

# — CONFERENCE BOOKLET —

# NEURIZONS

12th BIENNIAL NEUROSCIENCE  
CONFERENCE

# 2026

19-22 May,  
Max Planck Institute for  
Multidisciplinary Sciences,  
Faßberg Campus,  
Göttingen, Germany



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for Neurosciences  
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RESEARCH SCHOOL



[www.neurizons.uni-goettingen.de](http://www.neurizons.uni-goettingen.de)

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# Message from the Organizing Committee

Welcome to Neurizons 2026! We are very glad that you have decided to join us this week for the 12th edition of Neurizons. This conference is organised by PhD students of the International Max Planck Research School for Neurosciences, who, over the last 12 months, have joined efforts to bring you this forum of scientific exchange. As PhD students, our focus for this edition was on supporting young career researchers, by providing them with opportunities to present their work in various forms, network with great scientists, explore career opportunities and connect with their peers, on a personal, scientific and professional level. We also wanted to bring even more high quality science to Göttingen and, for this, we invited world-class researchers at the forefront of their fields, ranging from sensory experience, processing and restoration, to the molecular nature of neuronal communication and what happens when it goes wrong, and including how our brains make us. We are looking forward to seeing all the conversations sprouting from the poster sessions, the eye opening future opportunities of the career fair and hearing about all the wonderful work being carried out by our fellow early-career researchers on their various talks.

We hope that you have a wonderful and inspiring time with us at Neurizons 2026!



**Esther Marie Grewe & André Mendes Costa**  
Co-Coordinator,  
On behalf of the Neurizons 2026 Organizing  
Committee

# Welcome Note from the Program Coordinator

It is a pleasure for me to welcome all participants of NEURIZONS 2026 on behalf of the MSc/PhD Program and International Max Planck Research School Neurosciences to our venue at the Max Planck Institute for Multidisciplinary Sciences!

Our biennial conference traces its origins to 2004, when PhD students from the International MSc/PhD Program and IMPRS for Neurosciences organized the first meeting in Göttingen. Over time, NEURIZONS has cultivated a distinct identity as an intimate gathering with a family-like atmosphere. This setting fosters direct interaction among participants, particularly connecting early-career PhD students with established neuroscientists.

Since 2015, the conference has also included a career fair to showcase diverse professional paths. With active participation from IMPRS alumni, attendees can engage in insightful talks with robust Q&A sessions and participate in workshops designed to refine their career trajectories.

As usual, the organizing committee has invited internationally renowned speakers to share insights into their latest research. Scientific sessions are organized into five thematic tracks - Molecular and Cellular Neuroscience, Theoretical and Computational Neuroscience, Systems and Cognitive Neuroscience, Clinical Neuroscience, and Emerging Techniques - ensuring comprehensive coverage of the field with leading experts in each area. Early-career researchers are encouraged to showcase their work during the poster session and had the opportunity to enter the Young Investigator Contest. Contest winners have been selected for short oral presentations alongside invited speakers or deliver pitch talks to highlight their poster. Additionally, a panel discussion on the future of animal research will invite active participation from all attendees. Two keynote lectures frame the scientific program of NEURIZONS 2026, opening and closing the conference.

# Welcome Note from the Program Coordinator

Traditionally, the NEURIZONS closing ceremony includes the announcement of the biannual Otto Creutzfeldt PhD Award for the best doctoral graduates from the Neurosciences program. Ever since the award was launched in 2007, it has been sponsored by the Göttingen based company Sartorius with a cash price documenting the company's commitment and close cooperation with our program.

Several companies are continuously supporting NEURIZONS since many years. Thanks to their contribution, participation in NEURIZONS 2026 is free of charge, which is especially attractive for early career researchers as they can join the meeting without relying on the budget of their host institutions. The conference would not be possible without these sponsors, whose generous support is very much appreciated and will contribute to make NEURIZONS 2026 a memorable event for all participants.



**Dr. Jonas Barth**  
Scientific Coordinator of the  
IMPRS Neuroscience Program

# About Us

We are the Neurizons 2026 organizing committee, a group of MSc and PhD students from the International Max Planck Research School (IMPRS) for Neurosciences. The IMPRS Neurosciences program is part of the Göttingen Graduate School of Neurosciences and Molecular Biosciences (GGNB), which is funded by the German Excellence Initiative and operates under the umbrella of the Georg-August University School of Science (GAUSS). The program is jointly run by the Georg-August University Göttingen, the Max Planck Institute for Multidisciplinary Sciences, the Max Planck Institute for Dynamics and Self-Organization, the German Primate Center, and the European Neuroscience Institute Göttingen.



**Abigail Trebilcock**

University Medical Center  
Göttingen



**Ahsen Konaç-Sayici**

University Medical Center  
Göttingen



**Andrea Alcaraz Ramírez**

Max Planck Institute for  
Multidisciplinary Sciences



**Andrea Campos Perez**

European Neuroscience  
Institute



**André Mendes Costa**

European Neuroscience  
Institute



**Antonis Ntolkeras**

University Medical Center  
Göttingen

# About Us



**Anushka Deb**  
University Medical Center  
Göttingen



**Blossom Wing Sum Cheung**  
University Medical Center  
Göttingen



**Ece Idil**  
German Primate Center



**Esther Marie Grewe**  
University Medical Center  
Göttingen



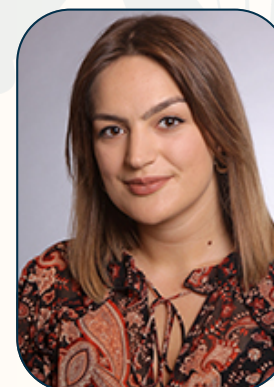
**Hannah Mariedele Luksch**  
University Medical Center  
Göttingen



**Klara Friederike Esch**  
University Medical Center  
Göttingen



**Laura Alacán Ricardo**  
German Primate Center



**Lejla Šošë**  
University Medical Center  
Göttingen



**Maren Cremer**  
European Neuroscience  
Institute

# About Us



**Marina Saade**

Max Planck Institute for  
Multidisciplinary Sciences



**Robert Haret**

University Medical Center  
Göttingen



**Ruchi Modgekar**

University Medical Center  
Göttingen



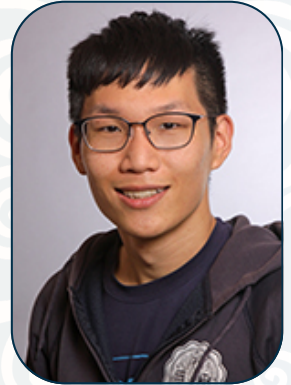
**Sage Martineau**

Georg August University  
Göttingen



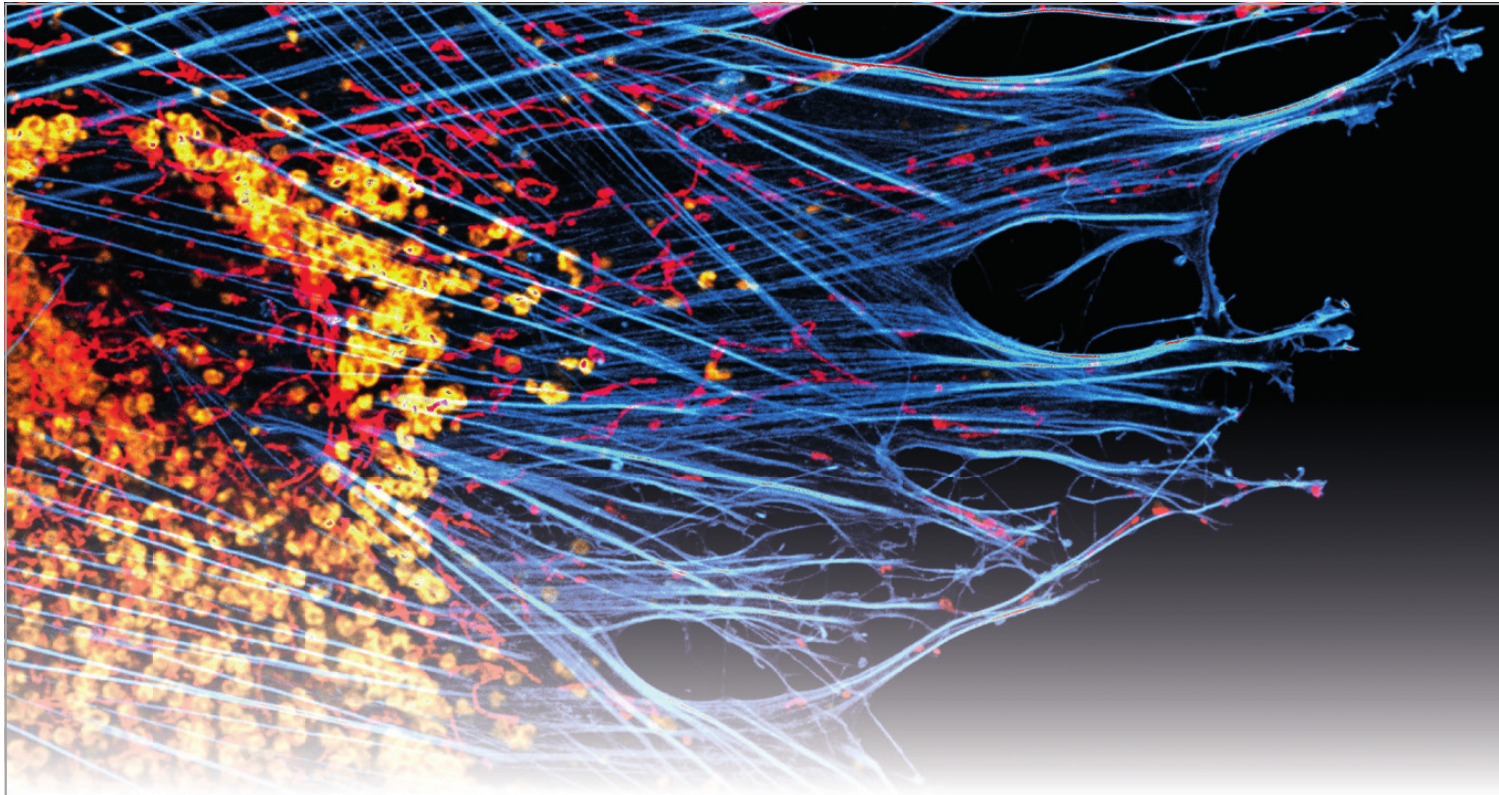
**Tarannomsadat Taghavi**

German Center for  
Neurodegenerative Diseases



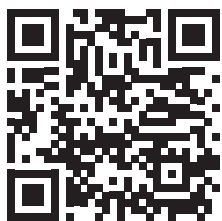
**Tsun-Kai Chang**

University Medical Center  
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Okinawa Institute of Science and Technology, Japan

# Göttingen, City of Science

Welcome to Göttingen: a city that fondly refers to itself as the “City of Science.” As you stroll through the historic old town with its traditional half-timbered houses, you don’t just pass our entire solar system, you also encounter Göttingen’s iconic landmark: the Gänseliesel, a statue traditionally kissed by the newly graduated PhD students.

Founded in 1737, the University of Göttingen is considered one of the oldest universities in Germany. Göttingen’s reputation as a university town and center of science grew rapidly, attracting world-renowned scholars such as Carl Friedrich Gauss, Max Born, Werner Heisenberg, Robert Koch, and Emmy Noether. Many buildings throughout the city bear plaques commemorating these famous former residents and the time they spent here.

Even today, the “Göttingen spirit” is deeply rooted in science. University buildings and research institutes are spread throughout the city, including several Max Planck Institutes:

- Max Planck Institute for Multidisciplinary Sciences (formerly the Max Planck Institute for Biophysical Chemistry and the Max Planck Institute for Experimental Medicine)
- Max Planck Institute for Dynamics and Self-Organization
- Max Planck Institute for Solar System Research
- Max Planck Institute for the Study of Religious and Ethnic Diversity

Other scientific institutions in the city include the German Primate Center, the German Aerospace Center, and the University of Applied Sciences and Arts, all of which come together to form the “Göttingen Campus.” Over the past century, more than 40 Nobel Prize laureates have lived and worked in Göttingen. Erwin Neher (Nobel Prize in Physiology or Medicine, 1991, for discoveries concerning the function of individual ion channels in cells) is one of the founding members of the IMPRS for Molecular Biology and Neurosciences. Stefan Hell (Nobel Prize in Chemistry, 2014, for pioneering work in ultra-high-resolution fluorescence microscopy) is also a faculty member of the same program.



# Göttingen, City of Science

Around 30,000 of Göttingen's 117,000 residents are students, making up roughly 30% of the population and contributing to the city's young, international atmosphere. The cityscape is shaped by restaurants offering cuisine from around the world (German: Zum Szultenberger; Asian: Gamie, Vietal Village, India Haus; Italian: Tante Giulia, Fellini, etc.), cozy neighborhood pubs (Gauß Pub, Duke, Thanners, Trou), alternative bookstores and cafés (Liesels, Sundays, Buchladen Rote Straße), and a lively nightlife (Savoy, T-Keller, Nörgelbuff).

You can find further information about Göttingen at: [www.goettingen-tourismus.de](http://www.goettingen-tourismus.de)



# Venue Information

Neurizons 2026 will take place at the **Max Planck Institute for Multidisciplinary Sciences, Faßberg Campus, am Faßberg 11, 37077 Göttingen**. The scientific talks and the career fair seminars will be held in the Manfred-Eigen Lecture Hall. The registration desk will be located in the entrance foyer, alongside our sponsors' industry exhibitions. Poster sessions will take place in the Ludwig Prandtl Hall. Lunch will be held in the canteen ("Mensa") located in the basement under the foyer (see image on the next page).

Please take care of your personal belongings. The Organizing Committee takes no responsibility for accidents or damages to participants' belongings. Feel free to approach the Neurizons Organizing Team if you need any further information or assistance. The organizers are the ones wearing Neurizons T-shirts!

## Bus Lines

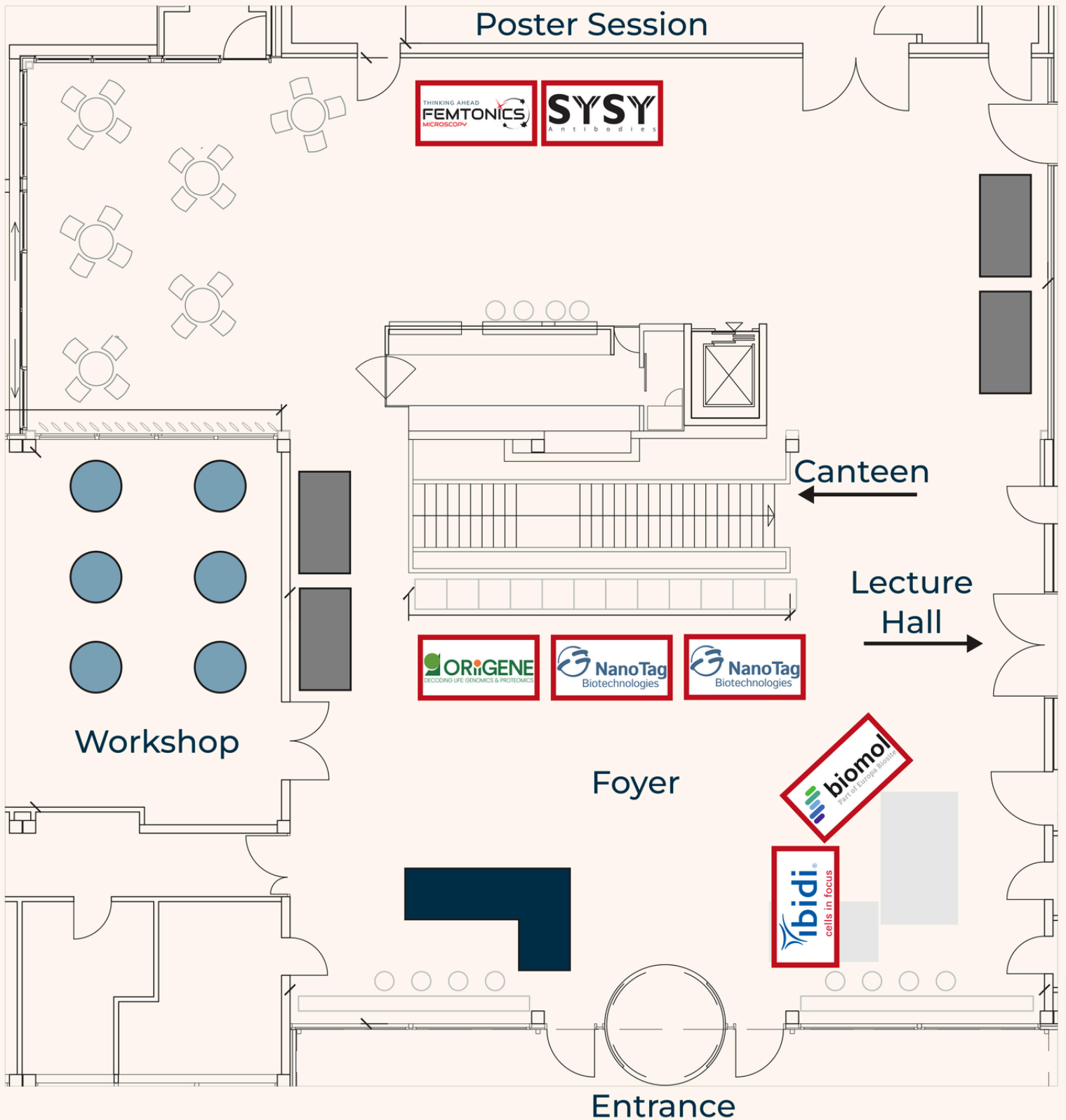
Buses no. 21, 22 and 23 connect the Max Planck Institute for Multidisciplinary Sciences, Faßberg Campus with the city center and the railway station.

To reach the venue, take the bus in the direction "Nikolausberg" (for no. 21/22) or "Faßberg" (for no. 23) and get off at the bus stop "Faßberg". From there it is a minute's walk to the first large administration building on the opposite side of the street. There are buses departing from Faßberg towards the city center approximately every 15 minutes. The last bus departs at 23:21. You can also consult Google® Maps, selecting the option for Public Transport. You can buy tickets from the driver.

**For more information about the bus fares please visit the bus company's webpage: [www.goevb.de](http://www.goevb.de)**

# Venue Layout

-  Sponsor Desk
-  Snack Tables
-  Organizer Desk
-  Workshop



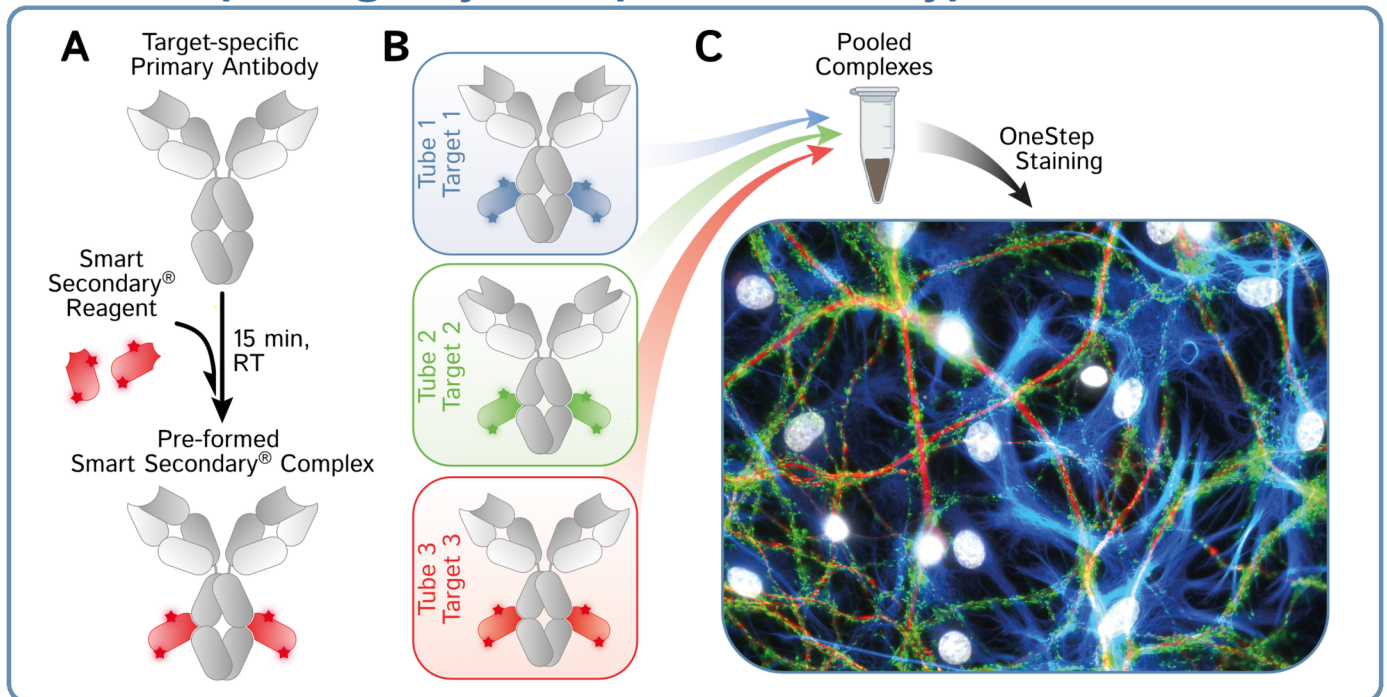
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## Name Tags

Every participant of Neurizons will receive a name tag. Please pick up your name tag at the registration desk. It must be worn throughout the conference, as it is required for admission to all events.

