NEUROSCIENCE
NEWSLETTER
Georg-August-Universität Göttingen · International Max Planck Research School
JULY 2020

The Neuroscience Program...

Reloaded

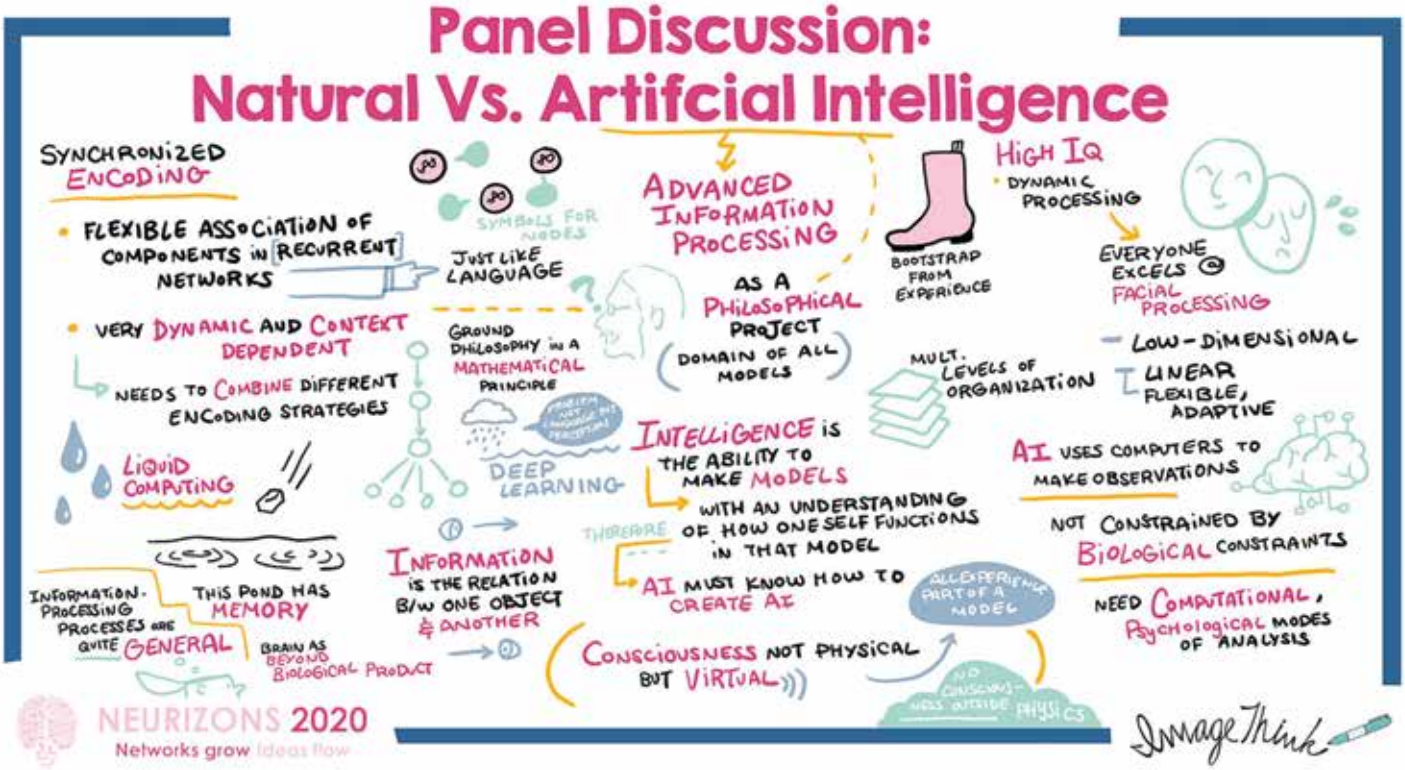
Welcome to the 7th Neuro-Newsletter of the Göttingen International Master/PhD/MD-PhD Program and International Max Planck Research School (IMPRS) Neurosciences.

The past year has shown that our program is strong, creative, and flexible - particularly in times of crisis.

After a long period of strain and sorrow due to the illness and death of Michael Hörner, the former coordinator of our program, 2019 was a year of beginning renewal. With Jonas Barth joining us as the new coordinator, our head office could finally generate free valences to resolve many lingering issues and develop new ideas and activities. The switch from an emergency mode, with a too heavy workload for too few people, to proactive development was a true relief!

In addition to reinvigorating some of the basics, such as plenary faculty meetings and regular meetings of the administrative leadership, we started to improve and reshape the curriculum. New coordinators took charge of the seven teaching blocks in the lecture series and began to implement new ideas and suggestions of the student body. This also included the overdue establishment of training courses for animal experimentation prior to lab rotations 2 and 3, which fulfill all relevant EU directives and provide the students of the program with a better preparation for their lab rotations.

CONTENT



Graphical summary of the Neurizons 2020 Panel Discussion by ImageThink

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Neuroscience in Göttingen...

The annual retreat of the program in Schloss Etelsen near Bremen in August 2019 was again a big success, with stimulating scientific discussions and vibrant social events. A joint retreat with the Molecular Biology Program had been planned for June 2020 but had to be postponed to 2021 due to the COVID-19 crisis. Likewise, the celebrations for the 20th anniversary of our programs, which had originally been planned for September 2020, had to be postponed to September 17th–19th, 2021.

Inevitably, the spread of COVID-19 across the world has had massive additional consequences for our program. While the selection of the new students starting in September 2020 could fortunately be completed before the number of COVID-19 cases in Germany started to rise rapidly, the following lockdown affected our program severely. Still, we were able to provide all lectures and tutorials of the Master Program online, and we are very grateful to our faculty, students, and administrators, who showed very substantial flexibility and adaptability in this crisis. Similarly, lab rotations could be continued in the form of dry-lab work or literature reviews, which will prevent delays of the study plan of our students and the final examinations. Together with GGNB and GAUSS, it was possible to extend the deadlines for all PhD theses by three months in order to be able to react to the restraints caused by the closure of laboratories during the COVID-19 lockdown.

We are also very glad that our biennial NEURIZONS symposium, organized by the PhD students of the Neuroscience Program, could take place in May 2020 as a virtual conference, including the award of the Otto Creutzfeldt PhD Prize 2020. The organizers showed brilliant initiative and improvisation skills in re-organizing the entire conference in a very short time, making it possible to attend all talks and even virtual poster sessions online. The symposium attracted more than 800 online participants from 48 countries and received very positive feedback.

Given the flexibility and creativity of the students, faculty, and administration of our program - particularly in these times of crisis - we look forward expectantly and optimistically to the new semester that starts in September 2020. Despite all current impediments and challenges due to the COVID-19 crisis, we are very confident that we will be able to continue to provide excellent teaching and support for our students.

Nils Brose
Speaker International Max Planck Research School

Martin Göpfert
Speaker MSc/PhD/MD-PhD Program

Jonas Barth
Scientific Coordinator

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Hearing the light

An optogenetic approach for hearing restoration *by Alexander Dieter*

Deafness is the most common sensory disorder, and would prevent you both from listening to your beloved course in Neuroscience, and to the friend sitting next to you in class, elaborating on happenings on the recent weekend. Consequences are, amongst others, social isolation, and decrease in professional abilities. Luckily, cochlear

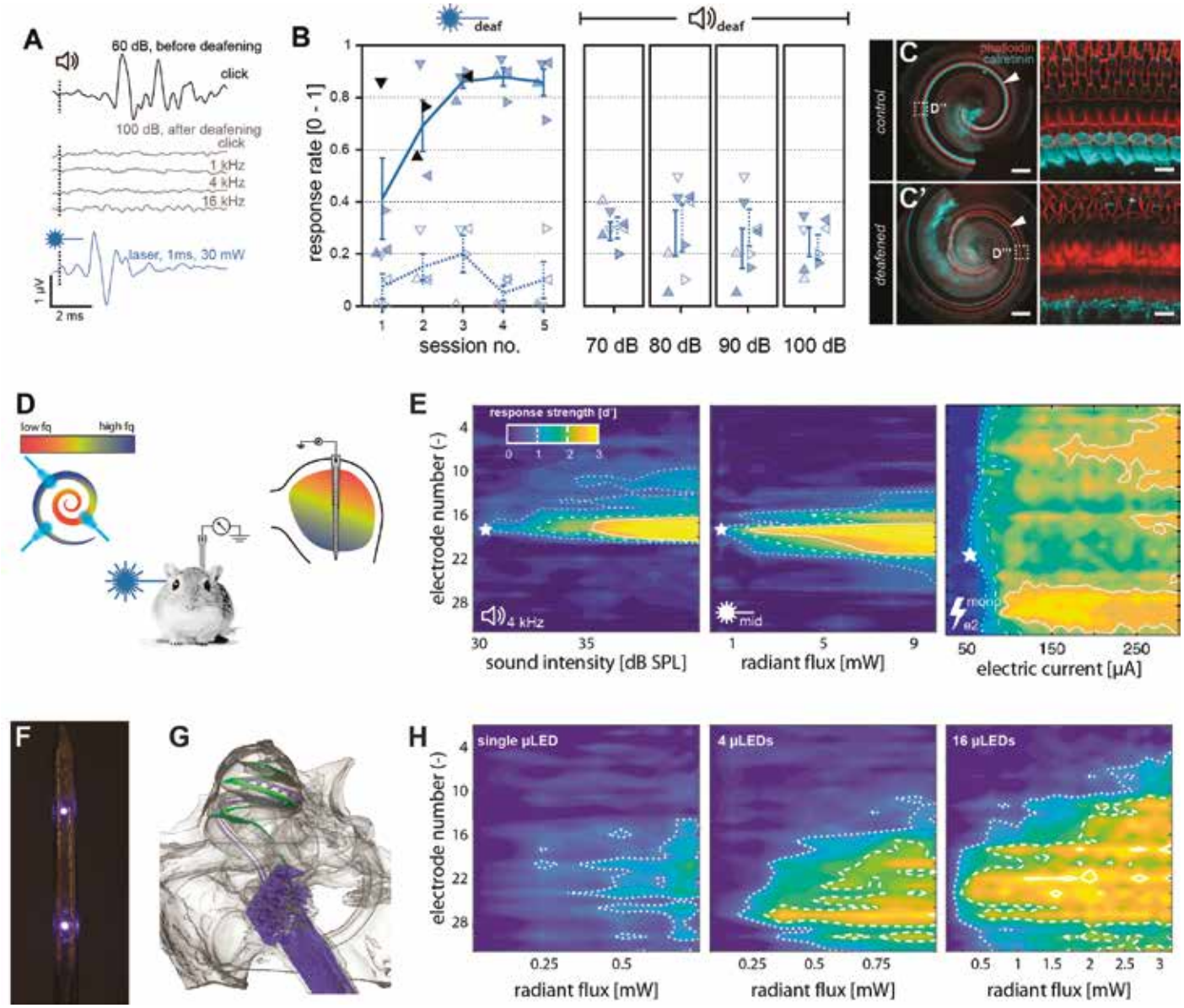

Fig. 1: *Optogenetic activation of the auditory nerve. Optogenetic hearing restoration in gerbils with sensorineural hearing loss revealed by physiological (A) and behavioral (B) methods. Loss of inner hair cells was demonstrated by immunohistochemistry (C). (D) Experimental paradigm to determine spread of cochlear excitation by recordings of neural activity in the auditory midbrain. (E) Auditory midbrain activation (response strength is color coded) upon acoustic (left), optogenetic (center) and electric (right) stimulation of the cochlea reveals near-physiological spectral selectivity of cochlear optogenetics, outperforming electrical stimulation. (F) 16-channel, µLED-based optical cochlear implant (oCI). (G) X-ray reconstruction of an oCI (blue) implanted in the gerbil cochlea. The basilar membrane is depicted in green. (H) Auditory midbrain activity resulting from optogenetic activation of the auditory nerve with a single µLED (left), four µLEDs (center) and all 16 µLEDs of the oCI (right). Color code is identical to panel E.*

implants (CIs) might relief you from this condition: by electrically stimulating the auditory nerve (AN), CIs mimic natural coding principles of the cochlea and re-connect patients to the auditory world surrounding them, enabling speech comprehension in more than half a million users. Unfortunately, electric current is hard to steer in the intracochlear fluids, limiting the spatial precision and thus the spectral resolution of electrical hearing restoration. This limitation might be overcome by optogenetics, as light can be conveniently confined in space, enabling AN activation with improved precision. Working with adult Mongolian gerbils whose AN has been virally transduced with the Channelrhodopsin-variant CatCh, some of the challenges toward optogenetic hearing restoration have been adressed in this project:

First, perception of optogenetic AN activation has been demonstrated on the behavioral level, which is essential when considering that oCIs must convey behaviorally relevant information to future users. Towards this end, a fiber-based single channel oCI has been implanted via the round window into the cochlea and animals have been trained to indicate perception of optogenetic SGN stimulation via avoidance behavior. In a different set of animals, optogenetic AN stimulation has been shown to restore activation of the auditory system both on a physiological and behavioral level in a gerbil model of sensorineural hearing loss (Fig. 1A-C).

