transient amplifying cell proliferation. Current research revolves around the questions how the reduced GABA signalling induced by DBI regulates symmetric cell division and whether and how enriched environment affects DBI modulation of postnatal neurogenesis.

Higher Brain Function

John Dylan Haynes

Bernstein Center for Computational
Neuroscience Berlin, Germany

Title of the talk

Free will and the brain: Turning Libet upside down

Research interest

The research of Prof. John-Dylan Haynes focuses on the neural mechanisms underlying cognitive processes in healthy humans. His special interests are mental state decoding, as well as the neuroscience of consciousness, intentions and free will. For this he uses noninvasive neuroimaging techniques such as fMRI and EEG. He has contributed to the development of neuroimaging analysis methods, including multivariate classification of neuroimaging data and functional brain connectivity analyses. Furthermore, he is actively engaged in promoting awareness for ethical implications of brain reading and neurotechnology.

Henrik Mouritsen

Department of Biology and Environmental Sciences, University of Oldenburg, Germany

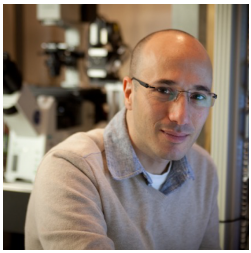
Title of the talk

The magnetic senses in migratory birds

Research interest

The research of Prof. Henrik Mouristen focuses on animal navigation. The long-distance navigational abilities of animals have fascinated humans for centuries and challenged scientists for decades. How is a butterfly with a brain weighing less than 0.02 grams able to find its way to a very specific wintering site thousands of kilometers away, even though it has never been there before? And, how does a migratory bird circumnavigate the globe with a precision unobtainable by human navigators before the emergence of GPS satellites? To answer these questions, multidisciplinary approaches are needed. Prof. Mouristens group and its collaborators use mathematical modelling, physics, quantum chemistry, molecular biology, neurobiology, histology, computer simulations and newly developed laboratory equipment in combination with behavioral experiments and analyses of field data to achieve a better understanding of the behavioral and physiological mechanisms of long distance navigation in insects and birds. In recent years, their main focus has been on unravelling the mechanisms underlying the magnetic senses in birds.

Ofer Yizhar



Department of Neurobiology at the
Weizmann Institute of Science, Israel

Title of the talk

Understanding the roles of amygdala-prefrontal connections through pathway-specific optogenetic perturbation

Research interest

Dr. Ofer Yizhar is a group leader at the Department of Neurobiology at the Weizmann Institute of Science in Israel. He received his Ph.D. from the Tel Aviv University, and completed his post-doctoral training with Prof. Karl Deisseroth at Stanford University. His research focuses on the role of the prefrontal cortex in learning and motivated behavior, and on the development and refinement of optogenetic technologies for manipulating neural circuits.

Sensory Systems

John F. Cryan

Department of Anatomy and Neuroscience, University College Cork, Cork, Ireland

Title of the talk

Microbiome- A key Regulator of Neurodevelopment and Behaviour

Research interest

Prof. Cryans research interests include the neurobiological basis of stress-related neuropsychiatric disorders including depression, anxiety and drug dependence. He is also interested in applying novel approaches to facilitate drug/siRNA delivery to the brain *in vivo*. Over the past number of years his group is also focused on understanding the interaction between brain, gut and microbiome and how it applies to stress and immune-related disorders, including irritable bowel syndrome and obesity and neurodevelopmental disorders such as autism. There is a growing appreciation of the relationship between gut microbiota, and the host in maintaining homeostasis in health and predisposing to disease. Substantial advances have been made in linking alterations in microbiota to brain development and even behaviour

and the concept of a microbiota-gut brain axis has emerged. Animal models have been essential in moving forward this frontier research area. His group has shown that the gut microbiota is essential for normal stress, antidepressant and anxiety responses. Moreover, microbiota is essential for both social cognition and visceral pain. At a neurobiological level microbiota is shown to affect a variety of brain processes from cortical myelination, amygdala spine density and adult hippocampal neurogenesis. Finally, Prof. Cryan's group is focused on critical time-windows early in life when the effects of microbiota on brain and behaviour appear to be more potent. Such data offer the enticing proposition that specific modulation of the enteric microbiota maybe a useful "psychobiotic"-based strategy for both stress-related and neurodevelopmental disorders ranging from depression to autism.

Yang Dan

University of California, Berkeley, CA, USA

Title of the talk

Neural circuits of sleep control

Research interest

Using a combination of electrophysiology, imaging, and optogenetic methods, Dr. Yang Dan's group aims to understand the microcircuits underlying cortical computation, cellular mechanisms for functional plasticity, and neuromodulation of sensory processing. One of her recent interests is to understand the subcortical neural circuits controlling sleep. By targeting genetically defined cell types for monitoring and manipulation, the goal of her team is to identify key neuronal circuits for the generation of both REM and non-REM sleep. Another interest of her lab is to understand the frontal cortical mechanisms for top-down control of goal-directed behavior.

Jennifer M. Groh

Department of Psychology and Neuroscience, Department of Neurobiology, Center for Cognitive Neuroscience, Duke University, USA

Title of the talk

Multiplexing in the Brain

Research interest

Jennifer Groh is interested in neural computation. Her laboratory studies the spatial transformations that facilitate interactions between visual and auditory processing. Her group has discovered that visual-auditory interactions occur much earlier in the brain than previously appreciated. A main thrust of current investigation involves brain representations of multiple simultaneous stimuli and how neural signals fluctuate across time to preserve information about each stimulus.

Justin Marshall

Sensory Neurobiology Group,
Queensland Brain Institute,
University of Queensland,
Queensland, Australia

Title of the talk

Stomatopod vision an ancient and totally new way to extract information

Research interest

Justin Marshall's principle aim is to understand how other animals perceive their environment. As arrogant humans, we tend to assume we are the pinnacle of evolution, however, certainly in sensory terms this is far from true. By taking an approach to sensory systems which is based around ecology but also includes physiology, anatomy, behaviour and neural integration, he hopes to decode languages such as colour and polarisation. As a sensory neurobiologist working in the ocean on animals that are no longer considered 'model animals', his best title is probably a Visual Ecologist. Much of his work focusses on the marine environment, in particular reef systems and the deep-sea, however he has also published on parrots, birds of paradise and reptiles. As a keen diver he has become acutely aware of man's influence on the marine environment and now heads CoralWatch, a citizen-science-based coral health assessment program used in 80 countries and translated into 12 languages.

Craig Montell

Department of Molecular Cellular and Developmental Biology, Neuroscience Research Institute, University of California, Santa Barbara, CA, USA

Title of the talk

Decoding the polymodal roles of TRP channels and opsins in sensory signaling

Research interest

One of the most fascinating goals in biology is to understand the biological basis of animal behavior. To address this question, Craig Montell is focusing on a relatively simple animal, the fruit fly, *Drosophila melanogaster*, which exhibits many of the same behaviors as humans and other mammals. The external environment is a major factor that controls what animals decide to do, and Montell will describe how he is using TRP channels to decipher how flies sense the world around them and impact on a wide array of behaviors. Montell discovered the original TRP channel, through his work on fly phototransduction, which is initiated by light activation of rhodopsin. Rhodopsin was discovered in the 1870s and thought to function exclusively in photoreceptor cells. However, the Montell laboratory recently made the surprising discovery that opsins lead to activation of TRP channels outside of photoreceptor cells, and initiate signaling cascades that participate in thermotaxis, chemotaxis and other behaviors. Many diseases result from defects in TRP channels, including the childhood neurodegenerative disease, MLIV, which results from mutations in TRPML1. Based on insights from a fly model for this disease, Montell will describe a concept for a therapy for this disease that is showing promise in a mouse model for MLIV.

Emerging Techniques

Sonja Kleinlogel

Department of Physiology, University of Bern, Bern, Switzerland

Title of the talk

Light in Sight - optogenetic gene therapy to recover vision

Research interest

The aim of Dr. Kleinlogel's laboratory is the implementation of optogenetics into regenerative medicine. Her group tailors optogenetic tools biotechnologically for specific therapeutic approaches. They presently focus on the development of optogenetic treatments for skin cancer and blindness. For this they biotechnologically engineer custom-made 'next-generation' optogenetic tools, which are membrane proteins equipped with a rhodopsin-based light antenna. In order to introduce the proteins into the cells of interest they use lenti- and recombinant Adeno-associated viral shuttle vectors, the latter of which are admitted to the clinic for gene-therapy. Through viral capsid modifications they aim to improve cell specific targeting and infectivity. The tools are tested in cell cultures, ex vivo preparations and finally in the living animal.

Elizabeth Hillman

Mortimer B. Zuckerman Mind Brain Behavior Institute and Kavli Institute for Brain Science, Columbia University, New York, USA

Title of the talk

SCAPE microscopy for high-speed 3D imaging of the awake, behaving brain

Research interest

Dr. Hillman is an Associate Professor of Biomedical Engineering and Radiology at Columbia University, a member of the Zuckerman Mind, Brain and Behavior Institute (Z-MBBI), the Kavli Institute for Brain Science and the Neurobiology and Behavior graduate program at Columbia. Dr. Hillman's lab specializes in the development and application of novel *in-vivo* optical imaging and microscopy techniques to perform functional, dynamic imaging, particularly in the living brain across length scales from flies to primates. Most recently, Dr. Hillman developed swept, confocally aligned planar excitation (SCAPE) microscopy, a single-objective light-sheet based technique capable of imaging the intact brain in 3D at video rates. Dr. Hillman's lab also has an established research program to apply her novel imaging techniques to explore the interrelationship between blood flow and neuronal activity in the brain.

Sudipta Maiti

Department of Chemical Sciences,
Tata Institute of Fundamental
Research, Mumbai, India

Title of the talk

TBA

Research interest

Dr. Maiti's laboratory investigates biophysically tractable yet biologically interesting systems, using (mostly) spectroscopic and imaging tools. The recent focus has been on two problems: protein misfolding/aggregation, and vesicular neurotransmission. Both of these interface with the phenomenon of amyloid-induced neuro-degeneration. Alzheimer's Amyloid beta is a small peptide, and therefore expected to be more tractable at a molecular level compared to typical proteins. Yet it is uniquely interesting in the biological context. Dr.Maiti's team has developed single molecule level fluorescence tools specifically suited for studying amyloid misfolding and aggregation. On the other hand, vesicular neurotransmission is a multifaceted phenomena and therefore difficult to simplify beyond the level of single neurons. However, monoaminergic vesicles can be tracked with unique label-free imaging techniques that they have developed in the lab. In addition, the development of biophotonic instrumentation and methodology has been a frequent offshoot of his work in the lab.

Glial Physiology and Neurodegeneration

Bruce R. Ransom

Department of Neurology, University of Washington Medical Center, WA, USA

Title of the talk

Ischemic and Hypoglycemic CNS White Matter Injury: Pathophysiology and Importance

Research interest

Dr. Ransom has three primary research interests: 1) glial cell physiology and function, 2) glial glycogen and brain energy metabolism, and 3) the pathophysiology of CNS white matter injury due to ischemia, anoxia or hypoglycemia. Using a variety of techniques, he has explored how astrocytes modulate brain extracellular [K^+], pH, [lactate$^-$] and [glutamate$^-$], and how this affects the behavior of nearby neurons. He has shown that astrocyte glycogen in the CNS, and Schwann cell glycogen in the PNS, can be broken down to lactate$^-$, which, in turn, can be passed to nearby axons where it serves as a fuel during hypoglycemia or

increased neural activity. Dr. Ransom is a clinician-scientist and has developed an ex vivo model for studying how CNS white matter is injured by clinically-relevant insults, including ischemia, hypoglycemia or anoxia. His work on this topic is especially important because CNS white matter injury is very common in humans and has a different pathophysiology compared to how gray matter is injured.

Thomas Misgeld

Institute of Neuronal Cell Biology,
Technical University of Munich,
Germany

Title of the talk

In vivo imaging of axon dismantling

Research interest

The Misgeld lab uses structural and functional *in vivo* imaging in transgenic mice to analyze the cell biological mechanisms underlying axon dismantling. Currently the group has a major focus on devising assays of organelle dynamics and function and applying these assays to settings of axon dismantling in development and disease.

Marie-Eve Tremblay

Centre de recherche du CHU de Québec, Canada

Title of the talk

Structural relationships between microglia and synapses in contexts of neuroinflammation

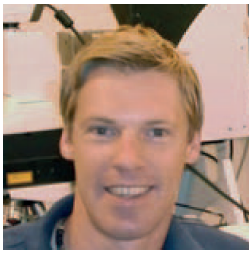
Research interest

During her training, Marie-Eve Tremblay developed expertise in non-invasive imaging to study the physiological roles of glial cells throughout the lifespan. Since glial cells are highly reactive to changes in homeostasis, non-invasive methods that prevent their phenotypic transformation during experimental procedures are required to study their physiological roles. Using these techniques, her postdoctoral work revealed that microglia, the resident immune cells of the brain, actively remodel neuronal circuits (by phagocytosis of pre-synaptic axon terminals and post-synaptic dendritic spines) during normal physiological conditions. As an independent investigator, she is now exploring the significance of this new cellular mechanism which could represent the missing link between neuroinflammation and cognitive dysfunction in the pathogenesis of diseases. In particular, her research focusses on elucidating the roles of microglia in the loss of synapses which best correlates with the impairment of learning and memory across chronic stress, aging, and various pathological conditions. In complement, she is investigating the involvement of bone marrow-derived myeloid cells which infiltrate the brain through the vasculature, to provide further insights into the relationship between the brain and body across homeostasis, plasticity and disease. She is also studying additional physiological roles of microglia and other myeloid cell types in the brain, as well as their dysregulation upon chronic stress, depression,

schizophrenia, aging, and neurodegenerative diseases to identify new pathogenic mechanisms. This work is conducted using a longitudinal approach that combines non-invasive chronic two-photon in vivo imaging structural and functional with superesolution microscopy, correlative 3D-scanning electron microscopy, and behavioural assessments. Her long-term goal is to help develop new therapies using myeloid cells as vectors for effecting targeted changes in neuronal circuits, in order to spare memories, learning and other cognitive functions.