## Lunch and Refreshments

Lunches are included in the conference fee. In order to receive your lunch, you will need to present a valid voucher. Cold refreshments, coffee and tea will be provided during each break.

## Internet Access

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

## Conference Dinner

The conference dinner will take place at the Deutsches Theater Keller (Theaterpl. 11, 37073 Göttingen) on Thursday. The event starts at 19:00 and includes a buffet with a variety of dishes (vegetarian and vegan options available). Drinks will be available at the venue and can be purchased by participants. After dinner, join us on the dance floor! We will have music until late hours. The dinner buffet is included for all participants who paid the conference fee.

## Happy Hour

Join us for a relaxed Happy Hour at the end of the conference on Friday, 22 May at 16.30. We warmly welcome all participants to unwind, connect, and enjoy drinks and snacks together.

# Career Fair Speed Dating

Career fair speed dating will take place on Tuesday, May 19th, from 15:00 to 16:00. Participants will meet with career fair professionals in a speed networking format across five meeting spots. The session will consist of three 20-minute rounds, with an auditory signal marking each rotation. The goal is to give participants the opportunity to connect with experts, exchange insights, and expand their professional network.

The meeting spots will be distributed throughout the venue, including the main lecture hall, coffee area, and available seminar rooms.

## German Primate Center (DPZ) Tour

The visit will take place on Tuesday, May 19th, from 16:00 to 17:30.

The Deutsches Primatenzentrum GmbH (DPZ, founded 1977) is an independent research institute providing service for the German science community. It is a member of the Leibniz Association and partly financed by the Federal Republic of Germany and its federal states. Many collaborations closely link the DPZ to the Göttingen Campus. Some heads of our units and laboratories maintain joint professorships at the University of Göttingen or the University of Veterinary Medicine in Hannover. Since the DPZ is unique in Germany and there is only one similar institute in Europe, the center is of supraregional importance.

The DPZ conducts basic research in the fields of infection research, neuroscience, and primate biology. For some of our research questions scientists at DPZ rely on experiments with non-human primates, which they keep and breed at the DPZ.

The tour of the DPZ will include both an introduction to the DPZ as an institute and give the participants a unique chance to see the DPZ primate husbandry.

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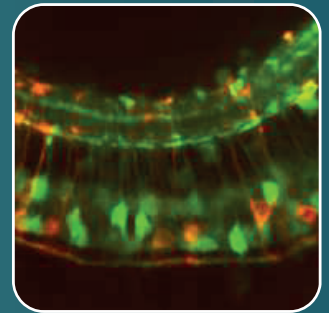
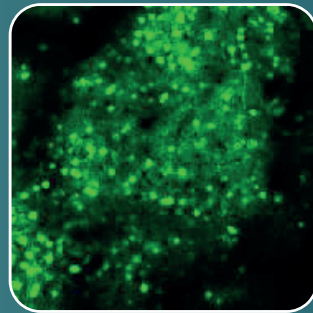
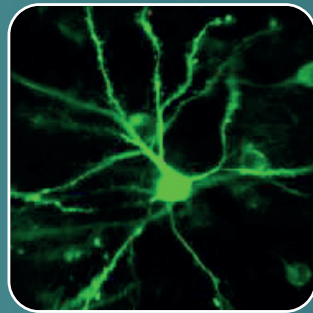
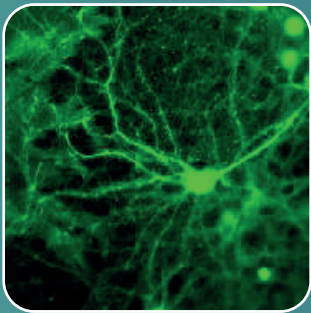
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# NEURIZ NS 2026

## SCHEDULE OVERVIEW

### Tues, May 19<sup>th</sup>

	8:30	Registration
	9:30	Opening Remarks
Career Fair	9:50	Marija Liutkutė
	10:20	Erika Avendaño-Guzmán
	10:50	Coffee Break
Career Fair	11:10	Aditya Singh
	11:40	Company Introductions
	12:00	Lunch
Career Fair	13:00	Marianna Spatola
	13:30	Sebastian Jähne
	14:00	Jenifer Rachel
	14:30	Companies & Coffee
	15:00	Speed Dating
	16:30	DPZ Tour

WorkShop # 1

WorkShop # 2

### Wed, May 20<sup>th</sup>

	8:30	Registration
	9:15	Opening Remarks
<b>Keynote</b>	9:35	Frank Winkler
<b>Clinical</b>	10:25	Ilka Diester
	11:05	Group Photo
	11:20	Coffee Break
<b>Clinical</b>	11:40	Volker Busskamp
	12:20	Ana Pinheiro
	13:00	Lunch
<b>Emerging Techniques</b>	14:00	Benjamin Judkewitz
	14:40	Noa Lipstein
	15:20	Pieter Roelfsema
	16:00	Coffee Break
	16:20	Flash Talks
	16:35	Poster Session (Wine & Cheese)

### Thurs, May 21<sup>st</sup>

<b>Systems &amp; Cognitive</b>	9:00	Helen Blank
	9:40	Andreas Nieder
	10:20	Uta Noppeney
	11:00	Coffee Break
<b>Young Scientist Talks</b>	11:20	Shashwat Sridhar
	11:35	Licheng Zou
	11:50	Henrike M. Jungeblut
	12:05	Lunch
<b>Young PI Talks</b>	13:00	Frederic Römschied
	13:20	Ivana Jaric
	13:40	Coffee Break
	14:00	Panel Discussion
	16:00	Poster Session
	19:00	Conference Dinner

### Fri, May 22<sup>nd</sup>

<b>Molecular &amp; Cellular</b>	9:00	Michael Grange
	9:40	Susana Castro Obregón
	10:20	Christian Rosenmund
	11:00	Coffee Break
<b>Theoretical &amp; Comp</b>	11:20	Sheila Nirenberg
	12:00	Jakub Vohryzek
	12:40	Pascal Fries
	13:20	Lunch
<b>Keynote</b>	14:30	Yukie Nagai
	15:20	Closing Ceremony
	16:30	Happy Hour

# NEURIZ NS 2026

## TUESDAY, 19.05

8:30 - 9:30

Registration

9:30 - 9:50

Opening Remarks

9:50 - 10:20

**Workshop #1**

**Cancelled**

**Marija Liutkutė**

Strategy Consultant at Catenion

CAREER  
FAIR

10:20 - 10:50

**Erika Avendaño-Guzmán**

Medical Affairs professional at UCB

CAREER  
FAIR

10:50 - 11:10

Coffee Break

11:10 - 11:40

**Aditya Singh**

Senior Data Scientist at zeroG

CAREER  
FAIR

11:40 - 12:00

Company Introductions

12:00 - 13:00

Lunch

13:00 - 13:30

**Workshop #2**

12:30 - 15:30

“How to get into the German job market.”

by Philippa Cook

**Marianna Spatola**

Director of the ImmuBRAIN program, Institute of Neuroscience, University of Barcelona

CAREER  
FAIR

13:30 - 14:00

**Sebastian Jähne**

Publisher at Springer Nature

CAREER  
FAIR

14:00 - 14:30

**Jenifer Rachel**

Consultant at Stradoo GmbH

CAREER  
FAIR

14:30 - 15:00

Company Booths & Coffee

15:00 - 16:00

Speed Dating with Career Fair Speakers

16:30 - 18:00

German Primate Center (DPZ) Tour

# NEURIZ NS 2026

## WEDNESDAY, 20.05

8:30 - 9:15

Registration

9:15 - 9:35

Opening Ceremony (Martin Göpfert)

9:35 - 10:25

**Frank Winkler**, German Cancer Research Center, Heidelberg  
*"Cancer neuroscience of brain tumors"*

KEYNOTE

10:25 - 11:05

**Ika Diester**, Optophysiology, University of Freiburg  
*"Towards bi-directional neuroprosthetics"*

CLINICAL

11:05 - 11:20

Group Photo

11:20 - 11:40

Coffee Break

11:40 - 12:20

**Volker Busskamp**, Department of Ophthalmology, University of Bonn  
*"Transient vascularization improves retinal ganglion cell survival and function in human retinal organoids"*

CLINICAL

12:20 - 13:00

**Ana Pinheiro**, Faculty of Psychology, University of Lisbon, Portugal  
*"From voice to speaker: computational mechanisms of self-voice perception and hallucinated agents"*

CLINICAL

13:00 - 14:00

Lunch

14:00 - 14:40

**Benjamin Judkewitz**, Universitätsmedizin & Einstein Center for Neurosciences, Berlin  
*"The smallest vertebrate brain knows how to sing"*

EMERGING  
TECHNIQUES

14:40 - 15:20

**Noa Lipstein**, Leibniz Forschungsinstitut für Molekulare Pharmakologie (FMP), Berlin  
*"Decoding molecular diversity in the nervous system"*

EMERGING  
TECHNIQUES

15:20 - 16:00

**Pieter Roelfsema**, Vrije Universiteit, Amsterdam & Institute de la Vision, Paris  
*"Toward visual brain prostheses: restoring sight through cortical and thalamic stimulation"*

EMERGING  
TECHNIQUES

16:00 - 16:20

Coffee Break

16:20 - 16:30

**Flash Talks** (See posters section for more information)  
• Niklas Alvar Laasch  
• Hari Prasad Sreekrishnapurath Variyam  
• Hannah Z. Kerger

16:35 - 18:30

Poster Session with Wine & Cheese

# NEURIZ NS 2026

## THURSDAY, 21.05

9:00 - 9:40	<p><b>Helen Blank</b>, Faculty of Psychology, Ruhr University Bochum  <i>"I know you! Hierarchical predictive processing in speech and face perception"</i></p>	SYSTEMS & COGNITIVE
9:40 - 10:20	<p><b>Andreas Nieder</b>, Institute of Neurobiology, University of Tübingen  <i>"How monkeys and crows crunch numbers"</i></p>	SYSTEMS & COGNITIVE
10:20 - 11:00	<p><b>Uta Noppeney</b>, Biophysics Department, Radboud University  <i>"To Integrate Or Not To Integrate: Solving The Binding Problem In A Multisensory World"</i></p>	SYSTEMS & COGNITIVE
11:00 - 11:20	Coffee Break	
11:20 - 11:35	<p>Young Scientist Talk #1 <b>Shashwat Sridhar</b>  <i>Modeling spatial contrast sensitivity in responses of primate retinal ganglion cells to natural movies</i></p>	
11:35 - 11:50	<p>Young Scientist Talk #2 <b>Licheng Zou</b>  <i>Highly distorted three-dimensional orientation fields in primary visual cortex</i></p>	
11:50 - 12:05	<p>Young Scientist Talk #3 <b>Henrike M. Jungeblut</b>  <i>Bridging Psychometrics and Neuroimaging: Latent Variable Modeling Reveals Robust Associations Between White Matter Microstructure and Fluid Intelligence</i></p>	
12:05 - 13:00	Lunch	
13:00 - 13:20	<p><b>Frederic Römschied</b>  <i>Modulation Of Neural Function Following Experience In Alternate Social Realities</i></p>	
13:20 - 13:40	<p><b>Ivana Jaric</b>  <i>Ovarian Cycle Disruption And Its Impact On Brain Plasticity And Behavior In Mice</i></p>	
13:40 - 14:00	Coffee Break	
14:00 - 16:40	Panel Discussion	
16:00 - 17:00	Poster Session	
19:00 - 21:00	Conference Dinner	

# NEURIZ NS 2026

## FRIDAY, 22.05

9:00 - 9:40	<p><b>Michael Grange</b>, The Rosalind Franklin Institute, Harwell Science &amp; Innovation Campus  <i>“Structural cell pathology: imaging the sub-cellular molecular makeup of the brain”</i></p>	MOLECULAR & CELLULAR
9:40 - 10:20	<p><b>Susana Castro Obregón</b>, Instituto de Fisiología Celular (IFC), UNAM  <i>“Molecular basis for autophagy dysfunction and neuronal senescence”</i></p>	MOLECULAR & CELLULAR
10:20 - 11:00	<p><b>Christian Rosenmund</b>, Institute of Neurophysiology, Charité Universitätsmedizin Berlin  <i>“The roles of synaptotagmins in neurotransmitter release”</i></p>	MOLECULAR & CELLULAR
11:00 - 11:20	Coffee Break	
11:20 - 12:00	<p><b>Sheila Nirenberg</b>, Department of Physiology and Biophysics, Weill Cornell Medical College  <i>“A new and unexpectedly effective treatment for restoring sight”</i></p> <ul style="list-style-type: none"> <li>• Speaker joining remotely via video conference.</li> </ul>	THEORETICAL & COMP
11:20:00 - 12:40	<p><b>Jakub Vohryzek</b>, Center for Brain and Cognition, Universitat Pompeu Fabra  <i>“Whole-brain digital twins: modelling and perturbing brain dynamics in health and disease”</i></p>	THEORETICAL & COMP
12:40 - 13:20	<p><b>Pascal Fries</b>, Max Planck Institute for Biological Cybernetics, Tübingen  <i>“Learning of stimulus probability and reward value in early visual cortex”</i></p>	THEORETICAL & COMP
13:20 - 14:30	Lunch	
14:30 - 15:20	<p><b>Yukie Nagai</b>, International Research Center for Neurointelligence, University of Tokyo  <i>“Embodied predictive processing: toward a unified account of human intelligence”</i></p>	KEYNOTE
15:20 - 16:00	Closing Ceremony	
16:30 - 19:30	Happy Hour	

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## Decoding your Neuroscience Research!

We are attending #Neurizons 2026! Stop by at our booth and discover our wide range of cutting-edge tools from Genomics to Proteomics!

Besides Antibodies and Proteins to research areas like TBI, Alzheimer's disease and Huntington's disease, we offer molecular tools and techniques such as cDNA clones, AAV and Lenti based products!

Let us help to support your Neuroscience research and stop by at OriGene's booth!



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# NEURIZONS



**CAREER  
FAIR**



## Philippa Cook

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### Abstract

#### How To Access The Non-academic Job-market - Knowledge Strategies & Success Stories!

It can be a hard to fit in time for career planning alongside your academic workload but it is definitely worthwhile. The options open to you are varied but after some time in academia, it can be a real challenge to (re-)navigate the job market. The entry routes into jobs are not transparent, you might not know what to expect in the application process, how to communicate your skills and competencies, and about how to build up and tap into a network. Now is your opportunity to take time to reflect on what it is you can do and how and where you'd really like to work, bearing in mind your priorities may have shifted. We will also take a look at the landscape of the job market, talk about strategies for finding opportunities and help you plan some of your next career steps.



## Erika Avendaño - Guzmán

Erika is an IMPRS Neuroscience alumni, and currently a Medical Affairs professional at UCB, focused on advancing innovation in rare diseases and neurology through strategic engagement with key opinion leaders. With a background in neuroscience and business, she combines scientific depth with strong business acumen to lead cross-functional initiatives and translate complex data into meaningful insights. Her experience spans medical affairs, clinical research, and scientific communication.



## Sebastian Jähne

Sebastian Jähne is a Publisher at Springer Nature, where he oversees a portfolio of BMC journals focused on animal science. He believes in open science and that research can positively impact society. Before joining Springer Nature, he worked as a neuroscientist in the lab of Silvio Rizzoli at the University Medical Center Göttingen. He is an alumnus of the IMPRS Neurosciences.



## Marianna Spatola

Marianna Spatola is neurologist, research group leader and director of the Neuro-Immune Crosstalk in Brain Infections and Autoimmunity (ImmuBRAIN) program at IDIBAPS-Hospital Clinic, Institute of Neuroscience, University of Barcelona, Spain. Her research aims to establish the pathogenic mechanisms underlying the development of immune-mediated neurological syndromes, such as autoimmune encephalitis and the interplay between antibodies and innate immunity.



### Marija Liutkute

Marija Liutkute is a strategic portfolio management professional specializing in R&D; pipeline optimization and asset valuation. She completed her PhD in biophysics at the MPI for Biophysical Chemistry in Göttingen. As a strategy consultant at Catenion, she works with diverse clients helping them make data-driven strategic R&D; decisions. Marija is passionate about sharing with fellow academics how their analytical skills and scientific training can create significant impact in industry roles.



### Aditya Singh

Aditya is an IMPRS Neuroscience alumni (Batch of 2015). He finished his PhD from the Systems Neuroscience and Imaging in Psychiatry Lab in March 2021. Since 2022, he is working at the junction of data and aviation. His day-to-day work involves envisioning and implementing solutions using data and AI for business impact.



### Jenifer Rachel

Jenifer did her doctoral thesis and postdoctoral work at the Institute for Neuroanatomy, in the lab of Prof. Dr. Jochen Staiger. She currently works as a consultant at Stradoo GmbH, a boutique life sciences consulting company headquartered in Munich, Germany.

# NEURIZ NS



## CONFERENCE SESSIONS



### Yukie Nagai

University Of Tokyo, Japan

Yukie Nagai is a Project Professor at the International Research Center for Neurointelligence at the University of Tokyo. She earned her Ph.D. in Engineering from Osaka University in 2004 and has held research positions at the National Institute of Information and Communications Technology, Bielefeld University, and Osaka University. Since 2019, she has led the Cognitive Developmental Robotics Lab at the University of Tokyo. Her research integrates cognitive developmental robotics, computational neuroscience, and assistive technologies to investigate the neural mechanisms underlying social cognitive development. Using computational models grounded in sensorimotor predictive learning and predictive coding, her work addresses the emergence of self-other cognition, mirror neuron systems, prosocial behavior, emotional development, and atypical cognitive processing associated with developmental disorders. In recognition of her contributions, she was named among Analytics Insight's "World's 50 Most Renowned Women in Robotics" (2020), IEEE IROS "35 Women in Robotics Engineering and Science" (2022), and Forbes JAPAN "Women In Tech 30" (2024).

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#### Abstract

#### Embodied Predictive Processing: Toward A Unified Account Of Human Intelligence

Predictive processing has emerged as a unifying framework for understanding brain function, yet it often underestimates the role of the body and environment. In this talk, I introduce Embodied Predictive Processing, an extended framework that emphasizes the co-development of brain, body, and environment through active perception and action. This perspective reconceptualizes intelligence as arising from continuous interactions between neural dynamics, bodily processes, and environmental structure. I will discuss how this framework is supported by a range of robotics experiments, highlighting its potential to bridge biological and artificial systems in understanding human intelligence.