Second, cochlear optogenetics has been demonstrated to activate the auditory pathway in a tonotopic manner and with increased spectral resolution as compared to electrical stimulation (currently used in clinical settings). Towards this end, the AN of anesthetized gerbils has been stimulated with acoustic, electric, or optogenetic stimuli, while multi-channel electrophysiological recordings have been performed in the tonotopically layered auditory midbrain (Fig. 1D). Activity-based analysis revealed that spectral selectivity of optogenetic SGN stimulation is comparable to acoustic stimulation using pure tones at low stimulus intensities, and outperformed electrical stimulation (Fig. 1 E). This finding is of high importance, since clinical translation of cochlear optogenetics is only justified if a substantial advantage of optogenetic over electric sound encoding is to be expected.

Third, virus-mediated gene transfer in adult gerbils has been combined with microsystems engineering in order to facilitate multi-channel optogenetic AN activation by 16-channel oCIs based on microscale LEDs (Fig. 1F-G). Using multi-channel electrophysiological recordings in the auditory midbrain while stimulating the AN optically with individual µLEDs or various µLED combinations, it was shown that individual µLEDs of the oCI were able to evoke neural responses, and that the strength of neural responses increased when recruiting additional µLEDs (Fig. 1H). The spread of excitation upon µLED-based oCI stimulation – even when stimulating with groups of four subsequent µLEDs – was shown to be more specific than the spread of excitation upon electrical SGN stimulation. These results confirm the findings of increased spectral selectivity of AN activation when using optogenetics as compared to state-of-the-art electrical stimulation, and demonstrate the feasibility of AN activation by multi-channel µLED-based oCIs.

Taken together, the results of this study demonstrate the perception of optogenetic SGN stimulation, optogenetic hearing restoration, increased frequency resolution, and *in vivo* functionality of a µLED-based optical CI. In conclusion, these results raise great hope that optogenetic hearing restoration might overcome the major bottleneck of electrical hearing restoration and thus improve the quality of artificial hearing for deaf patients in the future.

Alexander DIETER has completed his doctoral studies at the Institute of Auditory Neuroscience, University Medical Center Göttingen, under the supervision of Prof. Tobias Moser. After his graduation he joined the lab of Prof. Simon Wiegert at the Center for Molecular Neurobiology Hamburg, University Medical Center Hamburg-Eppendorf, as a post-doctoral researcher, investigating neuromodulatory effects on synaptic plasticity.
Synaptic Wiring Lab
Center for Molecular Neurobiology Hamburg
University Medical Center Hamburg-Eppendorf
Falkenried 94, 20251 Hamburg

Repurposing an old connection

Endophilin-A coordinates priming and fusion of neurosecretory vesicles via intersectin

by Sindhuja Gowrisankaran

Synaptic vesicle (SV) recycling is attributed as one of the finely controlled cell biological processes. Release of hormones and neurotransmitters from the vesicles by exocytosis has evolved to be a fast process, as they proceed in millisecond to second range upon arrival of stimulus. After the vesicular content is released, the excessive membrane and proteins added to the surface is removed and recycled by the process of endocytosis. Particular steps of SV recycling like exocytosis and endocytosis have been extensively researched in the last 30-40 years. While the molecular players involved in orchestrating the specific steps of the recycling process have been identified and characterized, the availability of these factors at the right time for each step along the recycling process is not yet fully understood. Moreover, the intermediate steps in the SV recycling process like coupling of exo- and endocytosis is still being investigated and my Ph.D. work aimed to address some of these open questions.

Endophilin-A is a well characterized endocytic adaptor protein, known to mediate key steps in clathrin-dependent and -independent endocytic processes[1,2]. A study using a mouse knock-out model showed that loss of endophilin-A resulted in impaired synaptic transmission; but it was not completely abolished[3]. This impaired neurotransmission could be a consequence of defective endocytosis and impaired SV recycling or due to a direct role for endophilin in the SV fusion process itself, or both. It is however difficult to address this in hippocampal neurons, since the process of exocytosis is tightly coupled to the endocytic retrieval mechanisms. To circumvent this problem, we used chromaffin cells (found in the adrenal gland) as a model system where a local recycling mechanism is not well established[4]. Chromaffin cells contain large dense core vesicles (LDCV), filled with hormones and/or neuropeptides and release their content by calcium-regulated exocytosis, using a similar molecular machinery as neurons. After the vesicular content is released, the retrieved proteins and membrane are recycled to the Golgi area, to be reused for the next cycle of events.

We found a direct role for endophilin-A in LDCV exocytosis, independent of its endocytic function, using chromaffin cells from mouse lacking all three mammalian endophilin-A (A1, A2 and A3) isoforms[5]. Briefly, we performed fast capacitance and amperometry recordings to measure the vesicles as well as the content released and found that lack of endophilin results in reduced exocytosis, smaller vesicle pools and altered fusion kinetics. Next, we checked if the reduced exocytosis was simply due to a reduction in the number of vesicles available for release. Morphological analysis showed that the number of vesicles, as well as their distribution was unaltered in the absence of all three endophilin isoforms. Further, the absence of endophilin-A did not affect protein or membrane recycling by endocytic mechanisms. Following this, we reasoned that the reduction in vesicle release could simply be due to

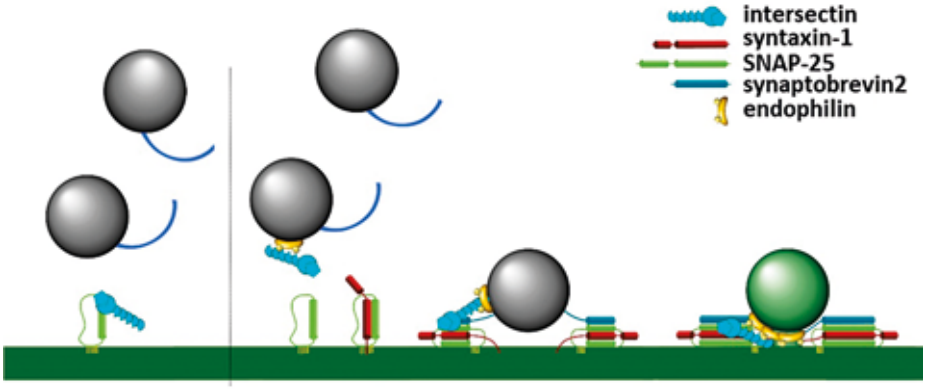

Fig. 1: Working model of endophilin-A and intersectin-1's role in exocytosis *Endophilin-A is found on neurosecretory vesicles and regulates their recruitment, priming and fusion during exocytosis. They co-ordinate intersectin-1's localization in the cell, likely to ensure that they act at the optimal location and time. In the absence of endophilin, intersectin is mislocalized to the plasma membrane and causes the observed exocytic defects in the endophilin mutant cells (left). We propose a model where endophilin-A and intersectin-1's interaction controls the recruitment of secretory vesicles to the plasma membrane to their release sites (right), likely by modulating actin network and protein availability for SNARE complex formation (through intersectin's inetraction with SNAP-25). After the vesicle release, they could be retained to act as a scaffold to couple exo- and endocytic events.*

the unavailability of exocytic proteins for the fusion process. However, there was no observed difference in exocytic protein distribution or levels in the endophilin deficient cells.

The exocytic defects could be rescued upon expression of both full length endophilin A1 and A2. To further understand how this protein affects exocytosis, we looked into its protein domain function and identified that its SH3- domain is crucial for its exocytic function. Specifically, we pursued the SH3-domain mediated interaction with a scaffolding protein intersectin-1 since this protein was mislocalized to the plasma membrane in endophilin mutant cells[6]. Interestingly, lack of intersectin also resulted in reduced exocytosis[7,8]. Absence of endophilin-A binding to intersectin-1 or vice-versa resulted in similar exocytic defects in chromaffin cells. We thus proposed a model based on previous works and our findings that endophilin may act as a regulator of intersectin in exocytosis and that the direct interaction between endophilin-A and intersectin-1 coordinates the vesicle recruitment, priming and fusion process in the neurosecretory cells (Figure 1).

Further studies are needed to understand if this model, which is based on results from neuroendocrine cells, can be extended to neuronal synapses. This study offers an example of how proteins can assist in several steps along the recycling process and protein-protein interaction acts as a mechanism to ensure they are available at the right moment for their action along the vesicle cycle.

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Sindhuja GOWRISANKARAN completed her doctoral thesis in Dr. Ira Milosevic's group at the European Neuroscience Institute in Göttingen. She will join the group of Prof. Thomas Schwarz in the Boston Children's Hospital, MA in September 2020 as a post-doctoral researcher.

European Neuroscience Institute
Synaptic Vesicle Dynamics
Grisebachstr. 5
37077 Göttingen

Cortical connectivity

in the absence of layers *by Georg Hafner*

It is one of the first things we learn about the neocortex: it consists of layers. The concept of layers is old. In fact, it is so old that at the time of its description the language of science was German. Theodor Meynert proposed in 1867 to separate morphologically different types of neurons into layers. Now the term layer is cemented as a principle of cortical organization. It is almost surprising that a clear reason why the cortex obeys this structure is not apparent[1]. What is the function of layers?

In 1945, a strange mutation spontaneously appeared in a mouse colony held in Edinburgh. The so called reeler mutant lacks the protein reelin, which orchestrates migration of cortical neurons during development[2]. The effect of its absence: this mutant has no layers. Neurons are chaotically dispersed across the cortex. One would assume these mice show severe cognitive defects, but they don´t. Their basic cognitive functions are preserved. Only when you really challenge them, they fail to be as good as wildtype (WT) mice[3]. Why does the absence of layers matter so little?