Systems, Circuits and Computation

Marcel Oberländer



Computational Neuroanatomy (Bernstein Group), Max-Planck Institute for Biological Cybernetics, Tübingen, Germany

Title of the talk

Towards a brain-wide model of perceptual decision-making in the rodent whisker system

Research interest

How the brain is able to transform sensory input into decisions remains unknown. Understanding the neuronal basis of decision making is hence one of the major challenges of systems neuroscience. Commonly, recording/imaging during sensory-motor tasks seeks to identify neural substrates of computational elements defined by statistical decision theories. This approach determined correlates of tactile-based sensation and action in sensory and motor cortex, respectively. Now, the crucial questions are 1) how these correlates are implemented within the underly-

ing neural networks and 2) how their output triggers decisions. The Oberländer lab uses the rodent whisker system to address these questions. Specifically they aim to elucidate how the interplay between biophysical, cellular and network mechanisms can encode a percept that gives rise to a decision. Rodents cross a gap when detecting its far side with a single facial whisker. This suggests that touch during exploratory movement of a whisker triggers the decision. A potential mechanism underlying the percept of active touch is that layer 5 thick-tufted (L5tt) neurons in somatosensory cortex receive touch and movement information via specific pathways that target basal and apical tuft dendrites, respectively. When localizing the far side of the gap, the two inputs coincide and result in burst spiking output to (sub)cortical areas, triggering the gap cross. To test this hypothesis, the Oberländer lab is reconstructing all sensory/motor-related local and long-range pathways involved in whisker information processing, measures whisker-evoked responses of these populations and uses the data to constrain network simulations of active whisker touch. To do so, they have developed a multidisciplinary strategy by combining in vivo electrophysiology, with virus injections, custom-designed imaging/reconstruction tools and Monte Carlo simulations. This reverse engineering approach will provide unmatched understanding of mechanisms that underlie perceptual decisions and will function as a roadmap to derive general principles across sensory modalities and species.

Bruno Cauli

CNRS UMR, Paris, France

Title of the talk

Neurogenic control of neurovascular coupling

Research interest

The cerebral cortex comprises diverse areas involved in perception, movement or cognition. In spite of this functional diversity, the cortical network is formed with the repetition of a microcircuit. This microcircuit contains excitatory and inhibitory neuronal types. The neuronal activity of this microcircuit, its local cerebral blood flow and metabolism are tightly coupled to match the increased energy needs occurring during neuronal processing. This neurovascular and neurometabolic coupling, essential to normal brain function and integrity, is also the physiological basis of the hemodynamic contrasts widely used to map neuronal activity in health and disease. A major goal of Bruno Cauli's laboratory is to understand how the microcircuit controls its own energy supply and metabolism via interactions with the glio-vascular network. These points are addressed at the molecular, cellular and network levels in rodent cortical slices. Patch-clamp electrophysiology often combined with single cell RT-PCR and histochemistry is the central methodology of the lab. Viral transfer or transgenic mice are also used to express various genes of interest in cell types. Among these genes, the light-operated channelrhodopsin are used to excite specific neuronal types and evaluate their influence on the glio-vascular network. Diverse bioluminescent or fluorescent genetically-encoded sensors are also to image metabolic activities at the cellular and multicellular levels.

Matteo Carandini

University College London, UK

Title of the talk

Probing Vision, Decision, and Navigation in Mouse Parietal Cortex

Research interest

The aim of Carandini's research is to understand the computations performed by neuronal populations in the visual system, the underlying neural circuits, and the way these computations lead to decisions and actions. A specific area of research concerns how the brain integrates sensory information from the eyes with information from within the brain. Techniques range from electrophysiology to optical imaging, with a focus on large neuronal populations.

Panel Discussion: "Why we do what we do?"

Georg Northoff

Institute of Mental Health Research,
University of Ottawa, Ottawa, Canada

Title of the talk

What the brain's spontaneous activity can tell us about self and consciousness

Research interest

He is a german philosopher, neuroscientist and psychiatrist with a main interest question: why and how can our brain construct subjective phenomena like self, consciousness, emotions. He has dedicated his research to study the self, the process in which the brain experiences the self and the mind-body problem. To accomplish this, he is using different approaches: the neuroscientific approach, in which using a series of techniques, such as fMRI, PET, TMS etc., he investigates subjective emotional and self-experience. The neuropsychiatric approach, working with patients with disorders like depression or anxiety. And finally,

the neurophilosophical approach to address the epistemology, ontology and ethics of the relationship between the brain and the self. With this combination of approaches, he aims to understand the brain mechanisms involved in the construction of the self and different mental states, to improve the understanding, diagnosis and therapy of certain psychiatric disorders and to have a better understanding of human nature.

Bernd Weber

Center for Economics and
Neuroscience, University of Bonn,
Bonn, Germany

Title of the talk

How can we use insights into decision making to improve health?

Research interest

Bernd Weber is one of the founders of the Center for Economics and Neuroscience (CENs) in the University of Bonn, in 2009. He is a medical doctor interested in neuroeconomics, which refers to the understanding of human behavior and the biological processes related to decision making in the context of economically relevant actions. Using techniques such as diffusion weighted imaging, functional and structural MRI, his lines of research include individual and social decision-making, consumer behavior and structural brain connectivity.

Abstracts

Young Investigator Talks

Seizing the brain with inhibition and silencing it with excitation [Y1]

Latefa Yekhlef[1,2], Gian Luca Breschi[2], and Stefano Taverna[1,2]
[1]San Raffaele Scientific Institute. Division of Neuroscience; [2]Italian Institute of Technology

The physiopathology of temporal lobe epilepsy (TLE) is unclear and the neuronal populations playing a key role in triggering ictal discharges are still to be determined.

We combined optogenetic stimulation together with whole-cell patch clamp recordings in mouse brain slice to dissect the role of glutamatergic principal cells and GABAergic interneurons in the entorhinal cortex.

Channelrhodopsin-2 (CHR2) was first expressed under the control of promoters for specific markers of either of the two most common subtypes of GABAergic interneurons, parvalbumin (PV) and somatostatin (SOM). Alternatively, CHR2 was expressed in principal glutamatergic cells (PCs) under the promoter of the synaptic vesicular transporter VGlut2. Spontaneous tonic-clonic seizure-like events were induced by extracellular perfusion with the proconvulsive drug 4-aminopyridine (4-AP, 200 μM).

In these conditions, direct optogenetic activation of GABAergic interneurons was highly effective in triggering both interictal and ictal discharges which closely replicated analogue events occurring spontaneously. The seizure-like events were associated

with a relatively high increase in extracellular potassium concentration and were strongly shortened by extracellular perfusion with the GABAergic receptor antagonist gabazine (10 mM). Selective PC photostimulation also induced tonic-clonic discharges; however, while interneuronal activation failed to stop or shorten the progression of ictal events, photostimulation of PCs was surprisingly very functional in abolishing ongoing seizures thanks to a substantial depolarization block effect.

Our results suggest that PV and SOM interneurons are instrumental in initiating but ineffective in terminating seizures. On the other hand, selective photostimulation of glutamatergic PCs paradoxically blocks the progression of ictal discharges.

[Y2] Proteins of the CAPS Family - Mode of Action and Relevance for Synaptic Computation

Nestvogel D[1], Benseler F[1], Jamain S[2], Rettig J[3], Brose N[1], and Rhee JS[1]

[1]Department of Molecular Neurobiology, Max Planck Institute of Experimental Medicine, Göttingen, Germany; [2]Inserm U955, Psychiatrie Genetique, Creteil, France; [3]Institut für Physiologie, Universität des Saarlandes, Homburg, Germany

Sensory systems encode environmental stimuli over a broad dynamic range by adjusting their neural responses to prolonged stimulation. Apart from receptor desensitization, such adjustments are mediated by transient changes in synaptic strength between nerve cells of the respective sensory system. Transient changes in synaptic strength - also referred to as short-term synaptic plasticity (STP) - in turn are heavily dependent on the action of presynaptic proteins. Some of these proteins, such as MUNC-13s, are required to prime secretory vesicles for release by turning these from a fusion-incompetent into a fusion-ready state. Upon binding of second messengers via distinct protein domains, MUNC-13s increase their priming activity and thereby

adjust the level of transmitter release according to recent patterns of presynaptic activity. Similarly, CAPS proteins are required for priming; however, their role in modulating STP is largely unknown. In this study, we systematically carried out a structure function study of CAPS proteins in cultured hippocampal neurons. Our results indicate a close interplay of MUNC-13- and CAPS proteins in modulating STP that is highly dependent on the level of intracellular calcium and the activity of second messengers. Furthermore, our data suggests that CAPSs prime vesicles by interacting with phospholipids and that expression of different isoforms and splice variants leads to different STP characteristics. Current and future experiments aim at combining mouse genetics with in-vivo whole cell recordings to study the role of CAPSs in modulating sensory adaption in the mouse visual system.

Oscillatory circuit organization during fear behavior [Y3]

Nikolaos Karalis[1,2,3], Cyril Dejean[1,2], Fabrice Chaudun[1,2], Suzana Khoder[1,2], Robert R Rozeske[1,2], Helene Wurtz[1,2], Sophie Bagur[4], Karim Benchenane[4], Anton Sirota[3], Julien Courtin[1,2,5], and Cyril Herry[1,2]

[1]INSERM, Neurocentre Magendie, U862, Bordeaux, France; [2]Univ. Bordeaux, Neurocentre Magendie, U862, Bordeaux, France; [3]Bernstein Center for Computational Neuroscience Munich, Munich Cluster of Systems Neurology (SyNergy), Faculty of Medicine, Ludwig-Maximilians University Munich, Planegg-Martinsried, Germany; [4]Team Memory, Oscillations and Brain states (MOBs), Brain Plasticity Unit, CNRS UMR 8249, ESPCI ParisTech, Ecole Superieure de Physique et de Chimie Industrielles de la Ville de Paris, Paris, France; [5]Friedrich Miescher Institute for Biomedical Research, Basel, Switzerland.

Recent converging evidence suggests that the expression of conditioned fear and extinction memories relies on the coordinated activity between the medial prefrontal cortex (mPFC) and the

basolateral amygdala (BLA), two structures densely and reciprocally interconnected. However, to date, the mechanisms allowing this long-range network synchronization of neuronal activity between the mPFC and BLA during fear behavior remain virtually unknown. Using a combination of extracellular recordings, pharmacological and optogenetic manipulations, we found that freezing, a behavioral expression of fear, temporally coincided with the development of sustained, internally generated 4-Hz oscillations in prefrontal-amygdala circuits. 4-Hz oscillations predict freezing onset and offset and synchronize prefrontal-amygdala circuits. Optogenetic induction of prefrontal 4-Hz oscillations coordinates prefrontal-amygdala activity and elicits fear behavior. Our data suggest that synchronized 4Hz oscillations constitute a major mechanism for the temporal coordination of the activity in the prefrontal-amygdala circuit, facilitating the encoding and expression of fear memory across the circuit. These results unravel a sustained oscillatory mechanism mediating prefrontal-amygdala coupling during fear behavior.

[Y4] Mapping the functional architecture of synaptic inputs in cortical cells

Benjamin Scholl[1], Daniel E. Wilson[1], and David Fitzpatrick[1]
[1]Max Planck Florida Institute for Neuroscience

Cortical neurons receive thousands of synaptic inputs and integrate across large populations of presynaptic neurons, forming a basis for feature selectivity and sensory computations. Despite decades of somatic subthreshold voltage measurements, there lacks a fundamental understanding of the functional properties of individual synaptic inputs and their integration within the dendritic tree. Here we unravel the functional and organizational properties of synaptic inputs in ferret visual cortex using two-photon calcium imaging to measure hundreds of dendritic spines on single neurons and their corresponding somatic output. We

first examined orientation selectivity of synaptic inputs onto single cortical cells using drifting gratings, uncovering a variety of orientation tuned calcium responses. Pooling across populations of dendritic spines, we were capable of predicting somatic orientation preference but not selectivity. Instead, dendritic spines aligned to the somatic preference were spatially clustered and correlated with local dendritic calcium signals, potentially underlying dendritic nonlinearities enhancing cortical feature selectivity. We further explored synaptic functional properties and dendritic processing by measuring the organization of visual space. Synaptic inputs communicate a much wider region of visual space than the somatic receptive field. We also find distinct spatial clusters of dendritic spines which can exhibit temporal correlation and provide a major contribution to somatic spatial selectivity. The functional clustering and nonlinear dendritic processing of clustered inputs may allow cells to generate spatially selective responses in the face of unselective synaptic inputs.