### Frank Winkler

University Of Heidelberg, Germany

Frank Winkler is a Professor of Experimental Neuro-Oncology at Heidelberg University and a managing senior physician at the Department of Neurology, University Hospital Heidelberg. He leads the Experimental Neuro-Oncology Research Group at the German Cancer Research Center (DKFZ), where his work focuses on the cellular and vascular mechanisms underlying brain tumor growth, invasion, and therapy resistance. After earning his medical degree from the University of Freiburg and completing research fellowships in Munich and at Harvard Medical School, he established himself as a leading figure in translational neuro-oncology. His pioneering studies have revealed how glioma cells form resistant multicellular networks through tumor microtubes and how vascular normalization impacts tumor therapy response. Recognized with several scientific awards, including the Neuro-Oncology Prize of the Sibylle Assmus Foundation, his research continues to shape new therapeutic strategies against malignant brain tumors.

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#### Abstract

#### Cancer Neuroscience Of Brain Tumors

Neural influences regulate cancer initiation, invasion, growth, metastasis, and therapy resistance. Those discoveries have changed the way we think about cancer, and fueled the emerging field of "Cancer Neuroscience". In this talk I will cover our discovery of neural-like communicating cancer cell networks in primary and metastatic brain tumors (Osswald Nature 2015; Hausmann Nature 2023) and of synaptic connections between neurons and cancer cells in the brain (Venkataramani Nature 2019 and Cell 2022). These neural influences drive brain tumor dissemination and growth. A special emphasis will be put on the clinical translation of the findings to novel Neuroscience-instructed Cancer Therapies, including ongoing clinical trials (Winkler et al. Cell 2023).

### Ilka Diester

University Of Freiburg, Germany



Ilka Diester is a Professor of Optophysiology at the University of Freiburg, where she leads the Optophysiology Lab funded by the BrainLinks-BrainTools Cluster of Excellence. She studied biology at Humboldt University in Berlin and received her PhD from the University of Tübingen for her work on numerical representations in the monkey cortex, which earned the Academy Prize for Biology in 2009. After a postdoctoral fellowship at Stanford University in the labs of Karl Deisseroth and Krishna Shenoy, where she established optogenetics in monkeys, she founded her own lab at the Ernst Strüngmann Institute in Frankfurt. Her research combines electrophysiology, optogenetics, and behavioral analyses to investigate neural mechanisms of movement and motor control. Recognized with multiple awards, including the Bernstein Award and an ERC Starting Grant, her work advances understanding of motor circuits and informs the development of prosthetic technologies and treatments for movement disorders.

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#### Abstract

##### Towards Bidirectional Neuroprosthetics

Bidirectional brain-computer interfaces (BCIs) are critical for restoring sensorimotor function, yet most existing systems decode motor signals without providing sensory feedback. The primary somatosensory cortex (S1) represents a key target for restoring touch and proprioception. Here, we propose an optogenetic framework combining bicistronic expression, two-photon calcium imaging, and holographic stimulation to map and recreate tactile activity patterns in S1. Holographic optogenetics enables precise, spatially resolved writing of naturalistic population activity. We further discuss how stimulation timing aligned with local field potential burst states may define optimal intervention windows, and how projection-targeted activation strategies could enhance stimulation efficacy and network-level engagement.

### Ana Pinheiro

University Of Lisbon, Portugal,



Ana Pinheiro is Assistant Professor of Neuropsychology and Cognitive Psychology at the University of Lisbon, Portugal, and a board member of Scientific Reports. Pinheiro's research focuses on the mechanisms underlying neural processing of perception of voice and speech. A particularly productive research avenue for her lab has been the exploration of auditory hallucinations and their neuroanatomical correlates. Pinheiro's lab has carried out impactful research into auditory recognition neural processes of hallucination-prone individuals. Additionally, her work exploring how auditory processing adapts to different conditions and changes through life has provided important insight into this field. In recognition of the impactful work carried out across her yet short career, Ana Pinheiro has been awarded by, among others, the Schizophrenia International Research Society (Rising Star Award and Early Career Award) and the Portuguese Association of Psychology (Young Investigator Award).

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#### Abstract

#### From Voice To Speaker: Computational Mechanisms Of Self-Voice Perception And Hallucinated Agents

How does the brain know a voice is truly one's own? Self-voice processing integrates sensory evidence with motor-related predictions generated during speech, enabling the distinction between self-generated and external voices. Drawing on behavioral and neuroimaging research across the psychosis continuum, I argue that alterations in these mechanisms provide a principled framework for understanding auditory hallucinations. Within this framework, hallucinated voices are reconceptualized as failures of self-other voice distinction. Centering self-voice processing bridges action, perception, and personal identity, opening new mechanistic pathways for computational psychiatry and translational neuroscience.

### Volker Busskamp

University Of Bonn, Germany



Volker Busskamp is Professor for Degenerative Retinal Diseases at the University of Bonn's Department of Ophthalmology and has, since forming his lab, established himself as a reference in retinal circuits in health and disease. His research explores neural circuit function, focusing on the retina and its diseases, such as Macular Degeneration. To that end, as well as working on the underlying causes of retinal diseases with techniques such as iPSC modelling and retinal organoid development, Busskamp is currently seeking multiple therapeutic avenues for treating these diseases, including optogenetics and microRNA therapies. By bridging the gap between cause and treatment, Volker Busskamp's work shows promising potential for tackling some of these diseases. Busskamp's work has been recognised from early on for the potential it has, having garnered multiple young investigator awards (TUD Young Investigator, Paul Ehrlich and Ludwig Darmstaedter Junior Award, Young Investigator Award from the ESGCT).

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#### Abstract

#### Transient Vascularization Improves Retinal Ganglion Cell Survival And Function In Human Retinal Organoids

Human retinal organoids offer promise for modeling retinal disease and testing therapies but are limited by poor vascular support and axonal instability, leading to retinal ganglion cell (RGC) degeneration. We developed a bioengineered retinal organoid platform incorporating stem cell-derived endothelial cells to form transient vascular-like networks and microfluidic devices to stabilize axonal growth. This approach reduced hypoxia and apoptosis, enhanced organoid growth, and supported long-term RGC survival and functional maturation. Integration with microfluidic-microelectrode arrays enabled sustained spontaneous and light-evoked activity, including photoreceptor-driven ON, OFF, and ON-OFF responses, establishing a durable, functional human retinal model for translational research and therapeutic development.



### Noa Lipstein

Leibniz Forschungsinstitut Für Molekulare Pharmakologie (FMP),  
Germany

Noa Lipstein is the Head of the Synapse Biology Junior Research Group at the Leibniz Forschungsinstitut für Molekulare Pharmakologie (FMP) in Berlin, Germany, where she investigates the role of the synaptic proteome in synaptic diversity and function. She is a member of the NeuroCure Cluster of Excellence and serves on the Executive Board of the Einstein Center for Neurosciences Berlin (ECN). Her current research aims to uncover how synapse identity is shaped by underlying unique protein compositions organized by transcriptional and translational programs. In addition, her group studies presynaptic mechanisms of plasticity to understand disorders of the synaptic vesicle release. She was able to identify major presynaptic pathways shaping synapse plasticity like Ca<sup>2+</sup>/calmodulin signaling. Her scientific achievements were recognized early in her career with the Otto Hahn Award for Excellence from the Max Planck Society, granted for outstanding doctoral research. Most recently, she received the Christiane Nüsslein-Volhard Stipend.

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#### Abstract

##### Decoding Molecular Diversity In The Nervous System

I will present our efforts to develop methodologies for mapping the molecular composition of diverse synapse subtypes at the subcompartment level, and how this work led to the discovery of pathways that control synaptic organization and plasticity.



### Pieter Roelfsema

Dutch Brain Institute (KNAW), The Netherlands

Pieter Roelfsema serves as the director of the Dutch Brain Institute (KNAW). He holds professorships in the Vrije Universiteit and the Academic Medical Centre in Amsterdam, while being a group leader at the Institute de la Vision in Paris. In addition, Prof. Roelfsema is the coordinator of the Dutch neurotechnology initiative Neurotech-NL, as well as the co-founder of Phosphoenix, a startup aiming to restore vision in blind individuals by developing a visual prosthesis that directly interfaces with the brain. His team investigates visual perception, blindness, plasticity, and consciousness across humans, non-human primates, and artificial neural networks. Prof. Roelfsema seeks to understand the mechanisms by which different brain areas coordinate during visual perception and learning. One of his primary goals is to design a visual prosthesis capable of restoring a rudimentary form of sight. His scientific contributions were honored by the Netherlands Organisation for Scientific Research (NWO) with a NWO-VICI award. He also received the prestigious ERC-Advanced grant on two occasions, and became a Falling Walls Winner in the Life Sciences category in 2023.

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#### Abstract

#### Toward Visual Brain Prostheses: Restoring Sight Through Cortical And Thalamic Stimulation

Our goal is to restore vision by directly stimulating the visual brain, bypassing damaged eyes of blind individuals. Electrical stimulation of visual cortex can evoke phosphenes, even in patients blind for decades. Using arrays of 1,000 electrodes, we demonstrated that patterned stimulation can generate recognizable visual forms. However, cortical implants face limitations in their longevity and visual field coverage. To address these challenges, we are developing a flexible "fountain probe" enabling large-scale stimulation of the lateral geniculate nucleus (LGN), offering improved durability and broader visual field access.



### Benjamin Judkewitz

Charité, Universitätsmedizin Berlin, Germany

Benjamin Judkewitz is a German neuroscientist and bio-imaging specialist. Since around 2019 he serves as Einstein Professor for Bioimaging and Neurophotonics at Charité, Universitätsmedizin Berlin, and the Einstein Center for Neurosciences (ECN) Berlin. He heads the "Judkewitz Lab" which combines neuroscience, engineering and physics to push the limits of optical microscopy and probe brain-wide circuits. He is a pioneer in the field of deep-tissue optical imaging, developing novel techniques to overcome light scattering in biological tissue. His lab also introduced the transparent fish *Danionella translucida* as a new vertebrate model organism, allowing researchers to observe brain-wide neural dynamics and behavior with single-cell precision. He has received numerous honors, including the Sir Henry Wellcome Postdoctoral Fellowship, the UCL Young Investigator Award, and the prestigious Einstein Strategic Professorship. His publications in *Nature*, *Nature Methods*, and *Light: Science & Applications* have been widely recognized.

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#### Abstract

#### The Smallest Vertebrate Brain Knows How To Sing

I will describe our work on *Danionella cerebrum*, a tiny fish that is small and transparent even in adulthood, when neural circuits and behavior have matured. Despite having the smallest known adult vertebrate brain, *Danionella* displays a rich set of behaviors, including courtship, schooling and - remarkably - acoustic communication. I will discuss recent insights into their vocalisation behavior, brain-wide processing of acoustic stimuli, and how these tiny fish solve a big problem posed by underwater acoustics: tell the direction of a sound source.

### Helen Blank

Ruhr University Bochum, Germany



Helen Blank is a Professor of Predictive Cognition at Ruhr University Bochum, where she leads a research group investigating how prior expectations shape human perception and communication. She is also affiliated with the Research Center One Health Ruhr within the University Alliance Ruhr and leads projects on Prediction in Communication as part of an Emmy Noether group, as well as contributing to the TRR 289 at University Medical Center Hamburg-Eppendorf. She completed her PhD at the Max Planck Institute for Human Cognitive and Brain Sciences where she investigated multisensory integration of faces and voices during human communication. During her postdoctoral research at the MRC Cognition and Brain Sciences Unit she combined computational modeling and multivariate fMRI to study how prior expectations enhance the perception of degraded speech. She later worked as a Marie Curie Fellow at the University Medical Center Hamburg-Eppendorf. Her research focuses on how the brain integrates prior knowledge with sensory input to support perception, particularly in speech and person recognition. Combining behavioural experiments, neuroimaging, and computational approaches, her work aims to uncover the neural mechanisms that enable humans to interpret ambiguous sensory information and communicate effectively in complex environments.

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#### Abstract

#### I Know You! Hierarchical Predictive Processing In Speech And Face Perception

How does the brain resolve sensory ambiguity? By combining computational modeling, fMRI, and EEG across speech and face perception, we identify a unified hierarchical principle of predictive processing. In both domains, prior expectations exert dual influences: they sharpen sensory representations in early processing regions to facilitate identification, while triggering prediction errors in higher-level areas when expectations are violated. Our findings reveal that the brain integrates precision-weighted priors to bias behavior and eye movements, demonstrating that sharpening and prediction errors coexist across hierarchical networks to ensure both efficient recognition and adaptive learning.

### Andreas Nieder

University Of Tübingen, Germany



Andreas Nieder is a Professor of Animal Physiology at the University of Tübingen and a leading figure in cognitive neuroscience. Since 2023, Dr. Nieder serves as the Chair of the "Systems Neurobiology" section of the German Neuroscience Society (NWG). His research investigates how higher cognitive functions--such as numerical cognition, vocal control, categorization, working memory, and consciousness--arise from neuronal activity in telencephalic association areas. Using an evolutionary-comparative approach, he studies crows, macaques, and humans to uncover fundamental principles of cognition and abstract thought across brains of varying complexity. Dr. Nieder's scientific excellence has been honored with numerous awards, including membership in the German National Academy of Sciences Leopoldina, the Career Development Award from the Human Frontier Science Program, and the Novartis Prize from the German Neuroscience Society. His work continues to shape our understanding of the neural foundations of abstract thought and symbolic reasoning.

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#### Abstract

#### Parallel Minds: How Monkeys And Crows Crunch Numbers

Mammals and birds diverged roughly 360 million years ago. Despite this vast evolutionary distance, both groups include species with advanced cognitive abilities, such as monkeys and crows. These animals can categorize abstract numbers, hold and manipulate them in working memory, and use quantity information to guide deliberate decisions. Their shared numerical skills provide a striking example of convergent evolution of intelligence. This talk explores the behavioral and neural bases of numerical cognition in monkeys and crows. The findings suggest that evolution often reaches similar solutions to the same cognitive problems, though it can also follow different paths.

### Uta Noppeney

Donders Centre For Cognitive Neuroimaging, Netherlands

No photo

Uta Noppeney is Professor of Systems Neuroscience at the Neurophysics department and a Principal Investigator at the Donders Centres for Cognitive Neuroimaging and Neuroscience within the Donders Institute for Brain, Cognition and Behaviour. Previously, she was a Professor of Computational Neuroscience and director of the Computational Neuroscience and Cognitive Robotics Centre at the University of Birmingham (UK) and independent research group leader at the Max Planck Institute for Biological Cybernetics, Tübingen (Germany). Her research investigates the computational and neural mechanisms of perceptual inference, learning and attention in dynamic multisensory environments. She uses a multidisciplinary approach integrating psychophysics, computational modelling (Bayesian, neural network) and advanced neuroimaging techniques (fMRI, MEG, EEG, TMS). She is the recipient of a Young Investigator Award of the Cognitive Neuroscience Society in 2013, a Turing Fellowship in 2018, an ERC starting grant in 2013 and an ERC advanced grant in 2023. She is also a member of the Academia Europaea and an academic editor of PLOS Biology and Multisensory Research.

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#### Abstract

#### To Integrate Or Not To Integrate: Solving The Binding Problem In A Multisensory World

Adaptive behavior in a complex, dynamic, and multisensory world requires the brain to solve the causal inference or binding problem, deciding whether signals come from common sources and should hence be integrated or from independent sources and be segregated. In this talk, I will delve into our recent research, spanning behavioral, computational, and neural systems levels, to explore how the brain tackles this challenge. Combining psychophysics, computational modelling and neuroimaging (fMRI, EEG) our results show that the brain arbitrates between sensory integration and segregation consistent with the principles of Bayesian Causal Inference by dynamically encoding multiple perceptual estimates across the cortical hierarchy. Next, I will explore how prior expectations and attentional mechanisms can modulate sensory integration.



### Christian Rosenmund

Charité, Universitätsmedizin Berlin, Germany

Christian Rosenmund is Professor of Neurobiology at Charité - Universitätsmedizin Berlin (Institute of Neurophysiology). He is also a board member of the NeuroCure Cluster of Excellence. Rosenmund's research focuses on synaptic transmission, in particular on synaptic vesicle release, making use of a wide range of techniques, which include electrophysiology, calcium imaging and electron microscopy, to characterise the function of presynaptic proteins on neurotransmission. His research has played an important role, for example, in the understanding of SNARE-mediated synaptic vesicle release. His long and prolific career has been widely recognised for its impact, resulting in several recognitions, such as the election as a member of the National Academy of Sciences Leopoldina.

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#### Abstract

##### The Roles Of Synaptotagmins In Neurotransmitter Release

Neurotransmitter release requires a release apparatus at the presynaptic active zone, which regulates several steps in the process of preparing synaptic vesicles for fusion and utilising the action potential induced  $\text{Ca}^{2+}$  signal to rapidly trigger vesicle exocytosis. I will provide experimental data that describe and compare the role of synaptotagmin 1 and -7 in mediating and modulating the release process itself. We use primary murine neurons and apply both electrophysiology as well as electron microscopy. We find that Synaptotagmin 7 shares redundant functions to Synaptotagmin 1 in preparing synaptic vesicles for release. Following  $\text{Ca}^{2+}$  triggering, the two synaptotagmins diverge in their function and provide opposing roles in affecting the efficacy of  $\text{Ca}^{2+}$  triggered release.



### Michael Grange

The Rosalind Franklin Institute, England, United Kingdom

Michael Grange is a structural biologist whose research bridges molecular imaging and neurobiology to uncover the mechanisms underlying neurodegenerative disease. He earned his D.Phil. in Structural Biology from the University of Oxford, where he used in-cell structural techniques to study viral trafficking and egress. As an EMBO Long-Term Fellow at the Max Planck Institute for Molecular Physiology, he developed high-throughput FIB-milling and molecular imaging workflows to analyze mammalian muscle and stem-cell-derived cardiomyocytes. His current group pioneers advanced light and electron microscopy approaches to achieve high-resolution imaging of native tissue, aiming to map molecular changes in the brain across synaptic types. Focused on disorders such as Alzheimer's disease, his team investigates how Tau fibrils alter cellular and synaptic integrity. Through innovations in large-volume tomography, cryogenic biochemical microscopy, and structural neurobiology, Dr. Grange's work is transforming our molecular understanding of brain organization and disease progression.

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#### Abstract

#### Structural Cell Pathology: Imaging The Sub-cellular Molecular Makeup Of The Brain

Studying biological structures within intact tissues requires methods that can prepare very thin sections while preserving the sample's native state, which remains technically challenging. Samples must be rapidly frozen to retain hydration and minimise preparation artifacts. I will describe approaches that use advanced ion beam and electron microscopy techniques to simplify sample preparation and enable high-resolution structural analysis. When combined with complementary imaging methods, these approaches allow specific features to be targeted within large, frozen tissue samples. I will outline how we are applying these methods to study early changes associated with Alzheimer's disease, including protein aggregation and cellular damage, and discuss how cryo- electron microscopy can be extended to clinical samples. Finally, I will highlight the broader potential of these techniques for future developments and their integration into emerging multimodal imaging workflows, including applications to human tissue.



### Susana Castro Obregón

Instituto De Fisiología Celular (IFC) At UNAM, Mexico

Susana Castro Obregón is a senior researcher at the Instituto de Fisiología Celular (IFC) at UNAM in Mexico City. She is a Humboldt Fellow and a former Pew Latin American Fellow, recognized for her pioneering work in cellular senescence and autophagy. Her research investigates how these fundamental processes influence nervous system development, aging, and genome stability. Her current work focuses on mechanisms of autophagy, including nucleophagy, in mammalian models such as mouse embryos and naked mole-rats, exploring how failures in autophagy contribute to neurodegenerative diseases and aging-related cellular dysfunctions. Her lab also studies comparative biology to understand how different species maintain cellular health over the lifespan. She has received numerous awards, including the Alexander von Humboldt Fellowship, the Miguel Alemán Medical Research Prize, and the Dr. Jorge Rosenkranz Medical Research Prize, and she mentors the next generation of scientists in Mexico through graduate and undergraduate programs at UNAM.

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#### Abstract

#### Molecular Basis For Autophagy Dysfunction And Neuronal Senescence

A main hallmark of aging in several species is autophagy dysfunction, and pharmaceutical or genetic interventions that improve its function delay aging symptoms. Yet, why autophagy becomes dysfunctional with age is still poorly understood. We discovered that neuronal senescence is caused by autophagic flux impairment, which seems to be based on an exacerbated nuclear-cytoplasmic transport.