There could be an obvious explanation: Although cells are dispersed, they could still form the same networks. We decided to investigate if the circuits in the reeler mouse are preserved despite the malpositon of its parts. We focused on a class of inhibitory neurons, the vasoactive, intestinal polypeptide (VIP) expressing cells. In the WT, they are mostly in the upper layers and suggested to be primary integrators of long-range input (Figure 1A). In reeler, they are dispersed throughout the cortical thickness (Figure 1A'). To see if these neurons receive the same pattern of long-range input as in WT, we used a tracing approach with rabies virus to label monosynaptic inputs to VIP

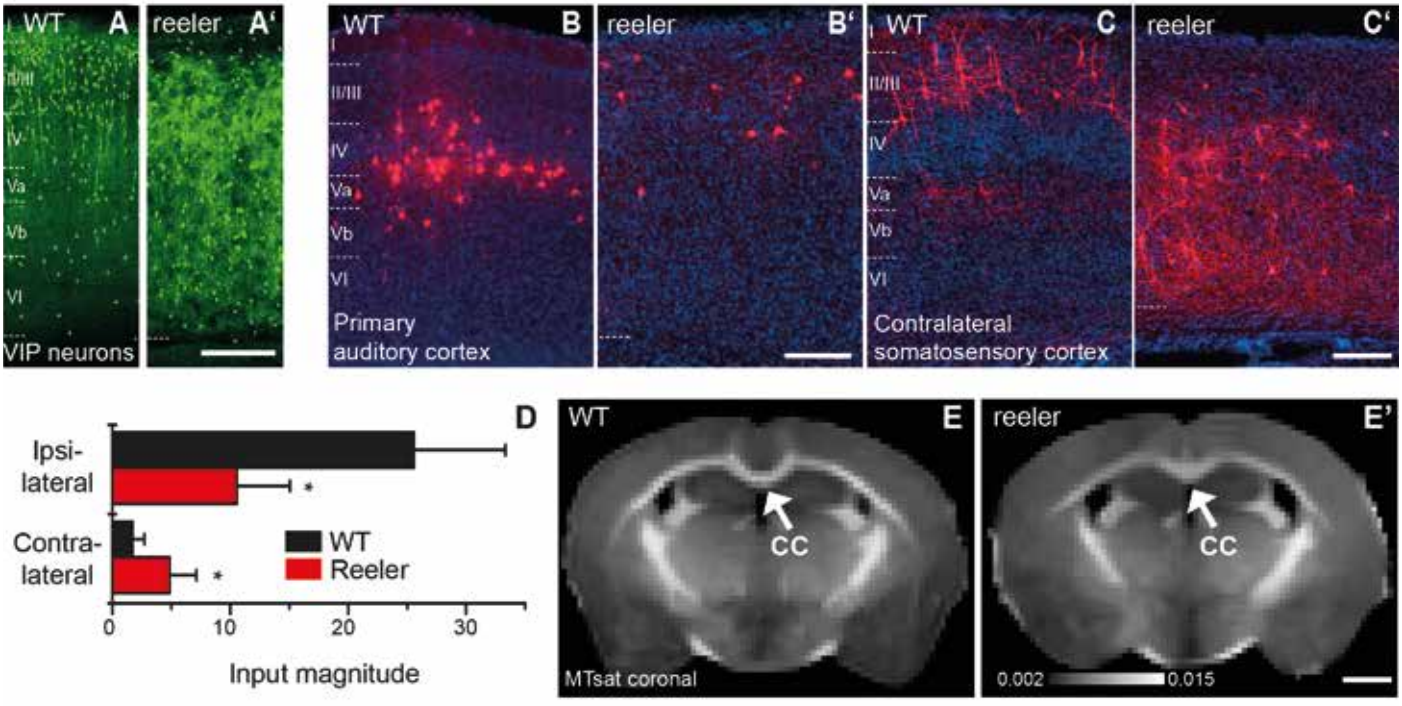

Fig. 1: *(A, A') VIP neurons in somatosensory cortex labeled with fluorophore. VIP neurons are biased towards the upper part of cortex in WT but have not bias in reeler. (B-C') Labeled input neurons in ipsilateral auditory cortex and contralateral somatosensory cortex in reeler and WT. (D) Quantification of all ipsi- and contralateral inputs. Input magnitude represents the average number of input neurons innervating one VIP cell in somatosensory cortex. There were significantly less ipsi – and more contralateral inputs in reeler. (E) Coronal brain sections acquired with MRT. Arrow points to the corpus callosum (CC). At the midline in reeler it appears thicker and fibers do not form the typical U-shaped trajectory. Scalebars: A, B, C, 200µm; E, 1mm.*

cells in somatosensory cortex from all over the brain[4]. There are examples of labeled input neurons in the auditory cortex and the contralateral somatosensensory cortex of WT and reeler mice (Figure 1B, C). As you can see already on the pictures, there seems to be a difference in the number of labeled neurons. Indeed, the inputs from the same hemisphere were strongly reduced but the inputs from the contralateral hemisphere were increased in reeler (Figure 1D). If there is more input from the other hemisphere in reeler, then the corpus callosum should be larger.

Luckily, Nikoloz Sirmpilatze, a current IMPRS PhD student, joined the project. With his colleagues at the DPZ, he analyzed the anatomy of the corpus callosum in reeler using MRT. We found it to be larger and also differently shaped with a thicker and flatter midline transition (Figure 1E). These results support the idea that there is an increased callosal connectivity in reeler.

In sum, the cortical circuitry is clearly different in the reeler mouse, showing a reduced connectivity within one hemisphere and an increased connectivity between hemispheres. There are multiple influences on circuit development in reeler including direct effects of the absence of the protein reelin, for example on neurite outgrowth. However, given the preservation of cognitive abilities in reeler, it is plausible that this circuit emerges to balance out developmental abnormalities like aberrant layering. Because callosal connections mature later than ipsilateral connections, the increased callosal connectivity might balance the decreased ipsilateral connectivity. We incline to the possibility that in the absence of layers an alternative network forms that is still capable of similar cognitive functions.

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Georg HAFNER joined the IMPRS Neurosciences in 2013. Growing fond of Göttingen and its scientific environment, he stayed for this doctoral thesis. Under the supervision of Jochen Staiger in the Institute for Neuroanatomy he worked on tools for viral tracing and applied them to study connectivity of neuronal types. After graduating in 2019, he stayed on as a postdoc.

University Medical Center Göttingen
Institute of Neuroanatomy
Kreuzbergring 40,
37075 Göttingen

Single cell partitions intensity information

via heterogeneous presynaptic control of release *by Özge Demet Özçete*

Sensory systems encode information about the world that ranges over many orders of magnitude. They use different strategies at different levels, such as circuity, cell type, or synapses. The auditory system encodes sound intensities ranging over six orders of magnitude via the functionally diverse primary auditory neurons, called spiral ganglion neurons. They receive sensory input from the auditory receptor cells, i.e. inner hair cells. The functional groups of spiral ganglion neurons exist at all tonotopic locations, hinting they may innervate the same inner hair cell. Furthermore, they show a spatial innervation preference on inner hair cells. We tested whether the sound intensity information in the receptor potential of inner hair cells is split into different information streams via heterogeneous synapses[1].

Sound encoding properties of individual inner hair cell active zones might be different based on the presynaptic control of release. We studied the synaptic transfer functions of individual inner hair cell active zones by combining patch-clamp recordings of inner hair cells with dual-sequential imaging of synaptic calcium influx and glutamate release. To detect calcium influx, we introduced the chemical low-affinity calcium indicator Rhod-FF to the inner hair cell via a patch pipette. To detect glutamate release, we imaged fluorescent glutamate sensor iGluSnFR that we targeted to the postsynaptic membrane of inner hair cells via viral transduction.

By simultaneous imaging of several inner hair cell active zones, we revealed the heterogeneity of synaptic transfer functions of even nearby synapses. This shows that a single presynaptic cell partitions their output for a given stimulus. Furthermore, we found heterogeneous voltage dependence of calcium channels and their coupling to release sites as one of the underlying mechanisms for such a diversification. Interestingly, synapses showed a spatial gradient: the ones on the pillar side of the inner hair cell were active at more negative potentials than the modiolar ones (Figure 1). This is consistent with the preferred innervation of high spontaneous rate fibers on the pillar side of the cell. The pillar synapses also typically exhibited a near-linear Ca^{2+} dependence of release, indicating the release is under control of a Ca^{2+}-nanodomain. On the other hand, modiolar synapses showed a nonlinear relation between Ca^{2+} influx and release. By unbiased clustering of synapses based on the obtained properties, we identified three putative synapse subtypes differing in their Ca^{2+} dependence of release, and thereby in their transfer functions.

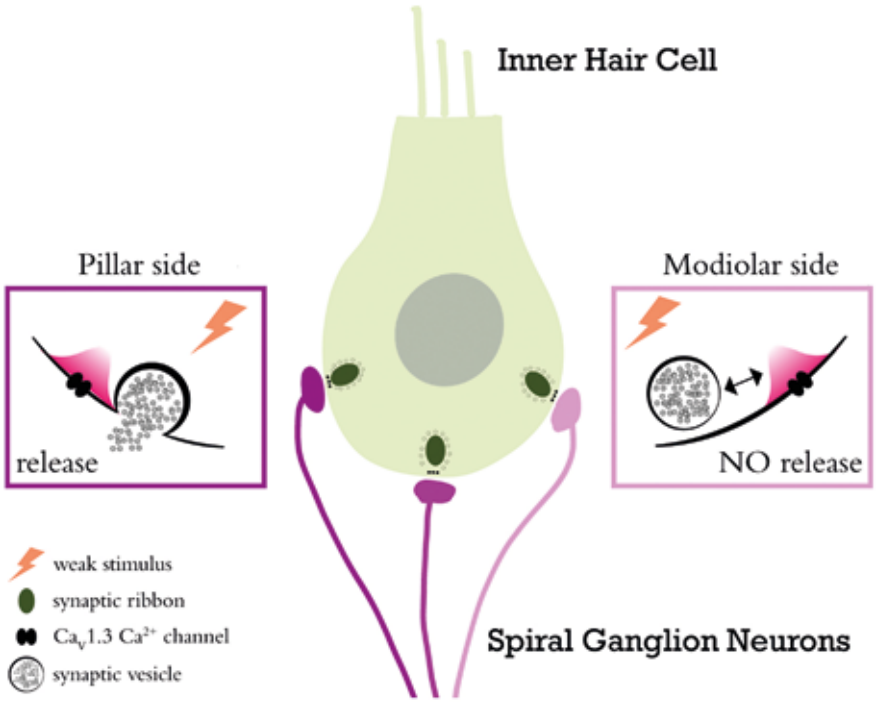

Fig. 1: *Inner hair cell splits sound intensity information via heterogenous coupling of Ca^{2+} channels and release sites. Synapses residing on the pillar side of the inner hair cell were active at more negative potentials than the modiolar ones. We suggested that the underlying mechanisms were the heterogenous voltage dependence of Ca^{2+} channels and their coupling to release.*

Overall, the heterogeneity of the voltage dependence of Ca^{2+} channels and their coupling to release sites among inner hair cell synapses outlines a mechanism how a single cell can split information. This may be a general solution used by neurons to decompose information from a single voltage compartment. Furthermore, we provided a link to the diversity of spiral ganglion neurons. Heterogenous coupling of Ca^{2+} channel and release sites could contribute to the differences in the firing responses of spiral ganglion neurons, such as spontaneous rate and threshold of activation. By this study, we propose a model where inner hair cell partitions the sound intensity information via heterogeneous presynaptic control of release (Figure 1).

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Özge Demet ÖZÇETE completed her doctoral thesis in the lab of Prof. Tobias Moser at the Institute for Auditory Neuroscience in 2019 and currently works as a postdoctoral researcher in the same lab.

Auditory Neuroscience Group
Max Planck Institute for Experimental Medicine
Göttingen, Germany

Master's class 2019/20

Hazim Abdelrahman Sudan, MBBS from University of Khartoum, Sudan

Abdelrahman AlOkda Egypt, BSc from University of Science and Technology at Zewail City, Egypt

Pietro Amerio Italy, BSc from Università degli Studi di Torino, Italy

Rachna Balaji India, BTec from Anna University, India

Laurin Büld Germany, BSc from Rheinische Friedrich-Wilhelms-Universität Bonn, Germany

Bruno Carniatto Marques Garcia Brazil, MD from Universidade Federal do Paraná, Brazil

Avika Chopra India, BSc from Sri Venkateswara College, University of Delhi, India

Hanna Dubrovska Ukraine, BSc from Taras Shevchenko National University of Kiev, Ukraine

Yomna Gohar Egypt, BPharm from German University in Cairo, Egypt

Paloma-Renata Huguet Rodríguez Spain, BSc from University of the Basque Country, Spain

Mariia Metelova Ukraine, BSc from Taras Shevchenko National University of Kiev, Ukraine

Ranjit Pradhan India, MSc from National Brain Research Centre, India

Varsha Ramakrishna India, MSc National Brain Research Centre, Manesar, Haryana, India

Perianen Ramasawmy Mauritius, BSc from University of Bristol, United Kingdom

Lucía Rojas Meza Peru, BSc from Peruvian University Cayetano Heredia, Peru

Hanna Rula Ukraine, BSc from Taras Shevchenko National University of Kiev, Ukraine

Jaya Sowkyadha Sathiyamani India, BSc Sri Venkateswara College, University of Delhi, India

Asude Tura Turkey, MD from Yeditepe University, Turkey

Alexandra Witt Germany, BSc from Technische Universität Braunschweig, Germany

Applications 2019

In the year **2019**, the Neuroscience program received 447 applications from 68 countries.

