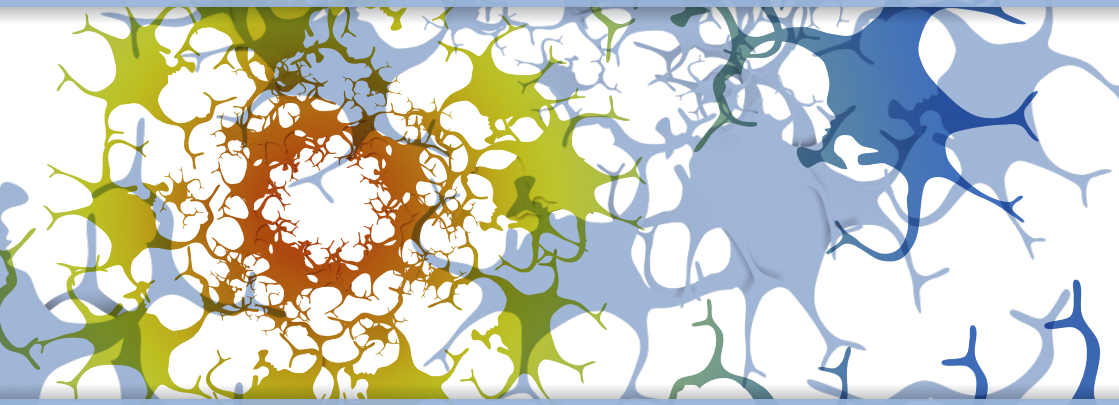
NeuroDoWo 2013 Göttingen



Program and abstracts

24th Neurobiology doctoral students workshop

July, 24th-26th

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Welcome to the NeuroDoWo 2013!

Back in the year 1990, three neuroscience professors at the University of Berlin initiated a special meeting: a workshop exclusively conducted by and for PhD students. This Neurobiology-Doctoral student-Workshop became an annual facility for PhD candidates from different institutes around the world to establish contacts and to present and discuss their ideas and findings without the interference of supervisors. Because the conference is held every year in a different institution, the participants also get to know a different university and the city around. We are happy to share that experience this year with you!

The focus is on us, the PhD students, and our work: We will get to know each other on Wednesday evening, July 24th, at the welcome ceremony and in the pubs of Göttingen afterwards. During the conference from Thursday, July 25th to Friday, July 26th, every participant will present a poster or a talk. There is room for lively discussion, for example directly after the presentations or at the barbecue on Friday evening.

Furthermore, it is a special pleasure to offer you some more cross-sector stimulating input by the means of public plenary talks given by international experts: Science philosopher Prof. David W. Miller (University of Warwick, UK) will open our meeting on Wednesday evening by asking whether improvement in scientific education does automatically lead to accelerated technological innovation and economic growth. On Thursday, Prof. Dr. Michael Hausser (University College London) will share his knowledge about vertebrate dendritic computation. The meeting will be topped off by the evolutionary/ecological perspective of Dr. Marcus C. Stensmyr (MPI for Chemical Ecology, Jena), he will talk about adaptation and specialization of the insect olfactory system on Friday evening.

Last but not least, we invite you to get to know the University and the city of Göttingen: join our guided city tour on Thursday evening and do not hesitate to ask us to show you around in our departments!

We wish you a pleasant and fruitful NeuroDoWo 2013,

the organizing team

The City of Göttingen

History

The first traces of human settlement that were found in the area of Göttingen derive from an era as early as the New Stone Age, i.e., around 5,000 BC. However, it has taken quite a while until the settlement has developed from the size of a village to the magnitude of a city. During the Middle Ages not more than a few thousand inhabitants are assumed to have lived in Göttingen (then known under the name of “Gutingi”. The economic and demographic growth of the city started with the foundation of the university in the year 1753 by George II King of Great Britain and Duke of Hanover due to the need of qualified physicists, theologicians and jurists in the region of lower Saxony. Soon the university had evolved to one of the most important in Europe. In 1770 Georg C. Lichtenberg became professor for physics and mathematics. His findings about the mechanisms of electricity are still an essential foundation of modern physics. The lecture series he held on experimental physics used to be very popular for its spectacular effects among the Göttinger students of that time. The most famous professor at the university of Göttingen was probably Carl F. Gauß, who strongly influenced mathematics and astronomy with his contributions to non-euclidian geometry, statistical distributions and much more. All together more than 40 Nobel prize winners are associated with the university, e.g., Richard Zsigmondy (the heterogenous nature of colloidal soultions), Bert Sakmann and Erwin Neher (discovery of the functions of individual ion channels in cells) and Werner Heisenberg (quantum mechanics). Nowadays, the university is the most prominent institution in the city, attracting students and scientists from all over the world. From the 120,000 inhabitants living in Göttingen 25,000 are enrolled at the university, having a big impact on the cityscape and cultural events.

Sightseeing

The town’s landmark is the statue of the Gänseliesel in front of the Göttinger town hall. It has been included into the tradition of Göttinger students, who migrate from time to time to the Gänseliesel in order to bring flowers and kiss the girl after a successful PhD. Further attractions are the two theatres: 'Deutsches Theater'

and 'Junges Theater', as well as the old botanical gardens in the heart of the city. In the city center one can find various old houses and a number of churches. Various Max Planck Institutes have settled in Göttingen, including Germany's biggest MPI for Biochemistry at the Faßberg , the MPI for experimental medicine (the NeuroDoWo venue), MPI for dynamics and self-organization, MPI for the study of religious and ethnic diversities and from 2015 the MPI for solar system research. Further important research centers are the European Neuroscience Institute and the German Primate Center.

General Information

Youth hostel

You can check in at the youth hostel on Wednesday from 12:30 pm. Tell the staff that you are a participant of the NeuroDoWo. Breakfast at the hostel is served between 7:30 and 8:30 am.

Hostel adress: Jugendherberge Göttingen
Habichtsweg 2
+49 (0)551 57622

Conference Venue

Lecture hall of the Max-Planck-Institute of Experimental Medicine, Hermann-Rein-Straße 3 (directly opposite the University hospital).

Registration

Name badges and conference bags will be handed out at the registration desk in front of the lecture hall on Wednesday from 6 – 7 pm.

Talks

We will provide Powerpoint 2007 and Adobe Reader XI. A laser pointer/presenter and microphones will be available. Please copy your presentations to the computer in the lecture hall in the break before your talk session (at the latest!).

Posters

The poster walls are in front of the lecture hall, thumbtacks are available. Your poster wall will be marked with your poster number. Both poster sessions are devided in two halves, uneven numbers will be presented from 3 – 4pm and even numbers from 4 – 5pm.

Internet access

WiFi is available at the NeuroDoWo venue, you will get login data at the registration desk

Lunch

Lunch will be at the at central campus canteen (see the "Maps" section). You will

get vouchers that you have to show at the cash desk of the canteen. (Tip: stick to one of the locals, the canteen is a bit confusing)

Transportation

You will get bus tickets at the registration desk, see pages 8–11 for timetables and maps. If you happen to miss the last bus to the hostel, here are the telephone numbers of two taxi companies:

Taxi-Zentrale: 0551 / 69300 Puk Minicar GmbH: 0551 / 484848

Contact

If you arrive after the hostel check-in hours or have other urgent problems, please call us: +49(0)1635377415

Maps and public transport

From the central station to the youth hostel

After leaving the central station go to the bus station to your right. Use the direct bus line **no. 6** in direction 'Klausberg' and drive to the bus station 'Jugendherberge'.

From the bus station to the youth hostel

From the bus station 'Jugenherberge', you can walk to the hostel.

From the youth hostel to the venue of the NeuroDoWo 2013

Please go to the bus station 'Jugendherberge' in direction Bahnhof and take the bus line no. 6 to the bus station 'Albaniplatz'. At 'Albaniplatz' go to bus no. 8 at 'Theaterplatz' in direction 'Klinikum' or 'Papenberg' till 'Robert-Koch Str'. Just cross the street and walk approx. 1 min to your right.

Timetables:

Linie 6 Jugendherberge - Zentrum - Bahnhof

Monday - Friday

Jugendherberge: 5.44 6.06 6.36 7.06 7.36 8.06 8.36 9.06 9.36 10.06 10.36 11.06 11.36 12.06 12.36 13.06 13.36 14.06 14.36 15.06 15.36 16.06 16.36 17.06 17.36 18.06 18.36 19.20 20.20 21.20

Linie 6 Jugendherberge - Zentrum - Bahnhof

Saturday

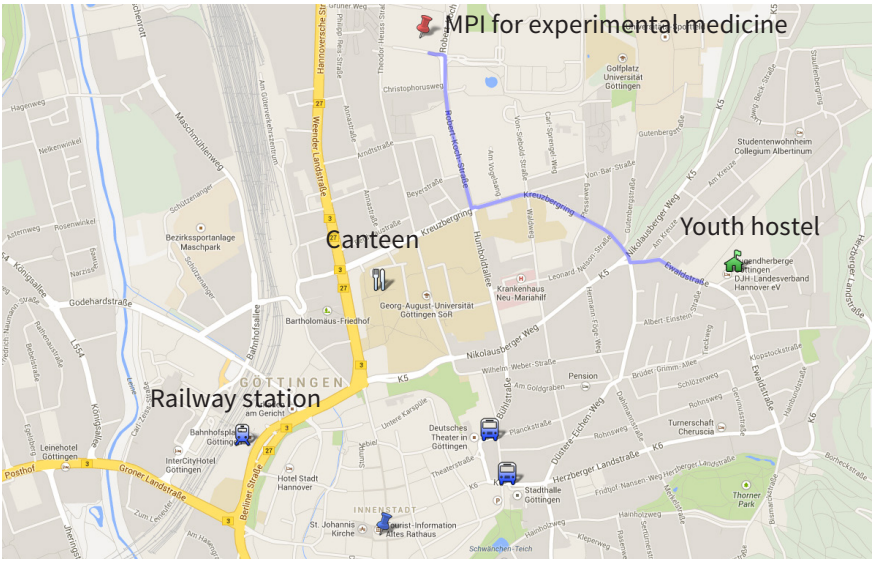
Jugendherberge : 6.20 7.20 8.20 9.06 9.36 10.06 10.36 11.06 11.36 12.06 12.36 13.06 13.36 14.06 14.36 15.06 15.36 16.20 17.20 18.20 19.20 20.20 21.20 22.20