Corticothalamic feedback in the mouse early visual system [Y5]

Sinem Erisken[1,2,3], Agne Vaiceliunaite[1], Steffen Katzner[1], and Laura Busse[1,2]

[1]Centre for Integrative Neuroscience, University Tuebingen, Germany; [2]Division of Neurobiology, Department Biology II, LMU Munich, Germany; [3]Graduate Training Centre of Neuroscience, University of Tuebingen, Germany

Sensory processing depends heavily on contextual influences. Hence, sensory information flow incorporates not only feedforward inputs originating from the periphery but also feedback from higher order structures. In the early visual system, the dorsolateral geniculate nucleus (dLGN) in the thalamus sends feedforward input into the primary visual cortex (V1) and receives feedback from corticothalamic (CT) cells in L6 of V1. However,

little is known about how CT feedback alters thalamic processing during wakefulness or whether feedback substantially changes the representation of sensory information.

Here, we investigated the role of CT feedback on dLGN of awake mice. When we globally silenced V1 by optogenetically activating cortical PV+ interneurons in PV-Cre mice injected with cre-dependent AAV coding channelrhodopsin (ChR2), dLGN neurons decreased their spontaneous activity and shifted towards burst-firing. Conversely, when we optogenetically activated L6 CT cells in Ntrs1-Cre mice, dLGN neurons increased their spontaneous activity and shifted towards tonic-firing. Importantly, V1 silencing also increased receptive field center size and decreased surround suppression in dLGN. We next selectively silenced CT synapses terminating in dLGN in Ntrs1-Cre mice expressing cre-dependent hm4D-Gi, a DREADD that decreases synaptic efficacy in the presence of CNO, by intracranially injecting CNO into dLGN. Similar to our optogenetic results, selectively silencing CT synapses shifted dLGN neurons towards burst-firing and increased responses to full-field stimuli, consistent with decreased surround suppression.

Finally, moving beyond stimulus context into behavioral context, we asked if CT feedback was responsible for the recently observed enhancement of dLGN activity during locomotion. We found that while the animal was running, selectively silencing CT synapses in dLGN did not abolish locomotion-related enhancements.

Taken together, our results suggest that L6 CT feedback shapes spatial summation, controls firing rates, firing mode, but not locomotion-related enhancements in dLGN.

Poster Session I

Subcellular targeting of VIP+ boutons in mouse barrel cortex is layer-dependent and not restricted to interneurons [1]

Xiaojuan Zhou[1], Michael Rickmann[1], and Jochen F. Staiger[1]

[1]Institute for Neuroanatomy, Universitätsmedizin Göttingen, Georg-August-Universität, Kreuzbergring 36, D-37075 Göttingen

Vasoactive intestinal polypeptide (VIP) interneurons innervate all cortical layers and are assumed to target mainly dendrites. Functional studies showed that they primarily inhibit other types of interneurons. However, a morphological study which quantifies the target specificity at the subcellular level in a layer-dependent manner is still lacking. Therefore we carried out an anti-GABA immunogold electron microscopy study combined with anti-YFP staining on coronal sections of VIP-Cre/Rosa-YFP mice. By systematic random sampling, we analyzed 200 VIP boutons and their postsynaptic targets from 5 animals across the 6 cortical layers. The targets were separated according to 3 subcellular compartments: dendrite, spine, and soma, over the entire sample accounting for 80%, 7% and 13%. A comparable distribution was found in layers II/III, IV and V. In layer I, all the targets were dendrites. In layer VI, 39% were on somata and 58% on dendrites. To determine the fraction of GABA-positive targets, we used receiver operating characteristic (ROC) statistics and the closest point to (0.1) method to obtain the thresholds for GABA-positivity. We found the GABA-positive fraction was only 37%

for dendrites, 7% for spines, and 26% for somata. For targeted dendrites, superficial layers had lower GABA-positive fractions: layer I (29%), layers II/III and IV (34%); while deep layers had higher fractions: layer V (48%), layer VI (39%). In conclusion, VIP interneurons target mainly dendrites except in layer VI; and have differential rates of interneuronal targeting across the cortical layers, with lower rates in superficial layers and higher rates in deep layers.

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[2] Ethical considerations for DBS in patients with early-onset autosomal dominant Alzheimer's Disease

John Noel M. Viaña[1], and Frederic Gilbert[1]

[1]Philosophy and Gender Studies Program, School of Humanities, University of Tasmania

Alzheimer's Disease is the most common form of dementia affecting more than 5.3 million people in the USA alone. FDA-approved drugs only provide temporary relief to memory problems, and no disease-modifying therapies are currently available. Although the cause of Alzheimer's Disease for most patients is multifactorial in nature, around 1% of people have early onset AD (EOAD) due to a rare autosomal dominant mutation in APP, PSEN1, or PSEN2. Recently, case reports and initial clinical trials on the potential use of DBS for memory improvement in people with Alzheimer's Disease or other neurologic conditions have been reported; however, none of them tested DBS on people with autosomal dominant EOAD. In this poster, we explore ethical considerations that must be undertaken when performing experimental DBS on people with autosomal dominant EOAD. While focusing on the best way to protect potential patients, we also examine the most appropriate kind of FDA approval that should guide such experimental trials and on how ethical guidelines would possibly differ from those in people where the onset of AD is at a later age.

Synaptic adhesion protein Nlgn2 regulates anxiety processing in mice [3]

Olga Babaev[1], Paolo Botta[2],Elisabeth Meyer[2], Hannelore Ehrenreich[1], Andreas Luthi[2], Nils Brose[1], and Dilja Krueger-Burg[1]

[1]Max- Planck Institute for Experimental Medicine, Goettingen, Germany; [2]Friedrich Miescher Institute, Basel, Switzerland

Loss- of- function mutations in synaptic adhesion proteins are established genetic risk factors for autism and schizophrenia in humans. Mice lacking synaptic adhesion proteins show behavioral and functional abnormalities that are akin to human neuropsychiatric conditions. Knockout mice of excitatory synaptic proteins have been successfully used to study excitatory synaptic dysfunction underlying behavioral deficits in vivo, but very few similar studies were done in knockouts of inhibitory synaptic proteins. Mutations in one such protein, Neuroligin 2 (Nlgn2), have been recently identified in patients with schizophrenia. Deletion of Nlgn2 in mice leads to increased anxiety, which is often co morbid to schizophrenia, but synaptic and circuitry mechanisms underlying this phenotype are completely unknown. Here, we combine behavioral, immunohistochemical, and electrophysiological approaches for detailed characterization of possible deficits in anxiety processing circuit in Nlgn2 KOs. We also test whether Nlgn2, previously believed to act mainly during synaptic development, also acts at mature synapses. For that, we deleted Nlgn2 in Cre dependent manner in adult mice. Additionally, we established retrograde tracing protocol to determine whether Nlgn2 deletion only affects neurons that project to anxiety related structures. Our data indicate that constitutional Nlgn2 deletion predominantly affects perisomatic inhibitory synapses onto specific population of projection neurons in basal amygdala, thus decreasing the inhibitory drive onto these neurons that causes

their excessive activation under anxiogenic conditions. The characterization of downstream targets of these projection neurons is possible by combining retrograde tracing and cFOS activation assays. Our data position Nlgn2 as a regulator of anxiety processing and suggest that disruption of perisomatic inhibition of projection neurons in basal amygdala may lead to increased anxiety. Strikingly, Tamoxifen- induced Cre-dependent deletion of Nlgn2 in young adult mice causes increased anxiety related behavior. This indicates that Nlgn2 may regulate anxiety during post developmental stages of synaptic life cycle.

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[4] Mover: A Synapse-Specific Regulator of Plasticity

Julio S. Viotti[1], Asha Kiran Akula[1], and Thomas Dresbach[1]

[1]Institute of Anatomy, Universitaetsmedizin Goettingen, Goettingen, Germany

Rare are the proteins in the neurotransmitter release machinery that escape the evolutionary conservation that makes synapses among nematodes, flies, mice and rats quite similar. Mover is one of these rare exceptions. Mover is a vertebrate-specific, synaptic vesicle-bound phosphoprotein. It binds both the highly conserved Calmodulin and the vertebrate-specific Bassoon. Moreover, it is differentially expressed among synapses.
Knock-down of Mover at the calyx of Held has been shown to increase the rate of vesicle reloading after synaptic depression, as well as the calcium sensitivity and probability of release. Shedding light onto the role of this new participant in the synaptic machinery would help us comprehend three fundamental questions: a) how is release probability regulated? b) how is synaptic heterogeneity accomplished? c) are there special signatures of vertebrate synapses?
Mover has the potential to be a key effector of important synaptic proteins such as the Bassoon and Calmodulin. Investigation of the role of Mover will bring us one step closer to unraveling

the mystery of what regulates synaptic strength in health and disease. Transmission dysregulation has been implicated in disorders such as schizophrenia, autism and epilepsy. Accordingly, Mover is strongly upregulated in anterior cingulate cortex brains of schizophrenic patients, indicating the importance of a better understanding of this protein.
In this study, we have used a Mover knockout mouse line in combination with imaging and electrophysiology to understand the role of this protein in synaptic transmission. Knockout of Mover increases frequency facilitation, paired-pulse ratio and high- frequency facilitation in the Hippocampal Mossy Fibers but not in the Schaffer Collaterals. These discoveries, together with the changes in the Calyx of Held, suggest that Mover is a synapse-specific regulator of synaptic plasticity. At the Mossy Fibres, activity-dependent regulation of Mover could increase the dynamic range for the induction of frequency facilitation and working memory.

Endophilin-A stimulates priming and fusion of secretory vesicles [5]

Gowrisankaran S[1], Steubler V[1], Houy SN[2], Sørensen JB[2], and Milosevic I*[1]

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The endophilins-A constitute a family of evolutionarily conserved endocytic adaptors with membrane curvature-sensing and curvature-inducing properties. Given that endophilin-A has also been found on secretory vesicles, we aimed to inspect whether endophilin A has a role in exocytosis, and we used adrenal chromaffin cell as a model system. Secretion in endophilin A1-A3 triple knock out (TKO) chromaffin cells was studied by fast capacitance measurements. Simultaneously, the catecholamine release was quantified using amperometry. The ultrastructure of chromaffin

cells was checked by confocal and electron microscopy. We found that the secretory vesicle priming and fusion is impaired in the chromaffin cells without endophilins-A, although the number of secretory vesicles is not altered, as seen by two independent morphological analysis (electron microscopy and immunostaining). Expression of endophilins A1 (neurons-specific) and A2 (ubiquitous) in endophilin TKO chromaffin cells can rescue exocytosis by stimulating priming. The stimulation-of-priming effect is dependent on endophilin A1 and A3's SH3 domain since expression of BAR-domain only constructs was not able to rescue the reduced burst size in chromaffin cells without endophilins. Most interestingly, endophilin with two point mutations that disrupt endophilin-intersectin interaction was not able to rescue the secretion. We report that in addition to its well established role in endocytosis, endophilin-A also plays a role in exocytosis of secretory vesicles.

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[6] Model-free inference of synaptic connectivity from spike trains

Jose Casadiego[1], Dimitra Maoutsa[2], and Marc Timme[1,3,4]

[1]Max Planck Institute for Dynamics and Self-Organization, Göttingen; [2]Faculty of Mathematics and Computer Science, Georg August University, Göttingen; [3]Institute for Nonlinear Dynamics, Faculty of Physics, Georg August University, Göttingen; [4]Bernstein Center for Computational Neuroscience (BCCN), Göttingen

Determining the synaptic connectivity of neural networks from their collective dynamics still poses a great challenge to current science. Up-to-date approaches either (i) require access to intracellular recordings and detailed models, or (ii) infer functional connectivities from similarity measures computed on spike trains. However, intra-cellular recordings may be difficult to perform on all neurons simulatenously, models may not be known for real-world problems, and functional connectivities are known to be

prone to recover spurious connections. Here, we propose a model independent approach for inferring the synaptic connectivity of neural networks from spike trains alone. By representing the spike trains in high dimensional event spaces, we determine the synaptic connections from linear approximations in such spaces. These approximations provide accurate mappings from recorded spike trains to synaptic connections. We demonstrate the efficiency of our approach by successfully reconstructing networks of Leaky Integrate-and-Fire (LIF) neurons from their spike trains alone under different dynamical conditions.

Endophilin-A deficiency causes age-dependent motor impairments and neurodegeneration in mice [7]

Christine Rostosky[1], and Ira Milosevic[1]

[1]European Neuroscience Institute Göttingen, Synaptic Vesicle Dynamics

Fast turnover of synaptic vesicles in neurons is essential to sustain the functionality of neuronal networks. Defects in endocytosis have previously been shown to cause loss of synapses and ultimately neurodegeneration. Endophilin-A is a key endocytic protein involved in both clathrin-mediated endocytosis and clathrin-independent endocytosis. In clathrin-mediated endocytosis, endophilin-A is thought to help in the recruitment of the GTPase dynamin and the phosphatase synaptojanin-1, which are essential for fission and uncoating of synaptic vesicles (SV), respectively. In previous studies it has been demonstrated that ablations of endophilin-A or synaptojanin-1 cause early lethality and impaired synaptic transmission in mice. In this study we aimed to characterize locomotion and neuronal morphology in animals with partial absence of endophilin-A or synaptojanin-1 using behavior tests and advanced imaging techniques. We show here that mice with partial loss of endophilin-A exhibit prominent motor impairments, increased cell death and neurodegeneration.