Germany 31
other Western Europe 15
Eastern Europe 12
North America 15
Central/South America 16
North Africa 22
Central/South Africa 68
Asia / Near East 108
Central Asia / Far East 159
Australia 1

New Students

PhD projects started in 2019

Juan Diego Prieto Ramírez
Connectivity pathways in the inner retina
Tim Gollisch,
Silvio Rizzoli,
Jan Clemens

Delane Espinueva
Investigating the SNARE complex disassembly
Reinhard Jahn,
Luis Pardo,
Claudia Steinem

Dmytro Nesterenko
Synaptic mechanisms of memory reconsolidation
Camin Dean,
Nils Brose,
Dilja Krüger-Burg

Deniz Yüzak
Neuronal computations underlying Drosophila acoustic communication
Jan Clemens,
Tim Gollisch,
Marion Silies

Inés Hojas García-Plaza
Investigating activity-dependent changes in presynaptic ultrastructure and their contribution to short-term plasticity
Nils Brose,
Silvio Rizzoli,
Brett Carter

Tarana Nigam
Feedback as the way forward: sensory predictions in the primate face processing network
Caspar Schwiedrzik,
Alexander Gail,
Siegrid Löwel

The Masters of 2019

Irene Melati Aji
(*B. Geurten*) Drifting movements in *Drosophila melanogaster* increase its foraging efficiency in darkness

Aishwarya Bhonsle
(*M. Wilke*) Oscillatory correlates of conscious visibility as a function of handedness and eye-dominance

Tony Joel Carricarte Naranjo
(*M. Wilke*) Hemisphere-dependent attentional effect on stimulus visibility during generalized flash suppression

Daniela Doda
(*G. Knott, external*) An ultrastructural investigation of cholinergic neuromodulatory axons in the barrel cortex

Delane Espinueva
(*R. Jahn*) Lipidated SNAP-25: palmitic-like modification method *in vitro*

Conor Heins
(*A. Pooresmaeili*) Hierarchical Evidence Accumulation - A Free Energy Account

Hendrik Heiser
(*A. Fischer*) Functional connectivity analysis of the ventromedial thalamus upon remote fear memory extinction

Inés Hojas García-Plaza
(*N. Brose*) Role of Alpha-Synuclein in Synaptic Transmission

Anna Marie Müllen
(*S. Boretius*) Structural Characterization of the Human Somatosensory SI Digit Area

Dmytro Nesterenko
(*S. Boretius*) Resting state connectivity and negative BOLD responses

Tarana Nigam
(*A. Gail*) Gaze and dyadic interactions in a social decision-making context in rhesus macaques and humans

Melanie Nuesch Germano
(*A. Fischer*) Development of a tool that automizes and optimizes ChIP-seq analyses and its application to neuroepigenetic studies of dementia in human brains

Adrián Palacios Muñoz
(*J. Clemens*) Implementation of unsupervised pose-tracker for Drosophila melanogaster behavior analysis

Sabine Rannio
(*A. Fischer*) Determining the Role of CRF in a Thalamocortical Circuit During Social Encounters

Marina Slashcheva
(*M. Wilke*) Influence of pulvinar inactivation on within- and interhemispheric functional connectivity in macaque parietal cortex during action selection

Jesse St. Amand
(*S. Treue*) Information Decomposition of Neural Activity in the Prefrontal Cortex

Yannan Su
(*A. Gail*) Modification of Local Field Potentials by Optogenetic Stimulation in the Frontoparietal Cortex

Mariia Zeziulia
(*A. Fischer*) Development of a microfluidic device for early detection of Alzheimer's disease

The Doctors of 2019

Lucas Araújo Caldi Gomes
Multi-omics analysis of human brain tissue and an animal model of Parkinson's Disease
Paul Lingor,
Silvio Rizzoli,
André Fischer

Michael Daan Feyerabend
Thalamocortical Innervation of GABAergic Interneurons in Mouse Primary Vibrissal Somatosensory Cortex
Jochen Staiger,
Camin Dean,
Tobias Moser

Thomas Offner
Wiring and information processing in the olfactory bulb of larval *Xenopus laevis*
Ivan Manzini,
Thomas Dresbach,
Silvio Rizzoli

Chi Chen
Auditory associative learning and its neural correlates in the auditory midbrain
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Miracle in Cremona?

The science behind Stradivarius by Gaston Sendin

An aura of unattainable perfection surrounds the violins created by Cremonese luthiers, particularly those made by Antonio Stradivari and Giuseppe Guarneri ‚del Gesù.' However, no objective study permits to establish their supposed tonal superiority over modern ones.

Recently, Fritz and collaborators decided to test whether soloists show a preference for old Italian instruments over modern ones. The results were striking: there was barely any correlation between the age or price tag of a violin and its perceived quality. Based on their playing experience, participants were not able to discriminate between old and new instruments.

Researchers have been trying hard to correlate different attributes of these violins with their tonal quality, pursuing different hypotheses. Let's have a look at what science can tell us about Stradivarius violins.

Acoustics

The body of a violin is composed of two parallel wooden plates that form a resonant box, which radiates into the surrounding air, when a string is bowed.

A resonant frequency is the natural frequency of vibration determined by the physical parameters of the vibrating object. It is easier to get an object to vibrate at its resonant frequency, than at any other frequency. The body of a violin behaves as an air cavity resonator.

Nia and coworkers studied the effect of the shape of sound holes on the acoustics of string instruments (see Fig. 1-2). Using a combination of X-ray and computer tomography (CT) scans as well as measurements obtained from technical drawings of string instruments from museum collections and books, they generated a computer model that monitors the evolution of sound holes' design throughout history and their acoustical impact.

They found that air flow at the perimeter rather than the broader surface of sound-holes dominates sound production. As the geometry of sound-holes slowly evolved over centuries from a circular open hole to the slender f-holes of Stradivari and Guarneri, the ratio of inactive surface area to total sound-hole area was dramatically reduced, basically doubling the power of emitted sound.

Based on measurements of 470 Cremonese violins from the workshops of Amati, Stradivari, and Guarneri, in only two centuries f-hole length increased by 30%, producing instruments with 60% higher resonance power.

The slow drift in design over these two centuries raises an intriguing possibility. This process might have occurred by chance, through the introduction of

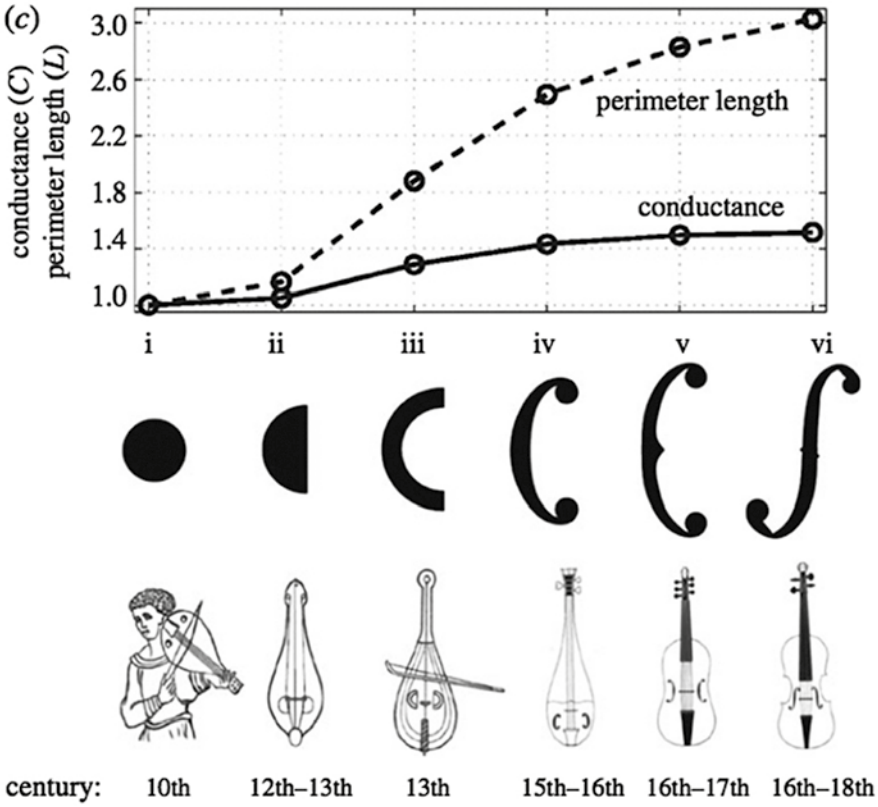

Fig. 1: *Acoustic power efficiency grows as sound hole shape evolves over centuries. Adapted from Nia et al., 2015.*

small mistakes in wood carving leading to violins with a more powerful sound. These errors conferring violins with a more robust sound were probably selected for replication within the workshops in Cremona, fixing the new trait in the pool of available violins.

Based on these results, it is interesting to speculate that the violin's prominence in 17th-18th centuries might have been a result of its ability to project sound more efficiently, as venue size increased during a shift from courtly circles of performance to public theaters.

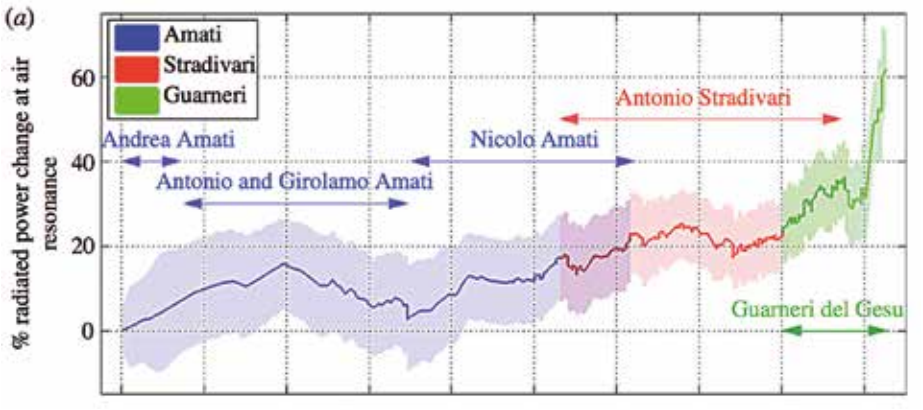

Fig. 2: *Time-series of acoustic power resonance changes during the Golden Age of violin making (from Nia et al., 2015).*

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GASTON SENDIN describes himself as a neurobiologist who is passionate about science communication and the history of art (more information on his blog: https://www.neurokunst.com/.) After finishing his studies in Biology at the University of Buenos Aires (Argentina), he went on to pursue a Ph.D. in Neuroscience at the International Max-Planck Research School & the University of Göttingen (Germany). Pursuing research in sensory neurobiology, he was a post-doctoral fellow at the MRC Laboratory of Molecular Biology in Cambridge (UK), the Department of Artificial Intelligence at the University of Groningen (Netherlands) and the Inserm-Institute for Neuroscience of Montpellier (France). Currently, he serves as Research Manager for DEBRA Austria, a patient organisation and research-funding agency that supports the development of therapeutics for patients suffering from Epidermolysis Bullosa.

Summer in Japan before diving into...

the PhD… *by Vasyl Mykytiuk*

Starting a PhD is long term commitment. Of course, you might still take some holiday breaks from the ups and downs of your doctoral project, but you can't really immerse yourself in a totally new environment for several months. This is exactly what I thought after completing my MSc studies in Göttingen. Shortly after the graduation, I secured a PhD position at the Max Planck Institute for Metabolism Research in Cologne, and just had to decide about the starting date of my 4-years PhD journey.