### Pascal Fries

Max Planck Institute For Biological Cybernetics, Tübingen, Germany



Pascal Fries is a Research Group Leader at the Max Planck Institute for Biological Cybernetics in Tübingen. He earned his Ph.D. from Johann Wolfgang Goethe University, conducting research at the Max Planck Institute for Brain Research. After a postdoctoral fellowship at the National Institute of Mental Health, he was Principal Investigator at the Donders Centre, Radboud University. He later became a Scientific Member of the Max Planck Society and Managing Director of the Ernst Strüngmann Institute. His research investigates how rhythmic neuronal synchronization enables selective communication between brain areas. He proposed the Communication-Through-Coherence hypothesis, positing that oscillatory alignment creates temporal windows that enhance information transfer during attention and perception. He also studies beta and theta rhythms in top-down and bottom-up cortical interactions across species. Among his recognitions are a scholarship from the German National Academic Foundation, the "VIDI" Award from the Netherlands Organization for Scientific Research, the European Young Investigator (EURYI) Award, membership in The Young Academy of the Royal Netherlands Academy of Arts and Sciences, the Bernhard Katz Prize, and the Boehringer Ingelheim FENS Research Award.

#### Abstract

#### Learning Of Stimulus Probability And Reward Value In Early Visual Cortex

Natural viewing entails repeating stimuli, whose processing could be optimized. Repetition typically leads to reduced neuronal firing rates and, as I will show, to increased neuronal gamma-band synchronization in visual cortex, likely preserving postsynaptic impact. These gamma increases are stimulus-specific, do not transfer to other stimuli, persist for minutes, occur with artificial and natural stimuli, and are observed in both non-human primates and humans. Moreover, stimulus-induced gamma reflects the optimal Bayesian estimate of a stimulus' occurrence frequency. Finally, repetition enhances gamma only if the first presentation was rewarded; otherwise gamma is reduced, suggesting a medium-term memory of stimulus-reward contingency.

### Sheila Nirenberg

Weill Cornell Medical College, USA



Sheila Nirenberg is the Nanette Laitman Professor in Neurology and Neuroscience (Department of Physiology and Biophysics) and Professor of Systems and Computational Biomedicine at Weill Cornell Medical College, renowned for her pioneering work in neural coding and neuroprosthetics. She is the founder of Bionic Sight, a biotech company translating her discoveries into clinical applications. Her research advances computational neuroscience by decoding how neurons represent and transform information. This knowledge drives the development of transformative technologies, including brain-machine interfaces, visual prosthetics, and intelligent robotics. Her team also applies these insights to broader systems neuroscience questions, such as population coding and how neural networks extract and represent complex sensory information. A recipient of the MacArthur "Genius" Award, Dr. Nirenberg is internationally recognized for her groundbreaking work in restoring vision. Her contributions have also been recognized with the Bressler Prize in Vision Science, the Beckman Young Investigator Award, and many more.

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#### Abstract

#### A New And Unexpectedly Effective Treatment For Restoring Sight

An unexpected finding during a clinical trial for a disease that causes blindness opened the door to a new type of treatment. Briefly, the trial was focused on an optogenetic gene therapy for a disease called Retinitis Pigmentosa, but in the process of assessing patients, a new mechanism-of-action emerged. This allowed the treatment to be much more effective than predicted and provided a new strategy for approaching retinal degenerative diseases and possibly other neurodegenerative diseases as well. \* Her talk will take place online and will be streamed in the conference room.

### Jakub Vohryzek

University Pompeu Fabra, Spain



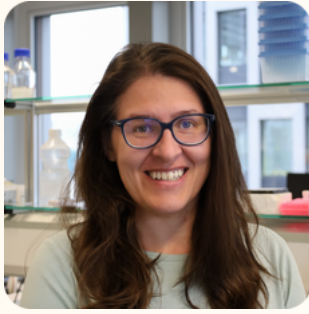
Jakub Vohryzek is a computational neuroscientist whose research focuses on whole-brain dynamics and the mechanisms underlying cognition and neuropsychiatric disorders. As a member of Gustavo Deco's research group, he integrates theoretical frameworks with neuroimaging data to investigate how complex patterns of brain activity emerge and how they are disrupted in disorders such as schizophrenia. His current work aims to bridge the gap between brain structure, function, and behavior by combining whole-brain models with empirical data. Through the study of brain dynamics and network organization, Dr. Vohryzek's research contributes to a deeper mechanistic understanding of cognition and its alterations in disease.

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#### Abstract

#### Whole-Brain Digital Twins: Modelling And Perturbing Brain Dynamics In Health And Disease

Whole-brain computational models provide a framework for linking structural connectivity with large-scale brain dynamics. In this talk, I will present recent work using neuroimaging-informed dynamical models to reproduce and perturb functional brain activity, forming the basis for "digital twins" of individual brains. By combining generative modelling with empirical data, these models can reveal mechanistic principles governing brain dynamics and predict how network activity changes in neurological disorders. I will discuss applications to conditions such as stroke and Alzheimer's disease, as well as ongoing efforts within large collaborative projects to develop personalized models that may guide targeted neuromodulation and therapeutic interventions.



### Ivana Jaric

University Of Zurich, Switzerland

Ivana Jaric is a Group Leader at the Institute of Laboratory Animal Science, University of Zurich, Switzerland. Using mice as an animal model, her work focuses on elucidating the relationship between stress, female reproductive health, and psychiatric disorders. Her research also aims to enhance the translational validity of rodent research by developing evidence-based guidelines for the implementation of the Sex as a Biological Variable (SABV) initiative. To this end, she has conducted research and presented best practices for implementing SABV in rodent experiments, including with respect to animal housing and experimental design. She also chairs the EU SABV COST Action, the first European network dedicated to strengthening SABV policy in preclinical biomedical research.

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#### Abstract

#### Ovarian Cycle Disruption And Its Impact On Brain Plasticity And Behavior In Mice

For decades, female subjects have been systematically excluded from preclinical neuroscience research, largely due to the assumption that ovarian hormone fluctuations would introduce unwanted variability. Although ovarian hormone status is now recognized as shaping brain physiology and contributing to psychiatric disorder risk, it remains largely overlooked in preclinical settings. Dr. Jaric will discuss how the ovarian cycle, and its natural or pharmacological disruption, drive changes in hippocampal plasticity that may underlie female-specific vulnerability to anxiety and depression. She will also outline strategies for integrating endocrine state into preclinical research to enhance reproducibility, translational relevance, and our understanding of sex differences.



### Frederic Rösched

European Neuroscience Institute Göttingen

Frederic Rösched is a group leader in the Computational Neuroethology of Social Flexibility laboratory at the European Neuroscience Institute. After completing his doctoral studies in Biophysics at the Humboldt University of Berlin, he worked at Princeton University as a postdoctoral research fellow until 2021. Since establishing his research group in the European Neuroscience Institute in 2023, he has been investigating social flexibility using the vinegar fly *Drosophila* as a model system. Combining a wide range of methodological approaches including optogenetics, neurogenetics, and computational modeling, Dr. Rösched aims to uncover the neural mechanisms of social behavior and flexibility at the behavioral and neural circuit level.

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#### Abstract

#### Modulation Of Neural Function Following Experience In Alternate Social Realities

Learning from social feedback is fundamental for flexible behavior across species, and deficits in such flexibility can impair social well-being. To investigate the neural basis of social flexibility, we studied male *Drosophila melanogaster*, a genetically accessible model of social behavior. Building on work showing that past social experience influences male courtship behavior, we developed a novel framework to test how distinct forms of social feedback from female flies shape the function of courtship-related neurons in males. We created alternate social realities by pairing males with females that either displayed atypical backward-walking responses to an approaching male (using closed-loop optogenetic activation of neurons driving female backward walking, Bidaye et al., Science 2014), or behaved normally. Following these experiences, we characterized the function of distinct sets of male neurons, spanning visual sensory, brain, and premotor levels, using a novel approach that has not yet been used in adult flies (but nematodes and fly larvae, Hernandez-Nunez et al., eLife 2015; Gepner et al., eLife 2015): optogenetic neural stimulation with stochastic light patterns (covering a broad range of neural dynamics) paired with automated behavioral identification to uncover the neurons' roles across the full behavioral repertoire. Males exposed to backward-walking females showed altered neural-behavior mappings in key neurons involved in courtship, requiring different stimulation patterns to elicit comparable behaviors relative to controls - indicating social modulation of neural function. The level of modulation depended both on neuron type and target behavior. This integrative approach-combining real-time behavioral tracking, closed-loop neural manipulation, stochastic optogenetic profiling, and behavioral classification-demonstrates how past social experience modulates a behavioral readout of neural dynamics to guide future interactions. By modeling how individuals update internal representations in response to social feedback, this work introduces a novel system for studying the neural basis of adaptive social behavior.

# NEURIZONS

A stylized brain logo where the brain's surface is composed of intricate, swirling patterns, resembling a tree or a complex neural network. The brain is rendered in a dark blue color.A large graphic featuring a stylized brain with swirling patterns, rendered in a light blue color. The brain is centered within a circular frame of curved, overlapping lines. A white rectangular box with rounded corners and a dark blue border is superimposed over the brain, containing the text 'PANEL DISCUSSION'.

## PANEL DISCUSSION

## Panel Discussion

"The future of animal research - navigating the landscape", with panelists Andreas Nieder, Frederic Römschied, Ivana Jaric and Maria-Patapia Zafeiriou, and moderator Roman Stilling. In response to growing public concern regarding the ethics and validity of animal research, multiple European countries have put forward increasingly strict regulations on the experimentation with animals. Non-governmental organizations and the European Commission have urged and supported the exploration and advancement of alternative methods, such as in silico computational models and organoids. However, animal models are still being used ubiquitously in neuroscience research, from studying molecular and physiological interactions to investigating animal behavior and cognition. What are the consequences of these prohibitive restrictions to the animals, scientists, and general public? If there are alternative methods available, why are neuroscientists still conducting experiments on animals? How should neuroscientists navigate the current landscape for animal research?

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### Roman Stilling (Moderator)

Roman Stilling obtained his PhD in Neurosciences in 2013 at the European Neuroscience Institute in Göttingen, and worked as a postdoctoral researcher at APC Microbiome Ireland from 2013 to 2016. Starting from 2016, he serves as a scientific officer for "Tierversuche verstehen" ("Understanding Animal Experimentation"), a German science initiative which focuses on communicating with the general public about animal research. The initiative is coordinated by the Alliance of Science Organisations in Germany and provides comprehensive and fact-based information on animal experiments at research institutions.



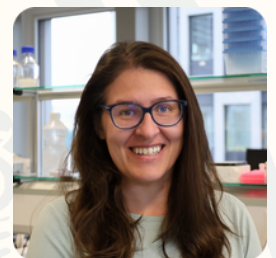
## Maria-Patapia Zafeiriou

Maria-Patapia Zafeiriou obtained her PhD in Biochemistry in 2007 from Center of Experimental Gynecology & Eicosanoid Research in Charité, Berlin and the National and Kapodistrian University of Athens. Since 2019, she has served as an Application Specialist for "Stem Cells and Organoids" within the Cluster of Excellence Multiscale Bioimaging: from Molecular Machines to Electrically Excitable Cells at the University Medical Center Göttingen, where she also leads the research group "3D Excitable Cell Networks" since 2020. Her research focuses on the molecular and cellular mechanisms governing electrically excitable cell networks, with particular emphasis on brain-heart communication, channelopathies, and autonomic dysregulation. Using human tissue engineering, genome editing, and induced pluripotent stem cell technologies, her group develops advanced neuronal and cardiac organoid models to investigate questions in neurodegeneration, epilepsy, and cardiology.



## Ivana Jaric

Ivana Jaric is a Group Leader at the Institute of Laboratory Animal Science, University of Zurich, Switzerland. Using mice as an animal model, her work focuses on elucidating the relationship between stress, female reproductive health, and psychiatric disorders. Her research also aims to enhance the translational validity of rodent research by developing evidence-based guidelines for the implementation of the Sex as a Biological Variable (SABV) initiative. To this end, she has conducted research and presented best practices for implementing SABV in rodent experiments, including with respect to animal housing and experimental design. She also chairs the EU SABV COST Action, the first European network dedicated to strengthening SABV policy in preclinical biomedical research.



## Frederic Römschied

Frederic Römschied is a group leader in the Computational Neuroethology of Social Flexibility laboratory at the European Neuroscience Institute. After completing his doctoral studies in Biophysics at the Humboldt University of Berlin, he worked at Princeton University as a postdoctoral research fellow until 2021. Since establishing his research group in the European Neuroscience Institute in 2023, he has been investigating social flexibility using the vinegar fly *Drosophila* as a model system. Combining a wide range of methodological approaches including optogenetics, neurogenetics, and computational modeling, Dr. Römschied aims to uncover the neural mechanisms of social behavior and flexibility at the behavioral and neural circuit level.



## Andreas Nieder

Andreas Nieder is a Professor of Animal Physiology at the University of Tübingen and a leading figure in cognitive neuroscience. Since 2023, Dr. Nieder serves as the Chair of the "Systems Neurobiology" section of the German Neuroscience Society (NWG). His research investigates how higher cognitive functions--such as numerical cognition, vocal control, categorization, working memory, and consciousness--arise from neuronal activity in telencephalic association areas. Using an evolutionary-comparative approach, he studies crows, macaques, and humans to uncover fundamental principles of cognition and abstract thought across brains of varying complexity. Dr. Nieder's scientific excellence has been honored with numerous awards, including membership in the German National Academy of Sciences Leopoldina, the Career Development Award from the Human Frontier Science Program, and the Novartis Prize from the German Neuroscience Society. His work continues to shape our understanding of the neural foundations of abstract thought and symbolic reasoning.



# NEURIZ NS



## ABSTRACTS

# Bridging Psychometrics and Neuroimaging: Latent Variable Modeling Reveals Robust Associations Between White Matter Microstructure and Fluid Intelligence

Henrike M. Jungeblut (1), Erhan Genç (2), Michael Burke (2), Patrick D. Gajewski (2), Stephan Getzmann (2), Edmund Wascher (2), Anna-Lena Schubert (1)

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Presenting author: Henrike M. Jungeblut

White matter microstructure is a candidate neurobiological substrate underlying individual differences in cognitive abilities. However, measurement inaccuracies in MRI-derived metrics often attenuate observed effect sizes, obscuring true brain-behavior relationships. Here, we demonstrate how latent variable modeling of neuroimaging data can mitigate these reliability concerns by estimating latent effect sizes free from measurement error.

We analyzed data of  $N = 365$  individuals (age range: 18–74) drawn from two independent samples (Dortmund Vital Study:  $N = 150$ , Clinicaltrials.gov: NCT05155397; Mainz Network Study:  $N = 215$ ). Using Structural Equation Modeling, we derived latent measurement models for three distinct microstructural markers across 52 white matter tracts: white matter integrity (fractional anisotropy, FA), neurite density (intra-neurite volume fraction, INVF), and myelin content (magnetization transfer ratio, MTR). All three microstructural markers were adequately captured by general-factor models, indicating that they all reflect brain-general rather than purely localized characteristics. Crucially, when relating the latent factors of white matter microstructure to a latent variable of fluid intelligence, we found robust latent positive associations for white matter integrity ( $\beta = 0.26$ ,  $p < .001$ ) and myelin content ( $\beta = 0.25$ ,  $p = .017$ ).

These findings not only establish anatomically informed measurement models for the microstructural properties of the white matter, but they also demonstrate that integrating psychometric methods with neuroimaging data provides a powerful, scalable framework to uncover the biological underpinnings of human cognition with greater precision.

# Highly distorted three-dimensional orientation fields in primary visual cortex

Licheng Zou (1), Abel Petik (2), Klaudia Csikós (2), Daniel Hillier (2), Fred Wolf (1)

(1) Göttingen Campus Institute for Dynamics of Biological Networks (2) HUN-REN Research Centre for Natural Sciences

Presenting author: Licheng Zou

Orientation preference maps (OPMs) are a canonical example of cortical organization and are commonly described within a two-dimensional framework, where orientation singularities appear as point-like pinwheels. However, (1) indicated that in three dimensions pinwheels rarely form straight columnar structures, challenging both the classical columnar hypothesis and existing two-dimensional descriptors. At present, a principled quantitative framework for characterizing three-dimensional OPM geometry is lacking.

Here we develop a unified theoretical framework that generalizes maximum-entropy models of OPMs from two to three dimensions. In this formulation, pinwheel points naturally extend to pinwheel strings, which constitute the fundamental topological defects of three-dimensional orientation maps. Within this framework, we derive exact analytical expressions for key geometric observables, including the mean string length, the statistics of distorted string motifs, and the full distribution of orientation differences between spatial locations.

We show how to apply this theory to functional ultrasound imaging (fUSI) data from cat primary visual cortex (2), resolving orientation preference across cortical depth at columnar scales. The theoretical observables robustly capture experimentally observed three-dimensional organizations, revealing quasiperiodic, surface-like orientation structures and systematic distortions of pinwheel strings along the cortical depth that are not apparent in two-dimensional analyses.

Together, our results provide a principled mathematical description of three-dimensional OPM organization, enabling quantitative comparisons across models and experimental modalities, and establishing extended topological defects as the natural building blocks of cortical organization beyond two dimensions.

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# Modeling spatial contrast sensitivity in responses of primate retinal ganglion cells to natural movies

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Presenting author: Shashwat Sridhar

A key challenge in computational neuroscience is designing easy-to-fit models that also capture the wide range of responses exhibited by sensory neurons. In the retina, predictive models of retinal ganglion cell (RGC) activity that rely on linear receptive fields (RFs) require few parameters but fail to capture the cells' sensitivity to high-frequency spatial contrast. Nonlinear models, such as subunit models, which divide the RF into smaller, nonlinearly combined regions, offer more accuracy but are often difficult to fit to experimental data, especially with natural stimuli. To address this gap, we use a model from literature [1] that effectively captures nonlinear spatial integration in RGCs with few tunable parameters, by combining signals representing the mean light intensity and its variance within the RF.

We extend this spatial contrast (SC) model to the spatiotemporal domain and evaluate it on spiking activity we recorded from marmoset retinas under artificial and naturalistic stimulation. We find that the predictive performance of the SC model exceeds that of standard linear models and a subunit model, particularly for cells with larger RFs, and is comparable to that of a 1-layer convolutional neural network. Furthermore, we use the model to estimate the cells' optimal spatial scale of nonlinear integration, finding that this scale remains consistent across cell types. Our results indicate that the SC model offers a straightforward approach to capturing key aspects of nonlinear spatial integration with minimal parameters, establishing itself as an effective benchmark for comparison with more complex nonlinear models.

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# Characterising Chaotic Dynamics in Cell Cultures Through Stimulus Reproducibility

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Presenting author: Hannah Z. Kerger

Session: Wednesday

Understanding the dynamical behaviour of neural networks is a fundamental challenge in neuroscience. Theoretical approaches usually provide complete knowledge of the phase space, facilitating a thorough characterisation of the dynamical system. Characterising experimental systems, however, presents a far greater challenge. Neuronal cultures possess a large number of degrees of freedom, many of which are unknown, which makes direct dynamical measures extremely difficult [1, 2]. Furthermore, conventional information-theoretic approaches such as mutual information or entropy involve multiple processing steps, strong statistical assumptions and free parameters [3].

Here, we propose reproducibility as a more direct and assumption-free alternative measure of network dynamics.

Using optogenetically driven primary rodent neuronal cultures, we deliver the same patterned stimulus repeatedly across trials and quantify the degree to which the network reproduces its response. In a purely chaotic system, the sensitivity to initial conditions would lead to a divergence of the responses across trials [4]. Thus, a high reproducibility indicates that the network is not in a purely chaotic regime. The degree of reproducibility can therefore provide an empirical proxy for the degree of chaos in the network dynamics. Furthermore, this approach is parameter-free and directly interpretable, making it robust to analytical biases and applicable across experimental preparations.