These changes depend both on age and the number of missing alleles of endophilin-A. However, the phenotype is not observed in mice with partial loss of synaptojanin-1. Altogether, our results suggest that endophilin deficiency, and not defective SV uncoating, lead to motor impairments and neurodegeneration.

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[8] "Yes, I experiment with animals" - How grassroots initiative Pro-Test Deutschland communicates science to the public

Peter M. Kraemer[1]

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Animal research is essential in neuroscience. Despite its relevance for the progress in basic and biomedical research, animal experiments are viewed with skepticism by large parts of the European population. This is shown by the support of more than 1.1 million people for the "Stop Vivisection" campaign which demanded the "full abolition of animal experiments" in the EU. One explanation of this opposing attitude is wide-spread ignorance of the actual ethical and practical standards in European laboratories. Various groups of animal rights activists endorse skewed beliefs by supplying lacking or even misleading information about both the conditions in animal testing and the general usefulness of its outcomes. On the other hand, research institutions often fail to communicate the conditions under which animal research is conducted. Reasons for that may include the unpopularity of this topic due to its ethical challenges. Additionally rigid structures in institutions may often impede open communication. Therefore, a group of committed young people found it imperative to have an independent platform for communication, founding the association Pro-Test Deutschland e.V. to fill that gap. Pro-Test supplies information to the general public to help understanding the role of animal experiments in basic and biomedical research. They discuss scientific, ethical, legal, social and psychological

aspects of animal research, using multiple channels of communication: social media, public debates, flyers, press and media work etc. Here the motivations behind founding Pro-Test Deutschland are discussed alongside with its relative successes so far. Furthermore future directions are outlined and opportunities for active or passive participation are pointed out.

Layer-specific intracortical microstimulation of the auditory cortex in vivo [9]

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Electrical stimulation of cortical neurons is used to activate cortical networks in a defined way to compensate a lost sensory or cognitive function. However, the techniques used in humans mainly provided unspecific sensations. We assume that this is the consequence of a broad, abnormal pattern of cortical activation that could be improved by layer-specific microstimulation mimicking the normal layer-specific response profile. By combining intracortical microstimulation and extracellular recordings on the same shank of a linear multi-electrode array, we investigated whether single pulses of low-current, layer-specific intracortical microstimulation (lsICMS) can stimulate the cortical network in a depth-dependent manner. A 16-channel Neuronexus array was used to record neural responses during lsICMS (varying current and stimulation depth) in the auditory cortex of 8 guinea pigs under ketamine/xylazine anesthesia. Responses of cortical neurons, including both local field potentials and multi-unit activity, showed a significant dependence on the stimulation current as well as the stimulation depth under the cortical surface. A cross-correlation analysis of current source density profiles evoked by electrical and acoustic stimulation revealed that neural activation most closely resembling the natural columnar response was

achieved by stimulation of middle layers. Histological analyses excluded current-related damage (Nissl, cytochrome-oxidase, and SMI-32 staining). Consequently it is possible to combine intracortical microstimulation and nearby extracellular recordings on one shank of a multi-electrode array. By the close recording we could reduce the stimulation current down to levels near the threshold for behavioral responses. Such low-current pulses activated the cortical network in a layer-specific manner. Stimulation of the thalamo-recipient granular layer IV led to the most natural response patterns. These results support the usefulness of lsICMS for the improvement of cortical neuroprostheses.
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[10] A study of inheritance trait and neurocognition aspects in relation with lefthanders

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Introduction : Approximately 10% of humans prefer to use their left hand for manual actions. Inadequate research, the results are not conclusive. As handedness is biologically and genetically linked, so it has various effects on one's behavior and abilities. Till now, there are many reviews of literature about the abilities and traits of left-handers indicate their high intelligence level but because of inadequate research, the results are not conclusive. Methods : This is observational based study using cross sectional approach to determine correlation between inheritance trait and neurocognition in lefthanders. There are 58 sample using total sampling from medical students in Hasanuddin University. Both group were taken from the same level education in medical faculty. This study will assess of inheritance trait of lefthander. For neurocognition, there are some aspects were assessed, such

as intelligence, learning, memory and concentration. Results: This study showed that left hander have a significant correlation with inheritance (p=0,000). Digit span test for forward (p=0,882) and backward memory test (p=0,593), there was no significant results and also for length of memory using digit span test, forward (p=0,893) and backward (p=0,596). Raven test showed lefthander more superior intelligence than righthander, but statistically, both group even in inteligence score (p=0,986) and time taken for the test (p=0,135) there is no significant results. The test of attention both group using TMT A (p=0,465) and TMT B (p=0,646). Lefthander group took less time to accomplished the test for attention. For learning style, both of group have visual on their learning style commonly. Conclusion : This study presented the correlation between inheritance trait to lefthander group. There was no significant neurocognition and intelligence correlation between lefthander group and righthander group when we controlled age and various of educational level. Keyword : Inheritance, Neurocognition, Lefthander.

Nanoscale probing of single synapse function and BDNF cell-to-cell transfer [11]

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The Brain-derived neurotrophic factor (BDNF) is one of the key modulator/mediator molecules for synaptic plasticity in the adult nervous system and also coordinates neural development, survival, differentiation and axon growth during development in the central and the peripheral nervous system. The understanding of our brain critically depends on the detailed understanding of the regulatory mechanisms for and of molecules like BDNF. Recent research has implicated that BDNF is recruited specifically to active synapses to modulate their function which has not been

demonstrated, additionally it is debated whether BDNF is released from post- or presynaptic sites and a modulatory function was also demonstrated for astrocytes implying that the activity spectrum of BDNF is even larger than already known. Here we propose and investigate a novel strategy to achieve focal stimulation of neurons using optogenetics, with the ultimate goal to study the influence of activity on the recruitment and release of the neurotrophic factor BDNF. We demonstrate the utility of current optogenetic tools to achieve highly focal depolarization and further examined a proof-of-principle of nanoscale activation using an initial macroscale approach. Using dissociated and organotypic hippocampal cultures from the rat, in which we coexpress BDNF-mRFP1 and a cytosolic fluorophore to identify the cell of origin we tested the influence of focal optogenetic activated sites on BDNF trafficking and further extended the study to the cell-to-cell transfer of BDNF to neighboring cells, where we found that BDNF was preferentially taken up by astrocytes and provide evidence for BDNF-mediate physiological effects on the astrocytic population.

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[12] Wiring and information processing in an amphibian olfactory network

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The glomerular layer of the main olfactory bulb is characterized by an array of ovoid neuropil agglomerates, the olfactory glomeruli. They represent the first relay station of olfactory information processing where the axon terminals of olfactory receptor neurons synapse onto the apical dendrites of mitral/tufted

cells. In rodents, each glomerulus is innervated by the single, unbranched axons of a particular population of olfactory receptor neurons. Remarkably in larval and adult *Xenopus laevis*, the axons of olfactory receptor neurons bifurcate and terminate in one or multiple anatomically distinct glomeruli. Via single cell electroporation and fast two photon calcium imaging we demonstrated the functional connection of both axon terminals with their respective glomerulus. In addition, we characterized the exact position and chemosensory map of an amino-acid responsive cluster in the ventro-lateral main olfactory bulb of larval Xenopus. Despite the unparcellated morphology of the cluster, we were able to derive the morphology of various glomeruli from the odor induced activity of mitral/tufted cell apical tufts. Single cell electroporation experiments revealed that the vast majority of mitral/tufted cells in the ventro-lateral bulb exhibited multiple apical dendrites projecting their tufts into either one or multiple anatomically distinct glomeruli. The targeting of multiple glomeruli by single neurons from both, the pre- and postsynaptic side, rules in the possibility of a yet unprecedented olfactory wiring logic. We are currently using transsynaptic tracing or a combination of single cell electroporation and two photon calcium imaging in order to understand the significance of this unique circuitry for vertebrate olfaction in general.

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[13]

Response properties of first-order interneurons in the fly visual system

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Changes in light intensity are a core feature of the visual world, that provide animals with important information from the environment. The nervous system must interpret patterns of contrast in order to correctly guide behavioral responses [1]. Contrast coding is therefore one of the most important features of the visual system. But how is contrast information actually encoded in the brain? Where precisely is contrast coding happening and what are the molecular mechanisms underlying it? To answer these questions, we will focus on the visual system of Drosophila. In the fly, two distinct parallel motion pathways have been described, that are specialized for detecting contrast increments (ON) or decrements (OFF) [2]. These pathways segregate downstream of photoreceptors at the level of the lamina neurons L1, L2 and L3. L1 is the input to the ON pathway, whereas both L2 and L3 provide input to the OFF pathway [2,3]. While L2 and L3 receive the same photoreceptor input, they possess very different physiological properties [2]. Whereas calcium signals in L2 axon terminals are transient, calcium responses in L3 axon terminals are sustained [3], suggesting that L2 provides downstream circuits with information about recent changes in luminance and thus encodes contrast, whereas the L3 properties are consistent with the encoding of luminance. We are using in vivo two photon calcium imaging in combination with visual stimulation as well as genetic molecular and circuit manipulations to identify the mechanisms that shape these fundamentally different OFF pathways. Using Drosophila as a model will allow us to link the potential cellular or molecular mechanisms back to circuit computations and behavior.

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Annu Rev Neurosci 2014;37:307-27. [3] Fisher et al. Curr Biol 2015;25:3178-89

The effect of increased levels of miR-132 on dopaminergic primary midbrain neurons [14]

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Parkinson's Disease (PD) is an age-related neurodegenerative disease, prevalent in up to 2% of individuals aged over 60 years. PD is characterized by marked cell loss in the substantia nigra and consequent dopamine depletion in the striatum, triggering serious deficits on motor control. The late diagnosis of PD and the limited regenerative capability of neurons in the central nervous system aggravate treatment and recovery possibilities for patients. miRNAs regulate gene expression post-transcriptionally, targeting messenger RNAs and leading to cleavage or translational suppression of those. Defects in the miRNA network are known to be involved in several pathogenic processes. By manipulation of miRNA expression levels, neuroprotective and neuroregenerative strategies might be explored, aiming the development of novel therapeutic alternatives. Previously, we identified changes in miRNA expression levels in PMNs upon development which are closely involved in maturation of dopaminergic neurons. miR-132 was found highly regulated during development and thus might contribute potentially to neuroregenerative/neuroprotective mechanisms. Here we investigated the effects of increased levels of miR-132 in dopaminergic PMNs. For that, cultured cells were transfected with a synthetic miR-132

mimic. After TH-immunostaining, average neurite length and regeneration in dopaminergic neurons were measured by neurite tracing. High levels of miR-132 significantly increased neurite outgrowth and regeneration in dopaminergic PMNs. We speculate that these effects are mediated by repression of P250GAP, a miR-132 target protein. This GTPase-activating protein regulates actin dynamics supressing the RAC1-PAK actin remodelling pathway and thus, directly influences neurite morphogenesis. Increasing miR-132 levels led to reduced P250GAP levels in PMNs. Our results indicate that miR-132 plays an important role in dopaminergic morphogenesis and regeneration, showing that it might be a valuable tool for the development of novel curative treatments for this disease.

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[15] Metabolic Regulation of Axonal Growth during Development

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During development, sensory axons in the peripheral nervous system (PNS) need to couple their robust axonal growth to their energetic homeostasis. The mechanisms that regulate this coupling are largely unknown. We have examined the role of Liver Kinase B1 (LKB1), a master regulator of energy homeostasis, in the developing PNS. We have found that genetic ablation of LKB1 cause axonal degeneration during development in vivo and reduced axonal growth of cultured embryonic sensory neurons in vitro. Biochemical analysis of LKB1 KO sensory neurons revealed a metabolic aberration that is manifested by reduced levels of ATP. Additional genomic analysis of the LKB1 KO sensory neurons uncovered deregulation of Mitocalcin, a mitochondrial

Ca^{2+}-binding protein. Interestingly, analysis of the Mitocalcin KO mice revealed reduced axonal growth during development and hyperactivation of the metabolic sensor AMPK. Overall, our work uncovers a new metabolic pathway that is required for axonal growth during development.

Tissue level optical benefits of photoreceptor nuclei inversion [16]

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The vertebrate retina bears the odd evolutionary heritage of being inverted, necessitating photons to travel through hundreds of microns of living neuronal tissue before detection by the photoreceptor outer segments. Owing to the large cell number density of the photoreceptors a large volume-fraction of the tissue are nuclei that can potentially scatter light. These retinal photoreceptor nuclei in nocturnal mammals postnatally undergo a hallmark process of inversion in their chromatin architecture [1]. Interferometric measurements and simulations, suggested that this chromatin re-arrangement could lead to reduced light scattering and it was shown that individual nuclei possess the optical quality of lenses [2],[3]. Subsequently, predictions about light transmission at tissue level were made on the basis of simulation. Using the concept of modulation transfer we now aim to experimentally verify the optical benefit stemming from this nuclear inversion on tissue level. Specifically a comparative optical characterisation of wild type and a transgenic mice retina lacking inverted nuclei is presented. Further results indicate that the optical quality of the retina improves during terminal retina development, the period in which the unique inversion of nuclei takes place.