Linie 8 Theaterplatz - Klinikum - (Papenberg) - Weende/Ost

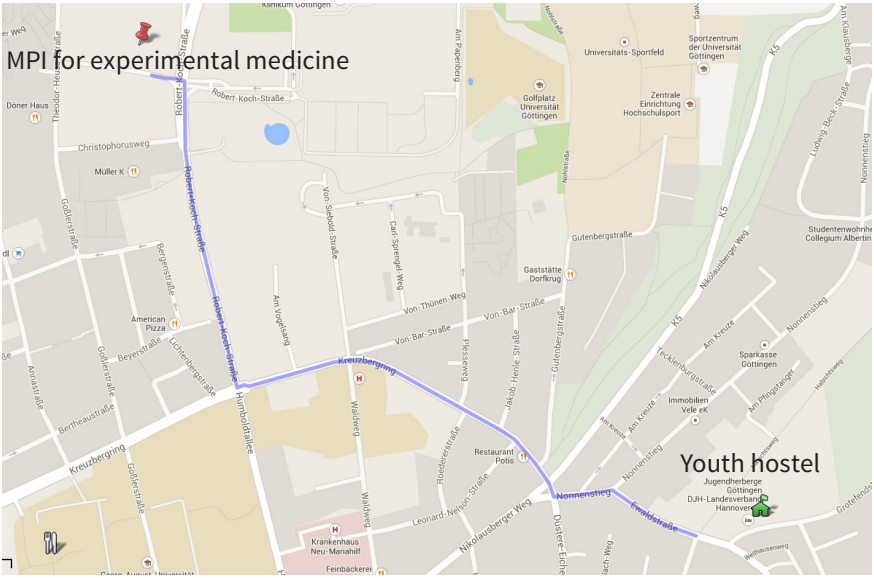
Monday – Friday

Theaterplatz: 5.37 6.17 6.32 6.47 7.02 7.17 7.32 7.47 8.02 8.32 9.02 9.32 10.02 10.32 11.02 11.32 12.02 12.17 12.32 12.47 13.02 13.17 13.32 14.02 14.32 15.02 15.32 15.47 16.02 16.17 16.32 16.47 17.02 17.32 18.02 18.32 19.02 19.33 20.03 20.33 21.03 21.33 22.03 22.33 23.03 23.33

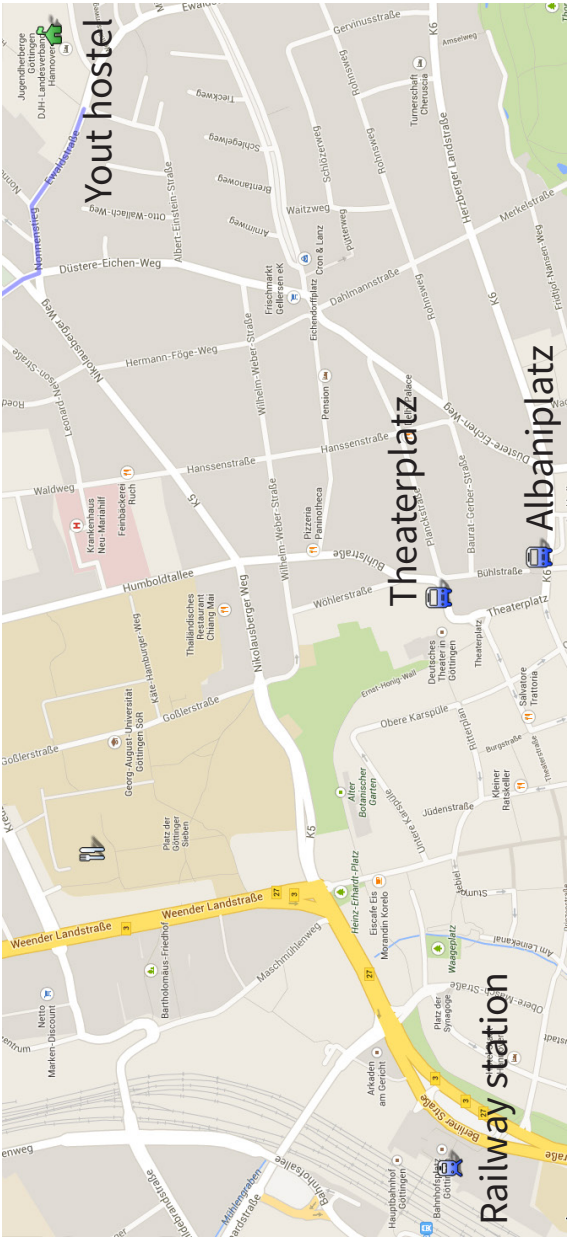
Overview



Hostel to conference venue



Railway station and youth hostel



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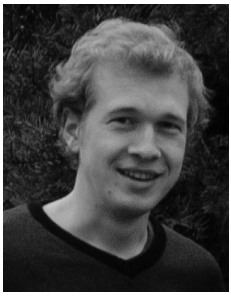
David Vasmer

Additional helpers (very important!): Andrea Adden, Kristina Corthals, Robert Wiek, Radoslav Katana, Monique Weidner, Dawid Lbik

Program

Wednesday, July 24th

17:00 – 19:00	Registration at the MPI for experimental medicine
19:00 – 19:15	Opening at the MPI lecture hall
19:15– 20:15	Prof. David Miller: "Putting science to work"
20:30	Wine and cheese at the MPI

Thursday, July 25th

09:00 – 09:30	Registration at the MPI for experimental medicine
09:30 – 10:30	Prof. Michael Häusser: "Dendritic computation"
10:30 – 11:00	Coffee break
11:00 – 11:20	T1: Benjamin Johannes Dombert
11:20 – 11:40	T2: Wolfgang Falk
11:40 – 12:00	T3: Markus Weschenfelder
12:00 – 14:00	Lunch break
14:00 – 14:20	T4: Manish Asthana
14:20 – 14:40	T5: Nils Becker
14:40 – 15:00	T6: Peter Christ
15:00 – 17:00	Poster Session
17:00 – 17:20	T7: Hany K. M. Dweck
17:20 – 17:40	T8: Abu Farhan
17:40 – 18:00	T9: Atefeh Pooryasin
20:00	Guided city tour, start at old townhall

Friday, July 26th

09:30 – 09:50	T10: Mit Balvantray Bhavsar
09:50 – 10:10	T11: Samson Chien
10:10 – 10:30	T12: Julien Guy
10:30 – 11:00	Coffee break
11:00 – 11:20	T13: Maren Reuter
11:20 – 11:40	T14: Anna C. Schneider
11:40 – 12:00	T15: Bianca Michelle van Kemenade
12:00 – 14:00	Lunch break
14:00 – 14:20	T16: Nanina Tron
14:20 – 14:40	T17: Martin Kollmann
14:40 – 15:00	T18: Kristina Buddrus
15:00 – 17:00	Poster Session
17:00 – 17:20	T19: Natalie Rotermund
17:20 – 17:40	T20: Anne C. Wolfes
18:30 – 19:30	Dr. Marcus Stensmyr: "Drosophila olfactory neuroecology"
20:00	Barbecue at the MPI, poster and talk prizes

Saturday, July 27th

til 09:30	Departure from the youth hostel

Plenary lectures

Putting Science to Work

Professor Dr. David Miller

University of Warwick, Department of Philosophy

Although it is uncontroversial that there is an intimate relation between pure science and technological progress, the relation is persistently misrepresented. What is especially ill understood is how indirectly scientific laws are applied in technology and engineering. This is not to diminish the part played by theoretical science, but to locate it correctly. Four explanations, one historical, one psychological, one sociological, and one philosophical, will be offered for the general lack of clear vision on this point. It then becomes easy to identify the logical mistake behind the belief, common to almost all governments and technocrats, that an improvement in science education is the royal road to accelerated technological innovation and economic growth.

Dendritic computation

Professor Dr. Michael Häusser

University College London, Wolfson Institute for Biomedical Research

The computational power of single neurons has long been predicted using modelling approaches,but actual experimental examples of how neurons, and in particular their dendrites, can solve computational problems are rare.

I will describe in vivo experiments which demonstrate how active dendrites contribute to shaping a canonical cortical computation.

Drosophila olfactory neuroecology

Dr. Marcus Stensmyr

MPI for Chemical Ecology Jena, Dept. of Evolutionary Neuroethology , Adaptation & Specialisation

In the past 15 years, the fundamental molecular and neuronal logic of olfactory coding in the vinegar fly, Drosophila melanogaster has been largely deciphered, at least at the periphery. The next major challenge is now to identify how the olfactory system fits the ecological needs of the organism. I will here outline recent work from our group aiming at unraveling the ecological significance of discrete olfactory pathways in the fly.

Talk abstracts

T1 The impact of neurotrophin BDNF on growth cone maturation and differentiation of embryonic mouse motor neurons

Benjamin Johannes Dombert, Michael Sendtner, Sibylle Jablonka

University of Würzburg, Institute for Clinical Neurobiology

Motor neuron development, functional acquisition and maintenance such as potential conduction along the axon and neurotransmission at the synapse strongly rely on neurotrophic factors, extracellular matrix proteins and the cytoskeletal system, particularly the microfilaments at the axonal presynaptic compartment. The microfilament system organises the proper orchestration of ion channels and growth factor receptors through a subtle equilibrium of polymerised and non-polymerised β-actin protein, the predominant cytoskeletal protein in neurons. Neurotrophic factors such as BDNF, CNTF or GDNF, respectively, promote survival and growth of several developing neurons in the CNS and PNS and additionally impact maturation and differentiation processes.

The pool of β-actin proteins depends on the presence of β-actin mRNAs at the growth cone tips. Neurotrophins like NGF, BDNF or NT-3, respectively, are thought to increase selectively β-actin mRNA transport from the cell body to axon terminals, regulating its localised mRNA levels. Consequently, the composition of the microfilament system at growth cone tips is indirectly modulated being relevant for differentiation events such as $Ca_v2.2$ accumulation and enhanced spontaneous Ca^{2+} influx.

However, the question which neurotrophic factor mainly drives motor neuron differentiation and growth cone maturation still needs to be addressed. Therefore, we compared the potency of BDNF with CNTF and GDNF to properly differentiate isolated embryonic mouse motor neurons on endplate-specific laminin 221(211), particularly the pre-synaptic compartment, i. e. the growth cone. The study implies that most notably BDNF promotes microfilament arrangement at the growth cone based on an increased availability of β-actin mRNA, leading to accumulation of both its receptor trkB and $Ca_v2.2$ channels, which in turn enhances spontaneous Ca^{2+} influx altering axon extension. By manipulating trkB these effects are abolished.