Crucially, this approach is not limited to mouse neuronal cultures, but is directly applicable to iPSC-derived neuronal networks and organoids [5]. It could provide an assumption-free characterisation of network dynamics in patient-derived models, enabling the detection of network-level dysfunction in diseased relative to healthy controls.

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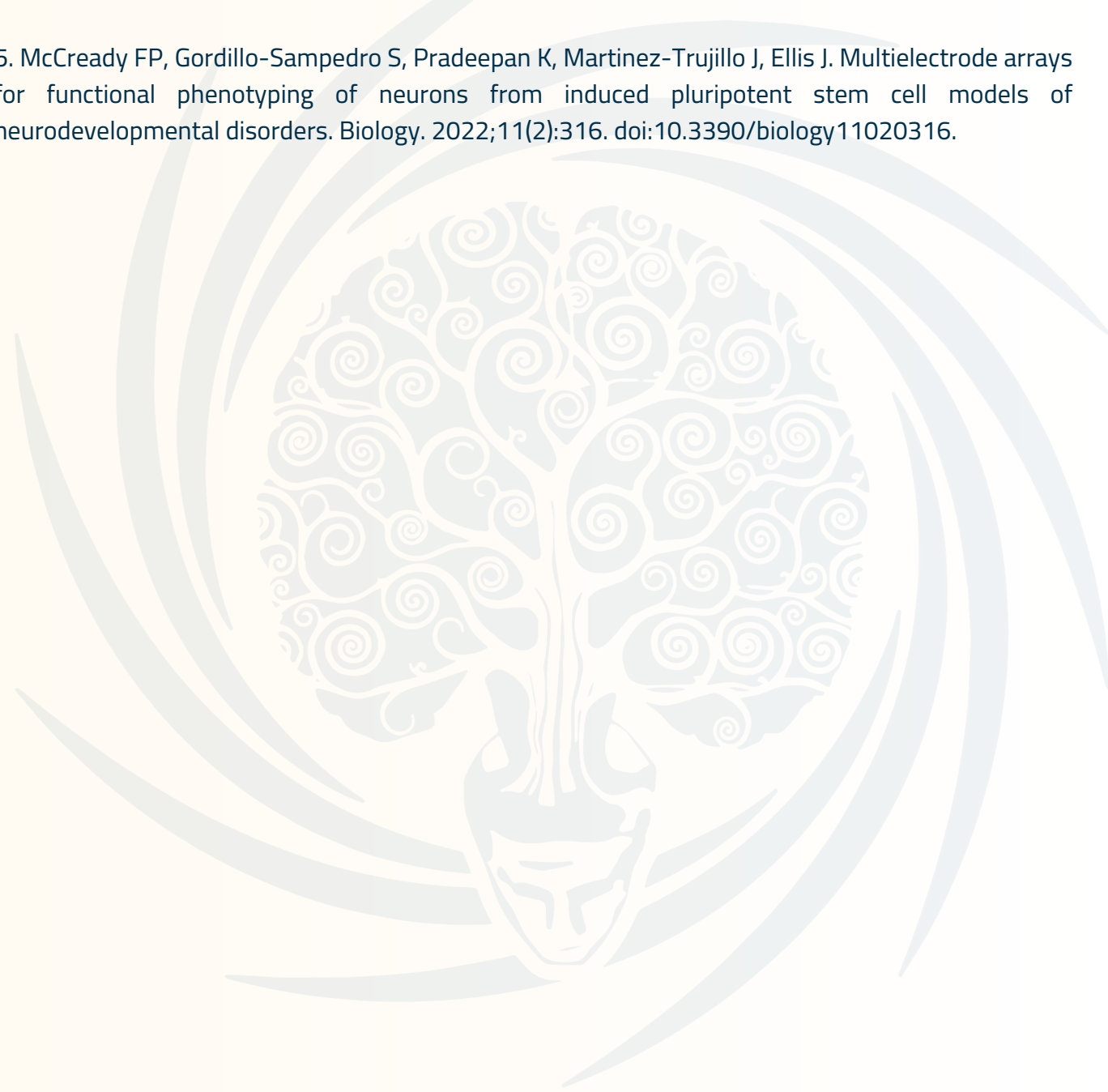
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# High Density Multielectrode Array based Neuronal Targetting via Illuminated Stimuli (H.D-M.A.N.T.I.S)

Hari Prasad Sreekrishnapurath Variyam (1), Josephine Marie Barbery (1), Dr. Andreas Neef (1)

(1) Campus Institute for Dynamics of Biological Networks (CIDBN), University of Göttingen.

Presenting author: Hari Prasad Sreekrishnapurath Variyam

Session: Wednesday

Understanding cortical microcircuits and their dynamics is a central goal in cellular neuroscience. Dissociated cortical cultures exhibit a wide range of dynamical repertoires and provide a rich model system for exploring these processes (1). Here, we introduce an experimental setup for directly interfacing with optogenetically modified cell cultures: HD-M.A.N.T.I.S. (High-Density Multielectrode-Array-based Neural Targeting via Illuminated Stimuli). This system combines an HD-OLED display for light stimulation with a commercial CMOS microelectrode array (MEA) for electrical recordings, enabling high-throughput stimulation and data collection with approximately 11  $\mu\text{m}$  resolution on both the input and output sides. A major advantage of this setup is its versatility and streamlined design. The entire platform can be assembled for under €1000 using readily sourced components and a straightforward, easily extensible code base. To validate its performance, we present a series of key characterization tests. The system integrates seamlessly with existing commercial MEA ecosystems, providing precise stimulus delivery. As a benchmark of its temporal accuracy and data-acquisition fidelity, we compute high-resolution spike-triggered averages (2) to infer receptive fields with fine spatial detail.

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# Cortical Topology emerges from a Multi-scale Cellular Potts Model

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Presenting author: Niklas Alvar Laasch

Session: Wednesday

The mammalian cerebral cortex displays a complex network architecture supporting high-level cognition, yet the developmental rules driving its formation remain poorly understood. Current computational models often rely on static templates or global optimization, failing to capture the physical morphogenesis of neural tissue. Here, we present a multi-scale generative model integrating tissue-level mechanics with local wiring rules to simulate the emergence of the cortical connectome. Our approach combines a Cellular Potts Model (CPM) for tissue dynamics with a biologically grounded connectivity algorithm. We simulate the "inside-out" cortical developmental program, where early-born neurons settle in deep layers and later-born neurons migrate past them to superficial positions [1]. This spatiotemporal process naturally creates distinct distance constraints and cytoarchitectonic profiles without a priori prescription. As neurons settle, they form connections via spatially constrained preferential attachment and lineage-based microcolumnar biases [2]. We demonstrate that realistic macro-scale network topology emerges solely from these local developmental interactions. Simulated networks exhibit heavy-tailed degree distributions, hierarchical modularity, and realistic reciprocal clustering coefficients. Crucially, we reproduce the Architectonic Type Principle [3], where connectivity profiles are predicted by laminar cytoarchitectonic similarity between areas. This suggests that brain network topology is not necessarily the result of global optimization balancing wiring cost and topological value, but may emerge from simple physical migration and wiring rules. This framework bridges developmental biology and network science, providing a platform to investigate how perturbations in physical growth lead to altered network phenotypes in neurodevelopmental disorders.

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## Role of regulatory B cells in the murine model of MS

Alexander Busch, Estibaliz Maudes Garcia, Silke Häusser-Kinzel, Martin S. Weber

University of Göttingen, University medical center göttingen, Department of Neurology

Presenting author: Alexander Busch

Session: Thursday

Multiple Sclerosis (MS) is a chronic inflammatory disease of the central nervous system (CNS), characterized by demyelination and neurodegeneration in white and grey matter[1,2]. While MS has long been considered primarily a T cell-mediated autoimmune disease, increasing evidence highlights a substantial contribution of B cells to disease pathogenesis[3]. Beyond antibody production, B cells can act as antigen-presenting cells and modulate immune responses through cytokine secretion[3,4,5]. However, the functional roles of distinct B-cell subsets, particularly regulatory B cells, remain incompletely understood.

This project aims to characterize the interaction profiles of regulatory and pathogenic B cells with CNS-infiltrating immune cells and CNS-resident cell populations, and to define their spatial organization in mouse models of experimental autoimmune encephalomyelitis (EAE). Mice were immunized with either Myelin Oligodendrocyte Glycoprotein1–117 (MOG1–117) protein or the MOG35–55 peptide, and immune cells from peripheral organs and the CNS were analyzed during chronic EAE.

Flow cytometry revealed increased activation marker expression and altered B-cell maturation states in both models. B cells also displayed elevated expression of molecules linked to immunoregulatory functions, suggesting infiltration of regulatory B-cell populations into the CNS.

To investigate cellular interactions within the inflamed CNS, spatial transcriptomics was utilized to resolve cellular composition, transcriptional states, and spatial organization of immune and CNS-resident cells. Integrating flow cytometry with spatial transcriptomic data will enable identification of spatially defined interaction networks between infiltrating immune cells and glial populations, providing insight into mechanisms driving CNS inflammation and demyelination in EAE models and clarifying the roles of regulatory B cells in neuroinflammation.

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## Natural facial motion unlocks predictive computations in macaque face patch ML

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Presenting author: Andrea F Campos-Pérez

Session: Thursday

For primates, faces are a critical source of information for interpreting the intentions and actions of others. In natural environments, faces are dynamic, continuously changing due to motion. This poses a challenge for the visual system, which must maintain stable representations of identity across changing views, but also offers an opportunity to exploit motion-derived predictive information. Here, we tested whether natural facial motion provides predictive context that shapes identity processing in macaque face patch ML, an area characterized by strong view tuning but limited motion and identity selectivity. We recorded 215 single neurons from ML in two rhesus macaques while they viewed sequences of faces presented either in natural rigid-head motion or in temporally scrambled order. Each sequence was followed by a static test image that either matched or violated the preceding identity. Identity violations elicited stronger population responses than matches, consistent with identity prediction errors (PEs), but only when preceded by natural motion. Moreover, significantly more neurons exhibited identity PEs in the natural motion condition (55.2% increase). Across neurons, motion sensitivity positively correlated with PE magnitude, indicating that natural motion systematically modulates identity error signals. Using representational similarity analysis, we further found that identity separability increased following violations in both contexts, but was significantly enhanced under natural motion. These results demonstrate that natural facial motion provides predictive information that sharpens identity representations and enables identity-specific error signaling in ML, revealing computational capacities that are not engaged when predictive context is absent.

# Regulatory functions of B cell-derived TGF- $\beta$ 1 in Experimental Autoimmune Encephalomyelitis

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Presenting author: Antonia Macioszek

Session: Thursday

Multiple Sclerosis (MS) is a chronic inflammatory disease caused by immune cells attacking the myelin sheath, leading to demyelination of the brain and spinal cord. Therapeutic approaches target B lymphocytes that are aberrantly activated in MS. However, regulatory B cells (Bregs) exert immunomodulatory functions, notably through expression of programmed death ligand-1 (PD-L1) and the secretion of anti-inflammatory cytokines such as interleukin (IL)-35, IL-10, and transforming growth factor- $\beta$ 1 (TGF- $\beta$ 1).

In this study, we investigated the role of B cell-derived TGF- $\beta$ 1 to better characterize the TGF- $\beta$ 1 Breg subset.

CD20<sup>-/-</sup>CD19cre<sup>+/-</sup> and CD20<sup>-/-</sup>CD19cre<sup>+/-</sup>TGF $\beta$ 1flox/flox B cells were adoptively transferred into C57BL6/J wild-type (WT) mice treated with the anti-CD20 monoclonal antibody Rituximab. Control groups receiving WT B cells were treated with either Rituximab or an isotype control. Six weeks after adoptive B cell transfer, mice were immunized with myelin oligodendrocyte glycoprotein peptide (MOG35-55) in Freund's complete adjuvant and Pertussis toxin to induce experimental autoimmune encephalomyelitis (EAE). Cytokine profiles were assessed using qPCR and ELISA. Phenotypic analysis of Bregs, T cells, and myeloid cells in peripheral and central nervous system compartments was performed by flow cytometry.

B cell depletion significantly exacerbated disease severity in EAE. Flow cytometry data revealed that the absence of TGF- $\beta$ 1 increased monocyte activation, suggesting that B cell-secreted TGF- $\beta$ 1 contributes to the regulation of pro-inflammatory antigen-presenting cell activity.

These findings demonstrate the regulatory impact of TGF- $\beta$ 1 during EAE and emphasize the importance of B cell-mediated immune regulation in MS pathogenesis.

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# Phenotype-dependent oxidative stress dysregulation and lipid peroxidation in X-linked adrenoleukodystrophy

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Presenting author: Bindhu Lakshminarayana

Session: Wednesday

Background: X-linked adrenoleukodystrophy (X-ALD) is a peroxisomal disorder caused by pathogenic ABCD1 variants, presenting with variable phenotypes. Cerebral X-ALD (CALD) causes progressive demyelination resulting in severe decline of motor and cognitive function. Several studies show that oxidative and mitochondrial stress plays a key role in cellular damage and phenotypic variability in X-ALD pathophysiology. Nuclear Factor Erythroid-2(NRF2) is a key regulator of cellular antioxidant defense. This study aimed to investigate potential dysregulation of the NRF2 pathway in X-ALD fibroblasts and its relationship to lipid peroxidation, exploring phenotype-specific differences.

Methods: X-ALD patient-derived(6) and control fibroblasts(3) were assessed for NRF2 target gene expression (NQO1, AKR1B10 and GCLM) by qRT-PCR. Lipid peroxidation was investigated with analysis of 4-hydroxynonenal(4-HNE) by Western blot. Cells were subjected to exogenous oxidative stress using tert-Butyl hydro peroxide(TBHP) and the NRF2 activator sulforaphane(SFN).

Results: SFN upregulates all NRF2 target genes across phenotypes, with stronger induction in asymptomatic and Addison-only cells than CALD, except GCLM, which is more highly expressed in CALD and asymptomatic cells. While NRF2 pathway activation is the expected stress response as observed in control cells, CALD cell lines show decreased expression compared to the relatively higher expression in asymptomatic cells. Lipid peroxidation is elevated in X-ALD cell lines and further increases upon TBHP exposure.

Discussion: These findings indicate a dysregulated oxidative response in X-ALD fibroblasts, characterized by altered NRF2-dependent gene expression and elevated lipid peroxidation thereby linking stress regulation and phenotypic variation. Targeting cellular defence mechanisms, particularly NRF2 signalling, may represent a potential therapeutic strategy for X-ALD.

# Investigating the Dual Roles of $\alpha 2\delta$ -2 in Shaping Cochlear Ribbon Synapse Architecture and Cav1.3 Function

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Presenting author: Bohan Meng

Session: Wednesday

The cochlear inner hair cells (IHCs) transduce mechanical signals into electrical signals and transmit them to spiral ganglion neurons (SGNs) through the specialized ribbon synapses. While the frequencies of sound waves are encoded on a tonotopic map along the cochlear helix by the position of individual IHCs, it is less clear how the amplitude is encoded. The existence of spatial heterogeneity in IHC ribbon synapses and the transcriptomic and physiological heterogeneity of their corresponding post-synaptic SGNs are considered an important candidate that implements sound intensity encoding, yet the mechanism of such heterogeneity remains elusive.

Previous studies indicated that the  $\alpha 2\delta$ -2 subunit of Cav1.3 at the active zone (AZ) of cochlear ribbon synapse might influence transsynaptic signaling. Traditionally known to regulate the transportation and localization of Cav1.3, the mouse strain with loss-of-function  $\alpha 2\delta$ -2 called Ducky reportedly exhibit misalignment of pre- and postsynaptic ribbon synapse structures, making  $\alpha 2\delta$ -2 a possible contributor to synaptic heterogeneity. With whole-cell patch clamp with fluctuation analysis and immunohistochemistry, we observed altered ribbon synapse and Cav1.3 distribution patterns, and mixed results in synaptic alignments. To our surprise, we also found significant differences between the biophysical properties of Cav1.3 between wildtype and Ducky mice that agreed with previous observations that Ducky mice had reduced calcium current, suggesting possible roles and machineries of  $\alpha 2\delta$ -2 in modulating single-channel activities of Cav1.3. Our results indicate the dual roles of  $\alpha 2\delta$ -2, which call for more detailed examination of the mechanism with which each function is implemented.

# Advances in CRLF3 neuroprotective potential: characterization and prediction of its endogenous ligand in insects

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Presenting author: Carlos Angel Ruelas Montes

Session: Thursday

Cytokine-Receptor-Like Factor 3 (CRLF3) emerged as a potential target to leverage erythropoietin-like signaling against neurodegenerative disorders. However, the architecture of CRLF3 is not completely defined, and its endogenous ligand in insects remains unidentified. These limit its translational potential. In parallel, evolutionary evidence suggests CRLF3 may represent the ancestral precursor of Type I Cytokine Receptors in vertebrates. Therefore, we developed a computational pipeline with state of the art predictive algorithms, to characterize CRLF3 structure between arthropods and mammals, and predict its endogenous ligand in insects. We generated high-confidence structural models of CRLF3 orthologs from *Locusta migratoria* and *Tribolium castaneum*, and conducted comparative analyses with mammalian orthologs. Our results reveal conserved structural features across distant lineages, including preservation of Fibronectin type III (FN3) and SPRY domains. The SPRY domain in arthropods lacks an intrinsically disordered loop, commonly associated with human pathologies, suggesting functional divergence. Also, our results indicate that FN3 may mediate both homotypic interactions and ligand binding, supporting a plausible homodimerization mechanism. We predict that the SPRY domain participates in ligand recognition, through conserved motifs. Finally, our bioinformatic mining identified candidate bioactive motifs in known CRLF3 agonists, enabling the prediction of four uncharacterized proteins in *T. castaneum*, as putative endogenous ligands. All together, our findings provide structural and functional insights into CRLF3 biology, laying a foundation for future experimental validation. Ultimately, our work advances the understanding of CRLF3 as a potential therapeutic target in neurodegeneration and contributes to the broader evolutionary narrative of immune and nervous system signaling.

# Expanding the Optogenetic Toolbox: Genome mining and automated characterization based discovery of red-shifted Channelrhodopsins

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Presenting author: Esther Marie Grewe

Session: Thursday

Optogenetics has profoundly impacted neuroscience by enabling precise, light-mediated control of neuronal circuits with high spatiotemporal resolution. Central to this technology are Channelrhodopsins (ChRs), light-gated ion channels. Over the past two decades, numerous ChR variants have been discovered and optimized. However, optogenetic stimulation in vivo remains challenging, particularly for applications requiring high-frequency activation, such as the auditory system. A key priority in addressing these challenges is the discovery of red-shifted ChRs, which reduce the risk of phototoxicity and allow dual-colour experiments in combination with blue-light-activated tools. In this study, we screened 50 previously uncharacterized ChRs from green algae, targeting sequences with amino acid residues linked to red-shifting. Using automated photocurrent measurements and high-throughput spinning disk confocal microscopy, we focused on residues influencing the polarity at the  $\beta$ -ionone ring, the retinal-binding pocket geometry, and the counterion complex. Our screening identified four promising red-shifted candidates, including what is, to our knowledge, the most red-shifted depolarizing natural ChR discovered to date with peak sensitivity at 610 nm. Furthermore, we identified a green-light-activated ChR with a  $\tau_{off}$  of  $2.5 \pm 0.3$  ms, which likely represents the fastest natural variant observed yet. These findings significantly expand the optogenetic toolbox, offering new possibilities for high-frequency neural coding and multi-wavelength circuit interrogation. By providing improved tools for both speed and spectral range, this work contributes to advancing the potential for optogenetic applications in both fundamental neuroscience and future clinical interventions, such as sensory restoration.