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[3] Błaszczak, Z., Kreysing, M. & Guck, J. Direct observation of light focusing by single "photoreceptor cell nuclei. Opt. Express 22, 11043 (2014).

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[17] Differential modulation of foreground and background in early visual cortex by feedback during bistable Gestalt perception

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A growing body of literature suggests that feedback modulation of early visual processing is ubiquitous and central to cortical computation. In particular stimuli with high-level content have been shown to suppress early visual regions, typically interpreted in the framework of predictive coding. However, physical stimulus differences can preclude clear interpretations in terms of feedback. Here we examined activity modulation in the early visual cortex (V1 and V2) using fMRI during distinct perceptual states associated to the same physical input. This ensures in a unique way that observed signal modulations cannot be accounted for by changes in physical stimulus properties, and can therefore only be accounted for by percept-related feedback interactions from higher level regions. We used a dynamic stimulus consisting of

moving dots that could either be perceived as corners of a large moving square (global Gestalt) or as distributed sets of locally moving dots. We found that perceptual binding of local moving elements into an illusory Gestalt led to spatially segregated differential modulations, in both, V1 and V2: retinotopic representations of illusory lines and foreground were enhanced, while inducers and background suppressed. The results extend prior findings to the illusory-perceptual state of physically un-changed stimuli, and show percept-driven background suppression in the human brain. Based on prior work, we hypothesize that parietal cortex is responsible for the modulations through recurrent connections in a predictive coding account of visual processing.

The effects of adenosinergic system modulation on TNF-α and IL-1β levels in the brain after PTZ-induced convulsive seizure [18]

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Epilepsy is an important pathological conditions characterized by recurrent seizures and affects approximately 1% of the population. Current studies indicated that there might be some relation between epilepsy and inflammation. Adenosinergic system affects epileptic seizures by regulating the secretion of neurotransmitters systems. The aim of this study to is investigate to the progression the inflamatuar processes during the PTZ-induced convulsive seizure and its possible interaction with adenosinergic system. Convulsive seizures were induced by pentylenetetrazol(PTZ, 60 mg/kg/ip) in male Wistar-albino rats, and the effect of caffeine(5 mg/kg/ip) and adenosine(500 mg/kg/ip) on seizure activity and TNF-α and IL-1β levels were evaluated. According

to our study results; there is no significant difference between saline and tween20 groups for TNF-α and IL-1β levels in cortex and thalamus (p>0,05). However, TNF-α and IL-1β were found to be significantly increased in PTZ induced seizure group. There is no significant difference in any parameter between PTZ and PTZ+caffeine (p>0,05). A significant difference was found between PTZ and PTZ+adenosine groups for TNF-α and IL-1β levels in cortex and thalamus (p<0,05). We observed a significant delay in seizures latency (p<0,05) and decline TNF-α and IL-1β levels in adenosine+PTZ group compare to PTZ. According to this result; the decrement of TNF-α and IL-1β levels might be related with the prolongation seizure latency. It has been found a significant difference between PTZ and saline groups for level of TNF-α in cortex and thalamus (p<0,05) but not for IL-1β level in cortex (p>0,05). In accordance with recent study, adenosine may play an important role in modulation of seizure activity and cytokines levels.

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[19] Uncovering the principles of voltage-gated calcium channel subtype-specific composition at a fast firing central nervous synapse

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Neuronal information flow requires tight regulation of synaptic vesicle (SV) release probability which directly correlates with the number of voltage-gated calcium channels (VGCCs) within

active zones (AZs). Since VGCC subtypes differ in activation kinetics, pharmacology and modulation by cellular messengers, VGCC composition directly impact SV release kinetics. In CNS synapses SV release in response to action potentials (AP) is mediated by a mixture of CaV2 isoforms or exclusively CaV2.1, depending on developmental stage and demands of the neuronal circuit. Studies in primary hippocampal neurons proposed specific, saturated slots with the highest affinity for CaV2.2 that define the total amount of VGCC in AZs. However, it is known that synapses within high fidelity transmission circuits exclusively utilize CaV2.1, while other presynaptic terminals can rapidly increase CaV2 subtype levels. Thus, it remains unknown in native neuronal circuits if slots are saturated and if CaV2 subtype levels affinity is determined by the neuronal circuit demand. To test this, we utilize the calyx of Held, a giant synapse in the auditory brainstem with unparalleled experimental accessibility and similarities to single release sites in presynaptic terminals. Furthermore, during neuronal circuit maturation the calyx transitions from a mixture of CaV2 subtypes to exclusively CaV2.1 to encode high fidelity auditory information. We therefore use the developing calyx as a model to investigate the mechanisms that regulate VGCC composition and abundance within AZs. Using viral vector technology to overexpress CaV2.1 at the calyx in combination with direct presynaptic recordings at the calyx, we tested whether slots at the presynaptic terminal are saturated and if the composition of slots correlates with the calyces function as a high fidelity synapse.

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[20] Early Effects of Emotions Associated to Human Faces in Event-related Brain Potentials

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Facial expressions of emotion are preferentially processed over neutral faces due to their high relevance to the human's social life. This processing advantage has not only been demonstrated at the behavioral level but is also reflected in emotion-related modulations of several components of event-related potentials (ERPs). Recently, it has been proposed that inherently neutral stimuli might gain increased salience through learning mechanisms. In the present study, we aimed at investigating whether acquired emotional valence would result in processing advantages similar to emotional expressions by employing an associative learning paradigm. In the learning session, participants (N= 24) learned to categorize inherently neutral faces as positive, negative, or neutral by receiving monetary gain, loss, or zero outcome. ERPs were recorded in the test session while participants performed a gender decision task on these faces, as well as on faces expressing happy, angry or no emotion. Whereas ERP effects to emotional - primarily angry - expressions occurred in well-established emotion-related ERP components (P1, N170, EPN, LPC) starting 100 ms after stimulus onset, ERP effects of associated valence occurred only for P1 and N170 with distinguishable scalp distribution, indicating that learned emotional salience modulates very early perceptual processing stages. Interestingly, the P1 modulations were restricted to reward associations. However, the absence of any later ERP modulations by associated valence indicates that elaborate, sustained relevance processing is restricted to biologically determined salience, as in the case of inherent facial expressions of emotion.

Poster Session II

Autoantibodies against synapsin - a novel neuronal autoantigen [21]

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Autoantibodies against neuronal antigens are a hallmark of autoimmune encephalitis and are increasingly being identified in association with other neurological disorders. Synapsin, an intracellular, vesicle-associated phosphoprotein, was recently described as the main autoantibody target in a patient with non-paraneoplastic limbic encephalitis. To gain insight into the significance of synapsin as an autoantigen, we assessed the presence

of anti-synapsin IgG antibodies in 375 patients with neurological or psychiatric diseases and 57 healthy controls. HEK293 cells transfected with synapsin Ia were incubated with patient serum (and CSF, when available) and visualized using indirect immunofluorescence. Antibody specificity was assessed through co-localization assays with commercial antibodies in murine hippocampal cultures and through immunoblots with cortex homogenates from wild-type, synapsin I knockout and synapsin I/II/III knockout mice. Anti-synapsin IgG antibodies were detected in 23 patients (6.1%) and in none of the healthy controls. The majority (69.6%) of positive patients had a psychiatric diagnosis; however, no predominant disease could be discerned. Titer analysis showed titers ranging from 1:320 to 1:100,000. While the pathogenicity of the antibodies and the mechanisms of the immune response remain to be elucidated, synapsin should be added to the list of autoantigens associated with neurological and psychiatric disease.

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[22] **Effects of volume level and emotional content on spoken word processing**

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For visual stimuli of emotional content as pictures and written words, stimulus size has been shown to increase emotion effects in the early posterior negativity (EPN), a component of the event-related potentials indexing attention allocation during visual sensory encoding. In the present study, we addressed the question whether this enhanced relevance of larger (visual) stimuli might generalize to the auditory domain and whether auditory emotion effects are modulated by volume. Therefore, subjects were listening to spoken words with emotional or neutral content played at two different volume levels while event-related potentials were recorded. Negative emotional content led to an increased frontal

positivity and parieto-occipital negativity - a scalp distribution similar to the EPN - between $\sim$ 370 and 530 ms. Importantly, this emotion-related ERP component was not modulated by differences in volume level, which impacted early auditory processing, as reflected amplitudes of the N1 (80 130 ms) and P2 (130 265 ms) component as hypothesized. However, contrary to effects of stimulus size in the visual domain, volume level did not influence later ERP components. These findings indicate modality-specific and functionally independent attention mechanisms triggered by emotional content of spoken words and volume level.

Role of the autism risk gene QPRT in neuronal differentiation [23]

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Autism spectrum disorders (ASD) are complex and highly heritable disorders, with a strong involvement of CNVs (copy number variations). The aetiology of ASD is still largely unknown, but impaired processes of neuronal development are discussed as major pathomechanisms. We hypothesized that genes associated with ASD are related to morphological development during neuronal differentiation (ND). We performed a whole transcriptome (microarray) and morphological (Sholl) analysis of a neuroblastoma cell-line (SH-SY5Y) during BDNF-RA-induced ND to identify ASD risk-genes associated with neurite development. Weighted Gene Co-Expression Network Analysis revealed four ASD-risk gene enriched modules. Within these modules, 20 genes

were recurrently hit by CNVs as tested in 665 ASD patients compared to 1,320 unrelated controls. Of these genes, 35% were located in 16p11.2 - an ASD-associated region accounting for 1% of cases. Based on our observation that in lymphoblastoid cell lines of patients with 16p11.2 CNVs the expression levels (RT-PCR) of respective genes are altered, we conclude that loss of a genetic copy has functional impacts. We further observed that expression of QPRT (Quinolinate-phosphoribosyltransferase) in the SH-SY5Y model correlated with the development of neuritic morphology. Indeed, we report that a knockdown (siRNA) of QPRT in SH-SY5Y cells resulted in an altered complexity of neuritic branching reminiscent of immature cells. Upon complete knockout (CRISPR/Cas9) of QPRT, cells were viable in the proliferating state but died during ND. Thus, our results lead to the suggestion that an altered expression of QPRT, a downstream enzyme of the tryptophan pathway, may lead to an aberrant neuronal morphology and maturity as observed in post mortem studies of ASD patients.

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[24] Molecular mechanisms of dendritic formation and maintenance

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A crucial element of neuronal networks and their homeostatic plasticity are the dendritic trees, where neurons receive and begin to integrate information. The transmission and integration of information is heavily influenced by the structure of the dendritic tree, whose morphogenesis and maintenance are therefore highly regulated. Our research focuses on key proteins involved in these processes, namely the glutamatergic receptor interacting protein

(GRIP) 1 and its molecular partners. Previous work in the Acker-Palmer laboratory showed GRIP1 requirement for dendritic development and identified and molecularly characterized an interaction between GRIP1 and 14-3-3 proteins that is essential for the function of GRIP1 in dendritic cargo transport (Geiger et al, 2014). We also showed that GRIP bridges a complex including the Reelin receptor ApoER2, the signalling molecule ephrinB2 and AMPA receptors, regulating AMPA receptor new insertion into the dendritic membrane (Essmann et al, 2008; Pfennig et al, submitted).

In this context, my project aims to better understand the functions in dendritic and spine morphogenesis, as well as in synaptic plasticity, of GRIP1 and its partners ephrinB2 and ApoER2. More specifically, I focus on dendrite and spine morphogenesis in the young or adult hippocampus of mice lacking one or a combination of these signaling partners. I also investigate the role of these interactions in long-term potentiation and in the principal mechanism of short-term synaptic plasticity in central glutamatergic neurons, homeostatic synaptic scaling.

Effects of Reward-Associated, Task-Irrelevant Distractor on Target-Directed Oculomotor Task [25]

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Introduction: Reward-associated stimuli can provide top-down information regarding the relevance of bottom-up sensory signals and enhance task performance. However, rewarding stimuli could also impair performance when they are unrelated to the task at hand. For instance, a distractor transiently associated with a higher reward causes deviations of the saccadic trajectories directed towards a target.

Objectives: In previous paradigms, selection history and reward regimen could have rendered the distractor task-relevant. Here, we try to remedy this potential confound by using distractors that are never targets of the saccades and their link to rewards is established in an independent task.

Materials and Methods: Twelve subjects were tested in a darkened laboratory containing equipment for visual stimulus presentation and eye-tracking. Subjects learned reward pairings of two colours while performing a simple localization task. In a separate task, they were instructed to make an eye movement towards a target circle. A distractor circle with a colour previously linked to either high or low reward was presented simultaneously in the same vertical hemifield as the saccadic target.

Results: Pupil size measurements during the learning of reward pairing revealed increased pupil dilation after the presentation of colours associated with high rewards. In the eye movement task, saccadic deviations from the vertical meridian were observed for both conditions. Nevertheless, the deviations were significantly reduced when the distractor was presented with a high-reward associated colour.