T2 Analysis of a long non-coding RNA in the Olfactory Epithelium of Mus musculus

Wolfgang Falk, Franco Weth

Karlsruhe Institute of Technology, Department of Zoology

The olfactory system in mice is an excellent model for studying the development of non-topographic projections in the brain. Every olfactory sensory neuron (OSN) expresses monoallelically only one of ~1200 olfactory receptor genes. OSNs of the same specifity are distributed in one of four slightly overlapping zones of the olfactory epithelium. During axonal outgrowth to the olfactory bulb (OB), axons start to sort themselves into “like” and “non-like” fibers. This leads to the coalescence of axon fibers expressing the same receptor. Via gradually distributed guidance cues these bundles will finally end up in one stereotypic position, named glomerulus. Here the OSNs connect with higher order neurons called mitral cells. The molecular mechanism of this complex development is not fully understood. It has been shown that the olfactory receptor itself plays a necessary but not a sufficient role in the axon guidance of OSNs.
Previously we showed via comparing single-cell transcriptomes the selective expression of a novel long non-coding RNA in immature neurons of the same receptor species. I am studying the function of this lncRNA in the mouse olfactory epithelium. Until now knowledge about this non-coding transcript is limited to its genomic sequence and location. Additionally it is not clear if this transcript is in fact a lncRNA or a 3’untranslated region (3'utr) extension formed by alternative polyadenylation.
I investigated the expression patterns of these transcripts via fluorescent *in-situ* hybridization and showed coexpression at early stages. A clear decrease in the expression of the lncRNA was observed in two and four weeks old mice. Next I will investigate the function of this RNA via *knock-down* and overexpression experiments. In particular, I will analyze the results for potential axon guidance errors.

T3 A Closer Look at Axon Guidance – Live Cell Imaging of EphA-/ephrinA- Dynamics

Markus Weschenfelder

Karlsruher Institut für Technologie (KIT), Zoologisches Institut

To establish neuronal maps, developing neurons send their axons steered by the so called growth cone on a journey to their appropriate target. In this process between axogenesis and synaptogenesis the growth cone has to read out biochemical guidance cues and integrate them to make a directional decision. An intensively studied example of topography in axon guidance and neural map development is the visual system of the chicken. Here retinal ganglion cells are connected to the optic tectum, preserving the axial identities of the neurons. The EphA/ephrin-A system is the main guidance component for mapping the temporal/nasal axis of the retina to the anterior/posterior axis of the optic tectum, the main visual centre in lower vertebrates. The variety of possible and confirmed interactions of Eph and ephrins in various cell types raise the question of their relevance in developing neurons. *Cis* and *trans* interactions, forward and reverse signaling, as well as endocytotic phenomena in *cis* and *trans* have been described in various cell types and neuronal systems, with partially inconsistent results. One reason may be that not all of this interactions and mechanisms are relevant during axon guidance of retinal ganglion cells to the optic tectum. In my work I establish a time lapse compatible toolbox consisting of SNAP-tagged ephrin-A5 and EphA3 expression constructs, allowing qualitative and quantitative analysis of their interactions, transport and endocytosis in living cells and retinal ganglion cells using a recently modified variant ofwhole mount electroporation suitable for embryonic retina.

T4 Alteration of fear memory via weak electrical stimulation (tDCS), behavioural and genetic polymorphism to prevent fear return

Manish Asthana

University of Würzburg, Department of Psychiatry, Psychosomatic and Psychotherapy

Overestimation or over-prediction of fear response in absence of threatening cue or stimuli is the root cause of anxiety or related disorders. Pavlovian conditioning is the most simple and common studied paradigm to study anxiety disorders. It offers a simple and basic associative learning between CS-UCS. This simple associative learning has been used past several decades to decode the cellular, molecular or neural signatures of anxiety disorder. In addition, the neuroimaging data combined with the animal genetic knock-out studies have nailed down our understanding of anxiety disorder. Taking into consideration of our current knowledge several methodologies such behavioral, electrical or magnetic stimulation and genetic polymorphism have been implemented in the current study. Hence, the current study designed 3-hypothesis which are as follows: (i) efficacy of weak electrical stimulation on fear memory consolidation; (ii) effects of reminder on fear return via targeting reconsolidation of fear memory; and (iii) allelic difference in the alteration of fear memory persistence via targeting reconsolidation. Here we report three-findings from the current work as follows: (i) weak electrical stimulation seems to interfere with the consolidation and promotes conditions required to disrupt fear memory; (ii) like earlier reports current work confirms that reminder disrupts reconsolidation and prevents fear return; and (iii) *BDNF* allelic difference plays an important role in the reconsolidation of fear memory. In conclusion, memory consolidation and reconsolidation holds a specific mechanism. However, these processes can be influenced or modulated via behavioral, weak electrical stimulation or via genetic polymorphism. The results are important in understanding the nature of reminder and re-storage of fear memory.

T5 Differential gene expression in the honey bee brain under light exposure

Nils Becker, Ryszard Maleszka, Wolfgang Rössler

Uni Würzburg, Zoo II

A worker honey bee performs different tasks throughout its life span. At the level of the colony, this results in a division of labor with young adult bees progressing through a series of tasks inside the hive (e.g. cleaning and nursing) and older bees starting to forage at about 3 weeks of age. The honey bee, therefore, is an ideal model to investigate neuronal mechanisms of environmentally induced behavioral plasticity.

The shift from one task to another, especially from in-hive tasks to outside tasks requires partly drastic adaptations to a different environment. One major difference between the in-hive environment and outside is exposure to light as bees leave the dark hive. Light plays an essential role in the life of forager bees in terms of visual navigation and spotting of food sources. It is apparent that for these important tasks foragers need to be optimally prepared by adaptive changes in the neuronal circuitry. We ask how neuronal plasticity in visual centers of the brain associated with this transition are controlled at the level of genes and molecular changes. The transition from in-hive tasks to foraging is associated with remarkable changes in brain structure and associated synaptic plasticity (Groh et al. 2012, J Comp Neurol). Ongoing work shows that the exposure of adult worker bees to light is sufficient to induce structural synaptic plasticity in visual subcompartments in the mushroom bodies (Christina Scholl et al. 2013, Frontiers in Behavioral Neuroscience).

Here, we show via quantitative real-time PCR that light effects gene expression of 6 candidate genes which might play a role in structural synaptic plasticity in the brain of the honey bee. Gene expression differs between bees exposed to light compared to a dark kept control group, and gene expression also varies between different brain regions.

T6 Quantitative Analysis of Neuropeptides in the Brain of Aedes aegypti

Peter Christ, Anna Reifenrath, Joachim Schachtner, Rickard Ignell

University of Marburg, Animal Physiology / Neurobiology

The yellow fever mosquito, *Aedes aegypti*, is the major vector of several arboviral diseases, e.g. dengue fever and yellow fever. The gonotrophic cycle of female *Ae. aegypti* consists of distinct behavioral and physiological phases, including host seeking, blood feeding and oviposition. Like in many insects the behavior of males changes after successful mating to allow a regain of fecundity.

These changes in behavior come along with changes in the processing of sensory information, especially the processing of olfactory information. A multitude of chemical signaling molecules modulates processing of odor information in the central nervous system, including the primary olfactory centers of insects, the antennal lobes (AL).

The most occurring and diverse group of neuromodulators, in vertebrates and invertebrates, are the neuropeptides. In the present study we analyzed neuropeptides in the antennal lobes of *Ae. aegypti* using direct MALDI-TOF mass spectrometric peptide profiling. We established a quantitative analysis to reveal changes in the concentration of specific neuropeptides by using isotope labeled peptides as internal standards.

This new technique gives us the opportunity to answer several questions concerning the regulation of behavior in insects. At the moment we focus on two behavioral aspects in *Aedes aegypti*; regulation of feeding and mating . Preliminary results suggest changes in the concentration of at least four neuropeptides in the AL depending on consumption of blood in females and seminal depletion in males.

T7 Vinegar flies have dedicated olfactory receptors for the detection of antioxidant aroma to improve survival and locomotor activity

Hany K. M. Dweck, Abu Farhan, Shimaa A. M. Ebrahim, Markus Knaden, Bill S. Hansson, Marcus C. Stensmyr

Max Planck Institute for Chemical Ecology, Evolutionary Neuroethology

Numerous studies have demonstrated that dietary supplementation with natural and synthetic antioxidants can extend lifespan and protect, rescue, and restore the impaired movement activity in the vinegar fly, *Drosophila melanogaster*. However, it is unclear whether flies prefer food supplemented with antioxidants, and if flies are able to detect the presence of antioxidants. Here, we show that vinegar flies prefer yeast supplemented with antioxidants over yeast alone and this preference is mediated via activation of a specific odorant receptor expressed on the maxillary palps. Silencing this receptor, render flies unable to distinguish yeast supplemented with antioxidants from yeast alone. We also show that the peripheral detection of the compounds associated with antioxidants is highly conserved, not only across the genus Drosophila but also in other genera of the Drosophilidae family. Finally, we demonstrate that supplementation of antioxidants in the food of the vinegar flies improve survival and locomotor activity.

T8 Olfactory modulations in starved and fed fruit fly Drosophila

A. Farhan, M. Knaden, B. S. Hansson

MPI for chemical ecology Jena, Evolutionary Neuroethology

Modulation and plasticity are key functions of all organisms for adapting to a changing environment and stress. Examples are blood-feeding insects, which after a blood meal switch their olfactory preference from host odors to odors specific for oviposition sites. We used the olfactory circuit of *Drosophila* as a well-established model to investigate whether the feeding status modulates the flies' physiological and behavioral responses to odors. Our main aim of study is, first to know the behavior of starved as well as fed flies and the molecular players for such modulations, and then to observe the modulations and its dynamics. In order to execute our idea we observed the differences in feeding and starvation.1st starvation is an internal input only but feeding is both. 2nd starvation dependent modulations are gradual and time dependent while feeding modulations are quick and time independent. 3rd Gustatory system involves in feeding but not in starvation. We found difference in behavior of fed and starved flies. Starved flies have a decreased behavioral threshold to odorants, while the sensitivity of OSNsis increased after starvation and vice versa for fed flies. Then we included electrophysiological study. The change in behavioral and physiological modulations in starved as well as fed flies was not restricted to food odors only, but was found also for non-food odors and pheromone. Furthermore we did microarray to get the hint for molecular players. We dissected out the role of biogenic amines by using the UAS-*RNAi* and GAL4silencing tool. It revealed neuropeptides have role at both OSNs as well as PNs level in starved but not in feeding modulations. With all this facts flies seem to be tuned to locate potential food sources from long distance, to evaluate food quality and the presence of conspecifics efficiently depending on their feeding status.