# Statistical Predictability and Acoustic Deviation Jointly Shape Neural Responses to Speech Sequence Violations

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Presenting author: Fatih Sivridag

Session: Wednesday

Language comprehension relies on predictions derived from learned statistical regularities. When incoming speech violates these expectations, neural responses may depend jointly on how predictable the context is and how large the acoustic deviation is. We investigate this joint impact using an artificial-language listening paradigm with EEG. Participants (target  $N \geq 60$ ) listen to three within-subject stream conditions: a random baseline stream with minimal transitional probabilities, a low-predictability structured stream in which triplet “words” have weak internal transitions, and a high-predictability structured stream with fixed triplets and maximal within-word predictability. Statistical learning during exposure is indexed neurally via inter-trial phase coherence (ITPC) at the word rate and behaviorally via a speeded target-detection task measuring reaction times and accuracy. In subsequent test blocks for the structured streams, each 12-syllable trial contains one deviant that replaces an expected syllable at either a word-medial or word-final position. Deviants vary in acoustic magnitude, ranging from small to large changes quantified by MFCC-based distance. We test whether violations in highly predictable contexts elicit larger mismatch negativity (MMN) responses and stronger disruption of word-rate ITPC, whether larger acoustic deviations amplify these effects, and whether predictability and deviation magnitude interact. Analyses use mixed-effects modeling to relate MMN and ITPC to predictability, deviation magnitude, and position while accounting for within-participant variability. Together, MMN and ITPC allow us to compare immediate error signals with changes in ongoing sequence tracking, helping to distinguish locally contained from globally disruptive prediction violations in speech processing.

## The language network responds stronger to connected than to unconnected sentences

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Presenting author: Fiona Paliga

Session: Wednesday

To improve the safety and efficacy of craniotomy in patients with lesions in language-eloquent brain regions, reliable functional mapping of the language network and preoperative assessment of language lateralization are essential. However, fMRI language paradigms are time-consuming and place substantial cognitive and economic demands on patients and diagnostic services. We therefore tested newly generated German stimuli designed to optimize measurement efficiency. Forty-three healthy participants (mean age = 38 years, range = 20–64; 24 women) were scanned on a 3T MRI while reading or listening to 4-, 8-, and 12-word sentences and pseudoword lists or texts, each followed by a decision task. Sentences were selected from German literary classics and matched across conditions for lexical and structural properties. Measurement times ranged from 12 minutes for 4-word sentences to 8 minutes for 12-word sentences and texts. Region-of-interest analyses based on subject-specific, functionally defined language-sensitive regions revealed robust activation of the language network. Within participants, texts elicited significantly larger effect sizes than sentences, and longer sentences generally produced stronger responses than shorter ones. Task manipulations that should increase cognitive demand (short 4-word sentences with frequent memory probes, coherent texts requiring deeper semantic integration) did not elicit stronger responses in the domain-general multiple demand network, suggesting that executive-control activity does not mask language responses. Instead, we observed substantial overlap between the default mode network and language-sensitive regions in the left temporal lobe, consistent with relatively automatic language processing. These findings support more efficient, language-specific fMRI protocols for preoperative diagnostics and individualized treatment planning.

## Female LepRLH neurons promote feeding and social behaviours in a cycle-specific manner

Gabriela Neubert da Silva (1), Rebecca Figge-Schlensock (2), Deema Imad Awad (2), Kriti Johri (1), Tristan Franke (1), Andrew Lehr (3), Tatiana Korotokova (2), Anne Petzold (1)

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Presenting author: Gabriela Neubert da Silva

Session: Thursday

The hormone leptin plays a role in metabolic homeostasis through different hypothalamic neuronal population expressing the long-form of the leptin receptor (LepR). We recently demonstrated that LepR-expressing neurons within the lateral hypothalamus (LepRLH) encode nutritional and social stimuli. When both stimuli are available, LepRLH neurons of males prioritise social exploration towards females over food approach despite hunger pressure. However, reproduction is more energetically costly for females, and leptin levels per fat-mass unit are higher in females than in males, suggesting hormonal modulation. First, we investigated how LepRLH neurons of females respond to and integrate nutritional and social stimuli, and whether these responses are affected by the estrous cycle hormonal fluctuations. We combined deep-brain calcium imaging, pharmacology, opto- and chemogenetics of LepRLH neurons of both sexes in freely moving mice, taking into account the estrous cycle of the females. LepRLH neuronal responses to leptin are sex- and estrous cycle-specific, leading to different feeding behaviour. Additionally, LepRLH neurons of females respond and promote social and sexual contact towards males, with greater responses in receptive than in unreceptive females. Second, we started to map the neuronal circuitry underlying these effects. We chemogenetically activated LepRLH neurons, quantified c-fos expression throughout the brain and measured LepR and estrogen receptor  $\alpha$  (Esr1) co-expression. We found that LepRLH neurons strongly inhibit the ventral pre-mammillary nucleus, a region involved with opposite sex odours that co-expresses LepR and Esr1 in a sexually dimorphic manner. Our results open avenues to study how hormonal and metabolic signals shape state-dependent behavioural choices.

## Dual-color approaches for optogenetic hearing restoration

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Presenting author: Hannah Luksch

Session: Thursday

Optogenetic stimulation of spiral ganglion neurons is constrained by the kinetic and efficiency limitations of available channelrhodopsins, restricting the temporal fidelity at high frequency auditory encoding. Additionally, optical stimulation exhibits a reduced dynamic range compared to natural hearing. To address these challenges, we aim to develop dual-color optogenetic strategies combining protein engineering, spinning-disk confocal microscopy, and electrophysiological characterization. To improve temporal fidelity, we expressed two spectrally separated channelrhodopsins in a single cell. By sequentially activating f-Chrimson – a red-shifted depolarizing channelrhodopsin – and HcKCR2-f1, a blue-light-activated potassium-selective (hyperpolarizing) channelrhodopsin, we achieve accelerated photocurrent decay. This approach exploits the inverse relationship between current decay kinetics and charge transfer, enabling a flexible adjustment of photocurrent decay to maintain a level of charge transfer sufficient for reliable neuronal stimulation. To expand the dynamic range of optical stimulation, we seek to develop highly efficient, blue-light-activated actuators. We engineered novel non-potassium-selective (depolarizing) HcKCR2 variants that exhibit depolarizing responses, accelerated closing kinetics, and current densities matching state-of-the-art blue tools like Chronos and CatCh. Blue-light-activated channelrhodopsins optimized for efficiency expand the toolkit for dual-color optogenetic strategies, especially given their compatibility with red-shifted tools. When paired with red-light-activated actuators, the independent stimulation of different populations of spiral ganglion neurons may increase the dynamic range of optical stimulation. Together, these approaches represent a step toward next-generation optical cochlear implants capable of delivering more naturalistic auditory perception.

# Inflammatory Mediators as Potential Biomarkers and Targets for Intervention in Parkinson's Disease

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Presenting author: Husna Ahmad

Session: Wednesday

Parkinson's disease (PD) is a progressive neurodegenerative disorder characterized by the loss of dopamine-secreting neurons residing in the substantia nigra, leading to severe motor symptoms such as tremors, stiffness, balance issues, and gait disturbances. It is the second most common neurodegenerative disease, with aging and environmental factors as major risk factors. Alpha-synuclein (aSyn) misfolding and aggregation are key pathological features identified in postmortem brain tissues of patients.

Biomarkers are crucial for the early detection of PD and monitoring disease progression. Alpha-synuclein seed amplification assay (aSyn-SAA) has also emerged as a highly sensitive diagnostic tool for PD.

This study aims to identify predictive inflammatory biomarkers and therapeutic targets for PD by analyzing samples from prodromal, early and advanced PD patients, as well as controls. Inflammatory mediators will be profiled in the plasma and cerebrospinal fluid (CSF).

Initially, pro-inflammatory cytokines were identified in PD patient plasma and CSF using Olink-based analysis of the Parkinson's Progressive Marker Initiative (PPMI) dataset. These biomarkers will be further validated using enzyme-linked immunosorbent assay (ELISA). Next, we will correlate our findings with aSyn-SAA status using real-time quaking-induced conversion (RT-QuIC) in order to understand the dynamic interplay between these two key pathological features.

In parallel, distinct aSyn species will be generated and purified for functional studies in microglia and astrocyte cell models. Candidate therapeutic strategies will then be tested for their ability to modulate inflammation and identify potential intervention targets.

This project integrates clinical and experimental validation to identify neuroinflammatory mechanisms in PD and molecular targets for intervention.

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# Uncovering Dynamics of Mouse-Chasing Behavior via Target-State-Aligned Stochastic Inference

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Presenting author: Ilia Leonov

Session: Thursday

Processes in living systems—such as cell division or decision-making—evolve toward functionally critical target states, where final states are well-defined but initial conditions are unknown, and dynamics exhibit substantial variability due to intrinsic noise and heterogeneity. Naive alignment to target states introduces spurious forces via statistical bias, compromising accurate inference of underlying dynamics. To address this, we developed a target-state-aligned reverse-time stochastic framework that correctly recovers effective dynamical laws. Extensions incorporating multiplicative noise and parameter heterogeneity reveal that the mean and two-time covariance matrix of aligned time-series encode rich information about the underlying dynamics, including distinctions between intrinsic and extrinsic noise sources. We apply this framework to real-world data from a prey pursuit task in mice. The resulting dynamics are force-dominated, enabling effective dynamical inference. Using simulation-based inference, we identify the effective stochastic differential equation governing the behavior. Strikingly, we recover both the distribution of a heterogeneous force parameter—revealing pursuit at approximately constant speed drawn from a normal distribution—and the intrinsic noise structure, which follows a power-law multiplicative form. This indicates that trajectory variability grows sublinearly as mice approach their prey. Our work establishes a transparent, theoretically grounded, and experimentally applicable method for inferring effective dynamics in complex biological target processes, offering a powerful tool for understanding real-world behavioral and cellular dynamics.

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## Freely moving rhesus macaques coordinate dynamically during social foraging

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Presenting author: Jessica Grunwald

Session: Thursday

Foraging animals continuously assess their environment regarding types and locations of food sources. During social foraging, individuals must additionally account for the positions and potential actions of conspecifics, integrating social dynamics into their foraging decisions. Here we test how rhesus macaques (*Macaca mulatta*) integrate information about a conspecific's actions in their own action planning while foraging freely in an experimentally controlled setting ("Exploration Room"). We hypothesized that monkeys would dynamically coordinate their foraging patterns in time and space, rather than splitting the territory, to maximize foraging success while minimizing conflict potential. To test our hypothesis, we offered to the animals a variety of feeding options in a shared space and tracked their full-body movements and interactions.

In line with our hypothesis, we found that the monkeys adopted a dynamic coordination strategy. After a few dyadic foraging sessions, they maintained a minimum distance from each other while foraging and tended to synchronize their foraging and relocation times between separate feeding stations. Additionally, we found that visual exploration of the food stations (head gaze) was indicative of where the monkey decides to go next, taking into account the partner's current location in the room.

The observed social foraging dynamics highlight the impact of a conspecific's presence on foraging strategies in rhesus macaques, indicating that a dynamic coordination approach may be more advantageous than rigid territorial divisions in ecologically relevant environments.

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# Internal State Modulates Odor-Guided Behavior and Neural Odor Processing in Larval Zebrafish

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Presenting author: Johanna Margaretha Waalkens

Session: Thursday

Internal states, such as stress, arousal, or alertness, strongly influence sensory processing and behaviour. Yet the neural mechanisms by which they modulate sensory representations remain poorly understood. Larval zebrafish offer a powerful model to study these processes, as whole-brain neural activity and behavior can be measured in parallel in vivo. Here, we investigate how internal states influence odor-guided behavior and neural odor processing in larval zebrafish.

To induce a stress state, larvae were briefly exposed to elevated temperature, while controls were kept at standard temperature. After a short recovery period, both groups were tested in a freely swimming behavioral arena, in which either an appetitive or an aversive odor was presented. Compared with controls, temperature-exposed larvae showed increased attraction to the aversive odor and decreased attraction to the appetitive odor.

To investigate the underlying neuronal signature, we repeated the same temperature manipulation and performed two-photon calcium imaging of the forebrain during odor presentation. Here we observed reduced responses to the appetitive odor across multiple forebrain regions, with particularly pronounced effects in the subpallium, pallium and preoptic region, suggesting region-specific modulation of odor representations by internal state. In addition, individual brain regions contained spatially distinct subdomains that showed differential sensitivity to temperature-induced state changes.

Together, these findings reveal a priming effect whereby brief temperature exposure induces an internal state that modulates subsequent odor-guided behavior and neural odor processing. This establishes larval zebrafish as a model for studying state-dependent modulation of sensory processing.

## Neuro-Fuzzy Rule Mining

Julia Hattendorf

University of Osnabrück

Presenting author: Julia Hattendorf

Session: Wednesday

Neuro-fuzzy systems allow us to obtain a rule base showcasing underlying patterns in data and to understand their decision-making processes.

This thesis investigates the extraction of rules from data utilizing a neuro-fuzzy approach; by building and training a classifying neuro-fuzzy network. The extracted If-Then rules are implicitly stored in the activation and weights of certain neurons of this network. A proof of concept is provided with the mined rule base of the XOR-problem and the Iris Dataset. This work addresses the accessibility issues of classifying neuro-fuzzy software and provides a neuro-fuzzy rule mining program freely-available at: <https://github.com/juelha/NeuroFuzzyRuleMiner>.

# Activity-dependent structural changes of murine endbulbs of Held

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Presenting author: Julius Bahr

Session: Wednesday

In the mammalian auditory pathway spiral ganglion neurons form the calyx-shaped endbulbs of Held that project onto bushy cells in the cochlear nucleus (CN). Loss of the hair cell protein otoferlin abolishes exocytosis at the cochlea and results in profound deafness[1]. Downstream, the input-deprived endbulbs of Held are reduced in size and branching[2] and at endbulb active zones (AZs) of otoferlin mutant (*Otof*<sup>-/-</sup>) mice, synaptic vesicles (SVs) decline in numbers at 6 months of age[3]. Despite showing some degree of degeneration, the question remains, if such activity-deprived AZs are still functional throughout life span. Therefore, we investigated structural correlates of mitochondria, endo- and exocytosis upon acute activation comparing wild-type and deaf animals.

Freshly prepared vibratome sections of the anteroventral CN were subjected to chemical high-K<sup>+</sup> stimulation. We analyzed synapses of wild-type and *Otof*<sup>-/-</sup> mice at different ages (P40-60, 6 months, ~1.5 years) with different activity states (stimulated or resting). We employed high-pressure freezing followed by freeze-substitution and embedding, for electron tomography imaging. Morphometric parameters were analyzed manually and with the automated segmentation tool SynapseNet[4]. Upon stimulation, an elevated count of omega-shapes in the periphery of AZs was detected, especially prevalent in young *Otof*<sup>-/-</sup> endbulbs. Docked SVs were already reduced in young *Otof*<sup>-/-</sup> endbulb AZs, potentially due to a vesicle cycling dysfunction. Overall, results suggest that in a deafness model, AZs remain partially functional over months but might deteriorate at older ages.

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# Grade-dependent immune remodeling distinguishes T lymphocyte-rich benign from myeloid-dominated malignant glioneuronal tumors

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Presenting author: Kittitach Sri-ngern-ngam

Session: Wednesday

Glioneuronal tumors are heterogeneous neoplasms with mixed neuronal and glial components, often presenting with cognitive changes and seizures. While most human cases are benign, rare malignant forms exist. Beyond the neuronal and glial compartments, immune cells are crucial components of the tumor microenvironment (TME) modulating homeostasis and progression; however, the immune TME in malignant glioneuronal tumors remains poorly defined. To address this, we generated murine models of both benign (BRAFV600E/pAKT) and malignant (BRAFV600E/pAKT/Trp53KO) glioneuronal tumors using in utero electroporation (IUE) and investigated the cellular heterogeneity within the tumor microenvironment using single-cell RNA sequencing. Our results revealed striking grade-dependent differences in immune cell composition. Benign tumors exhibited significantly elevated infiltration by CD3<sup>+</sup> T lymphocytes, comprising approximately 50% of the immune population. In contrast, malignant tumors were predominantly populated by microglia and border-associated macrophages (BAMs), accounting for roughly 70% of immune cells, indicating that the malignant tumors exhibited a more myeloid-dominated immune architecture than the benign tumors. Differential gene expression analysis showed osteopontin (SPP1) was selectively upregulated in malignant, but not benign, tumor microglia. Functional assays using cultured cells from malignant tumors showed that exogenous recombinant SPP1 promotes microglial/BAM proliferation, supporting its role in driving myeloid expansion. Overall, these findings reveal a distinct immunologic dichotomy between benign and malignant glioneuronal tumors, with benign glioneuronal tumors exhibiting T lymphocyte-enriched microenvironments and malignant glioneuronal tumors instead dominated by myeloid cells. Furthermore, SPP1-expressing microglia represent a hallmark of malignant glioneuronal tumors, suggesting SPP1-mediated myeloid activation contributes to their progression and aggressiveness.

## Active zone proteins cluster heterogeneously in the Inner Hair Cells of the Cochlea

Klara Esch (1,2,3), Rohan (1, 2), Sophia Mutschall (1, 2, 4), Carolin Wichmann (1,5,6), Constantin Pape (4,7), Tobias Moser (1,2,4)

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Presenting author: Klara Esch

Session: Thursday

Inner Hair Cells (IHCs) of the cochlea, the main sensory receptor cells of the auditory system, use graded receptor potentials to encode the entire dynamic range of sound intensities at one tonotopic position. Spiral Ganglion Neurons (SGNs) innervating the IHCs only change their firing rates over a fraction of this dynamic range and cumulatively convey the sound intensity information to the brain. One possible mechanism behind this so-called "dynamic range problem" (Evans, 1981) is the position-dependent heterogeneity of the highly specialized IHC-SGN ribbon synapses (Moser et al, 2023). We studied the position-dependence of diversity in cluster size and morphology for the CaV1.3 calcium channels in the center of the IHC active zone (AZ) as well as for other important protein AZ components by combining confocal imaging with super-resolution Stimulated Emission Depletion (STED) microscopy. We observe that all examined AZ players display position-dependent heterogeneity in morphological properties, including the multi-domain protein CAST1, which we were able to visualize at IHC synapses for the first time. Currently, we employ MINIFLUX nanoscopy recently made available in the lab for the organ of Corti to investigate differential AZ topography and its position dependence within a given IHC. Furthermore, we use electron tomography in combination with optogenetic IHC stimulation followed by high-pressure freezing on a millisecond time scale to explore heterogeneity of distinct functional synaptic states. The obtained results explore molecular underpinnings of presynaptic organization, important both for fundamental principles of biological information transmission and translational auditory research.

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Moser T, Karagulyan N, Neef J & Jaime Tobón LM (2023) Diversity matters — extending sound intensity coding by inner hair cells via heterogeneous synapses. EMBO J 42: e114587



## Apical planar polarity regulator Rgs12 influences synaptic heterogeneity in inner hair cells

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Presenting author: Leon Bösche

Session: Wednesday

The auditory system responds to an astonishing range of sound pressures, spanning over six orders of magnitude. While the receptor potential of the inner hair cells (IHCs) covers this entirely, postsynaptic spiral ganglion neurons (SGNs) alter firing only within limited subranges. Physiological SGN subtypes collectively cover the entire dynamic range, by heterogenous IHC active zones and molecularly distinct SGN profiles. How presynaptic heterogeneity is established remains incompletely understood. Spatial organization is also crucial at the IHC apex for mechanotransduction, where G-Protein signaling is required for correct stereocilia morphogenesis. Rgs12 has been identified as a regulator that polarizes the GPSM2-G $\alpha$ i complex to ensure normal hair bundle development. We studied whether Rgs12-dependent planar polarity mechanisms might also coordinate synaptic heterogeneity at the IHC base, investigating IHC synapses in Rgs12 knockout mice (Rgs12<sup>-/-</sup>) and testing whether its loss disrupts both morphological and functional gradients along the pillar-modiolar axis. We quantified ribbon synapses using immunohistochemistry and assessed Cav1.3 channel function using spinning disk confocal Ca<sup>2+</sup> imaging combined with whole-cell patch-clamp recordings. Rgs12<sup>-/-</sup> mice exhibited reduced ribbon immunofluorescence, while whole-cell Ca<sup>2+</sup> current amplitude was significantly increased, suggesting a decoupling of function from ribbon size. This was further reflected in gradients. The ribbon size gradient was inverted whereas gradients of maximal Ca<sup>2+</sup> influx and voltage dependence were preserved. Together, our findings identify Rgs12 as essential for establishing the correct ribbon size gradient. We suggest that Cav1.3 channel organization can be maintained independently, but further work will be required to determine how Rgs12 influences Cav1.3 cluster organization.