Conclusion: These results show a value-driven enhancement of the performance during a target-directed saccadic task. We interpret the task-irrelevant distractor as a reward-associated cue that helps the top-down control mechanisms to overcome distraction. We conclude that whether task-irrelevant rewards enhance or impair tasks depend on the exact nature of the task and history of reward pairings.

Combined fMRI- and eyetracking-based decoding of bistable plaid motion perception [26]

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The phenomenon of bistable perception has been particularly useful in probing the neural bases of conscious perception. Study of bistability requires access to the observerś perceptual dynamics which is usually achieved via active report. Validity of active-report paradigms, however, is questioned due to issues such as response bias (when studying perceptual dominance in presence of incentives) or confounding of report and perception (when studying neural correlates of perception). To enhance usability of paradigms independent of active report, we optimized decoding procedure employing a combination of two biological measures of perception, namely brain activity patterns and eye movements. Twenty participants continuously observed a bistable visual plaid motion stimulus in 11 runs. Functional magnetic resonance imaging (fMRI) data and eye movements were recorded simultaneously during these runs. Multivariate pattern analysis (MVPA) using support-vector machine was adapted to decode participants' perceptual time courses from fMRI data and from eye movement patterns reflecting optokinetic nystagmus. Results revealed that both measures can individually offer high decoding accuracies (M=81, SD=7% and M=79, SD=11% for fMRI and eye-tracking, respectively). Additionally, classification based on the two measures together further improved the accuracy significantly ($p<0.001$, M=85, SD=7%). These findings show that combined MVPA of fMRI and eye movement data can be used to decode bistable plaid motion perception with high accuracy, thus offering a useful tool for the study of conscious perception in no-report paradigms.

[27] Estimating the dynamical state of a network from Local Field Potentials

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When studying the activity of the brain a persistent problem is that of incomplete information due to our inability to measure all neurons in the neuronal network at the same time. As an approximation the local field potential (LFP) is recorded. It is a coarse measure that sums activity of many neurons, but in turn sacrifices information on the activity of each individual neuron. We studied how this form of coarse sampling affects our inference about the dynamical state of the underlying spiking network. To that effect we used a branching process model and approximated the LFP as a weighted sum of the spiking activity of the surrounding neurons. To infer the state of the underlying network we employed avalanche analysis and also considered the power spectral density (PSD) of single electrodes.

We found that a variety of parameters both of the LFP generation model and of the analysis have a significant effect on the apparent state of the underlying network. More precisely, we investigated the popular hypothesis that the brain operates in a critical state - a state that maximizes processing capacity in models. We found that depending on the chosen parameters a sub-critical spiking network can appear as if it was in a critical state, and vice versa. This ambiguity can often be resolved by combining the established avalanche analysis with analysis of the PSD of the LFP. By comparing our models and LFP recordings from different preparations, we found indications that the decay in signal strength due to distance and the frequency dependent filtering is different between in vivo and in vitro experiments.

The role of microglia in brain pathology associated with Systemic inflammation [28]

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Microglia are macrophages that seed the neuro-epithelium early during embryonic development, expand and eventually reside in brain and spinal cord, where they intimately interact with neurons and other glial cells. During CNS development and adulthood, microglia prune excess neuronal synapses and thus critically contribute to the fitness of neuronal circuitries. Moreover, microglia are as CNS resident innate immune sensors poised to respond to peripheral challenges of the organism to orchestrate immune responses. The Jung laboratory recently introduced a novel tamoxifen (TAM)-inducible Cre/lox-based mouse model that allows the specific conditional mutagenesis of microglia in otherwise intact animals. Using this CX3CR1-CreER system, the group tests the impact of microglia production of pro-and anti-inflammatory agents as well as biological activities such as antigen presentation to T cells. Recently, we generated animals whose microglia lost critical control modules and thus respond to physiological stimulation with profound hyper-activation. Specifically, this includes mice whose microglia lack expression of the IL-10 receptor (IL-10R) or expression of small noncoding microRNAs (miRs), that are critical for post-transcriptional gene regulation. Here we will report our efforts to define the impact of microglia-hyperactivation on CNS functions. Specifically, LPS challenged mice harboring IL-10R-deficient microglia display severely enhanced sickness behavior. LPS challenged CX3CR1-CreER:dicer fl/- mice on the other hand, showed enhanced and prolonged impairment of hippocampal long-term potentiation (LTP), as measured by extracellular recordings on acute

slices prepared from dorsal hippocampi of the animals. Taken together, these two models provide us with a novel system to define the hippocampal microglia-neuron axis, potential involvement of other glia, and the peripheral events that trigger microglia activation.

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[29] Crucial role of right frontopolar cortex in directed exploration

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Effective adaptation in a dynamic and ever-changing environment requires optimizing the balance between exploiting well known options and exploring new ones. Recent behavioral evidence suggests that people use at least two distinct strategies while exploring the environment: directed and random exploration (Wilson et al, 2014). Directed exploration is driven by uncertainty and the need of obtaining essential information about the less known option while random exploration is driven by mechanisms related to behavioral variability. However, it has not yet been shown that these two types of behaviors have separate neural origins. In this study we present first causal evidence of the involvement of right frontopolar cortex (RFPC) in directed exploration. We designed a within-subject experiment using continuous theta bursts TMS protocol and a modified, sequential version of the Horizon Task (Wilson et al, 2014). We examined 16 participants in two conditions: vertex (control) and RFPC stimulation (experimental). Inhibiting the RFPC significantly reduced directed exploration while not affecting random

exploratory behaviors nor ambiguity preference. This finding establishes the uniquely human role RPFC plays in exploration and inspires the creation of more detailed, mechanistic models of higher cognitive functions.

Disease-like tau modification alters synaptic connectivity in old transgenic mice [30]

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Tau is a microtubule associated protein with mainly axonal localization under physiological condition. During tauopathies, like in Alzheimer‘s disease, tau becomes hyperphosphorylated and relocalizes to the somatodendritic compartment. The altered tau protein might modify the dynamics of the microtubules that transiently enter the spines and thereby influence spine morphing. To study the potential role of tau hyperphosphorylation on spine density and morphology, we analyzed 24 months old mice transgenic for human pseudohyperphosphorylated tau protein (PHP tau). PHP tau has ten phosphorylation-mimicking glutamate residues at sites, known to be phosphorylated to a high extent in AD brain. We focused our analysis on the second and third order dendritic segments of the pyramidal neurons in the stratum radiatum of the CA1 subfield of the hippocampus. Mice of both genders were analyzed. High-resolution confocal laser scanning micrographs of at least 25 μm long dendritic segments were subjected to algorithm-based analysis by the 3DMA software. We observed significant reduction in spine density in both female and male transgenic mice compared to non-transgenic controls. Furthermore, we observed significant reduction in fraction of mushroom shaped spines in PHP mice in both sexes, while there was a significant increase in the fraction of stubby spines in male PHP mice. There were no significant changes in the fraction of thin spines. Our data indicate that disease-like modified tau

induces synaptotoxicity, thereby altering synaptic connectivity in hippocampal neurons of old transgenic mice.

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[31] Identification and characterization of Piezo2 interactors

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Somatosensation (sense of touch, pain, temperature etc.) remains the most uncharacterized sense in vertebrates. The ability of somatosensory neurons to perceive mechanical stimuli relies on specialized mechanotransducing proteins and their molecular environment. Only recently a major transducer of mechanical forces in vertebrate somatosensation has been revealed by the discovery of Piezo2. Further work has established its pivotal role for innocuous touch in mice. Notably, elegant work in other mechanosensory systems (e.g. *D. melanogaster* and *C. elegans*) demonstrated the involvement of a complex molecular machinery in the detection of mechanical stimuli. However, in vertebrates this complex remains largely unexplored and Piezo2 provides a unique platform for its molecular investigation. We aimed at identifying novel proteins implicated in mechanotransduction by determination of Piezo2 binding partners. Towards this goal, we performed a quantitative mass spectrometry-based interactomics screen on native Piezo2, immunoaffinity-purified from somatosensory neurons of mouse dorsal root ganglia (DRG). By means of stringent statistical analysis we identified 36 novel binding partners of Piezo2. Among these candidates were previously reported modulators of somatosensory mechanotransduction showing the biological significance of our results. The next stage of the project involves studying specific candidates with regard to their role in Piezo2-mediated mechanotransduction.

Investigation of polyadenylation status of Neuroligin-1 transcript at synapses [32]

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Synapses are very dynamic structures adjusting to changing environment in response to stimulation. In neurons a subset of mRNAs is transported to dendrites and locally translated in response to synaptic stimulation. The question is how certain mRNAs are activated while others remain dormant. It is proposed that cytoplasmic mRNA polyadenylation at synapses plays important role in translational control, what has been proved for several dendritically localized transcripts such as CaMKII or MMP-9. Neuroligin-1 (NLG1) is a postsynaptic adhesion molecule, involved in the formation and maintenance of synapses by binding to its presynaptic ligand - neurexin (NRXN). Neuroligins are locally translated at the synapse. Therefore we asked whether neuroligin-1 transcript is polyadenylated at synapses in response to stimulation. To assess NLG1 mRNA polyadenylation status we isolated RNA from synaptoneurosomes freshly prepared from mouse brain. Synaptoneurosomes were in vitro stimulated using NMDA and glutamate. Next, we analyzed Poly(A) tails length using PAT assay. We have observed that neuroligin-1 mRNA polyadenylation changes in an activity-dependent manner. Our results show that in synaptoneurosomes glutamate-induced signalling can stimulate neuroligin-1 mRNA polyadenylation.

[33] Orientation and organization of Bassoon: from the Golgi to the synapse.

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Bassoon is one of the largest scaffolding proteins in the cytomatrix of active zones (CAZ) of a neuron's presynaptic terminal. The CAZ is a specialized sub-compartment assembled in close proximity to the neurotransmitter release site, or active zone, and consists of interconnected scaffolding proteins. The CAZ promotes short-term and long-term plasticity by enabling priming and docking of synaptic vesicles and binding to Ca^{2+} channels. Despite its integral role in presynaptic transmission, the mechanisms of mammalian CAZ formation and maturation are still poorly understood.

Bassoon is one of the first proteins to be incorporated into young synapses and enhances their stability. At the synapse, Bassoon is oriented with it C-terminus towards the plasmemembrane and the N-terminus towards synaptic vesicles. To analyze the biogenesis of the CAZ, we generated single and double tagged full-length Bassoon constructs optimized for super-resolution imaging. Using nanobodies against the fluorescent tags and stimulated emission depletion (STED) nanoscopy, we resolved and characterized the orientation of the N- and C-termini of the protein in cultured neurons. Using FLIM imaging we probed the intermolecular organization of neighboring Bassoon molecules.

At the Golgi-apparatus, where CAZ precursors are thought to be assembled, Bassoon was oriented with its N-terminus towards and its C-terminus away from the trans-Golgi network. Both at the Golgi and at synapses the N-termini of two Bassoon molecules

were close enough to each other to undergo FRET, whereas the C-termini were not. Based on these data we discuss a model of the orientation of Bassoon attached to membranes at different steps of trafficking between the Golgi and the synapse. The study also introduces Bassoon as a molecular ruler to compare orientation of other CAZ and synaptic proteins at the mammalian synapse.

Frontal midline theta during solving supercomplex working memory tasks [34]

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The main aim of this study was to reveal EEG correlates of individual differences in working memory performance. The final sample included 65 women (mean age = 20,92, SD = 2,96). The random sequences of letters of the alphabet were used as stimuli for WM task. Participants were instructed to memorize sets of 5, 6 and 7 letters either without any manipulations (retrieval task) or after mental recombination of letters in the alphabetic order (manipulation task). EEG data were collected from 19 sites according to standard 10-20 system. EEG data analysis preceded the division of participants into 2 groups: the high performance group (HPG) and the low performance group (LPG) (the 1st median and the 2nd). Measured characteristics of EEG frontal midline theta (FMT) during manipulation or retrieval of information in WM were compared in two groups. The obtained behavioral data have shown rather uniform and similar dynamics in decreasing of correct answers quantity in process of tasks' complexity increasing. However, changes of FMT in different groups had pronounced differences. HPG had systematic increasing power of FMT from easy to the moderate difficulty tasks with stabilization on the most difficult ones (memorizing of 7 letters in the alphabetic order). Meanwhile in LPG there was a sharp falling

of FMT after achievement of its maximum activation in the moderate difficulty tasks. This "overload" effect of WM obtained on the supercomplex tasks and on a large sample of subjects propose crucial role of FMT activation in individual differences in WM performance.

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[35] Forebrain-specific knockout of acetyltransferase Tip60/Kat5 causes massive transcriptional changes and progressive neurodegeneration in the hippocampus

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Protein acetylation is a rapid and reversible posttranslational modification, which is important for normal cellular function. In neurons, it has a pivotal role in synaptic plasticity, which has been best studied in the context of gene regulation at the level of histones. The acetylation status of proteins is determined by the counteracting activities of acetyltransferases (KATs) and deacetylases (KDACs). While there has already been an extensive amount of studies on the roles of KDACs in the CNS, studies on KATs are - with a few exceptions - still lacking. Here, we characterize the role of Tip60/Kat5, which is a member of the highly conserved MYST family of KATs, in the hippocampus. We use an inducible knockout mouse model to study Tip60's functions, restricting gene deletion to excitatory neurons of the forebrain. In this model, we have conducted a series of molecular analyses in order to identify the effects of Tip60 deficiency. Already 10 days after gene deletion, we observed wide-spread changes in the CA1 transcriptome, including upregulation of several immediate

early genes (IEGs), e.g. Npas4 and c-Fos. Moreover, we identified upregulation of Npas4 target genes involved in neuroprotection, consistent with the aberrant neuronal activity indicated by permanent IEG upregulation. Later in life, Tip60-deficient mice show seizures accompanied by extensive neurodegeneration in the hippocampus. Based on this work, we propose that Tip60 has an important role in neuronal homeostasis as well as neuronal viability.