T9 Thermogenetic activation of serotoninergic neurons and its effect on the arousal state of Drosophila

Atefeh Pooryasin, André Fiala

Georg-August-University Göttingen, Molecular Neurobiology of Behavior

The serotoninergic "system" in the brain of *Drosophila melanogaster* consists of about 80 neurons and represents one of the major modulatory aminergic systems. There are various studies which indicate a regulatory effect of serotonin in different types of behaviors like locomotion, sleep-wake rhythms, feeding and aggression. In this study we use a thermogenetic approach to investigate the effect of serotonin on the arousal state of the animals.

In order to thermogenetically activate cells, transgenic flies that carry the heat-activated dTRPA1 channel coupled to mCherry protein were generated. Animals expressing dTRPA1-mCherry in the serotoninergic neurons were studied in different locomotion paradigms. Elevating activity of the serotoninergic neurons in the brain drastically reduces walking velocity of the flies. This locomotory reduction can be distinguished from a deficit caused by a manipulation of motor neurons. External stimuli, like electric shocks or mechanical disturbance, bring the flies to the pre-activation arousal state. In addition, random expression of dTRPA1-mCherry in subdivisions of the serotoninergic cells using the FLP FRT system reveals that number of the activated cells is not correlated to the observed reduction in velocity. We are going to investigate in more detail the contribution of the diverse serotoninergic clusters in the arousal state.

T10 From Hearing to Singing: Sensory to Motor information processing in the grasshopper brain.

Mit Balvantray Bhavsar

University of Goettingen, Cellular Neurobiology

Grasshoppers, and among them especially the species *Chorthippus biguttulus*, have been used as a model system to study insect acoustic behaviour since 25 years. The behaviour and various neurobiological mechanisms underlying song recognition and song production are well described. Numerous studies identified the set of Auditory neurons in the thorax and the way they process information. Projection of ascending neurons to the brain have been identified among various species. Since only few data exist about brain neurons involved in acoustic pattern recognition, the neuronal basis of the song is still poorly understood. Particularly there is no information about correlated or synchronized activity of larger sample of auditory neurons which might indicate representation of particular features of auditory signals in the different types of neurons.

This projects aims at elucidating important steps of neuronal processing involved in the recognition of specific-specific acoustic communication signals and in the selection of appropriate acoustic responses. It will employ extracellular multi-unit recordings with tetrodes, a method that has been recently used with increasing success to study circuit activities in other insect's brains. The first goal will be to analyse simultaneous activity in the set of ascending auditory neurons and to detect potential correlations with regards to specific features of the song used as auditory stimulus. The second part would be to detect the combined activity in the postsynaptic auditory neurons in the lateral protocerebum and their potential specialization in the process of song recognition. In addition, active stimulation of neurons using recording electrodes may indicate an overlap of circuits involved in signal recognition and motor response. In a third step, the tetrode will be inserted into the central complex to study the activation of neural elements by sensory inputs that promote or supress sound production. Electrical stimulation via the tetrode, eventually in combination with sensory or pharmacological stimuli, may determine the functional importance of the recorded neurons. Successful complition of project will incerease our knowledge about neural mechanisms of the song pattern recognition and the coupling of higher sensory networks for song recognition with higher motoric areas select and coordinate appropriate responses.

T11 Influence of Inherent Prior Values in Decision-Making

Samson Chien, Jan Gläscher

University Medical Center Hamburg-Eppendorf, Institute for Systems Neuroscience

Reinforcement learning has become the predominant model for predicting a subject's decision based on the expected value (EV) of each option, which is continuously adjusted during learning in proportion to a prediction error (PE). Common experimental setup utilizes value-neutral cues (e.g., fractal images) to solely study the emergence of EVs. However, most environmental cues are not value-neutral but exhibit certain inherent values. We investigate how these inherent values affect the learning of new EVs. One possible mechanism is that inherent values differentially affect learning rates such that congruent cue-outcome associations, in which the inherent values and the EVs are similar, are learned faster (i.e., with a higher learning rate) than incongruent pairings.
We tested the hypothesis in a 2x2 factorial design, using facial attractiveness (high/low) of a visual cue as a proxy for inherent value and reward probability (0.7/0.3) as a target for newly learned EV. Subjects were shown both attractive and unattractive face pictures of the opposite gender. Each picture was paired with a positive or negative monetary reward either congruently or incongruently. Subjects were instructed to select the pictures with the goal of maximizing the overall monetary reward. Computational RL models were fitted to the behavioral data to derive cue-specific learning rates. Concurrent fMRI data were correlated with these learning rates, EVs, and PEs.
The behavioral results indicated both a faster response time and a faster learning rate for the congruent cue-outcome pairings. The model-based fMRI data analysis revealed well-established brain regions involved in decision making, such as the ventromedial prefrontal cortex for EVs and the ventral striatum for PEs. In addition, we identified a formerly unreported correlation between the cue-specific learning rates and the BOLD activity in the ventral striatum. Our result complemented other studies and further established the roles of the ventral striatum in decision-making.

T12 Persistence of a somatotopic sensory map in the absence of cortical layers in the reeler mouse

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Rodents possess a set of facial vibrissae on each side of their snout, which they use for tactile perception. Layer 4 of the posteromedial barrel subfield (PMBSF) of the primary somatosensory area (S1) of rodent is home to the barrel field, where facial vibrissae are represented as a dense cluster of cells called barrel, neurons contained within each barrel being primarily responsive to stimulation of the corresponding vibrissae. In the reeler mouse, a model of disturbed cortical development characterized by a loss of cortical lamination, the barrel field exists in a distorted manner. Little is known about the incidence of the loss of lamination on cortical function in this model. We used in vivo functional imaging to explore sensory map organization and stimulus representation in the barrel field. We found that the loss of cortical layers in reeler mice had surprisingly little incidence on these properties.

T13 Electrophysiological Analysis of Projection Neurons and their Targets in the Honeybee´s Olfactory System

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Honeybees use odor cues for communication with conspecifics and orientation. Odors are received by sensilla on the antennae, from where the olfactory receptor neurons converge onto the antennal lobe (AL). From there, a dual olfactory pathway innervates the mushroom bodies (MB) and lateral horn (LH) in opposing directions. This configuration is unique to Hymenopterans and consists of the medial and lateral antennal-lobe-protocerebral tracts (m- and l-APTs, respectively). Imaging studies have found the olfactory input into both APTs to be remarkably redundant. Additionally, the AL output has recently been shown to respond to odors in parallel by using simultaneous multi-unit recordings of both tracts. The m- and l-APT respond to the same tested odors, but with different characteristics.

The same setup will now be used to analyze the temporal processing properties of the olfactory system and for addressing questions about coding principles in higher-order brain centers, e.g. Kenyon Cells (KCs) of the MB. Since the m- and l-APT were found to respond to odors with different tract- and odor-dependent latencies, we suggest that their target neurons, the KCs, are triggered by coincidental activation via neurons of both tracts. We aim at simultaneously recording from three sites (l-APT, m-APT, KCs) to uncover their interconnections and temporal dependencies. Furthermore we want to stimulate the projection neuron tracts electrically to induce controlled latencies and record the KCs responses simultaneously. Stimulation with various odors, both simple and complex mixtures, are planned to complete the understanding of prevailing coding principles. The experiments will be presented as an outlook into future work.

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T14 Encoding of Coordinating Information in a Network of Coupled Oscillators

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The simple neuronal organization makes the crayfish swimmeret system a powerful model to investigate neuronal and synaptic properties of coupled oscillators needed for locomotion. The four pairs of swimmerets move with alternating power-strokes (PS) and return-strokes in a metachronal wave from posterior to anterior. We investigate ascending and descending neuronal signals, which are necessary and sufficient for coordinating locomotor output in the isolated ganglia chain that controls the swimmerets.

Each limb is controlled by one central pattern generator (CPG) located in each hemiganglion, consisting of five types of non-spiking interneurons. The coordination of the local neuronal circuits is achieved by one ascending (ASC_E) and one descending coordinating neuron. They encode information about the activity state of their home module and send it to the other ganglia, where this information is decoded and integrated by the Commissural Interneuron 1 into the CPG.

To understand how ASC_E encodes information, I compared neuronal properties at different levels of system excitation. I induced different excitation levels by perfusing the ganglia chain with different concentrations of carbachol, a cholinergic agonist. ASC_E is active in phase with the PS of its home module. Its input resistance (R_{in}) was highest during its bursts. The drop in R_{in} in the interburst might be due to the inhibitory effect from the CPG neurons. R_{in} decreased when I excited the system to higher levels. I am going to use the results of the comparison of cellular properties at different levels of excitation to test the Adaptive Encoding Hypothesis, which states that the system's excitation tunes the properties of the encoders and decoders of coordinating information. In this context, I want to investigate the possibility of excitatory input to ASC_E in future studies.

T15 Decoding pattern motion information in V1

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Two superimposed gratings moving in different directions can be perceived bound together in a pattern, moving in the average direction of the two gratings. This is referred to as pattern motion. It has been proposed that V1 processes the motion of the components, whereas pattern motion would be processed at higher levels of the visual hierarchy, especially in hMT+/V5. Using multivariate pattern analysis we investigated whether pattern motion is processed as early as in V1. We used stimuli composed of sinusoidal gratings, perceived as patterns, of which the angle between the gratings ranged from 30° to 120°. Two different pattern directions were used. Participants were presented with these stimuli in a pseudo-randomised block design, during which they had to perform a fixation task and a speed discrimination task. Eye tracking was performed to ensure proper fixation. Polar angle retinotopic mapping and a standard functional hMT+/V5 localiser were used to define ROIs. A classifier was trained to discriminate the two pattern directions. The classifier was able to decode the two pattern directions significantly above chance in all ROIs. Cross-classification was performed by training the classifier on a stimulus pair with a certain angle between the gratings, and testing the classifier on another stimulus pair with a different angle. Again, decoding accuracies were significantly above chance, and no significant differences between any of the performed cross-classifications were found in any of the ROIs including V1. This suggests the classifier did not use component motion signals, but more likely pattern motion information. Our results indicate that V1 contains pattern motion information. Whether this information is due to genuine pattern motion processing in V1 or to feedback from higher areas remains to be investigated.