# AdaFDA: Source-Free Few-Trial Neural Adaptation via Multi-Scale Flow Matching

Ling Liu (1), Songming Zhang (2), Jian K. Liu (3)

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Presenting author: Ling Liu

Session: Wednesday

Brain-computer interfaces (BCIs) aim to directly bridge neural activity and behavioral output through neural decoding. A persistent challenge is that neural signals are inherently non-stationary, causing decoders trained on a single session to suffer significant performance loss across subsequent sessions and undermining long-term reliability. Existing adaptation methods often require access to source data or fail under few-trial calibration, limiting practical deployment. To address this, we propose AdaFDA (Adaptive Flow-Based Distribution Alignment), a source-free framework that achieves efficient and stable neural adaptation with minimal trials. Our approach introduces two key innovations: a multi-scale autoregressive flow that captures temporal dependencies across varying scales to enhance the stability of latent dynamics, and an adaptive memory bank that dynamically stores and retrieves domain-invariant representations, enabling robust alignment without any source data. Theoretical analysis using Lyapunov exponents guarantees the stability of the learned latent dynamics. Notably, AdaFDA not only operates in a source-free setting but also outperforms existing methods that rely on source data, achieving superior decoding accuracy across multiple motor cortex datasets with fewer than five calibration trials. Together, these contributions establish a new state-of-the-art in few-trial neural adaptation, offering a practical pathway toward reliable, long-term BCI usability.

## Short Excitatory Projections Promote Burst Activity and Modular Functional Organization in Neural Networks

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Presenting author: M. Sharif Hussainyar

Session: Thursday

Physical constraints in the brain favor short, distance-dependent connections. However, short-range projections are not merely a compromise imposed by these constraints; they also serve essential functional roles. Here, we explore networks with balanced excitation and inhibition, demonstrating that short excitatory projections fundamentally increase the number of common presynaptic inputs, thereby enhancing the correlations of neural responses. Strengthened recurrent correlations can lead to bursting states, amplifying postsynaptic neuronal activity and supporting signal propagation over long distances within the network. Moreover, even without an explicitly imposed modular structure, short excitatory connections can give rise to functional clustering and support a broad spectrum of modular functions. Therefore, this structural principle provides a mechanistic basis for functional column formation and dynamic burst propagation, suggesting that the brain transforms structural wiring constraints into opportunities for complex computation and distributed processing. These findings pave the way for a deeper understanding of how the brain transforms structural limitations into opportunities for complex computation.

# The Fly in the Machine: Drosophila Connectome Simulations on SpiNNaker-2 Neuromorphic Hardware

Martin Leandro Paleico (1), Maryam Raahemi (1)

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Presenting author: Martin Paleico

Session: Thursday

Understanding how structure gives rise to function in neural circuits remains a central challenge in neuroscience. In this project, we leverage mapping data of the Drosophila brain connectome[1] to explore how biologically realistic network topology can be brought into large-scale spiking simulations on dedicated SpiNNaker-2 neuromorphic hardware[2][3]. The SpiNNaker-2 architecture supports energy-efficient and scalable modeling of structures with up to millions of individual neurons and tens of thousands of synapses, helping to address some of the limitations of traditional computational approaches in theoretical neuroscience. The hardware can also be used for more general neuromorphic computing simulations, including various optimization algorithms, live signal processing, control loops, and more.

This poster will provide an introduction to the SpiNNaker-2 neuromorphic platform and neuromorphic computing in general, practical suggestions for transforming connectome information into on-hardware spiking neuron simulations considering the numerical and design limitations of dedicated hardware, and results obtained from preliminary simulations of the Drosophila connectome. We study the behavior of different parts of the fly central nervous system as a response to changes in the balance of excitatory–inhibitory neurons, the relative strength of inhibitory synapses, and the level of background noise modeled as random Poisson input, and the neuron model used. These simulations highlight the strong interaction between connectome structure and dynamical behavior. As such, we believe this poster would be of interest to attendees of the Neurizons conference.

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from:



# Microstructural Brain Integrity and Resting-State Functional Connectivity in Pediatric-Onset Multiple Sclerosis: A Cross-Sectional Multimodal MRI Study

Jonas Gadomska (1,2) Max R. Schulze (1) Peter Dechent (2,3) Jutta Gärtner (1,2) Kolja Meier (1,2)

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Presenting author: Max Richard Schulze

Session: Thursday

Pediatric-onset multiple sclerosis (POMS) is a chronic immune-mediated disease of the central nervous system, characterized by neuroinflammation and neurodegeneration. Brain alterations in POMS include structural changes, such as grey matter (GM) atrophy, altered diffusion properties in white matter (WM), as well as functional network alterations. These pathological processes may contribute to cognitive decline and disability progression. Despite advances in neuroimaging and its role in POMS diagnosis, a comprehensive multimodal understanding of the underlying brain pathology remains limited.

This cross-sectional study employed multimodal neuroimaging to investigate structural, microstructural, and functional brain alterations in 28 POMS patients compared to 30 healthy controls (HC). We performed volumetric, diffusion tensor imaging (DTI) and resting-state functional connectivity (FC) analyses using multimodal magnet resonance imaging (MRI) data.

POMS patients showed significantly reduced thalamus volumes compared to HC. Additionally, higher lesion volume was associated with greater thalamic atrophy in patients. No significant atrophy was observed in other brain regions. Analysis of the DTI parameters replicated prior reports, showing decreased fractional anisotropy (FA) and increased radial diffusivity (RD), mean diffusivity (MD), and axial diffusivity (AD) in patients relative to HC. Seed-to-voxel analysis revealed decreased FC within the Default Mode Network (DMN) in POMS, however, this effect did not remain significant after controlling for sex and age. No other significant group differences in FC were observed.

Overall, these findings replicate previous results and contribute to improving the understanding of early pathological changes in POMS, which may support advancements in early diagnosis and prognosis.

## Neuronal infection, restriction factors and neutralization of Herpes B Virus using recombinant reporter viruses

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Presenting author: Michael Winkler

Session: Thursday

Non-human primates like rhesus macaques are naturally infected with simplexviruses closely related to human herpes simplex viruses. While these viruses generally cause mild disease in their native hosts, zoonotic transmission of Macacine alphaherpesvirus 1 (McHV-1, Herpes B Virus) from rhesus macaques to humans can result in fatal encephalitis. Recent cases in China, Belgium and Japan underscore the clinical relevance, emphasizing the need for further investigation. We therefore aimed to establish a recombinant system for McHV-1 equipped with reporter genes to study the infection of cell lines, including neurons, and human brain organoids as well as restriction by antiviral factors or antibody-mediated neutralization.

Recombinant McHV-1, including variants expressing GFP or Gluc, was successfully rescued, demonstrating growth kinetics comparable to the parental virus. Cell lines of human, non-human primate and rodent origin supported McHV-1 replication. Human-derived SH-SY5Y neurons and human brain organoids exhibited susceptibility to infection, confirming the virus's neurotropic nature. HSV-1 restriction factor TMEFF1 did not restrict McHV-1 infection of 293T cells as well as infection by other primate simplexviruses. Sera from seropositive macaques efficiently neutralized McHV-1, and neutralization efficiency was higher than that measured for HSV-1 and related primate simplexviruses from baboons or African green monkeys.

The recombinant McHV-1 system represents a valuable tool for studying the virus's biology, neurovirulence, and host interactions, including comparative studies with related primate simplexviruses.

# Dopaminergic Modulation of Chemosensory-Driven Motor Behavior in Larval Zebrafish

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Presenting author: Mireia Salut Puig-Segui

Session: Wednesday

Dopaminergic neuromodulation is a key regulator of sensorimotor transformations and plays an important role in shaping behavioral responses to sensory stimuli. However, how dopamine specifically modulates chemosensory-driven behavior remains incompletely understood. In larval zebrafish, dopaminergic neurons are prominently located in the posterior tuberculum (PT), a major target of olfactory bulb (OB) projection neurons. These PT neurons project to reticulospinal and hindbrain circuits that are essential for locomotor control.

Here, we investigate the contribution of dopaminergic signaling to olfactory-driven motor behavior in 4 days post-fertilization zebrafish larvae. Using a head-embedded preparation, we expose larvae to well-established chemosensory stimuli of different valence, including appetitive and aversive odors, and quantify both spontaneous and stimulus-evoked motor activity via high-speed imaging of tail kinematics. To test the role of dopamine, we perform pharmacological manipulations targeting dopamine receptors and assess resulting changes in behavioral output.

This approach allows us to examine how dopaminergic modulation influences chemosensory processing and transforms sensory input into motor behavior. A key novelty of this work lies in combining a controlled valence-based chemosensory assay with the investigation of dopaminergic circuits linking olfactory input to descending motor pathways.

In future studies, we aim to extend this framework by targeting specific dopaminergic subpopulations and testing additional pharmacological manipulations to further dissect the circuit mechanisms underlying odor-guided behavior.

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## Long term potentiation-induced mechanical interactions at the synapse

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Presenting author: Mitha Thomas

Session: Thursday

Long-term potentiation (LTP) of synapses can occur in two phases: an early phase which constitutes a transient increase in synaptic strength, and a late phase which sustains this increase for a longer duration. According to the synaptic tagging and capture hypothesis, a necessary condition for the late phase is the formation of a transient memory of the stimulation event - the 'synaptic tag' - which persists for 1 to 3 hours and enables the synapse to capture newly synthesized proteins. What implements the tag remains elusive. Using computational modelling, we test and support the hypothesis that it is implemented by actin dynamics in interaction with spine geometry.

Actin in spines exists in distinct pools - dynamic and stable - with different turnover rates. Upon LTP, there is a rapid increase in dynamic actin, which increases the spine volume. However, this only lasts as long as the actin dynamics is modulated. When we introduce the stable pool, it exhibits an overshoot that persists on the timescale of hours, consistent with the lifetime of the synaptic tag. This translates into a sustained increase in spine volume. In this tagged state, we also observe long-lasting changes in the membrane curvature around the postsynaptic density (PSD), permitting its growth through protein capture and hence the expression of late-phase LTP. This state can be further modulated by mechanical interactions with components such as the presynaptic terminal and the extracellular matrix, potentially extending the longevity of changes and contributing to long-term synaptic stability.

# Developmental Characterization of Cardiac Sympathetic Influence in Larval Zebrafish (*Danio rerio*)

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Presenting author: Muhammad Reza Hamid

Session: Thursday

The heart-brain axis is essential for regulating physiological, cognitive, and emotional homeostasis. Disruptions of this axis have been implicated in a wide range of disorders, and due to the tight coupling between the neural and cardiovascular systems, dysfunctions in one system have been observed to lead to pathology in the other. Despite its importance, the fundamental physiological mechanism underlying the heart-brain axis, particularly the developmental timeline of sympathetic control of the heart, remains incompletely understood. Here, we combined functional and pharmacological approaches to refine the developmental timeline of sympathetic efferent control of the zebrafish heart. We found that  $\beta$ -adrenergic signaling, a key mediator of sympathetic regulation of heart rate, is functionally active by 3 days post-fertilization (dpf). Additionally, we found that dependency of heart rate on this signaling increased between 3 and 4 dpf, and that stimulus-evoked increase in heart rate emerges at 4 dpf. These findings suggest that while  $\beta$ -adrenergic responsiveness is present earlier, functionally evoked sympathetic influence on the heart emerges at 4 dpf. Together, this study provides a more refined temporal framework for investigating the development of heart-brain circuitry in vivo.

# Out-of-field activity is associated with reduced representational drift in hippocampal place cells

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Presenting author: Namra Aamir

Session: Wednesday

In the hippocampus, spatially tuned place cells underlie the animal's use of a cognitive map of the environment. These neurons exhibit elevated firing within localised regions known as place fields. Outside these preferred regions, neurons exhibit low-level activity, termed out-of-field firing, that is usually considered background noise. These spatial representations are not static and undergo representational drift [1]. The extent to which firing activity within and outside a place field shapes this drift is unclear, especially in neurodegenerative conditions such as Alzheimer's disease (AD), a disorder associated with spatial navigation deficits.

To address this question, we monitored place cell activity in a murine AD model and a control group of wild-type mice, using longitudinal two-photon calcium imaging in CA1 as animals traversed a linear virtual path. We tracked the activity of place cells over weeks and used a multi-level approach to quantify their drift. Our results show elevated drift in AD mice, particularly at early ages. To understand how the firing activity relates to stability of these dynamics, we compared the contributions of in-field and out-of-field firing. Stability in drift parameters shows little dependence on the in-field activity. Surprisingly, higher out-of-field activity is associated with greater stability of drift parameters, an effect comparable in both mouse genotypes.

These findings suggest that out-of-field activity may play a substantial role in shaping the representational drift. Ongoing work aims to develop a computational framework to quantify the spatial information content of out-of-field activity and to test whether this contribution is altered in AD.

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# Investigating possible interactions between basal ganglia loops and cerebellar network in the 6-OHDA rat model of idiopathic Parkinson's syndrome

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Presenting author: Nesrine Melliti

Session: Thursday

Levodopa-induced dyskinesia (LID) is a major complication in the treatment of Parkinson's disease (PD), yet its underlying mechanisms remain poorly understood. While basal ganglia dysfunction is central to LID, recent evidence suggests that the cerebellum plays a critical modulatory role. My project investigates how abnormal oscillatory activity emerges through cerebellar–basal ganglia interactions and contributes to the severity of LID. Using the 6-OHDA rat model combined with chronic L-DOPA treatment, I record electrophysiological activity across cerebellar (deep cerebellar nuclei), basal ganglia and motor cortex M1 circuits. By analyzing oscillatory dynamics at baseline (PD state) and during L-DOPA treatment (LID state) this study aims to clarify whether pathological interactions between the cerebellum and basal ganglia drive parkinsonian and dyskinetic symptoms. Ultimately, this work seeks to identify new therapeutic targets for mitigating LID and improving treatment strategies in Parkinson's disease.

## Striatal and frontal signatures of social context and cost-benefit decision making in developmental stuttering

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Presenting author: Nicole Neef

Session: Thursday

Developmental stuttering is usually framed as a sensorimotor disorder, yet it manifests in communicative situations that engage motivational, self-referential, and regulatory processes. In this case-control study, we combined a socio-economic decision task outside the scanner with a socially modulated speech task during fMRI to test how listener presence and self-referential speech shape neural activity in 34 adults who stutter and 32 controls. Both groups valued talking with another person about themselves more than talking with another person about someone else or talking to themselves. On the neural level, listener-directed (vs. private) speech and self-disclosure (vs. guessing the preferences of a famous other) elicited stronger responses in the ventral striatum and medial prefrontal cortex, extending social valuation effects previously reported in fluent speakers to adults who stutter. Within the stuttering group, individual differences revealed a systematic reweighting of socially modulated activation as a function of symptom burden: higher anticipation of stuttering and greater overall impact were associated with stronger engagement of motivational circuitry, greater recruitment of frontal evaluative-control regions, and reduced contextual differentiation within speech-language cortex. Stuttering anticipation and lived experience gradually shift the balance between control, language, and motivational salience-processing systems, contributing to the disorder's marked heterogeneity and context sensitivity. These findings indicate system-level signatures of the interaction between social context and symptom severity, rather than isolated motor deficits, in developmental stuttering. More generally, they reveal how recurrent experiences shape brain activity through the interplay between language, motivational and control systems that governs human social interactions.

# Towards AI-Assisted Surgical Targeting: Automated Epileptogenic Zone Prediction from Multimodal SEEG Biomarkers

Petr Nejedly, Martin Pail, Valentina Hrtonova, Pavel Daniel, Barbora Matouskova, Irena Dolezalova, Pavel Jurak, Petr Klimes, Milan Brazdil

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Presenting author: Petr Nejedly

Session: Thursday

**Introduction:** Accurate EZ localization is critical for surgical planning in drug-resistant epilepsy, yet SEEG interpretation remains time-consuming, expertise-dependent, and subject to inter-rater variability. Current clinical practice relies heavily on ictal recordings and visual analysis, leaving interictal data underutilized. We present a second-generation AI-driven decision-support framework, building on a pilot study (Nejedly et al., 2025), that integrates multiple interictal biomarkers, anatomical localization, and whole-network connectivity to generate per-contact EZ probability scores.

**Methods:** For each contact, we extracted interictal features — spectral band power, epileptiform discharge rates, and phase–amplitude coupling — combined with MNI coordinates, implantation geometry, and functional connectivity measures. By evaluating each contact within the context of the broader epileptic network simultaneously, the framework produces a clinically interpretable ranked probability output, designed to complement rather than replace clinical judgment.

**Results:** Retrospectively evaluated on 30-minute resting-state recordings from 90 SEEG patients (38 Engel I, 52 Engel II–IV) who underwent resection or thermocoagulation, the framework achieved AUPRC/AUROC of 0.74/0.92 in seizure-free patients and 0.21/0.79 in those with unfavorable outcomes, outperforming state-of-the-art methods and single-biomarker approaches. In patients with unfavorable outcomes, highly ranked contacts were located approximately 20 mm outside the resection zone, suggesting possible incomplete targeting. A prospective observational study is currently underway to validate these findings clinically.

**Conclusions:** By integrating electrophysiological, anatomical, and connectivity features into a unified network-aware model, this framework has strong potential to augment pre-surgical hypothesis generation, improve surgical targeting, and ultimately expand the pool of patients who may benefit from epilepsy surgery.

## References

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# Role of unpaired2–dome signalling in feeding and courtship behaviour in *Drosophila melanogaster*

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Presenting author: Richard Jensch

Session: Wednesday

## Introduction:

Animals must dynamically balance competing behavioural demands such as feeding and reproduction to maximize evolutionary fitness. In *Drosophila melanogaster*, the primary satiety signal is the leptin-homolog cytokine unpaired 2 (upd2) that is produced in the fat body. Following nutrient intake, upd2 is secreted from the fat body and activates the domeless (dome) receptor in neurosecretory regions of the brain, promoting the release of *Drosophila* insulin-like proteins (Dilps). Here, we investigate how the upd2-dome signalling pathway modulates the behavioural trade-off between feeding and mating drive.

## Methods:

Development, feeding and courtship behaviour were assessed across different conditions, including knockout and knockdown of upd2 and dome, as well as during optogenetic activation of the upd2-dome pathway, in fed and starved animals. Feeding drive and meal structure were assessed using the FlyPad® capacitance-measurement system. Courtship essays were conducted in chambers with both sexual partners and food present. Behavioural analysis was performed using AI-based pose estimation and behavioural segmentation.

## Results:

Developmental defects were observed only in upd2 knockout mutants. In the presence of food starved females exhibited shorter copulation latency, while copulation rate remained unchanged. Whereas starved control males showed no reduced courtship effort, Upd2-deficient males did. RNAi-mediated disruption of the upd2-dome-pathway increased food intake for both sexes, while upd2 mutation in males did not. Optogenetic activation of domeless-expressing neurons decreased food exploration and increased male courtship.

## Conclusion:

Our results indicate that upd2–dome signalling modulates satiety and feeding motivation,

while the coordination between feeding and reproductive behaviours likely involves additional regulatory pathways.



# Investigating the molecular effects of hypoxia on alpha-synuclein biology and pathobiology

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Presenting author: Richard Scheytt

Session: Wednesday

Parkinson's disease (PD) is a neurodegenerative disorder characterized by the loss of dopaminergic neurons in the substantia, leading to motor symptoms like bradykinesia, rigidity, and resting tremor. A central pathological hallmark of PD is the misfolding and aggregation of the protein  $\alpha$ -synuclein (aSyn), which plays a pivotal role in PD pathogenesis. aSyn, exists in equilibrium between soluble monomeric forms and membrane-bound states, and its propensity to aggregate into toxic oligomers and fibrils is influenced by a complex interplay of genetic predispositions, environmental exposures, and posttranslational modifications (PTMs). PTMs, have been shown to significantly alter aSyn's conformation, stability, aggregation kinetics, and cellular toxicity.