Coincidently or not, at that time I learnt about the Summer Internship Program, organized by the RIKEN Center for Brain Science in Japan. Performing a short research project in one of the leading Japanese institutes and spending the whole summer experiencing an astonishing culture of Japan… This sounded like an unrealistic dream to me. So I decided to apply. And that summer certainly stays among the most memorable adventures in my life.

I started my research project in the lab of Dr. Joshua Johansen. The whole lab investigates different aspects of emotional learning and memories. Usually we do not remember the ordinary events of our everyday life for a long time. However, if something that triggers strong emotional reaction happens, then be sure, that you will remember it for years. Which mechanisms underly such selective formation of strong memories? How can one affect the emotional memories of traumatic events? I was enthusiastic of pursuing these questions with other members of Josh's lab.

RIKEN Summer internship usually lasts two months (I was lucky to get one month extension) with one week dedicated to the lectures, given by renowned scientists. My project consisted of two parts. One comprised the making use of viral tracing techniques to elucidate brain connectivity, critical for learning of negative emotions. Second, I was helping with analysis of *in vivo* calcium imaging data. This is an amazing method that allows scientists to look at the neuronal activity of the living, freely moving animals, when they execute a certain behavior or receive a particular stimulus.

Participants of the RIKEN CBS Summer Internship Program 2018

Source: Press Center of RIKEN CBSnet

The lecture course of the program provided with a possibility to network with both local and international scientists, as well as to gain new insights into the recently developed techniques. For example, Prof. Michael Hausser (UCL) gave a talk about the method for all optical investigation of neuronal circuits. First, you record activity of neurons in rodents with 2-photon microscope and then you select which exactly cells in your visual field you would like to activate or inhibit, and in which order. I was also impressed by the Dr. Hayashi-Takagi (now in RIKEN CBS) talk about the labeling and erasure of specific memory traces.

Besides doing the scientific part of the internship, the organizers also arranged a traditional Japanese hot spring bathing (onsen), as well as gave us a chance to wear traditional clothing, called yukata. I am afraid it is impossible to describe my experience during the exploration of Tokyo and neighboring areas in few lines. Just to mention a several things that I did: watched the sunset over Fuji mountain, tried dish made of poisonous pufferfish, played virtual reality games with locals, participated in tra-

ditional festival Matsuri, experienced a small earthquake, got lost in Tokyo subway, held a conversation with a robot, spent the night in karaoke, saw the traditional wedding ceremony and the biggest firework festival, enjoyed the tastiest seafood ever and much more…

Looking back to my summer in Japan, I am really happy with my experience. Japan is fascinating, with its traditions and technological advancements, kind and polite people, and great research possibilities. I arrived back to Germany in a great mood and full of enthusiasm to start what's meant to be the longest scientific endeavor in my life so far.

Vasyl spontaneously participates in the matsuri festival with locals Source: private

Vasyl MYKYTIUK graduated from the IMPRS Neuroscience program with an MSc degree in 2018. In summer 2018 he performed a research internship in RIKEN Center for Brain Science in Japan at the lab of Joshua Johansen. After that, Vasyl started his PhD at the laboratory of Prof. Tatiana Korotkova at the Max Planck Institute for Metabolism Research in Cologne, Germany, where he investigates neuronal circuits underlying reward-seeking behavior.

Neuronal Circuits and Behaviour Laboratory
Max Planck Institute for Metabolism Research
Gleueler Str. 50
50931 Cologne, Germany

From the lab to science communication

and scientific editing *by Dorota Badowska*

Towards the end of my PhD, I was tormented by a dilemma faced by most PhD students – what next? To the typical question "Do you want to stay in academia or go to industry?" my answer was "none of them". With my passion for reading papers, public speaking, and concepts rather than techniques, I was more interested in stimulating dialogue between scientists from different disciplines rather than in lab work. After months of networking and discussing career paths with various people, I finally pacified my internal Hamlet and decided to become a science communicator.

For my first post-PhD job, I moved to Newcastle, UK, where I coordinated science communication for the EU project RD-Connect. RD-Connect is a platform for data sharing in rare disease research, which is crucial in that field because of patient scarcity. For many years neglected, now the rare disease research community became leader in developing innovative approaches, which could also be adapted for common diseases in the future. This makes the field particularly interesting. I worked closely with experts across many disciplines: scientists, clinicians, biobankers, law and ethics experts, as well as patients and their families. This eye-opening experience changed my way of seeing the role of research in society.

The switch from the lab to an EU project was inspiring, but initially also overwhelming. The tasks were so different – instead of experimenting, I would manage and coordinate outreach activities across the project. The greatest challenge was to get my head around the jungle of interactions between RD-Connect and other international projects and initiatives. Although I enjoyed the structured workday, friendly colleagues and the work-life balance, sometimes I had moments when I almost missed my mice.

It is important to note that the character of a sci-comm job will depend on the project. In this case, an EU infrastructure, the focus was on managing the outreach (website, newsletter, flyers, etc.) and planning the engagement with different stakeholders. A sci-comm job for a research project might focus more on disseminating research findings.

Source: private

In 2019, I moved to Amsterdam to work as an editor for iScience, an interdisciplinary journal by Cell Press. This time, the transition was smoother because an editor is essentially a scientist, only without a pipette. The tasks differ depending on the journal, and can include assessing and/or commissioning manuscripts, managing peer-review, outreach and cross-journal initiatives. Usually, editors spend 10-30min per submission, which may appear shocking, but after 6-12 months of training, an editor can very quickly extract the main message of the paper and make a decision considering the significance, novelty and how well data support conclusions.

Newcastle is a city in northern England famous for its beautiful bridges on the river Tyne

Source: private

Outside Academia

What I love about this job is that every day I read about something different: neurons, plants, psychology, sometimes fields I didn't even know exist. My other favourite are the conferences, which are exciting but also exhausting. Coffee breaks, which used to be the time to rest, are now the time of intense work full of networking and commissioning papers. The pace of the editorial job is ultra-high, and without excellent organisation skills the manuscripts will pile up quickly. You can never predict how many submissions you will receive, so you need to adapt to a changing workload.

The Netherlands, the land of windmills

Source: private

Dorota BADOWSKA completed her PhD in Neuroscience in the Dept. of Neurogenetics at the Max Planck Institute of Experimental Medicine under the supervision of Prof. Moritz Rossner. Her thesis focused on gene-environment interaction in schizophrenia. Afterwards, she did an internship at the Embassy of Poland in Buenos Aires, Argentina, and then worked as RD-Connect Science Communication and Impact Coordinator at the Newcastle University, UK before joining Cell Press as Scientific Editor in Amsterdam. She currently works in Hamburg as Communications Officer for EMBL Hamburg.

European Molecular Biology Laboratory c/o DESY
Notkestrasse 85, Bldg. 25a
22607 Hamburg, Germany
dorota.badowska@embl-hamburg.de
LinkedIn: https://www.linkedin.com/in/dorotabadowska/

Sci-comm and editorial jobs have many similarities, and in fact, many editors are active science communicators as well. Interested in this career? Be prepared to leave the comfort zone of your field. An editor needs the ability to read and understand text, take decisions, be curious and have broad interest in science, as well as being able to deliver quality on time and stand constant pressure. Good networking skills are essential too. Want to know more? Check the recent video by Cell Press https://youtu.be/DzA8zPhak_s or drop me a line!

How is working in pharma R&D?

by Hugo Cruces-Solís

I remember reading about the life of other neuroscience alumni from the same magazine as you are reading now and getting all excited about the possibilities of the future. That was almost nine years ago! What convinced me to pursue a scientific career was a documentary about how Judah Folkman spent >20 years looking for factors that induce growth of blood vessels. He thought that by blocking this factor it would be possible to prevent the growth of tumors and cure cancer. Something clicked on me when I saw the passion to answer questions with a bigger idea to help people directly from the lab. Around the time I was finishing my bachelor degree, I came across an article in Scientific American from a scientist who was recording simultaneous neural activity from hundreds of neurons from mice and found what he termed "neural cliques". I was in awed because he could literally read the mind of the mouse. At that moment, I realized I wanted to do similar studies: reading the brain to understand how to control it.

Once in Göttingen, although I was extremely motivated at the beginning of my PhD project, this motivation was at its lowest around graduation time. I realized I have chosen a rather specialized topic that interested only a handful of scientists and the publication of my work did not seem close. Suddenly, I was in a gray area where I did not know what to do and how to continue my career. At this moment, I had the opportunity to start a "short post-doc", switch research topic and do something closer to that article that got me into neuroscience in the first place. The idea was to record neuronal activity in a mouse model of pathological anxiety during exploration of an anxiogenic environment. I worked hard to establish the protocol from scratch and soon I was recording simultaneously from six different brain regions. I still remember the moment where I was recording from a mutant mouse and seeing in the screen of the computer an increase in neuronal activity every time the mouse tried to approach the center of the open field (that turned out to be beta oscillations). Although, I was motivated again to do experiments and worked very hard, I was anxious about my professional future. During my time as PhD and post-doc, I experienced how much of life quality is lost in pursue of an academic position (move to a big expensive city, live in a small apartment, give up holidays, work extra hours every day, secure funding, etc.), to the point that can be incompatible with the development of my personal life (have hobbies, start a family, have time to visit parents abroad). Mostly, I wanted to do science closer to the development of therapies to treat diseases but academia did not seem the right setting for me. Therefore, I started looking elsewhere. When I visited Boheringer-Ingelheim for the interview process, I was impressed by their approach to develop therapies for brain diseases. Their approach focuses on investigating specific brain circuitry underlying psychiatric symptoms. When I joined the CNS department, I loved the highly collaborative spirit of working towards a common goal. This has given me a solid ground to develop and learn about the drug discovery process and all the challenges that come with it. Depending on the question, I use multiple techniques such as *in vivo* electrophysiology, chemogenetics, calcium imaging, behavior and computational approaches to target and interrogate specific neuronal circuits. Additionally, I support multiple projects with data analysis and programming. Since there is no rush to publish, we focus more on developing highly reproducible experiments robust enough to test compounds in complex settings. The company has a strict policy regarding working hours, so that means I need to keep close attention not to do more extra time than allowed. That has resulted in a better life-work balance.

Yes, I was afraid of leaving academia, but that feeling disappeared as soon as I started working. Joining Boehringer-Ingelheim has been one of the best decisions in my life (after joining the neuroscience program of course). If you decide to join the pharmaceutical industry, I can guarantee you that you will not regret it.

Hugo CRUCES-SOLIS conducted his doctoral research in the Dept. of Neurogenetics at the Max Planck Institute for Experimental Medicine. After his postdoc at the Dept. of Neurobiology at the Max Planck Institute for Experimental Medicine, he joined Boehringer-Ingelheim as researcher in the CNS department.

Boehringer Ingelheim Pharma GmbH & Co. KG
CNS Diseases
Birkendorfer Straße 65
88397 Biberach an der Riss
hugo.cruces_solis@boehringer-ingelheim.com

Life as a Pharma Strategy Consultant

by Mariana Cerdeira

One thing was clear to me even before I started my PhD: becoming an academic (or industry) researcher was not the career path I wanted to pursue. I have always loved science, but I just knew running a lab was not what I was meant to do. That often made me feel like a black sheep, as if I were the only student having those thoughts in grad school – as I have previously shared in my TEDx talk (see link below). But still, I truly believed (and still do) that a PhD is beneficial in many ways (apart from all the suffering), even for those who will not pursue a career in academia afterwards. So, after completing the Neuroscience Master's program, I took the road less traveled and left Göttingen to Berlin, to join the MedNeuro PhD at the Charité. During my PhD, I took it as a priority to find clues that would help me identify a job which would likely be a good fit with my skills and interests. The effort put into this screening process paid off, and now I can say that this mission has been accomplished.