T16 Three dimensional acoustic orientation in insects

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Acoustic communication in insects is quite common and evolved several times in different groups. Intraspecific acoustic communication in mating context is widespread in insects. Additionally, in some systems parasitic flies can exploit the sexual acoustic signals for their host detection.

In this project we investigated acoustic behaviours of the parasitoid fly *Emblemasoma auditrix*. The host, male cicadas of *Okanagana rimosa*, call for their female mating partner and this signal attracts female cicadas as well as gravid females of the parasitoid fly. This system provides the possibility to investigate three dimensional acoustic orientation in a complex habitat.

In field experiments an artificial calling song of *O. rimosa* was broadcasted from a loudspeaker and the behaviour of the phonotactic active insects was recorded. Different experimental setups and habitat structures were used to analyse the complex phonotactic behaviour. Here, data on the phonotactic orientation in the vertical plane are presented.

The acoustic localisation of the sound source is rather accurate and distinct characters can be extracted: Up to 70% of the animals landed *above* the target, indicating a bias in vertical orientation. This bias is hypothesized to be related to the ventrally positioned ear. By contrast, analysis of the starting position of *E. auditrix* at the beginning of phonotaxis show that the orientation of the longitudinal body axis of the fly points *below* the target position. Nevertheless, the orientation angle correlates well to the target angle. The positional information present at the start seems not to be decisive and corrections can be made during flight. Additionally, the fly regularly uses landmarks during phonotaxis for landing and re-orientation. In summary, the fly is able to locate a sound source in the vertical axis and *E. auditrix* might use a bouquet of acoustic cues for phonotaxis.

T17 Show me your brain and I tell you who you are - The diversity of beetle brains

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Worldwide approximately 1.4 million animal species have been described and insects account for about 70% of this huge number of species. In particular almost 30% of all described animal species are coleopteran (beetles). This species richness of more than 400,000 taxa is associated with vast varieties of morphology, behavior and ecology. E.g. beetles inhabit arid areas like deserts as well as aquatic habitats and even alpine and arctic regions. Especially in nutrition a vast diversity can be observed ranging from carnivore to herbivore and omnivore and includes many special feeding types like saprobiontic or coprophagiac. Also according to their environment their moving patterns alternate from flying, walking, swimming/diving to ground-dwelling. It is to assume, that this broad diversity is somehow reflected in the neuronal anatomy of the beetle's brain.

To investigate this theory, we analyzed the brains of a large number of beetles, covering different aspects like phylogeny, feeding types, habitats, body sizes or movement types. To compare the brains with each other, we performed immunostainings with phalloidin coupled to Alexa Fluor 488 and a synapsin antibody to analyze the morphology of the whole brain. An antibody against the neuropeptide Locusta tachykinin 2 was used to indentify the central body and the antennal lobes. As well as DAPI to characterize the mushroom bodies by labeling the Kenyon cells. Based on this immunostainings we perform 3D-reconstructions and compared relative volumes of neuropils associated with different functional properties, as well as the staining patterns of different beetles and look for differences / similarities which could be explain by specification of the animals.

T18 Calcium Signaling In Olfactory Ensheathing Cells Modulates Blood Vessel Diameter In The Olfactory Bulb

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A specialized glial cell type in the olfactory bulb (OB), the olfactory ensheathing cells (OECs), enwraps axon bundles in the olfactory nerve layer and contacts surrounding blood vessels. Changes in the glial calcium (Ca^{2+}) level can lead to alterations in local blood flow by either causing vasoconstriction or vasodilation of neighboring arterioles. Therefore we evoked calcium signaling in single OECs by using laser photolysis of caged Ca^{2+} and simultaneously monitored the tone of adjacent vessels. Vessel diameter and glial cell calcium were measured using confocal imaging techniques. Photolysis of caged Ca^{2+} in OECs led to vasoconstriction of arterioles in 97.1% and to vasodilation in 2.9%. In studies performed in acute cortical brain slices, different substances such as lactate and prostaglandin E_2 have elicited vasodilation of cerebral blood vessels dependent on glial Ca^{2+}. We intended to verify the effect of these substances in an in-toto preparation of the mouse OB. When lowering the oxygen level from 95% to 20% to enhance glycolysis and lactate release, only vasoconstriction occurred. Furthermore, application of lactate, to increase the extracellular prostaglandin E2 concentration, as well as elevation of external K+, to hyperpolarize smooth muscle cells (SMC) by Kir channels activation, did not evoke dilation of blood vessels in the OB. However, application of adenosine induced dilation of blood vessels in cortical brain slices in the OB, independent of the oxygen concentration. We then preconstricted arterioles of cortical brain slices and the OB with the thromboxane A_2 agonist U-46619 to induce physiological levels of arteriolar tone. Additional application of the group I metabotropic glutamate receptor agonist DHPG caused arteriole dilation. The results suggest that in isolated brain tissue preparations, constriction is the predominant vasoresponse upon glial Ca^{2+} signaling, and that preconstriction of blood vessels is required to evoke a physiological vessel tone and hence promote vasodilation.

T19 A1 Receptor-Mediated Modulation of Neuronal Network Activity in the Olfactory Bulb

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Neuromodulation by ATP, ADP and adenosine is unique with regard to its complexity and specificity, achieved by tissue-specific combinations of transmitters with a variety of receptor subtypes, second messenger systems, transporters and enzymes. ATP and its metabolites, in particular adenosine, are ubiquitous co-transmitters and neuromodulators, participating in synaptic transmission as well as in neuron-glia interactions. Proteins associated with the purinergic signalling system are highly expressed in the olfactory bulb of rodents, suggesting purinergic modulation of olfactory information processing. In the present study, we focus on the effect of adenosine on the neuronal network activity in the olfactory bulb. We monitored the activity of olfactory bulb neurons by recording postsynaptic whole-cell currents of mitral cells, the output neurons of the olfactory bulb. Bath application of adenosine reversibly reduced the frequency of spontaneous synaptic inputs in mitral cells. DPCPX, a specific antagonist of the A_1 receptor subtype, blocked the effect of adenosine. Analyses of mitral-to-granule cell connections suggest an influence of adenosine on the performance of this dendro-dendritic synapse. Current clamp recordings show a direct hyperpolarising effect of adenosine and a reduction of the excitability of olfactory bulb mitral cells. Morphological and physiological evidence indicate that A_1 receptors are located on mitral/tufted cells and affect other olfactory bulb neurons indirectly by decreasing the excitability of these major output neurons.

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T20 Glial synaptotagmin isoforms: Vesicle exocytosis in astrocytes?

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Astrocytes influence neuronal signalling and plasticity by releasing gliotransmitters (e.g. glutamate, ATP, D-serine). If this involves exocytosis, identifying the molecular mechanism is key to understanding how astrocytes communicate with neurones in an activity-controlled way. In neurones, SNARE complexes steer exocytosis, and synaptotagmins (SYTs) promote vesicle fusion upon Ca2+ influx. Interestingly, isoforms of the key SNARE proteins exist in astrocytes, e.g. SNAP23 (Hamilton & Attwell, 2010).

Similarly, the mRNA of several SYT isoforms was found in astrocytes (Mittelsteadt et al. 2009), which hints at functional similarities in vesicle fusion. Using different techniques, I confirmed that astrocytes further express several SYT proteins, and that they have distinct functional characteristics in astrocyte vesicle fusion. Therefore, I hypothesise that SYTs interact with SNARE complex proteins to mediate exocytosis in astrocytes.

Further, in vitro studies of astrocytes are currently in question because of aberrations from in vivo astrocytes (in morphology and gene expression). However, growing in vivo-like astrocyte monocultures is now possible, although the required protocol has some flaws like low cell yield (Foo et al. 2011). To clarify this technical issue within the field, I analysed different protocols (for astrocyte monocultures, co-cultures of neurons and glia, and in vivo samples), and indeed found dissimilar morphology and protein expression.

Poster abstracts

P1 The seen and the unseen: processing of object identity during change detection and change blindness

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In everyday life, accessing details in a visual scene seems to occur effortlessly. In contrast to the subjective experience, we do not always detect changes in our visual environment. The inability to see even large changes in visual scenes is called change blindness. Change blindness occurs when, e.g. an original and a changed scene are shortly interrupted by a brief blank screen. The persistence of change blindness in many different experimental situations (real life experiments, video clips, for abstract stimuli, etc.) raises questions about just how detailed and accessible visual representations really are. Some researchers argue for rich visual representations even in the presence of change blindness; however, findings are controversial and still debated.

In our experiment we wanted to test whether object identity are processed during change blindness, favoring the proposal of rich visual representations and implicit processing (processing without awareness) of changes. In a electroencephalography study, we recorded behavioral and neuronal data while participants viewed 8 objects on each trial. In change trials we substituted 1 object (prime) with a new object (target). The prime and the target object were either related (screw and screw driver) or unrelated (screw and apple). Presenting semantically unrelated objects is known to trigger a characteristic event related potential –N400, a negative deflection at central electrodes around 400 ms after target onset.

Preliminary results show that the N400 was present in trials where participants detected the change; moreover, it was also present on trials where subjects were change blind. Thus, the identity of the object was processed irrespectively of the participant‘s conscious awareness of it (change detected or change blind). Hence, change blindness does not preclude a detailed representation of the visual scene.

P2 How plastic is the neuropeptide repertoire in the Tribolium central olfactory pathway?

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Philipps-Universität Marburg, Neurobiologie/ Ethologie

Neuropeptides represent the largest and most diverse group of signaling molecules in the CNS. They are able to shape the activity pattern of neuronal circuits and are thus accepted to be of major importance for the functional condition and output pattern of the CNS. Furthermore, neuropeptides are thought to be involved in processes related to neuronal plasticity, the substrate for learning and memory. But, how plastic is neuropeptide expression in adult insects? We started to examine neuropeptide plasticity in the antennal lobes (ALs) of the red flour beetle *Tribolium castaneum* during the time period after adult eclosion when the adult animals are for the first time confronted with odors from the environment. The paired ALs of insects are the first integration centers for the processing of olfactory information in the insect brain. A typical character of adult insect ALs is a variety of neuropeptides located mainly in local interneurons but also in other neuron types including olfactory sensory neurons, projection neurons and centrifugal neurons. In antennal lobes of adult *T castaneum* we described 28 neuropeptides from 10 precursor genes by direct profiling using matrix-assisted laser desorption/ ionization-time-of-flight (MALDI-TOF) mass spectrometry and their localization in neurons was subsequently revealed by immunohistochemistry. In the presented project we investigate changes in the neuropeptide repertoire of the ALsof freshly eclosed adult *T. castaneum* (A0) and from animals seven days after adult eclosion (A7). To assess AL neuropeptides, isolated tissue samples were subjected to direct peptide profiling by MALDI-TOF mass spectrometry. To quantify relative differences of selected neuropeptides we use synthetic peptide analogues as stable isotope-incorporated internal standards.