Disrupted Lateralization in Motor Control in Congenital Mirror Movement Disorder with RAD51 mutation [36]

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Mirror movements (MM) are unintended, non-suppressible contralateral mirroring movements of intended side of the body. Execution of a unilateral movement requires the contribution of a complex network of motor system whereas symmetrical homologous muscle contradiction requires less cortical activation. Disruption in the interaction of the complex network results mirroring activity on the unintended side. Congenital cases of mirror movement disorder (MMD) constitute a unique opportunity to

investigate lateralization in motor control, i.e. the intricate cortical network and mechanisms that subserve movement. Here we report functional and structural connectivity changes in 2 cases (F/M: 0/2, $\mu \pm \sigma$: 29.5 ± 0.71) with congenital mirror movement disorder. Importantly, the genetic basis of MMD in these patients has been linked to a RAD 51 haploinsufficiency.

Compared to a control group that was matched in age-, sex-, and socio-economic status (n=10, F/M:0/10, $\mu \pm \sigma : 30.9 \pm 5.04$) the MMD patients exhibited i) an abnormal decussation of the corticospinal tract, ii) increased grey matter volume in the cerebellum accompanied by an abnormal functional shift in the cerebellum during unilateral movements, iii) disrupted microstructural integrity in the middle cerebellar peduncle, and the afferent cortico-ponto-cerebellar tract, and iv) decreased functional connectivity within the DMN as well as the motor network.

Lateralization requires fine-tuned interaction between interhemispheric, corticocerebellar communications and corticospinal wiring which are critical for fine-tuning of voluntary motor movement and gating by integrating the information from cognitive and sensory areas of the cortex. Affected lateralization of motor communication was identified to unveil function of RAD51 gene in neurodevelopment.

Key words: Mirror movement, fMRI, DTI, motor, lateralization, RAD51

Network analysis in medicinal leech ganglia based on voltage-sensitive dye recording [37]

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In our study we use the relatively simple nervous system of the medicinal leech to investigate how the properties of neurons and their connections with each other produce a specific behavior. The leech is a segmented annelid with one neural ganglion per segment. Each contains 400 neurons, which are responsible for sensory processing and motor control of the corresponding body part.

Our main experimental method is voltage-sensitive dye (VSD) recording of neuronal activity. It allows recording of the activity of around 100 neurons simultaneously over a short period of time. The experimental work is complemented by data analysis techniques to determine the network topology and causal relations between different cell types. To accomplish this goal, the time-series of various cells in the VSD recordings are compared with theoretical methods like Granger causality analysis, convergent cross mapping and information theoretic approaches. The application of these methods for fMRI network analysis was demonstrated in several publications (e.g. Roebroeck 2005, Bressler, 2011), leading to the assumption that they could also be used for detecting directional connectivity in time-series recordings from VSD experiments. However, since time-series analysis often just shows predictive causality the results are compared with physiological knowledge about the leech ganglion.

As a first step for discovering the structure of an un-known neuronal network, the combination of experimental and theoretical approaches revealed a connection between the sensory neurons and a cell of unknown function, the AP cell. This cell is now investigated further via intracellular recordings and cell staining, showing its morphology and the spatial structure of putative synaptic connections.

[38] Exploring the Protein Signature of Chronic Pain

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Pain is the worldwide number one reason for people to seek medical assistance. Unlike acute pain, which can be treated, effective chronic pain therapies remain elusive since a deeper understanding of molecular mechanisms is necessary. People suffering from pathological pain forfeit quality of life, combined with restriction in their professional life producing economic costs. Therefore, a major goal is the investigation of therapeutics targeting mediators of chronic pain, while leaving nociception intact. Hence, targeting differentially expressed molecules in the beginning of the pain axis presents a promising analgesic strategy in pain research. We employed unbiased mass spectrometry on membrane-enriched fractions of peripheral sensory neurons of dorsal root ganglia (DRG) and compared two mouse models of chronic pain. Our results revealed differentially regulated proteins including commonly known pain players and dozens of proteins, which have not been related to pain before. Our major focus lies on the latter group of proteins, since these may contribute to the characterization of novel signaling pathways relevant and specific for chronic pain models in mice. Considering that, the project aims at functionally characterizing two of these specifically regulated proteins using a wide variety of in vitro (biochemistry, microscopy, primary neuronal cultures, calcium imaging) and in vivo (mouse pain models, in vivo gene transfer, mouse behavior studies) techniques.

Identification and functional characterization of Piezo2-associated proteins involved in vertebrate mechanosensation [39]

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Mechanosensation remains the least understood sense in vertebrates. It requires the activation of specialised neurons which innervate the skin and internal organs of vertebrates. These somatosensory neurons are commonly believed to express distinct mechanosensitive proteins to facilitate mechanotransduction, the conversion of mechanical stimuli into electrical signals. After decades of investigating the molecular identity of such transducers in the vertebrate somatosensory system, Piezo2 was recently discovered to represent a novel bona-fide mechanosensitive ion channel. As little is known about the workings of this channel, let alone its interactome, we aim at identifying and characterising Piezo2-associated proteins. Several significantly associated proteins have been identified using affinity purification of native Piezo2 from sensory neurons and quantitative mass spectrometry followed by stringent statistical analysis. Among identified candidates of the Piezo2-interactome, three particular ones have previously been reported to cooperate in specific cargo trafficking events. In order to assess their functional significance for Piezo2 physiology, we compared mechanically activated whole-cell currents of cultured sensory neurons transfected with anti-candidate siRNA to non-targeting siRNA. These studies revealed a profound decrease in the current amplitude of Piezo2-mediated rapidly-inactivating currents. Further efforts to define this interaction will include in vitro immunohistochemistry, in situ immunohistochemistry and in vivo behavioural assays to evaluate the significance for the sense of touch.

[40]

Inner hair cells require endophilin A for efficient vesicle replenishment

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Murine auditory inner hair cells (IHC) exhibit high rates of synaptic vesicle (SV) transmission over long periods of time. This challenging task requires fine-tuned exocytic processes as well as efficient endocytosis and adapted SV replenishment. So far, mechanisms and mediators in IHC endocytosis are poorly understood.

The protein family endophilin A1-A3 plays an essential role in neuronal clathrin-mediated endocytosis but also in clathrin-independent endocytosis, as recent studies substantiated. It is thought to mediate the recruitment of proteins involved in several steps like membrane bending, fission, and SV uncoating. Yet, the role of endophilin A1-A3 in IHCs remains to be investigated.

In the present study, we combined morphological approaches with electrophysiological measurements to reveal the impact of endophilin A1-A3 on IHC exocytosis and endocytosis.

Based on our results, absence of endophilin A genes does not alter size or shape of synaptic ribbons. However, knockouts of en-

dophilin A1 and A3 (here labeled 1KO-2Wt-3KO) exhibit slightly reduced numbers of SVs around the ribbon. This effect is more severe if the mice are additionally heterozygous for A2 (1KO-2Ht-3KO). Furthermore, more coated structures were present within 1 μm proximity of the ribbon in 1KO-2Ht-3KO than in 1KO-2Wt-3KO. Patch-clamp recordings revealed that sustained exocytosis that requires efficient replenishment of SVs is impaired in 1KO-2Wt-3KO mice as well as in 1KO-2Ht-3KO. The kinetics of slow endocytic membrane retrieval in 1KO-2Wt-3KO was comparable to wild-type mice, while fast endocytosis recruited upon stronger membrane turnover was slowed down.

Disentangling Effects of Motivational, Associated, and Inherent Emotional Salience: Evidence from Event-Related Brain Potentials (ERPs) [41]

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Many studies indicate a tight relationship between cognition, emotion and motivation. Emotional as well as motivational factors have been demonstrated to modulate the processing of different kind of stimuli at various processing stages, ranging from initial perception to elaborate stimulus evaluation. There is growing evidence that emotionally and motivationally salient stimuli are preferentially processed which is reflected not only on a behavioral but also on a neural level. Recently, it has been proposed that this processing advantage is not limited to stimuli of emotional content. Rather also inherently neutral stimuli have been shown to gain increased salience through motivational context and learning mechanisms. In the present study, we aimed at disentangling impacts of motivational, associated, and inherent

emotional salience on face perception by means of ERPs. During a learning session, participants (N=34) performed a prime-target face-matching task while neutral target faces were associated with monetary gain, loss or zero outcome. Feedback conditions were indicated by cues prior to the subliminally presented prime faces. On the following day, participants performed the same task, without monetary feedback, on the previously learned faces and, in addition, on unfamiliar faces showing happy, angry, or neutral expressions. All three salience types modulated morphologically similar ERP components after about 200 ms, i.e. the Early Posterior Negativity (EPN) and the Late Positive Complex (LPC). Both positive (reward) and negative (punishment) salience similarly boosted EPN and LPC, indicating enhanced attention to and elaborate processing of target faces with incentive value during learning. Interestingly, the effects of associated negative valence vanished during the delayed testing, whereas ERPs to unfamiliar faces indicated a processing bias towards angry faces. Together, our findings demonstrate qualitatively differential effects of motivational, associated and inherent salience in face perception.

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[42] Head-body-coordination in walking Drosophila melanogaster

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Due to the small stereobasis and interocular overlap, most insects lack stereoscopic vision. Therefore, other cues for distance estimation become prevalent as for example the retinal image shift by self-motion. During translational movements, close objects will travel faster across the retina than distant ones, whereas during rotational movement all objects move with

the same speed. Therefore, only translational movements provide distance information[1]. Insects overcome this problem by using a saccadic strategy, which consists of very short and fast rotations, called saccades[2,3] that disrupt long translational movements. This strategy has been found in different insects[4-6]. Here, we show that walking *Drosophila melanogaster* perform body saccades, without the typical head saccades described for other insects[4]. This was also paired with the absence of haltere movement during walking, which seems to coordinate head movement in other insects. Modeling of the visual field of *Drosophila* revealed that head movements affect the retinal input only marginally.

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Ca^{2+} binding protein 2 prevents Ca^{2+} channel inactivation and supports spacially confined Ca^{2+} signals in inner hair ce [43]

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At ribbon synapses of inner hair cells (IHC) voltage-gated Ca^{2+} channels ($Ca_V1.3$) mediate Ca^{2+} influx-exocytosis coupling resulting in glutamate release. In order to achieve fast signal transmission, $Ca_V1.3$ Ca^{2+} channels activate at rather negative membrane potentials and undergo weak inactivation kinetics. Ca^{2+} binding proteins (CaBPs) are members of the EF-hand Ca^{2+} binding protein family and are candidate proteins known to antagonize calmodulin-induced Ca^{2+} dependent inactivation of voltage-gated Ca^{2+} channels. Among CaBPs, CaBP2 was suggested to be required for faithful sound encoding, since a missense mutation in CaBP2 causes moderate-to-severe hearing impairment in DFNB93 patients (Schrauwen et al., 2011). In the present study, we combined mouse genetics, immunohistochemistry as well as systems and hair cell physiology to elucidate the function of CaBP2 in the auditory pathway. To thoroughly investigate $Ca_V1.3$ channel regulation and sound encoding, a CaBP2 defective mouse line was generated. Recordings of the auditory performance in CaBP2 mutant animals revealed progressive hearing impairment while cochlear amplification was intact, indicating a deficit in synaptic transmission at IHC ribbon synapses. In vitro patch-clamp recordings of Ca^{2+} and Ba^{2+} currents in IHCs showed enhanced $Ca_V1.3$ inactivation, while sustained exocytosis was only mildly affected. Moreover, extracellular in vivo recordings of auditory nerve fibers indicated impaired sound onset coding due to reduced onset firing rates that coincided with delayed responses with increased jitter. In summary, we hypothesize that a disruption of CaBP2 induces steady-state inactivation of $Ca_V1.3$ channels, resulting in delayed activation of the channels upon hair cell depolarization, which we propose as un-

derlying disease mechanism of DFNB93.

Developmental synapse refinement in mouse visual cortex [44]

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Most excitatory neurons in the brain transmit signals at glutamatergic synapse via AMPA-type glutamate receptor-mediated synaptic transmission. However, how these synapses are initially generated remains elusive. In early developmental stage, many glutamatergic synapses are postsynaptically silent, i.e. they lack AMPA receptors and contain only NMDA-type glutamate receptors and are at resting potential non-transmitting. However, other studies indicate that these synapses contain labile AMPA receptors and gain silence during synaptic transmission. Both, concepts agree that silent synapses mature into active synapses through the insertion of AMPA receptors into the postsynaptic site. Using failure rate analysis of evoked excitatory postsynaptic currents (EPSCs), we previously showed that there is a decrease in silent synapses in layer 2/3 pyramidal neurons of mouse visual cortex during development (Huang et al. 2015). However, unexpectedly, the developmental profile of the frequency of miniature EPSCs (mEPSCs, a measure for AMPA receptor positive synapses) did not change during the developmental period after eye opening. The high number of AMPA receptor positive synapses was not due to labile synapses. Thus the apparent contradiction predicts that, besides maturation of silent synapses into AMPA receptor positive synapses, additional mechanisms exist to maintain a fixed set point of mEPSC frequency during development.