Catenion Company Retreat in Croatia (2019) Source: private

Since October 2018, I have been working as a consultant at Catenion, a strategy consultancy firm that focuses solely on biopharma. My colleagues share my background: we are all life scientists, have come from academia, and the vast majority of us has a PhD, although it is also possible to join the company straight after the Master's. Contrary to the large, "classical" consulting firms such as McKinsey and BCG, we only have pharmaceutical and biotech companies as clients. Therefore, I am still working with science on a daily basis. Other big advantages of a smaller, or "boutique", consulting firm include the much more reasonable working hours and the fact that we do not have to be at the client site from Monday to Thursday. We do travel for work, but just occasionally. I also really wanted to continue living in Berlin (this amazing city won me over) and to have English as my work language, which are both the case at Catenion. Our company is based at the German capital and now also has an office in Boston, and all our projects are conducted in English.

In a nutshell, we help our clients find the best strategies to develop new medications or medical devices. We do not really get involved with drug pricing and market launch, we focus on R&D. We put together different pieces of a larger puzzle that will make our client's life easier. Instead of doing experiments myself, I give recommendations to my clients regarding what they should do to reach their goals. For this, I need to identify, gather and analyze large amounts of scientific information in a short period of time, making the most of time management and prioritization. It is essential to have an eye for what is relevant for the answer to your specific question, and what is not. Aided by databases, some of which were developed internally by our Data Science team, we analyze different aspects of diseases, drugs, clinical trial results and competitors. So in a way I'm still doing research, only at the desk and not at the bench.

A consultant's work is project-based, which means that every few months I take on a new project, with a different client, on a different topic, and often with different colleagues in my team, which makes the job very dynamic. I also love the sense of accomplishment and completion that you get by working in shorter projects: they have a beginning, a middle and an end, which is often not the case in lab research. Instead of being a specialist, I'm now a generalist: if this month I am going deep into cell therapy, next month I will need to learn everything about glioblastoma, and last month I could have easily discussed with any expert in NASH. Not all projects are related to Neuroscience (most of them actually are not), but that is not an issue in my view. I learn new things every single day.

Being a consultant also fulfills my need for human interaction. We regularly meet with our clients, which is probably when I feel most in my element. We do not just deliver our findings. We sit down and discuss them with a team of very smart professionals on the client's side, often also scientists. They value our opinion and input as if we were part of their team. I feel useful and appreciated at the workplace, which is really rewarding.

Catenion Company Retreat in Croatia (2019)

Source: private

My colleagues are young, savvy, high-achieving, inspiring people from many countries in the world. At my company, we have a clear career progression, so one always has the opportunity to grow and move forward. I was promoted in December 2019, so my responsibilities and work independence have been gradually increasing. Working in a smaller company allows you to have a larger impact and leave a bigger mark.

As you can tell, I am very happy in my job. It is highly demanding, fast-paced and sometimes exhausting. But I truly care about what I do, I feel acknowledged and rewarded and, honestly, I now contribute more to the development of new therapies than I ever did during my PhD. I must say that writing for the Neuroscience Newsletter describing my job and sharing how satisfied I am, as other alumni have, is a dream come true. So many times during my studies I dreamt about this day, when I could look back and see that it all worked out. Well, it did. I am very grateful for it and do not take it for granted. I guess what I would say to anyone reading this who wants to pursue a science-related job outside academia is: there are so many opportunities out there, not even just in pharma consulting. Do your research, network, and follow your gut feeling. There is scientific life outside the lab, and it is brilliant!

Mariana CERDEIRA is an alumna of the Göttingen Neuroscience Master's program as part of Neurasmus (2012-2014). Since finishing her PhD in Medical Neurosciences at the Charité in Berlin (2014-2018), she has been a consultant in biopharma strategy at Catenion. For years she has been involved in projects to promote science communication and to improve career support for graduate students. She has given a TEDx talk on the need for a culture change in the academic world – you can watch it using the QR code.

Another one bites the host:

studying mosquito olfaction in Zambia *by Diego Giraldo*

When I joined the IMPRS-Neuroscience program in 2012 I had to write about my scientific interests and my long-term goals. I was told to go back to them after finishing my PhD to see how much they had changed. Since I was interested in insect sensory neurobiology, I did my PhD with Dr. Bart Geurten and Prof. Martin Göpfert studying mechanosensation and thermosensation in flies. 5 years later, after finishing my PhD I realized that my interests had not changed. I wanted to study how insects that are vectors of disease sense their environment to detect their human hosts.

Aerial picture of the flight cage (green roof) surrounded by 8 tents. Air-conditioning ducting brings odor from the tents into the cage Source: J. Adam

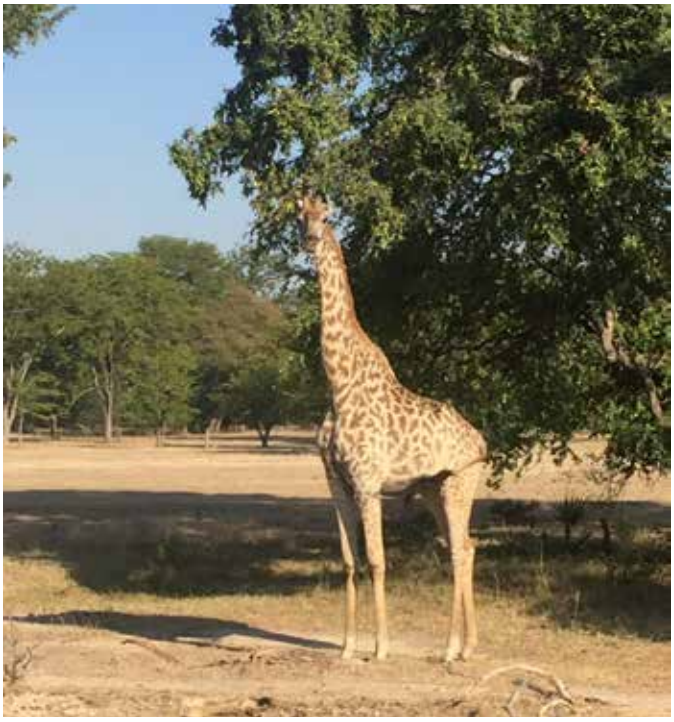
In January of 2019 I joined the lab of Dr. Conor McMeniman as a post-doctoral fellow in the Johns Hopkins Malaria Research Institute at the Johns Hopkins Bloomberg School of Public Health. In our lab we study how mosquitoes that are responsible for the transmission of diseases like dengue, yellow fever and malaria, detect human odors. Mosquito brains have only 100,000 neurons, yet they are responsible for over one million deaths per year. The first step in the transmission of deadly diseases happens when a female mosquito detects human volatile chemicals that are emitted from our skin and breath as cue to find us and bite us. In the McMeniman lab we use genetic tools to study odorant receptors that are important for olfaction and host seeking. We also have unique setups to extract human odors and study how human smell is processed in the mosquito brain using functional imaging and behavior.

As a neuroscientist studying mosquito olfaction, I always get asked the same questions: Why do mosquitoes like me so much? Why are they attracted to me and not the people around me? The answer is: we don't exactly know, but we are trying to figure it out. To answer these questions, we started working at the Macha Research Trust in southern Zambia. This research facility receives funding from the Johns Hopkins Malaria Research Institute to carry out field studies in malaria epidemiology and vector biology. There we built a semi-field 'flight cage' where Anopheles gambiae mosquitos (the main vector of malaria in sub-Saharan Africa) can fly freely. Our goal is to study the olfactory preferences of these mosquitoes in their natural environment.

Surrounding our 20x20 meter cage, 8 tents are connected to it by air-conditioning ducting, and air carrying odors

Cruise on the Zambezi river Source: private

from the tents is pumped into the cage onto a heated pad that mimics the temperature of human skin. Mosquitoes attracted to the odors land on the pad and these landings are recorded with video cameras for 6 hours overnight. The idea is to have people sleeping in the tents and bring their odor into the cage, to screen for humans that are highly attractive to mosquitoes in a natural setting and subsequently characterize their smell with gas chromatography and mass spectrometry. Their odor will be sent back to our lab in Baltimore and presented to mosquitoes to understand how it is processed in the brain using calcium imaging. We hope that by figuring out what chemicals in our smell attract female mosquitoes we can develop synthetic lures that will be very efficient in trapping them in the field.



Giraffe in the Mosi-oa-Tunya National Park Source: private

For the first stage of this study I spent one month in Zambia setting up the tents and testing if mosquitoes could detect odors coming from them and land on the heated pads. We found that just by adding CO_2 (a chemical stimulus that is attractive to mosquitoes) to a tent, mosquitoes could detect where the stimulus was coming from and land on the respective pad. A colleague and I spent three nights sleeping in two of the tents, while having CO_2 coming from the remaining six. Female mosquitoes preferred landing on the heated pads baited with our scent over the control CO_2 tents. I had up to 86 landings in one single night! This proved to us that our behavioral paradigm can help us detect humans that are attractive to mosquitoes. Our plan is to return and do a full experiment having groups of eight human subjects in the tents at a time. We plan to do this during the rainy season when the environmental conditions are more favorable for mosquito behavior.

After weeks of hard work, I finally had time to explore the wonderful Victoria Falls and do a Safari in the Mosi-oa-tumm National Park where I got to see African fauna including giraffes, antelopes and white rhinos. As a perfect end to my Zambian experience, I went on a cruise on the Zambezi river. As I watch the sunset surrounded by elephants, hippos and Nile crocodiles, I feel happy and fortunate that my journey through the IMPRS program and my passion for insect neurosciences has led me to such a beautiful place.

Diego GIRALDO
completed his doctoral studies in the Department for Cellular Neurobiology under the supervision of Prof. Martin Göpfert and Bart Geurten, Ph.D., and joined the McMeniman Lab (Dept. of Molecular Microbiology and Immunology) at the Johns Hopkins Malaria Research Institute as a postdoctoral fellow in January 2019.

Johns Hopkins Malaria Research Institute
Department of Molecular Microbiology and Immunology
McMeniman Lab
Johns Hopkins Bloomberg School of Public Health
615 N Wolfe St
Baltimore, MD 21205
USA

When Science meet arts...

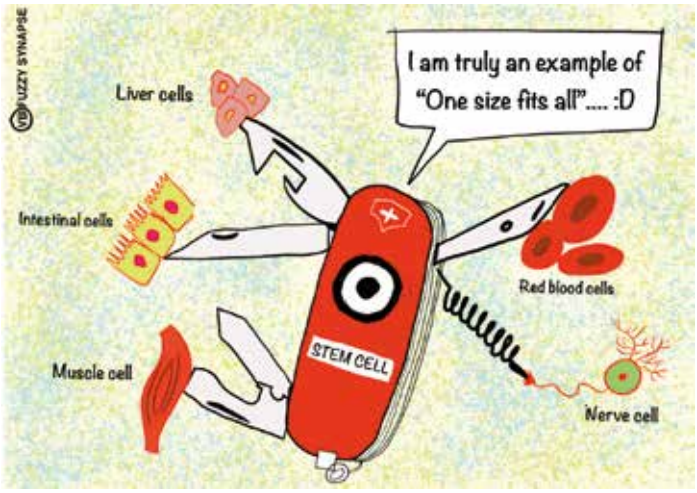
FUZZY SYNAPSE: Connecting science and the world *by Vinita Bharat*

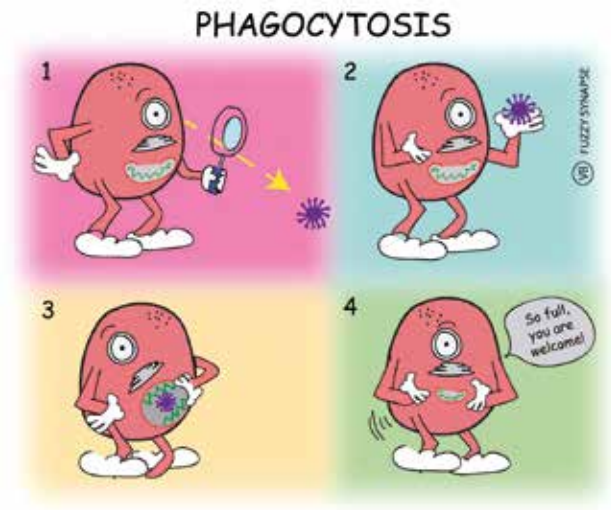
During my PhD in Goettingen, I have worked on the role of Synaptotagmin 4 in dense core vesicle fusion and release at synaptic sites in hippocampal neurons. This sentence describing my doctoral work is full of complex words and jargons, which only neuroscientists are able to get but family and friends are just clueless about what I did in my PhD. This was something, which always caught my attention that what we do inside the labs, what we work on does not reach the masses. Science, for me, has never been just another degree; it is a field where so many curious minds are seeking answers to many important questions arising from the world around us. Being in the field of research for almost a decade now, I have clearly seen the gap between science and the world. Hence, to bridge this gap, I started my own science communication platform called "Fuzzy Synapse" (www.fuzzysynapse.com) in April 2017 to explain scientific topics and concepts in simple and fun way using art and pinch of humor.