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P3 Aberrant mitochondrial redox balance and ROS generation in RETT mouse hippocampal neurons

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Rett syndrome is associated with mitochondrial dysfunction and oxidative stress. Since mitochondria are partly uncoupled and show increased respiratory rates, they may contribute to the oxidative burden in MeCP2-deficient tissues. Furthermore, mitochondrial alterations occur early in life and may facilitate the manifestation and progression of typical Rett symptoms. Earlier we reported exaggerated responses of the hippocampus of MeCP2-deficient (*Mecp2*$^{-/y}$) mice to oxidative challenge and mitochondrial inhibition. Extramitochondrial ROS production was, however, not intensified. Therefore, we now analyzed ROS production in mitochondria themselves. Mitochondrial redox status was quantified using the mitochondria-targeted optical redox indicator (mito-roGFP1). Hippocampal cell/slice cultures were virally transduced to express mito-roGFP1 neuron specific; sufficient expression was obtained 7-8 days upon transduction. Individual mitochondria were homogenously labeled, confirming equal distribution of roGFP1 in the matrix. For quantitative recordings, the ratiometric responses of mito-roGFP1 were calibrated to full oxidation and reduction. Comparing these responses to those determined earlier with cytosolic roGFP1 indicates less intense redox changes in mitochondria. Mitochondrial redox baselines were more oxidized in cultured cells than in slices. Furthermore, genotypic differences exist, since mitochondrial redox baselines were more oxidized in *Mecp2*$^{-/y}$ hippocampus. Block of superoxide dismutase evoked similar oxidizing responses in cultured neurons, but was less efficient in *Mecp2*$^{-/y}$ slices. The responses to 200 µM H_2O_2 did not differ among cells, yet oxidation was more intense in *Mecp2*$^{-/y}$ slices. Anoxia decreased the mito-roGFP1 ratio and elicited more intense reducing shifts in *Mecp2*$^{-/y}$ neurons. In conclusion, mitochondria-targeted roGFP1 responds reliably to oxidation and reduction. Redox balance seems more stable in mitochondria than in cytosol. Genotypic differences are evident especially in the more complex organotypic slices. Neuronal mitochondria of *Mecp2*$^{-/y}$ hippocampus show a more oxidized and more vulnerable redox balance, which supports our hypothesis that mitochondria underlie the oxidative burden in Rett syndrome.

P4 Octopaminergic modulation of the sugar response in Drosophila

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The biogenic amine octopamine (structurally related to noradrenaline in vertebrates) acts as a neurohormone, a neuromodulator and a neurotransmitter. Due to this diversity of physiological functions, manipulations of octopamine levels lead to a plethora of behavioral effects, among them alterations in locomotion and appetitive learning. *Drosophila* with its diverse genetic toolbox is a suitable model system to dissect the function of distinct octopaminergic neuronal subpopulations.

Here, we investigate the role of octopamine in sugar motivation, i.e. responsiveness to sucrose after starvation, which depends on both sucrose concentration and the internal state of the animal. As a locomotion-independent test, we tested the proboscis extension response (PER) to a serial dilution of sucrose after different starvation times.

We used genetic manipulation to modify the octopamine synthesis in flies: mutation of the tyramine-beta-hydroxylase (*tßh*) gene in combination with UAS/GAL4-driven rescue of this gene. Our experiments indicate that octopamine is necessary for an appropriate sugar response level and suggest that octopamine levels are associated with motivational status. Flies mutant for the *tßh* gene exhibit longer survival under starvation conditions and higher carbohydrate concentration in the haemolymph after starvation, compared to wild type controls.

Our data suggest that octopamine is required both during starvation and during the PER test to drive normal sugar responses and are in accordance with a model where octopamine would be a signal for hunger in the *Drosophila* brain. We are presently testing this hypothesis by elevating octopamine concentrations in satiated animals.

P5 The Interplay Between alpha-Synuclein and Rab GTPases: Insight into The Molecular Basis of Synucleinopathies

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The deposition of protein aggregates is a central pathological hallmark in a variety of age-related neurodegenerative disorders, such as Parkinson's disease (PD) and Alzheimer's disease (AD). In PD, these protein aggregates accumulate inside neuronal cells and are known as Lewy bodies, consisting primarily of fibrilar alpha-Synuclein protein. alpha-Synuclein (aSyn) is a cytosolic protein localized at presynaptic terminals and close to the nucleus, whose cellular function remains unknown, but which has been implicated in protein trafficking. Rab GTPases are important coordinators of membrane trafficking, including vesicle formation and movement. Rab7 participates in various regulation steps of the endosomal sorting process and the biogenesis of the lysosome. Further, it has been shown to be upregulated in basal forebrain neurons in AD. Thus investigating the interplay of α-Synuclein with this specific GTPase might lead to a better understanding of the molecular events underlying the etiology of PD and other synucleinopathies.

P6 Adaptation towards chemoaffinity cues in topographic axon guidance

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Topographic projections are abundant in the brain and are defined by the preservation of neighborhood relationships upon projection. The development of the retinotopic map involves complex interactions of axon guidance signals mediated by ephrin/Eph interactions. A recent comprehensive computational model of our group explains major experimental evidences gained on this system. However, it raises new fundamental questions, e.g., how axons can first invade the target. We have recently gained first experimental evidences for growth cone adaptation to the guidance cues, potentially explaining target innervation. On tailored micro-patterned adaptation substrates we found RGC axons to get desensitized towards ephrin-A5 and EphA3 respectively via adaptation, i.e. down-regulating their forward and reverse signaling.

It is, however, conceptually challenging to understand how adaptation might be compatible with topographic mapping. We therefore upgraded our computational model with an adaptation mechanism. By regulating receptor and ligand levels simultaneously, the new model now explains adaptation experiments and is still able to build up a proper topography. The suggested adaptation mechanism amounts to a completely novel form of co-adaptation. By regulating ephrin-A and EphA levels at the same time, an axon adapting towards one of the cues should simultaneously adapt towards the other cue even without having contacted it. Here we show first *in vitro* results, strongly supporting co-adaptation as a novel, ephrin-A/EphA-specific mechanism of signal integration.

P7 Connection between nutritional signalling and histone deacetylases in honeybees

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By changing the chromatin structure and thus the efficiency of transcription processes, histone modifications have a strong impact on the regulation of gene expression and are also linked to cellular metabolism. The key players that mediate histone acetylation are histone acetyltransferases and the antagonistically acting histone deacetylases (HDACs). The removal of acetyl groups on histones leads to a dense chromatin structure and suppresses transcription. Due to the activity of HDACs neuronal plasticity and memory formation is negatively influenced. Not all upstream regulators responsible for these changes are yet identified.

To address this issue we combine HDAC assays, antibodies against HDACs, pharmacological treatments, and associative appetitive learning in honeybees. Pathways connected to nutritional signalling, like AMPK and mTOR, are promising targets for research to identify the upstream regulators that mediate the learning-induced changes in HDAC activity.

P8 Modeling inner hair cell ribbon synapses: response heterogeneity and efficiency of sound level encoding

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Spiral ganglion neurons (SGN), which are postsynaptic to auditory inner hair cells (IHC), show high variability in spontaneous and sound-driven discharge rate, dynamic range, and sensitivity. Recent experimental evidence suggests that molecular properties of the IHC presynaptic active zones also vary from synapse to synapse. These findings support the hypothesis that the apparent variability of SGN responses could be due to the differences in the molecular organization of the presynaptic active zones. However, it is not quantitatively understood how sound-driven SGN responses are affected by the organization of IHC presynaptic active zones.

In this work, we approached that question theoretically. To this end, we formulated and studied an analytically tractable biophysical model of the presynaptic active zone. As a quantitative response characteristic, we considered adapted rate-level (RL) functions of high characteristic frequency SGNs. We found that the model is capable of reproducing experimental RL functions quantitatively. Furthermore, we showed that the same RL function could be reproduced by considerably different parameter sets of the model. For example, shift of the stimulus dependence of RL functions was achieved either by shifting the voltage dependence of presynaptic Ca2+ channel activation curves, changing release site recovery rates, or changing rates of Ca2+ binding to the vesicle release receptors. Changes in RL function slopes resulted either from changes in slopes of Ca2+ channel voltage activation curves or varying levels of response heterogeneity among different release sites of the same active zone. To assess efficiency of the stimulus level encoding, we estimated mutual information based on stationary inter-spike-intervals and spike count. Interestingly, in spite of the freedom of the parameter choice in reproducing the RL functions, some choices resulted in considerably more efficient stimulus encoding than the others.

P9 Descending octopaminergic interneurons of the locust brain

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In insects, octopamine and its precursor tyramine are both known to act as neurotransmitters and neuromodulators. Most cells are either purely tyraminergic or tyraminergic/octopaminergic. However, in locusts, Kononenko (Kononenko et al. , 2009) identified descending interneurons, switching from tyramine to octopamine under stressful conditions, which we labeled as OA3/TA cluster. We currently aim to analyse cell properties, morphologies and sensory input of these cells by intracellular recordings, subsequent dye injection and immunocytochemistry.

P10 Discreet long-term monitoring of electric fish behavior

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A prerequisite for the full understanding of sensory systems is knowledge about the natural context these systems evolved in. The electric sense of the gymnotiform electric fish *Apteronotus leptorhynchus* is a successful model system in research on the neural computations underlying behavior. These fish generate an electric organ discharge, which can be modulated in amplitude and frequency to create various communication signals. Much is known about the sensory system's anatomy and physiology as well as the fish's behavior and intra-specific communication signals. However, recent laboratory studies indicate that electrocommunication behavior depends strongly on the experimental situation. Further, the fish's behavior is subject to seasonal changes, e.g. mating-related behaviors occur during specific phases of the year only. Therefore, a better knowledge about the fish's behavior in its natural habitat is desirable, in particular for interpreting electrophysiological data of the electrosensory systems.