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[45] Low cost hardware and openscource software for behavioral and neurophysiological experiments: microcontrollers and processors

Benjamin H. Paffhausen[1]
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Behavioral science can be accelerated greatly by the use of digitally controlled machines capable of measuring relevant parameters and, if necessary, interact with the experiment. Those machines can be bought and they can do things in the implemented way. They are however neither cheap nor as adaptive as they could be. How to overcome the increasingly small barrier keeping inexperienced scientists from developing devices quickly by them self is the focus of this poster. Recently, open hardware projects like the Arduino or the Raspberry Pi draw enormous community coding and building elements that can be fused together to fit the experimenters needs. We as scientists can benefit from large numbers of projects that are documented well, mostly by step-by-step videos including component lists and code. Here we present a number of simple suggestions how to get the very first steps on the way to build your own devices that can help your behavioral and neurophysiological experiments.

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[46] Neuronal correlates of social interactions in honeybees

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So far no data exist about the neural correlates of social interaction in the honeybee. We record from multiple mushroom body extrinsic neurons during social interaction in a small functioning honeybee colony. The recorded animal is freely moving and interacts with colony members. Neural activity increases frequently

during interactions. Furthermore, we find that the variance of spike activity of the units increases suggesting that the neurons sense or controls the contacts with other bees. Hints were found that different activity patterns across neurons changes with different forms of social interactions. Ongoing analysis, that include machine learning, are pursued to clarify whether the activity changes are related to, for example, the origin of the approaching bee or the division of labor within the bee colony. The highly variability of neural activity needs further analyses.

Visual misperceptions in Parkinson's disease with stimulus processing outside of awareness [47]

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Background and aims: Besides motor impairments, patients with Parkinson's disease (PD) often experience non-motor symptoms such as visual hallucinations (VH) and misperceptions. In the current study we asked whether misperceptions in PD rely on consciously accessed visual information and how they relate to clinical features and low-level visual functioning.

Methods: Twenty-four non-demented patients with PD (10 PD-VH and 14 PD-non-VH) and 19 age-matched healthy controls

underwent psychophysical testing with continuous flash suppression (CFS) that renders visual stimuli perceptually invisible for prolonged periods of time. Images (faces, cars, scrambled) with slowly increasing contrast were presented to one eye, while dynamic Mondrian patterns were flashed into the other eye. In the ́visible ́condition, the same images were shown without the rivaling pattern. Subjects were instructed to press a pre-assigned button when they recognized a car or a face. Reported effects were statistically significant at a level of $p < 0.05$.

Results: PD-VH patients exhibited a higher proportion of image recognition errors, and reported objects in scrambled images more frequently as compared to PD-nonVH and controls. Most strikingly, PD-VH patients showed higher trial-by-trial fluctuations in recognition times as compared to PD-nonVH and healthy controls, while the mean RTs were only slightly increased. All effects were more pronounced in the 'visible' condition and could not be explained by differences in motor performance, medication or lower-level vision.

Conclusions: Our findings suggest that misperceptions in PD are triggered by consciously accessed visual information. In addition, fluctuating visual performance seems to be a signature of PD patients with visual hallucinations.

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[48] Neural variability related to subjective percept in area V4 and the pulvinar

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Neural trial-to-trial variability as well as correlated variability between pairs of neurons have been shown to decrease with the

onset of a visual stimulus, and to be further reduced when the stimulus is attended. Here, we examined whether changes in neural variability also reflect conscious perception of a stimulus. We recorded single and multi unit spiking activity from area V4 and the thalamic pulvinar in two monkeys reporting the visibility of bright luminance patches in the context of a generalized flash suppression paradigm, a visual illusion during which a salient stimulus can be rendered intermittently subjectively invisible. As expected from previous studies, trial-to-trial variability (Fano factor) as well as noise correlations in area V4 showed a substantial decline with stimulus onset. Surprisingly, the onset of the visual stimulus had only modest effects on either variability measure in the pulvinar where spiking variability was already relatively low. Perceptual suppression strongly modulated mean firing rates in both V4 and the dorsal and ventral pulvinar. Trial-to-trial variability in V4 was significantly reduced when the stimulus was subjectively invisible. The reported effects of subjective visibility closely resemble attentional modulation and may thus give insight into the neural mechanisms of suppression paradigms commonly used to investigate the neural basis of conscious perception.

Functional characterization of the neural circuitry for OFF edge motion detection [49]

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Many organisms rely on their visual systems to safely navigate their environments. To extract visual motion cues, they decompose the changes in visual scenery into a set of local motion vectors using elementary motion detectors (EMDs). These EMDs rely on inputs with a relative temporal delay, and that originate from two local sensors offset in space. Moreover, EMDs

exist for the ON- and OFF-pathways that compute the motion of bright, and dark moving edges, respectively, in parallel. Unexpectedly, OFF-pathway function is disrupted when a neuron type with wide receptive-fields is genetically silenced. This neuron type possesses sustained responses, and a nonlinear receptive field structure. Those wide-field responses do not fit into classical models of motion detection, which rely on local spatial computations, raising questions about the fine structure of the EMD circuitry. Thus, we aim at functionally characterizing the neural circuit elements of this novel OFF pathway. Interestingly, this neuron type appears to adapt its receptive field structure under some stimulus conditions [1,2]. We thus set to thoroughly characterize this neuron's receptive field including previously ignored parameters, such as ambient illuminance. As a result we identified potential presynaptic partners as source of wide-field inputs, and obtained a first draft of the receptive field structure; including ON-, and OFF-subunits. This work paves the quest for illuminance-dependent receptive-field modulation, and its computational implications for the EMD circuit, and the Drosophila visual system in general.

[1] Fisher, Y.E., Leong, J.C.S., Sporar, K., Ketkar, M.D., Gohl, D.M., Clandinin, T.R., and Silies, M. (2015). A Class of Visual Neurons with Wide-Field Properties Is Required for Local Motion Detection. Current Biology.

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Ultra-fast and Fast Kinetic Phases of Release Measured from Ground Squirrel Cones Photoreceptors Suggests Heterogeneity among Ribbon Primed Vesicles [50]

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Cones provide the visual system with signals that are triggered by rapid fluctuations in light, and these signals serve as precursors for high acuity vision. Our understanding of synaptic communication in the mammalian outer retina is dominated by studies performed in ground squirrel where signaling between pairs of cones and bipolar cells have been studied in detail. In the current study we directly examine the release properties of ground squirrel cones rather than using the post-synaptic readout. First we examined the voltage-dependence of membrane incorporation with 1 and 30ms steps and found that the largest response was achieved at -10mV, and the results suggest that Cav channel activation sharply tunes release when V_m < -10mV, while step to more positive V_m values showed a shallow incremental reduction in release as the Nernstian drive for Ca^{2+} decreased. The results also indicated limited availability of primed vesicles, so we examined this more systematically and found two rapidly released populations of vesicles with τ's of 0.5 and 11ms, that stimulated 13 and 7 vesicles/ribbon, and these vesicles re-primed at a rate of 13 vesicles/s/ribbon. A distinct kinetic phase was witnessed when depolarizations exceeded 100ms (slower phase $\sim$ 250ms). Electron microscopy was used to determine the arrangement of vesicles on ribbons, and the results show that 25 vesicles are docked at the ribbon base, more than enough to account for the two rapid release phases. Taken together, cones have a mixed population of ultra-primed and primed vesicles.

[51] Promotion of axonal and dendritic collateral branching as potential mechanism underlying erythropoietin-induced poststroke plasticity.

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[1]Chair of Vascular Neurology, Essen University Hospital.

We have previously demonstrated that erythropoietin (Epo) induces contralesional pyramidal plasticity after transient middle cerebral artery occlusion (t-MCAO), thereby enhancing neurological recovery. To better elucidate the mechanisms behind this important neurological recovery we have further examined the response of cortical neurons both in vivo and in vitro and long distance thalamocortical connections in vivo. rhEpo significantly increased dendritic spine density (11,35±0,84 spines/20μm dendrite) as compared to normal saline-treated control mice (8,9 ± 1,81 spines/20μm dendrite) (N= 4-5 animals group; $p<0.05$) but not dendritic spine length two weeks after t-MCAO. In vitro Epo induced a significant increase in the axonal length (Control: 116,73±1,76 μm vs. Epo: 144±12,83μm N=3 experiments, $p<0.05$) and in the density of axonal collateral branches (Control: 3,27±0.58 spines/20μm vs. Epo: 4,12±0.32 spines/20μm. N=3 experiments, $p<0.05$) in cortical neurons. Strikingly, we have unveiled a previously unexpected effect by means of Cholera Toxin B (CTB) retrograde tract tracer injection in the post ischemic brain and found that the number of CTB-labelled neurons was significantly increased by 2,55 times in the contralesional thalamus of erythropoietin-treated (69.35±28.55 cells/mm^2) as compared to normal saline-treated control mice (27.83±17.64 cells/mm2) (N= 4-5 animals group; $p<0.05$). Together this suggests that Epo promotes neurological recovery not only by promotion of sprouting of long distance efferences of the cortico spinal tract, but also by enhancing local dendritic spine plasticity in the motor cortex and long distance thalamocortical afferences. Further studies are necessary to characterize the functional im-

plications of local and long distance plasticity effects on cortical excitability and their contribution to post stroke recovery.

Effects of different doses of Retigabine on aged genetic absance epileptic WAG/Rij rats [52]

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Absance epilepsy is a type of non-convulsive epilepsy characterized by sudden loss of consciousness, bilateral synchronous and symmetrical EEG spike-wave complexes (SWD). Retigabine is an new anticonvulsant drug used in the treatment of partial seizures and effects through the activation of M-type current dependent on KCNQ channels. The purpose of this study was to investigate the dose dependent effects of Retigabine on aged WAG/Rij rats that show spontenously occuring SWD activity. In this study 12 month old WAG/Rij rats were used. EEG recording electrodes were placed to proper coordinates on skulls to obtain SWDś under xylazine/ketamine anasthesia by using stereotaxic frame. Three groups were established for this study; 20DMSO administration decreased number and total duration of SWD during 3 hours compared to baseline. 5 mg and 15 mg Retigabine treatment signifficantly increased number and total duration of SWD in 1st hour compared to baseline ($p<0,05$), but not in 2nd and 3rd hours ($p>0,05$). Two doses of retigabine did not exhibit any siginfficant difference in the number and total duration of SWD along 3 hours after injection compared to each other. According to our result; increased SWD activity after single dose administration of Retigabine (5 mg or 15 mg) suggests that Retigabine has a pro-epileptic effect on aged absance epileptic rats irrespective of dose.

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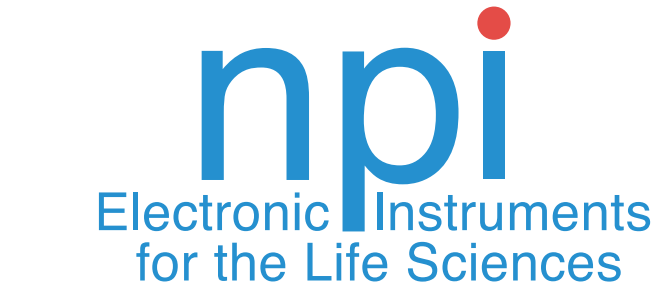

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Time	WED, June 1	THU, June 2	FRI, June 3	Time
09:00	Welcome	09:00 Yang Dan	09:00 Bruce R. Ransom	09:00
09:30	09:30 Ole Paulsen	09:40 Jennifer M. Groh	09:40 Thomas Misgeld	09:30
10:00	10:10 Richard Tsien	Coffee break	Coffee break	10:00
10:30	Coffee break	10:45 Justin Marshall	10:50 Marie-Eve Trembley	10:30
11:00	11:05 Arthur Konnerth	11:25 Craig Montell	Young Investigator Talks	11:00
11:30	11:45 Hannah Monyer	Group Photograph	Break	11:30
12:00	12:25 John Dylan Haynes		Award Ceremony	12:00
12:30	Lunch	Lunch	Lunch	12:30
13:00				13:00
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14:00	14:05 Henrik Mouritsen	14:00 Sonja Kleinlogel	14:00 Marcel Oberländer	14:00
14:30	Coffee break	14:40 Elizabeth Hillman	14:40 Bruno Cauli	14:30
15:00	15:00 Ofer Yizhar	Coffee break	Coffee break	15:00
15:30	15:40 John F. Cryan	15:45 Sudipta Maiti	15:35 Matteo Carandini	15:30
16:00		16:25 Stuart Firestein *Keynote*	Closing Remarks	16:00
16:30	Panel Discussion *Why we do what we do?*			16:30
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17:30		Poster Session II		17:30
18:00	Poster Session I			18:00
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19:00		Break		19:00
19:30		Coach Me		19:30
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