I still remember sitting in the lab at the European Neuroscience Institute (ENI), Göttingen doodling some scientific concept, when some of my friends encouraged me to put it on social media and start sharing with others. Now in the year 2020, I will be finishing my three years of running this platform where I have drawn on more than 150+ different topics.

I have seen over these years through Fuzzy Synapse that visualization is a super powerful tool, drawing a concept captures and conveys the idea more strongly than mere words. The drawing need not be artistic, what is required are creative ideas and desire to simplify a scientific concept.

Along with my postdoctoral studies, running this science communication platform helps me in drawing science in the form of graphical abstracts for manuscripts, figures for grants, or even fun illustrations for presentation. To summarize, I can say that through Fuzzy Synapse I have truly seen that indeed a picture is worth a thousand words.





Vinita BHARAT carried out her PhD work under the supervision of Camin Dean at the European Neuroscience Institute. After graduating in 2016, she joined the research group of Xinnan Wang at Stanford University. She currently works on understanding the mitochondrial dynamics in neuronal functions and neuropathology.

Taking Neuroscience to Engineers...

and Managers *by Zaved Ahmed Khan*

Source: private

Ever since I was nine years old, I had dreamed of studying abroad and solving the mysteries that surround the brain. I had never heard of any acquaintance who had studied abroad, prior to my departure to Germany, and I had thought it was the most difficult task to achieve. Being from an economically weaker section of India, I would have never been able to pay the hefty fees for higher studies abroad. Luckily, I got admission to the prestigious MSc/PhD programme at Goettingen. I can still vividly remember my desktop computer at night projecting the email about the selection at IMPRS. With this came the excitement and fear of living in a new country with no knowledge of its language, culture and people.

However, to my surprise, I found that uprooting myself and living in a different country was an essential step to my growth. During the fall semester of 2002, I found my life to be full of excitement for Germany, and during my stay here, everything about university life resembled a movie. Every day was a journey to the deep insides of the brain through lectures and lab. Usually, I would wake up at eight thirty, grab something to eat on the rush to catch the class starting at nine. All my fear of the unknown disappeared as I found myself with the able coordinators of IMPRS Neuroscience/Molecular Biology at that time. The format of the programme was very different from what we had in India. It was focused on practical knowledge rather than on theoretical components. I was lucky to be part of the labs of Dr. Nils Brose, Dr. Klaus-Armin Nave, and Dr. Victor Tarabykin at the Max Planck Institute of Experimental Medicine for lab rotation. My last lab rotation was with Dr. Detlev Schild at the Molecular Physiology lab.

Lab rotation was one practice that I missed in the Indian education system. I struggled hard to introduce this system at the different Indian universities I worked at, but found it difficult to get it accepted. However, I was at least able to bring Neuroscience to engineering and management institutes in India. During my tenure at VIT University, I introduced Neuroscience as a 3-credit course to a batch of 120 students of BTech (Biotechnology). I think this was the biggest

Current BE Biotech students at Chandigarh University, India

Source: private

Zaved searching for a young version of himself Source: private

Zaved Ahmed KHAN completed his Master's thesis in Ludger Hengst`s lab at the Institute of Biochemistry in Martinsried. After graduation in 2004, he joined VIT University as a lecturer and completed his PhD in the field of neuropharmacology. He has worked on "Pre-clinical studies on the role of green tea polyphenols/EGCG nanoparticles for cancer therapy" and "Encapsulation of L-theanine to increase its bioefficacy as anxiolytics" with research grants from the National Tea Research Foundation, India.

Presently, he is working as the Head of Department and Professor at the Department of Biotechnology Engineering, Chandigarh University, India. He is exploring the neuroscience extension to education, psychology, engineering and management.

group of engineering students taught neuroscience in India. I have also introduced an interdisciplinary subject of Neuroecomics and Consumer Neuroscience for students of Management programs.

I was involved with neuroscience during my PhD at VIT University, Vellore, where I was also working as an Assistant Professor. The thesis titled 'Withaferin-A as a nitric oxide modulators in stress-induced neurobehavioural patterns' was awarded in 2011. Presently, I am working on the development of nano-based formulation for neurodegenerative diseases. One can easily search for my current research paper published with my PhD students in the field of neuroscience.

I gained a new outlook during my stay in Goettingen as a master's student. Unfortunately, I had to leave Goettingen and move to Munich to work in the lab of Dr. Ludger Hengst, Max Planck Institute of Biochemistry, for my Master's Thesis on Regulation of cell cycle inhibitor p21 by tyrosine kinase. After getting my Master's degree from IMPRS, I moved back to India due to family-related issues, although I had never planned to leave Germany. I wish I could take admission in an MSc/PhD programme once again and complete one more PhD here. In all, I feel fortunate that I received a chance to study and work in one of the best neuroscience programmes in the world, which shaped not just my academic future but also changed my world-view; thus making me a better scholar, and a better teacher.

Creutzfeldt Award

Creutzfeldt PhD Prize
The Creutzfeldt PhD Prize is awarded for the best PhD thesis in memoriam of Prof. Dr. Otto Detlev Creutzfeldt, founding director of the department of Neurobiology at the Max Planck Institute for Biophysical Chemistry in Göttingen. The prize has been awarded since 2007 to PhD graduates of the Neuroscience program based on excellent achievements during the PhD and the grading of the written dissertation and the oral defense. In 2011 for the first time 2 winners have been selected for the Creutzfeldt Prize.

Traditionally, the award ceremony is part of the official opening of the NEURIZONS Symposium and takes place in the presence of the spokespersons of the MSc/PhD/MD-PhD Program & International Max Planck Research School for Neurosciences, a representative of Sartorius stedim AG and Mary Creutzfeldt, widow of the late Otto Creutzfeldt. Due to the Corona pandemic, the "NEURIZONS" conference this year was held online as a virtual conference, so that the prize was handed over virtually during the opening ceremony.

The award includes the book present 'Cortex Cerebri' written by Otto Creutzfeldt and a financial reward sponsored by the Göttingen company Sartorius stedim biotech AG. Having supported the Neuroscience program since its foundation, this year, Sartorius has been even more generous by increasing the prize from 500 to 1,000 Euros!

2007 Prize winner:
Dr. Irina Dudanova
Max Planck Institute of Neurobiology Martinsried

2009 Prize winner:
Dr. Henry Lütcke
Brain Research Institute Zurich, Switzerland

2011 Prize winners:
Dr. Ioanna Bethani
Goethe-Universität Frankfurt

Dr. Stephan Junek
Max Planck Institute for Brain Research Frankfurt

2013 Prize winners:
Sadim Jawhar, Ph.D.
Biomedical Research Institute, Doha, Qatar

Dr. David Owald
Oxford University, United Kingdom

2015 Prize winners:
Dr. Natalia Revelo Nuncira
Radboud umc, Institute for Molecular Life Sciences Nijmegen, Netherlands

Nicolas Snaidero, Ph.D.
Technical University / Ludwig-Maximilians University München

2018 Prize winners:
Dr. Pratibha Narayanan
Teach for India, New Delhi, India

Dr. Dennis Nestvogel
University of Oregon, Eugene, USA

2020 Prize winners:
Dr. Alexander Dieter
Center for Molecular Neurobiology Hamburg

Dr. Lina María Jaime Tobón
Max Planck Institute for Biophysical Chemistry Göttingen

New Faculty

Joining the program since 2019

Brett Carter joined the European Neuroscience Institute as a research group leader in summer 2017 and has been a member of our program since 2019. The 'Synaptic Physiology and Plasticity' group seeks to understand fundamental principles of synaptic transmission in neurons and synaptic plasticity at the level of single synapses. They use electrophysiological recordings and 2-photon imaging and uncaging to understand how certain patterns of neuronal activity lead to long-lasting changes in synaptic strength. Brett takes part in the organization of the extended GGNB methods course in electrophysiology "ELECTRAIN", where he also contributes his expertise as trainer.
Further information: http://www.uni-goettingen.de/en/608214.html

Left the program since 2019

Henrik Bringmann was appointed as a research group leader at the Max Planck Institute for Biophysical Chemistry, Dept. of Sleep and Waking, in 2009. He joined the Neuroscience program in 2013 and investigated the function and regulation of sleep by studying different model organisms, especially in the larva of the nematode *Caenorhabditis elegans*, and in mice using behavioral assays, genetics and functional imaging. In 2018, he was appointed full professor of Animal Physiology at the University of Marburg where he continues to work on sleep behavior in *C. elegans*.
Further information: https://www.uni-marburg.de/fb17/fachgebiete/tierphysio/neurophysiologie

Jens Frahm had been an active faculty member since the start of the program in 2000. As a director of the Max Planck Institute for Biophysical Chemistry in the department Biomedical NMR he devoted his research to the development and application of novel magnetic resonance imaging (MRI) techniques. Non-invasive MRI techniques are used to study organ systems, physiological processes and body functions of intact living organisms. Since 2019 he heads an emeritus group at the MPI for Biophysical Chemistry but decided to leave the Neuroscience faculty.
Further information: http://www.biomednmr.mpg.de/

Robert Gütig came to Göttingen as a group leader at the Max Planck Institute for Experimental Medicine in 2011. The group's research interest is directed towards the identification of the computational principles underlying spike based information processing and learning in central nervous systems and the understanding of how these principles are implemented by biological processes. In 2018, he was appointed Full Professor in Mathematical Modeling of Neural Learning at the Charité Berlin and the Berlin Institute of Health (BIH).
http://www.em.mpg.de/index.php?id=281

Faculty Leaving

Camin Dean
had been a group leader in the European Neuroscience Institute Göttingen since 2010. Working on Trans-Synaptic Signaling, she is investigating the mechanisms by which individual synapses, neurons and circuits dynamically adjust their transmission properties in response to changes in neuronal network activity. As of March 1, 2020 she joins the DZNE-Berlin/Charité with a Heisenberg award.
Further information: http://www.uni-goettingen.de/en/215192.html

Marion Silies
headed the Emmy-Noether- and ERC-funded junior research group "Visual Processing" at the European Neuroscience Institute Göttingen since 2014. Her group is investigating how neural networks receive, analyze and extract visual information from the environment to guide adaptive behavior. By studying motion detection in the visual system of fruit flies using cell biological and genetic approaches in combination with physiology and quantitative behavioral analysis, she aims to identify mechanisms by which nervous systems integrate molecular, cellular and circuit characteristics to compute behaviorally relevant outputs. In 2019, she was appointed Full Professor at the Johannes-Gutenberg Universität Mainz.
Further information: https://ncl-idn.biologie.uni-mainz.de