The present study targets just this question by providing and applying a novel method for undisturbed long-term monitoring of electric fish behavior. Using an array of electrodes, which is spread out over the fish's habitat and continuously records the electric fields of the fish, allows for tracking of individual fish's motion, communication signals, and conspecific interactions. Although the recorded signal traces often are superpositions of multiple fish signals, the method provided is able to robustly retrieve the original signals on a fine timescale. Here, we discuss the underlying principles, prospects and limits of our method and present recent data from our study-site in Panama, where we monitored behavioral changes in *Apteronotus rostratus* during the transition from dry to rainy season.

P11 A laboratory test of spatial recognition in solitary and social bees

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Navigation is an important cognitive faculty in Hymenopteran insects when finding their way back home after foraging and searching for new nest sites. We set out to develop a laboratory test of spatial recognition using a solitary bee species (*Osmia rufa*) and two social bees, honeybees (*Apis mellifera*) and bumblebees (*Bombus terrestris*). Our final goal will be to combine these tests with chronic recordings from high order neurons. The test apparatus consists of an arena (31.5 x 31.5 cm) that provides both local cues and panorama patterns. A single bee is trained to feed at a location characterized both by a local cue (a blue cardboard, 5x5 cm) and a position relative to the panorama. In following tests, we change the relative positions between local cue and the panorama. The walking pattern of the single test bee is video recorded during the learning and test sessions. As a control, walking patterns of naïve bees are also recorded. The analysis of the walking trajectories indicates that in both bumblebees and *Osmia* the local cue and the location characterized by the panorama can be set into competition. Under these conditions the animals shuttle between the two locations during test sessions. However, honeybees are much less motivated in the same trainings and tests and, therefore failed to show their spatial learning ability.

P12 Direct reprogramming of distinct cell types in C. elegans into GABAergic motor neurons

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One major goal of our group is to elucidate mechanisms restricting transcription factor (TF)-induced direct reprogramming (DR) of cell fates. Our ongoing genetic screens use defined cell fate specification programs in order to identify DR-inhibiting factors. To date, mis-expression of the Zn-finger TF CHE-1, inducing glutamatergic ASE neurons, is used as a neuronal specification program for our screens. To extend our neuronal screening system we will use mis-expression of the Pitx-like TF UNC-30 in combination with unc-47::gfp as a reporter for GABAergic neuron. Manual as well as an automatic whole-genome RNAi screen using the BioSorter allows for high-throughput rates to discover new DR phenotypes. Identified factors will be further characterized phenotypically by determining the degree of reprogramming based on morphology and expression of cell type specific markers. Clones allowing UNC-30 to induce ectopic GABAergic neuron fate will be also tested for the possibility to induce ASE neuron or muscle cells upon misexpression of the TFs CHE-1 or HLH-1, respectively. We believe that most identified DR-inhibiting factors will be rather 'general' inhibitors. However, some might be more cell-type specific. Furthermore, we aim to test neurons derived by DR whether they are physiologically functional. Previously, it was shown that mitotic germ cells can be converted into distinct neuron-like cells upon knock-down of PRC2 subunits (Tursun et al. 2011, Patel et al. 2012). We will test whether germ cell-derived neurons are electrophysiologically active by establishing an ex vivo procedure to convert germ cells in extracted gonads to facilitate the electrophysiology. Additionally, physiological activity of DR-derived neurons will be visualized in vivo using calcium imaging. Assessing physiological properties of converted cells will allow to determine the functional degree of cell fate reprogramming and thus offers an invaluable addition to morphology and cell fate markers. Ongoing work and preliminary results will be presented at the meeting.

P13 Spinal muscular atrophy with respiratory distress (SMARD1): Insights from the Nmd mouse model

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Spinal muscular atrophy with respiratory distress type 1 (SMARD1) is a childhood motoneuron disease caused by mutations in the gene encoding for IGHMBP2, an ATPase/Helicase. Paralysis of the diaphragm is an early and prominent clinical sign resulting both from denervation and myopathy. In skeletal muscles, muscle atrophy mainly results from loss of motoneuron cell bodies and axonal degeneration. Although it is well known that loss of motoneurons at the lumbar spinal cord is an early event in the pathogenesis of the disease, it is not clear whether the corresponding proximal axons and NMJs are also early affected. In order to address this question, we have investigated the time course of the disease progression at the level of the motoneuron cell body, proximal axon (ventral root), distal axon (sciatic nerve), NMJ, and muscle fiber in *Nmd*^{2J} mice, a mouse model for SMARD1. Our results show an early, and apparently parallel loss of motoneurons, proximal axons, and NMJs. In affected muscles, however, denervated fibers coexist with NMJs with normal morphology and unaltered neurotransmission. Furthermore, unaffected axons are able to sprout and reinnervate muscle fibers, suggesting selective vulnerability of neurons to Ighmbp2 deficiency. The preservation of the NMJ morphology and neurotransmission in the *Nmd*^{2J} mouse until motor axon loss takes place, differs from that observed in SMA mouse models in which NMJ impairment is an early and more general phenomenon in affected muscles.

P14 How retinal ganglion cells encode object motion and motion direction

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In our everyday life we can distinguish moving objects from a moving background. What we usually do not perceive is the motion of our eyes. This motion shifts the image on our retina even while fixating an object and influences the encoding of that image. Therefore mechanisms must exist which decorrelate eye movements and image information from the shifted scene.

An important step for understanding these mechanisms is to analyze different encoding strategies at the level of the retina. We study what information about eye movements and moving objects can be extracted from the responses of specialized retinal ganglion cells. It is already known that some retinal ganglion cells respond preferentially to certain directions of motion. Furthermore, a new functional property has been observed by Ölveczky et al. where cells respond to the motion of an object on a moving background, but not when the whole visual field moves homogeneously. These object-motion-sensitive (OMS) cells are considered to play a crucial part in the decorrelation of eye movements and object motion. A significant number of the OMS cells we found even display a direction preference, indicating that OMS cells are not a homogeneous group.

Here we study the interplay of different cells types for motion encoding in the retina. We project visual stimuli onto isolated salamander retina and record the responses of retinal ganglion cells using a multielectrode array. We apply a set of drifting and jittering images to investigate the encoding of different features of motion. Using reverse correlation analysis, we are able to extract which motion feature is driving each cell and how much information can be gained from single-cell responses by downstream brain regions.

P15 Systematic comparison of the effects of alpha-synuclein mutations on oligomerization and aggregation

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Aggregation and accumulation of alpha-synuclein (ASYN) in Lewy bodies (LBs) and Lewy neurites is the typical pathological hallmark of Parkinson's disease (PD) and of other disorders known as synucleinopathies. In addition, mutations in the gene encoding for ASYN are associated with both familial and sporadic forms of PD, suggesting this protein plays a central role in the disease. The precise contribution of ASYN to neuronal dysfunction and cell loss is still unclear. Although accumulating evidence suggests oligomeric ASYN species may constitute the actual culprits, there is still no definitive answer as to whether ASYN aggregation is detrimental or beneficial. Moreover, little is still known about the molecular determinants of oligomerization and aggregation of ASYN in the cell. In order to clarify the effects of different mutations on the behaviour of ASYN, we assembled a panel of 18 mutants that were previously described but that were never systematically compared side-by-side in the same cell-based systems. We found that although familial mutants linked to PD (A30P, E46K, and A53T) showed a similar propensity to oligomerize in living cells, they demonstrated different effects on inclusion formation. While the A30P mutant reduced the percentage of cells with inclusions, the E46K mutant had the opposite effect. Interestingly, artificial proline mutants designed to interfere with the helical structure of the N-terminal domain, showed increased propensity to form oligomeric species rather than inclusions. Lysine substitution mutants (E35K and E57K) increased oligomerization and altered the pattern of aggregation, in comparison to wild type ASYN. Altogether, our data shed light into the molecular effects of ASYN mutations in a cellular context, and establish a common ground for the study of genetic and pharmacological modulators of the aggregation process, opening new perspectives for therapeutic intervention in PD and other synucleinopathies.

P16 Suppression of HCN channel-mediated current impairs motor function in mice

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The hyperpolarization-activated cyclic nucleotide-gated (HCN) channels belong to the superfamily of voltage-gated K^+ channels and are composed of four isoforms (HCN 1-4) that are expressed in the heart and nervous system. The HCN channel-mediated current, I_h, is a crucial determinant of neuronal excitability. HCN channels exert several important physiological functions, e.g. in mechanisms of network oscillations, learning and memory, and nociception. Also, I_h may play a role in the expression of motor functions as mice deficient for HCN1 display impaired performance in the accelerated rotarod test.

Here, we investigated the effects of subunit-unspecific ablation of I_h on the development of motor functions. I_h was suppressed via transgenic expression of a dominant-negative HCN subunit (HCN-DN). Using the Tet-Off system we reversibly and inducibly expressed HCN-DN, and thereby suppressed I_h in cerebellar Purkinje cells or forebrain neurons under the control of the Purkinje cell protein 2 (PCP2) or calmodulin-dependent protein kinase II (CaMKII) promoter, respectively. Ablation of I_h in cerebellum did not result in motor function deficits of mutant mice. In contrast, forebrain-specific suppression of I_h throughout development affected postnatal sensorimotor functions as indicated by impaired righting, geotactic and cliff avoidance reflexes of mutant mice at postnatal days 6 to 8. Also, motor and gait deficits were observed in adult mutants as measured in the beam walking, rotarod, Catwalk and pole tests. Normalization of I_h function by blocking HCN-DN expression starting at postnatal day 21 did not prevent motor impairments in adulthood. Finally, no motor deficits were observed when I_h was suppressed only in adulthood starting at postnatal day 21.

Our results indicate that pre- and early postnatal suppression of I_h in the forebrain, but not cerebellum drastically affects the development of postnatal sensorimotor reflexes and motor function in adulthood.

P17 Analysis of connectivity between interneurons and thoracic DUM neurons in the locust, Schistocerca gregaria

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Octopamine, the invertebrate analogue to adrenaline in vertebrates, is known to act as a neurotransmitter, a neurohormone, and a neuromodulator. The locust thoracic ganglia contain a defined cluster of octopaminergic efferent dorsal unpaired median (DUM) neurons with axons that run through the thoracic ganglia nerves projecting into the periphery. DUM neurons can be functionally subdivided according to their innervation of the wing or leg muscles, as well as by their different responses to sensory stimuli. Some of the sensory pathways are known in detail, but so far none of the previous studies were able to identify any presynaptic neuron that directly innervates efferent thoracic DUM neurons. In contrast to sensory neurons, little is known about the effects of local spiking and non-spiking interneurons on DUM neurons. The aim of our study is to find and describe these presynaptic neurons that directly activate or inhibit DUM cells in the thoracic ganglia. By using paired intracellular recording techniques we observe the responses of efferent thoracic DUM neurons while simultaneously manipulating the activity in local spiking or non-spiking interneurons. All cells get labelled and their neuroanatomy is visualized for further characterization as well as to identify the recorded targets. So far we accomplished parallel intracellular recordings of DUM neurons with local interneurons in a *semi-intact* preparation of the locust. To reveal interesting recording sites we applied backfills in an isolated CNS from descending interneurons at the neck connective and from sensory neurons in the thoracic nerve 2 (N2).