Aerobic exercise, has gained attention for its disease modification effects in PD. Studies have demonstrated that regular aerobic physical activity can enhance motor function, cognitive function, and quality of life in PD patients. However, the precise molecular mechanisms involved are unclear.

This study investigates the impact of hypoxia, a condition mimicking the metabolic stress associated with physical exercise, on the molecular behavior of aSyn in a cellular model. Using HEK 293 cells overexpressing aSyn fused to enhanced green fluorescent protein, we are examining how hypoxic conditions alter the PTM profile of aSyn. Western blot analyses are being employed to quantify changes in phosphorylation and other relevant PTMs, and fluorescence microscopy is being used for assessing aSyn aggregation dynamics and subcellular localization. We hypothesize that hypoxia-induced cellular stress modulates the PTM-landscape of aSyn. Furthermore, we aim to explore whether these molecular changes mirror those observed in response to exercise.

# Modelling Temporal Contrast Adaptation in Retinal Ganglion Cells

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Presenting author: Robert Mihai Haret

Session: Wednesday

Early visual pathway neurons modulate their activity based on their input's mean and variance. In the retina, contrast adaptation (sensitivity changes as a function of stimulus variance) is prevalent in retinal ganglion cells (RGCs). Upon a change in stimulus contrast, RGCs change their baseline activity, modify their temporal filtering properties and adjust their gain and sensitivity(1).

We characterize contrast adaptation in the context of stimuli with discrete and continuous distributions in contrast. Subsequently, we explore computational models fitted to experimental data which are able to capture contrast dependent changes in RGCs.

Using in vitro extracellular multi-electrode array recordings of mouse RGCs, we analyze spiking responses to spatially homogeneous white-noise stimuli of continuously varying contrast regimes, to investigate the continuity of adaptation across contrast levels. Firstly, we employ the linear-nonlinear (LN)(2) model to describe changes characterized by contrast adaptation. Extending upon the LN model, we fit the nonlinear-input model (NIM)(3) which consists of multiple linear filters and nonlinear processing stages.

We find that, reflecting temporal kinetics adaptation, linear filters change continuously with contrast (the extent varies between cell types). Accounting for changing gain and thresholding, so do the nonlinearities. Similarly, different spiking rate predictions reflect changes in the average baseline activity as a function of contrast. The NIM fitted across all contrast regimes predicts responses to novel stimuli better than separate LN model fits per contrast level. We observe that the NIM trained on different stimuli generalizes in order to capture and reproduce the contrast dependent changes from experimental data.

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# Comparing EEG-Based Epilepsy Diagnosis Using Neural Networks and Wavelet Transform

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Presenting author: Saina Golnejad Parluki

Session: Thursday

Epilepsy is a common neurological disorder characterized by the recurrence of seizures, which can significantly impact the lives of patients. Electroencephalography (EEG) can provide important physiological information on human brain activity which can be useful to diagnose epilepsy. However, manual analysis and visual inspection of many EEG signals can be time-consuming and may lead to contradictory diagnoses by doctors. EEG signals play an important role in the diagnosis of epilepsy, as the quantification of cerebral signal anomalies may indicate the condition and the pathology of the cerebral signal. In this study, we attempted to develop a two-step process for the automated diagnosis of epilepsy using EEG signals. In the first step, we applied a low-pass filter and designed three intermediate filters for different frequency bands, employing multi-layer neural networks. In the second step, we used a wavelet transform method to process the data. The characteristics of the local brain are the distribution of epileptic EEG activity in the wavelet model across the whole brain surface. We also evaluated the use of two different classifiers, an artificial neural network (ANN) and a support vector machine (SVM), for the diagnosis of epilepsy. The results of this paper show high accuracy rates for both the artificial neural network (92.38%) and the support vector machine (95.5%) classifiers. Moreover, the study highlighted the effectiveness of utilizing a multilayer neural network for improved precision.

## Pallium-encoded valence-specific chemosensory amplification of eye-body coordination in larval zebrafish

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Presenting author: Samuel K. H. Sy

Session: Thursday

Coordinated eye-body movements are essential for adaptive behavior, yet little is known about how multisensory input, particularly chemosensory cues, shapes this coordination. Using our enhanced Fish-On-Chips optofluidic platform, we uncovered complex dynamics in how larval zebrafish coordinate saccadic eye movements with tail flips. Under baseline conditions, spontaneous tail flips dynamically align with saccades in frequency and direction for coordinated turns. Chemosensory valence further modulates this coordination: death-associated cues intensify both the strength and frequency of coupled saccade-tail flips during turns, whereas food-related cues promote forward gliding without altering saccade coupling. Concurrent brain-wide neuronal imaging reveals that the zebrafish pallium represents the transformation of aversive valence into enhanced saccade-tail coordination, with stronger coupling associated with higher pallium activation. These findings uncover the neural basis by which chemosensory inputs of different valences distinctly regulate eye-body coordination to drive adaptive locomotion in a developing vertebrate, offering insights into principles of sensory-motor integration.

# Biosafety and function of brain-wide optogenetic manipulation in a non-human primate

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Presenting author: Simone Capitain

Session: Thursday

Optogenetic brain-computer interfaces (oBCI) bridge damaged or missing nerves by direct stimulation into the central nervous system. For this, channelrhodopsins need to be expressed throughout the brain. One solution is the systemic injection of adeno-associated viral vectors (AAV), which can cross the blood-brain barrier to induce channelrhodopsins into neuronal cells. Since systemic injections distribute themselves throughout the whole body, they bear the risk of being excreted through different bodily fluids as well as inducing a pronounced immune response.

We used CAP.B10, an AAV9 variant reported to cross the blood-brain barrier in marmoset [1]. It carries genetically encoded calcium-indicator GCaMP6 as well as the channelrhodopsin ChReef [2].

We used common marmoset monkeys from which samples of blood, saliva, urine and faeces were collected over 10 weeks. These samples were analysed by two different PCR methods, as well as a blood serum-based neutralising antibodies assay. While fiberphotometry was used to test the functionality of stimulating and reading out neurons, with a focus on the visual cortex.

The PCRs showed an increase in shedding two days after the injection, declining over the next weeks but never fully vanishing. During the same time, neutralising antibodies against the viral vector increased, indicating an intensifying immune response against the AAVs.

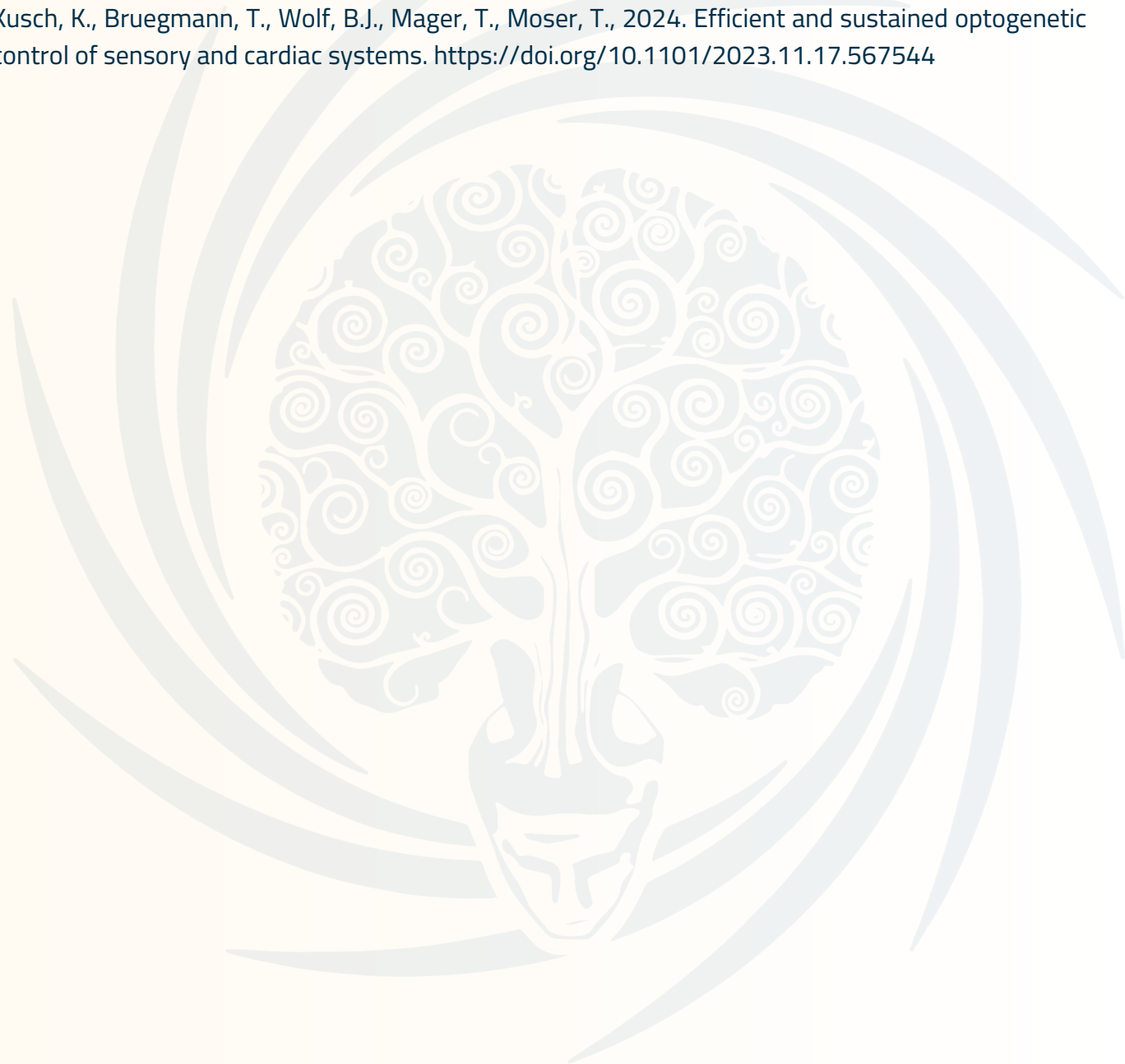
Using fiberphotometry, we did not find evidence of successful transduction in the visual cortex. Further immunohistochemical analysis will provide more insight into why no functional response could be observed.

We will continue improving our experimental setup to bring us closer to the goal of oBCI.

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# HYPOTHALAMIC LEPTIN-RECEPTOR NEURONS ENCODE SOCIOSEXUAL BEHAVIORS IN A SEX- AND CYCLE-SPECIFIC MANNER

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Presenting author: Tristan Franke

Session: Wednesday

The lateral hypothalamus is a critical brain region for aligning behavioral output with internal state. The adipose tissue-derived hormone leptin is an important internal signal that reflects the level of energy stores and strongly biases feeding behavior and energy expenditure. In the LH, leptin-receptor (LepR) expressing neurons facilitate feeding and exploration under anxiogenic conditions, while limiting feeding and promoting sex-specific social interactions under non-anxiogenic conditions. The underlying neuronal computations that enable LepRLH neurons to balance nutritional and social needs are poorly understood. Here, we investigated how LepRLH neurons encode behavior during natural social interactions and how this encoding is shaped by sex and reproductive state. We used single-cell calcium imaging to measure the response of LepRLH neurons in freely behaving mice of both sexes and both main cycle stages. Based on a generalized linear model and random forest regression of single cell activity, we show that LepRLH neurons display sex- and cycle-specific adaptations in their response to key sociosexual behaviors. In male animals, fewer neurons exhibit alignment to behavior in comparison to their female counterparts, as well as stronger behavioral selectivity. In female animals, the landscape of behavior-aligned responses shifts between cycle stages in a fashion that shows adaptation to the reproductive context of the animal. Together, we demonstrate that activity levels of leptin-sensitive hypothalamic populations during free social behavior is dynamically tuned by sex and reproductive state, providing a functional framework for understanding how internal signals shape hypothalamic behavioral control in a highly contextualized manner.

# Transposable Element-Mediated Epigenomic Remodeling Drives Erythropoietin-Induced Neurogenesis in the Adult Hippocampus

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Presenting author: Umut Cakir

Session: Thursday

Erythropoietin (EPO) is a hypoxia-responsive neurotrophic factor induced by hypoxia-inducible factor-1 $\alpha$  (HIF1A), a master regulator of cellular adaptation to hypoxia[1]. EPO has emerged as a next-generation neurotherapeutic with consistent beneficial effects on mood, memory, and cognition in experimental models and clinical settings[2–5]. Nevertheless, the epigenomic mechanisms by which EPO remodels adult neuronal circuits remain insufficiently understood.

We combined snATAC-seq with snRNA-seq to investigate the molecular impact of recombinant human EPO on the adult mouse hippocampus[6]. Using snATAC-seq, we demonstrated accessible chromatin at the Epo locus in the adult hippocampus, providing direct evidence of active EPO engagement. We identified pronounced, lineage-specific chromatin remodeling predominantly in newly formed pyramidal neurons. These epigenomic changes were coupled to transcriptional programs governing neuronal differentiation, synaptic maturation, and plasticity. In our previous work, we showed that EPO rescues neuronal loss[7–9]; the current findings offer mechanistic insight into how EPO supports circuit repair.

Notably, transposable elements (TEs), particularly evolutionarily conserved LINEs and SINEs, emerged as a major class of EPO-responsive cis-regulatory elements. These TE-derived regions exhibited increased chromatin accessibility and were preferentially bound by neurogenic TFs, including NEUROD1/2, FOXG1, and ASCL1, thereby coordinating gene regulatory networks essential for neuronal integration and synaptic remodeling. Our study identifies TEs as critical epigenomic mediators of HIF1A-EPO signaling and reveals a regulatory mechanism through which EPO promotes neuronal plasticity. These findings provide a molecular framework for EPO's neuroprotective and procognitive effects and support its therapeutic potential in neurological and neuropsychiatric disorders characterized by impaired neurogenesis and synaptic dysfunction.

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# Safety cues modulate feeding behavior during activation of GABAergic neurons of the Lateral Hypothalamus

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Presenting author: Xareny Diaz Zarate

Session: Wednesday

The lateral hypothalamus (LHA) is key in consummatory eating behavior and integrates a variety of signals to guide and drive behavior, including stress signals. Particularly, GABAergic neurons promote approach and consumption of food and gnawing. Though LHA guides food intake by integrating different signals, the influence of stress on feeding behavior guided by its GABAergic neurons is yet to be described. The present study evaluates the effect of stress in consumption of solid food regulated by LHA GABAergic activity of mice with different metabolic states during consumption with two different palatability levels. Using chemogenetic activation of GABAergic neurons we analyzed feeding behavior during Ad-Libitum consumption of pellets, where we used the Cruchometer, a monitoring feeding system that automatically detects bites combining information from audio and video recordings. After video segmentation and classification we analyzed the microstructure of solid food consumption during the 2 hour period of ad libitum access to both HFD and Chow pellets comparing between bedding and no bedding elevated cage. We found that the presence of bedding acts as a safety cue during chemogenetic activation, reducing the spillage of food generated while the amount of food consumed remains constant. We also observed that activation of GABAergic neurons of LHA induces gnawing. The findings propose that stress increases consummatory responses of feeding behavior induced by LHA GABAergic neurons, while a safety cue can decrease gnawing behavior while maintaining consumption. Suggesting that GABAergic neurons of the LHA integrate signals such as stress to modulate feeding and consummatory responses.

## Functional and Structural Alterations in the Mammillary Bodies in a Mouse Model of Alzheimer's Disease

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Presenting author: Xiaoyu Yang

Session: Thursday

Dysfunction of the mammillary bodies (MB), a key hypothalamic relay within the hippocampal–diencephalic memory circuit, disrupts spatial and episodic memory. The MB are among the earliest brain structures affected by Alzheimer's disease (AD) pathology, yet their subregional organization, functional contributions to memory, and selective vulnerability during disease progression remain poorly understood.

We combine behavioral, anatomical, molecular, and electrophysiological approaches to define subregion-specific roles of the MB in memory processing and AD-related degeneration using the 5xFAD mouse model. Contextual fear conditioning reveals that neuronal activity in the medial mammillary body (MMB) robustly correlates with fear memory retrieval performance. Molecular profiling identifies two distinct MMB subregions defined by complementary marker expression: a parvalbumin-positive pars dorsalis (MMd) and a dopamine D2 receptor-positive pars basalis (MMpb).

Quantitative histological analyses demonstrate significant differences in neuronal cell density across MB subregions that are preserved across genotypes, while revealing striking subregion-specific vulnerability to amyloidosis. In both young and aged 5xFAD mice, amyloid pathology preferentially accumulates in the MMd, whereas the MMpb is comparatively spared. Anatomical tracing shows that dorsal and ventral MMB receive hippocampal input, with dense projections from the dorsal subiculum to dorsal MMB and from the ventral subiculum to ventral MMB. Notably, the ventral subiculum–ventral MMB pathway exhibits reduced amyloidosis. Finally, analyses of intrinsic electrophysiological properties further support functional specialization across MB subregions.

Together, these findings reveal molecularly and functionally distinct mammillary body subregions with differential susceptibility to AD pathology, providing mechanistic insight into how selective degeneration of diencephalic memory circuits dysfunction.

# A Standardized and Scalable In-Cage Platform for Cognitive Training of Non-Human Primates

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Presenting author: YANG HU

Session: Wednesday

Training non-human primates (NHPs) to perform complex cognitive behavioral tasks remains a major challenge in cognitive neuroscience, as reliable and comparable results depend on animals mastering task rules and sustaining stable performance over extended periods. Automated in-cage training offers a promising solution by reducing manual intervention while enabling voluntary, low-restraint, self-paced task engagement. However, many existing home-cage systems are tightly coupled to specific cage structures, hardware configurations, and experimental workflows, making them difficult to replicate, standardize, and scale across laboratories. Here, we present two versatile in-cage behavioral platforms, cagelab for rhesus macaques and mxbi for common marmosets, developed to address these limitations and promote reproducibility, scalability, and broader cross-laboratory adoption. We have deployed more than 20 systems and established an integrated hardware-software ecosystem to support large-scale operation. On the software side, cogmote and cogmoteGO provide middleware for multi-device coordination, experimental command distribution, real-time bidirectional communication, status monitoring, and synchronization across components. cogmatrix serves as a centralized database for large volumes of automatically generated behavioral data and supports integration with Alyx, a metadata management system widely used by the International Brain Laboratory (IBL). For the mxbi platform, pymxbi and mxbiflow further streamline device control, workflow automation, deployment, and maintenance. Building on this infrastructure, our long-term objective is to establish a scalable and stable marmoset auditory cognitive testing model for long-term in-cage experiments and comparative evaluation of optical and conventional electrical cochlear implants in hearing restoration, sound encoding, and complex auditory behavioral paradigms.

# Can Targeted Memory Reactivation Improve Pattern Separation? – A novel at-home paradigm

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(1) Universitätsklinikum Schleswig-Holstein Kiel, Klinik für Neurologie

Presenting author: Yasmin Fiedler

Session: Wednesday

Neurodegenerative processes disrupt the neural dynamics underlying hippocampal replay, thereby impairing pattern separation (PS) known as mechanisms essential for distinguishing overlapping memory representations. As a validated behavioral proxy for successful engram consolidation and hippocampal replay, the Mnemonic Similarity Task (1) is employed to quantify mnemonic discrimination performance by targeted memory reactivation (TMR) over the course of a week.

This study investigates whether repeated TMR can modulate PS as a downstream behavioral correlate of hippocampal ensemble reactivation across an extended intervention window. Participants undergo seven consecutive nights of at-home polysomnographic monitoring via a fully automated, mobile EEG platform enabling real-time sleep staging and open-loop acoustic stimulation during N2 and N3 sleep. Following initial encoding of semantically categorized object stimuli, recall phases before and after the first TMR night establish baseline PS performance. Four subsequent TMR nights provide sustained reinforcement of category-specific neuronal ensemble reactivation. A final recall phase quantifies training efficacy, with maximal divergence expected between reactivated and non-reactivated stimulus categories.

This paradigm extends the conceptualization of TMR beyond acute consolidation enhancement toward longitudinal modulation of hippocampal replay and mnemonic discrimination. Clinically, iterative TMR may constitute a scalable, non-pharmacological intervention supporting residual replay capacity despite progressive hippocampal neuronal loss in early-stage dementia.

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