Ivan Manzini
was the first graduate of our IMPRS and obtained his doctoral degree from the University of Göttingen in 2003. Dr. Manzini stayed in Göttingen and became a group leader at the Center for Nanoscale Microscopy and Molecular Physiology of the Brain in 2011. Shortly after joining the faculty of the IMPRS Neurosciences in 2016, he was appointed Full Professor at the Justus Liebig University Gießen and his last doctoral student in our program graduated with a PhD in 2020.
Further information: https://www.uni-giessen.de/fbz/fb08/Inst/tphys/zel

Current Faculty Members

Andrea Antal
Matthias Bähr
Thomas Bayer
Susann Boretius
Nils Brose
Wolfgang Brück
Brett Carter
Jan Clemens
Peter Dechent
Thomas Dresbach
Hannelore Ehrenreich
Gregor Eichele
André Fiala
André Fischer
Alexander Flügel
Tim Friede
Alexander Gail
Tim Gollisch
Martin Göpfert
Ralf Heinrich
Stefan Hell
Swen Hülsmann
Reinhard Jahn
Igor Kagan
Siegrid Löwel
Ira Milosevic
Tobias Moser
Klaus-Armin Nave
Tiago Outeiro
Luis Pardo
Walter Paulus
Arezoo Pooresmaeili
Jeong Seop Rhee
Silvio Rizzoli
Annekathrin Schacht
Hansjörg Scherberger
Oliver Schlüter
Manuela Schmidt
Caspar Schwiedrzik
Michael Sereda
Jochen Staiger
Anastassia Stoykova
Stefan Treue
Melanie Wilke
Sonja Wojcik
Fred Wolf
Fred Wouters

For details regarding the research of all faculty members, please see www.gpneuro.uni-goettingen.de/content/c_faculty.php

Neurizons 2020

Networks Grow. Ideas Flow. Going Virtual! – by Aishwarya Bhonsle

In May 2020, scientists from all over the world attended Neurizons, the biennial conference organized by the students of the MSc/PhD/MD-PhD programme of the International Max Planck Research School (IMPRS) for Neurosciences. And on many fronts, it was an unusual conference indeed. In one of many firsts, it was a virtual Neurizons – held in lieu of the physical conference, which had to be cancelled due to the global COVID-19 pandemic. The already daunting task of planning and organising the four-day conference, which normally took a whole year, suddenly boiled down to completely changing gears to the virtual format in the two months leading up to the event. The team of 22 students organising the conference had to go from arranging flights, accommodations, and venues, to becoming experts on audio and video settings and equipment for webinars, practically overnight.

Yet, the unprecedented circumstance of hosting a conference in the face of a global pandemic was met with an equally unprecedented response: 792 people from 48 countries had registered for the conference. As of the end of the conference, 755 attended at least one session live and 546 had watched replays, and many more people were able to take advantage of the fact that the talks were recorded and available online for a week after the conference. With an average of 205 people attending each session, attendance of Neurizons 2020 surpassed every previous iteration of the conference by quite a margin.

As if this wasn't exceptional enough, Neurizons 2020 also had not one, but two keynote speakers: Wolf Singer, who presented some fascinating insights about cortical computations of the cerebral cortex, and Daphna Joel, who enlightened us with her talk on representations of sex and gender in the brain. Yet another aspect in which Neurizons stood out this year was that 61% of the invited speakers were women, in a conscious effort to avoid the frequent imbalance of men and women at scientific conferences.
The conference offered talks from a variety of themes ranging from molecular & cellular level, all the way to cognitive neuroscience. Participants had the opportunity to learn about the metabolic cost of thinking from Timothy Ryan's engaging talk to being introduced to Eirini Papagiakoumou's cutting-edge work in the field of three-dimensional optical microscopy methods used to study the brain. Talks

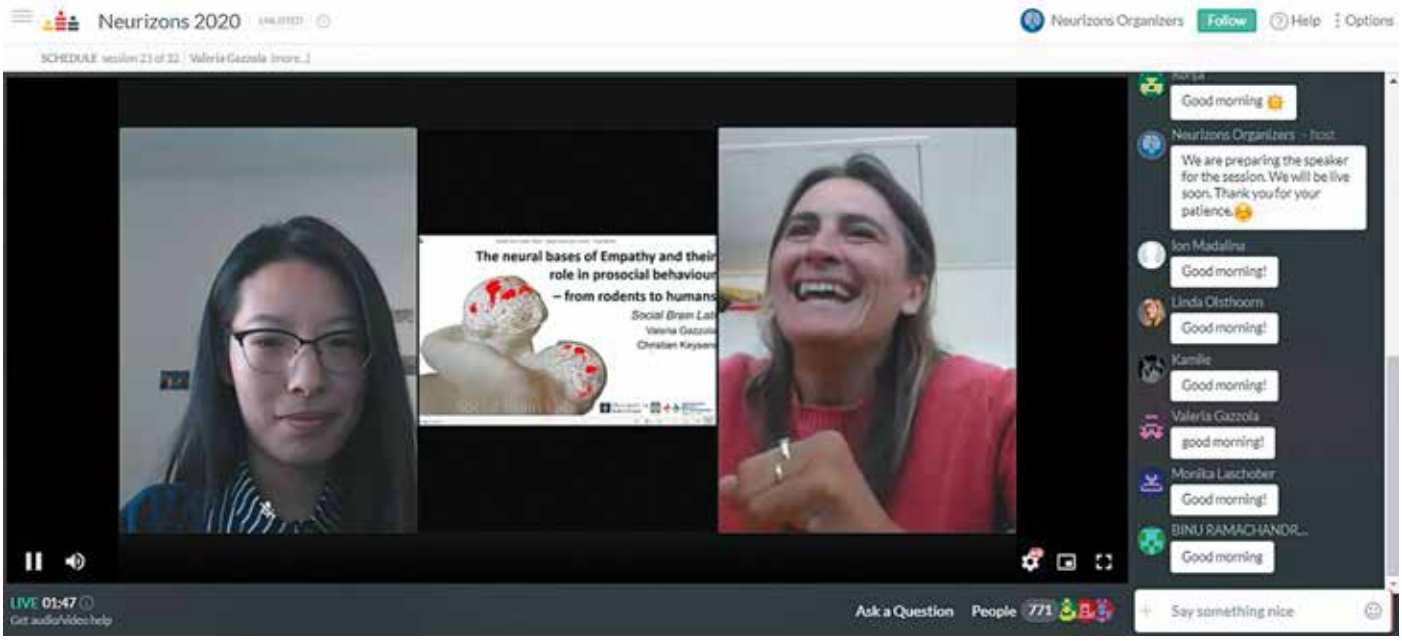
Participants of Neurizons 2020 joined the virtual conference from 48 countries around the globe

Source: CrowdCast

such as Sabine Kastner's delved into experimental investigations of cognition, in contrast to Evelyn Tang's very theoretical/computational approach to the same, catering to a wide range of interests.

Additionally, participants also had the opportunity to compete in the Young Investigator Contest and experience giving a talk at the conference, which culminated in three brilliant young scientists being given a platform to share

while being free of charge and in an extremely eco-friendly format as compared to the physical conference. As an additional benefit, the virtual format allowed introverted and younger scientists a format to engage effec-



Yifan hosting the live session of Valeria Gazzola as first session of the last day of Neurizons 2020

Source: private

Further, to capture the essence of the physical conference as closely as possible, there was more to the virtual conference than just the talks. This year's panel discussion was on the very up-and-coming topic of Natural vs. Artificial Intelligence, and it was as lively and thought provoking a debate as any held in the past. As always, the first day of the conference was dedicated to the career fair, which included a round-up of talks about careers in fields such as patent law to consulting available to PhDs, as well as a session about mental health in academia. Participants also had the chance to take part in more interactive workshops sessions on scientific communication and managing stress in academia.

their work. With a lot of coordination and effort, Neurizons 2020 even had poster sessions for participants to present their work. To cater to the networking aspect of the conference that many feared would fall short in a virtual setting, the virtual conference provided the option of 'speed-dating' CoachMe sessions where participants had the opportunity to chat with and pick the brains of the world-renowned scientists speaking at the conference.

While some of the more social aspects of the physical conference were regrettably missed, the advantages of the virtual format were nonetheless clear: the virtual Neurizons 2020 was able to reach more people than ever before,

tively and comfortably in the conference. And all this was possible while sitting in your pyjamas… erm, from the comfort of your own home!

The pivot from the physical to virtual format called for a vast amount of ingenuity and adaptability from all involved, from organisers to speakers and participants. It will be exciting to see what the takeaways from Neurizons 2020 will be for the future iterations of the conference – perhaps a combination of the physical and virtual formats? Whatever the format, rest assured that the indomitable spirit of Neurizons will continue to showcase exemplary science. **Here we come, 2022!**

Retreat in the Schloss

by by Madhura Ketkar and Juan Diego Prieto Ramirez

"How's the PhD? Which lab, again?" asks a former classmate we haven't seen in a year. Embarrassed, we realize how spectacularly we failed to keep up with that group of brainy people who claim some unforgettable moments of our life in Göttingen. Despite the fear of missing out, there is hope: the upcoming Neuroscience retreat.

August 5, early morning. We head to the Göttingen Bahnhof and meet with 30-odd students from four cohorts. Our representatives, Albert and Linda, who had diligently planned this 3-day journey, look alert. On board we find Prof. Heinrich, who has been consistently accompanying us on the retreats, and would be joined this time by professors Staiger and Eichele. Sandra and Franziska, our beloved administrators, would see us directly at Schloss Etelsen: a historical castle awaiting to host us near Bremen.

A variety of tapas was served for dinner on the first evening Source: private

On arrival at Etelsen and after settling up in our rooms, the first scientific session commenced with a welcome to Jonas Barth, who is an alumnus of the program and our new scientific coordinator. Talks ensued, covering topics from molecules inside neurons to the extra-neuronal environment. A subsequent poster session fostered lively discussions. Already in full retreat mode, we left for a guided tour in Bremen. What a beautiful city! We learnt about the Town Musicians of Bremen and walked the narrow alleys of the Schnoor quarter, flanked by small, picturesque houses – some among the oldest in Germany! Once done, we caught up with friends over a delicious tapas dinner.

After a successful breakout from the Escape Room Source: private

The next morning was kicked off with talks focusing on sensory neuroscience. The most senior PhD students had an opportunity to practice their thesis defences and take home some valuable advice. Discussions on the talks continued well into the lunch break, as we replenished our energy stores for a demanding afternoon ahead. Table talk comprised the final poster session of the retreat, followed by the election of our new representatives with Linda playing second chair this year and your current addresser – Juan Diego, aka JD– the main one.

Later, we revisited Bremen to decompress. Some of us attended a tour of the Beck Brewery, which was regarded as quite educational, especially due to the beer tasting at the end; the rest took a chilly boat ride on the Weser followed by a visit to an Escape Room parlor. Our honed-by-science, problem-solving skills came in handy decoding our way out of a locked room, with one team escaping their room in record time! Tired, or slightly high-spirited (pun intended) from the beer

The city tour of course also highlighted the famous Town Musicians of Bremen from the Brothers Grimm Source: private

tasting, we reconvened at the Elisa restaurant, where we were regaled with Mediterranean cuisine to bring the day to an end.

After a superb breakfast buffet next morning, we attended the last scientific session covering topics from the synaptic substrate of behavioral alterations in mice to how anesthesia affects brain functions in different species. To top off the retreat we had three alumni sharing their post-PhD experiences: Derya Akad talked about her current work at a pharmaceutical company overseeing clinical studies, while Roman Stilling shared his passion for animal welfare education to the general audience. Finally, Marija Herholz recounted her transition from PhD to an independent postdoc as well as how successfully she attains work-life balance, kids included. Furthermore, she gave us a huge Aha! moment: hers is among the famous faces that appear on the main webpage of the Neuroscience program!

The alumni kindly answered our endless questions, until it was time to return home. On the train back to Göttingen, we were already thinking of the 2020 retreat – a special one to be, where the Neuroscience and Molecular Biology students will together celebrate the 20th anniversary of our twinned programs.

http://www.gpneuro.uni-goettingen.de/

Neurofaces 2000- 2019