P18 Morphological and Electrophysiological Characterization of VIP Expressing Interneurons in Mouse Barrel Cortex

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GABAergic inhibitory interneurons play an important role in information processing in the barrel field of the somatosensory cortex. There are different subgroups of inhibitory interneurons, generally distinguished by morphology, electrophysiology and molecular markers. One of the least well characterized groups expresses vasoactive intestinal polypeptide (VIP) and can be found throughout all six layers of the neocortex. Therefore we performed a morphological and electrophysiological characterization of VIP expressing interneurons in transgenic 24 – 36 days old VIPcre dTomato labeled mouse brain slices by whole cell patch clamp recordings, staining with biocytin and subsequent quantitative reconstructions of somatodendritic and axonal morphologies. Somatodendritic morphologies were diverse, including bipolar, modified bipolar and tufted configurations. Dendritic trees from a vast majority of neurons showed many varicosities and spanned across at least one neighboring layer, mostly staying within the home column but sometimes also reaching adjacent columns. Axonal arborizations formed by layer II/III VIP cells were usually found in layer II/III and descended further towards layer VI with a varying number of boutons in supra- and infragranular layers. Most VIP neurons in infragranular layers had axonal projections more locally and were in general never ascending. Membrane properties and firing patterns of VIP neurons varied greatly throughout layers. The most abundant firing pattern observed was regular spiking (also called adapting) with different adaption ratios in response to higher current pulses. Although the enormous variability in the before mentioned parameters does not suggest a classification scheme yet, we found one distinct subpopulation of layer II/III VIP neurons which can be identified by a specific firing behavior: A switch from a tonic to a bursting firing mode contingent on the membrane potential. These specific layer II/III VIP neurons show a brain state dependency that will have a profound effect on columnar sensory processing.

P19 The role of microRNAs in memory formation processes in the honeybee (Apis mellifera)

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Memory formation and its mechanisms have been studied intensively in the last decades. Understanding the molecular processes regulated during the training phase is one important aspect of explaining the different fundamentals of memory formation. MicroRNAs are an essential part of these molecular processes. They are short (18-23nt), non-coding ribonucleic acids, regulating processes like transport and degradation by silencing gene expression on the post-transcriptional level. MicroRNAs also play a critical role in learning and memory formation processes via regulating the mRNAs of important proteins such as CREB. This work aims to identify microRNAs involved in memory formation and synaptic plasticity in the honeybee brain and to establish a method for the quantification of these microRNAs.

P20 Transgenic expression of a dominant negative HCN subunit affects brain development

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Neuronal h currents (I_h) are mediated by tetrameric channels composed of Hyperpolarisation-activated Cyclic nucleotide-gated Nonselective cation (HCN) channel subunits. I_h activity influences the neuronal resting membrane potential, input resistance and dendritic integration of synaptic activity. To study HCN channel functions in the mouse brain, we controlled I_h activity by transgenic expression of dominant negative HCN (HCN-DN) subunits harboring a mutation in the ion channel pore. Transgene expression was driven by two different promoters: the EMX1-promoter, which is activated at E 9.5, or the CaMKIIα-promoter, which starts expression in early postnatal development. This approach leads to a functional knockout of I_h starting at the respective promoter-determined developmental time points.

The aim of this on-going study is the morphological characterization of the two different I_h-deficient mouse lines using magnetic resonance imaging (MRI) and histology of newborn (P0) and adult mouse brains. Our data show reduced body weight, brain volume and cortex thickness in animals expressing HCN-DN during prenatal development und suggest a hitherto unknown function of I_h in brain maturation.

P21 Decoding properties of a neuron, ComInt1, in a chain of coupled oscillators

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The swimmeret system of crayfish, *Pacifastacus leniusculus*, is an excellent model to study coordination of distributed, local neural networks (oscillators) in locomotion. This system contains a chain of four identical local networks. Each includes its own pattern generating kernel and a set of motor neurons, which drive the movement of one limb. From each module one coordinating neuron projects anteriorly and one posteriorly. They encode information about the status, duration and timing of their module and send it to all neighbours.

The coordinating information is decoded in each module and integrated through only one non-spiking commissural interneuron, ComInt1. For the correct timing of motor activity ComInt1 receives coordinating information via a gradient in synaptic strength, in so far as the coordinating neuron from the posterior neighbouring module elicits the strongest postsynaptic response and the others show a successively weaker effect.

In my thesis I focus on two main aspects of the information transfer between the coordinating neurons and ComInt1, first I will identify the transmitter(s) involved at this point of transfer to comprehend the cellular processes underlying the gradient in synaptic strength. Second, I attempt to identify the cause of the gradient in synaptic strength by comparing the number of release sites/ synaptic butons between the different coordinating neurons and ComInt1.

These questions are assessed with electrophysiological methods, i.e. extra- and intracellular recordings in split bath (blocking) experiments and by use of labelling tools, i.e. direct intracellular labelling as well as immunohistochemical methods. So far, my results indicate that glutamate is not the transmitter. This was tested with non-NMDA glutamate receptor antagonists in split bath experiments. Additionally, as an immunohistochemical approach revealed no serotonin-like immunoreactivity in the coordinating neurons, serotonin may be dismissed as putative transmitter, too.

P22 When the size matters: Large electrodes induce more intense stimulation-related cutaneous discomfort than smaller electrodes at equal current density

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Background: Transcranial direct current stimulation (tDCS) is currently one of the most frequently investigated Non-Invasive Brain Stimulation techniques. At present, little is known about the relationship between the subjectively perceived stimulation-related cutaneous discomfort during tDCS, electrode size and related current density. At a given stimulation intensity (e.g., at 1.0 mA), larger electrodes (35 cm^2) have lower current density (0.028 mA/cm^2), than smaller electrodes (16 cm^2, 0.062mA/cm^2). However, using larger electrodes more skin receptors are stimulated which can lead to an increased amount of discomfort.

Method: We investigated the effect of electrode size (35 cm^2 vs. 16 cm^2), current intensity (equivalent at large and small electrodes) and current density (equivalent) on self-reported intensity and perceived spatial dimension of stimulation-induced cutaneous discomfort by using a visual analog scale. Twenty participants took part in the study by using a randomized repeated-measure design.

Results: The intensity of the indicated cutaneous discomfort was significantly higher in the equivalent density condition for the larger electrodes, compared to the smaller ones ($F_{1,18} = 25.04$, $p<0.001$). We have found no significant differences between the two electrode types in the equivalent current intensity condition ($p=0.944$).

Discussion: Despite the low current intensity applied in tDCS studies, most of the participants perceive cutaneous discomfort during and after the stimulation, which is a restrictive factor of cross-over tDCS studies. Here, we have demonstrated that the evoked cutaneous discomfort was significantly smaller for small electrodes, compared to large ones, using equivalent current densities. Our findings might be a basis for improving the quality of tDCS in terms of procedural discomfort by using smaller electrodes. In addition to better blinding potentials, modeling studies also indicate better spatial focality for smaller electrodes compared to larger ones.

P23 Neuroarchitecture of the central complex of the desert locust

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Insects show exceptional abilities for spatial orientation that in many respects parallel those of vertebrates. Most types of navigation require the animal to localize itself relative to a destination such as a food source, a mating partner or its nest. The diversity of navigational strategies like landmark-aided orientation, path integration and sky compass orientation reflects adaptations to different ecological conditions. In many navigational tasks, a prominent assembly of midline-spanning neuropils in the insect brain is involved, the central complex (Homberg et al. 2011, Phil Trans R Soc B 366:680). The central complex has a highly regular neuroarchitecture and plays an increasingly apparent role in motor control and visual integration, in particular visual place learning and spatial orientation (Strauss 2002, Curr Opin Neurobiol 12:633; Ofstad et al. 2011, Nature 474:204). We have reconstructed the arborization patterns of single neurons in the central complex of the desert locust (*Schistocerca gregaria*) based on single-cell tracer injections combined with immunohistological labeling of neuropils and registered them into a 3D standard of the central complex. These three-dimensional reconstructions are compared across different anatomical preparations for two main purposes: classification of neurons with respect to branching patterns and locations of somata, and identification of likely synaptic partner neurons in neural networks.

P24 Functional Connectivity of Layer II/III GABAergic Martinotti Cells in the Primary Somatosensory (Barrel) Cortex of Mice

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GABAergic interneurons play a crucial role in information processing within the neocortex and are directly integrated in the circuitry of rodent primary somatosensory cortex, known as barrel cortex. Martinotti cells, a well-defined subclass of GABAergic interneurons, modulate the dendritic excitation of pyramidal cells, thereby having direct influence on barrel cortex output structures. One prominent feature of these cells is that they receive dense local excitation from pyramidal cells, which makes them suitable for feedback and lateral inhibition but also for "interfacing" the lemniscal and paralemniscal pathways, which process different aspects of tactile information resulting from whisking behaviour. In addition, in vivo data also showed that Martinotti cells receive inhibition during active whisking. The neocortical origin of these inputs, especially of the inhibitory, to the Martinotti cells is still unknown. In this study a combination of whole-cell patch clamp and local photolysis of caged glutamate in acute brain slices has been used to detect local neocortical circuits responsible for the excitation and/or inhibition of Martinotti cells. The resulting data indicates that these cells receive local inhibition from cells of layer II/III and in addition inhibition from cells in layer V. To identify distinct cell types responsible for the inhibition of Martinotti cells, mouse cre-driver lines were utilized which, besides expressing GFP in Martinotti cells, exhibited a second fluorescent marker (PV, VIP or SOM) in different subtypes of inhibitory interneurons. Moreover, caged GABA was employed to define the spatial distribution of $GABA_a$ receptors. In a next step we will perform paired recordings from Martinotti cells and their "upstream" connected inhibitory interneurons to identify and characterize those presynaptic GABAergic neurons. Our results will contribute to a model of processing sensory information in the barrel cortex (e.g. "interfacing" the lemniscal and paralemniscal pathways) and will improve the understanding of the GABAergic interneuron network.

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