SALZBURG MIND BRAIN ANNUAL MEETING 2024

The Centre for Cognitive Neuroscience (CCNS) at the University of Salzburg
presents

the 6th Salzburg Mind – Brain Annual Meeting
SAMBA 2024

Local organizing committee

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PROGRAM

SALZBURG MIND BRAIN ANNUAL MEETING 2024

Time	July 11	Time	July 12
08:15	Registration & Coffee		
08:40	Opening Remarks		
09:00	Talk 1: Josef Rauschecker Learning and plasticity in the auditory system	09:00	Talk 6: Benjamin Morillon Neural dynamics and computations constraining music and speech processing
10:00	Coffee	10:00	Coffee
10:30	Talk 2: Surjo Soekadar Neuromagnetic brain-computer interfaces for restoration of motor function and beyond	10:30	Talk 7: Roberto Bottini Structuring knowledge across reference frames
11:30	Short Break	11:30	Short Break
11:45	Talk 3: Yulia Oganian The cognitive neurophysiology of speech comprehension	11:45	Talk 8: Clare Press The interdependence of statistical learning and perception
12:45	Lunch Break	12:45	Lunch Break
14:15	Talk 4: Valentin Riedl The energetic costs of the human brain	14:15	Talk 9: Natalie Sebanz Self and other in joint action
15:15	Coffee & Posters	15:15	Coffee & Posters
17:15	Talk 5: Kerstin Konrad Interpersonal synchrony: Neurobiological mechanism, methodological considerations and potential pathways towards mental health interventions	17:15	Talk 10: Beatrice de Gelder The body from inside out
		18:15	Closing Remarks
		19:00	Social Event

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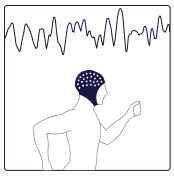
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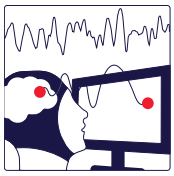
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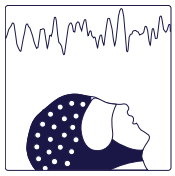
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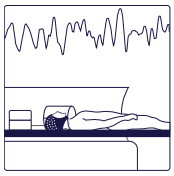
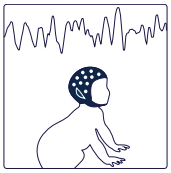
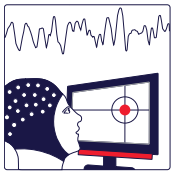
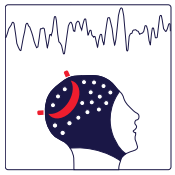

EEG & fMRI


Developmental EEG


EEG &
Eye Tracking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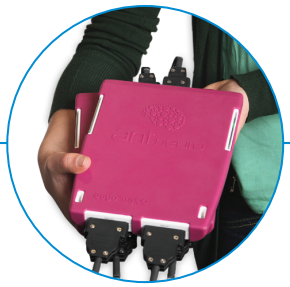

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1.Zhigalov, A., et al. (2019). NeuroImage, 195.
2.Minarik, T., et al., (2023). NeuroImage, 281.
3.Seijdel, N., et al. (2023). Cerebral Cortex, 33(5).
4.Zhigalov, A., & Jensen, O. (2020). Human Brain Mapping, 41(18).
5.Brickwedde, M., et al. (2022). Journal of Neuroscience Methods, 382.
6.Pan, Y., et al. (2021). Nature Communications, 12(1).
7.Drijvers, L., et al. (2021). Human Brain Mapping, 42(4).
8.Ferrante, O., et al. (2023). Journal of Neuroscience, 43(12).

TALKS

Talk 1:

Learning and Plasticity in the Auditory System

Josef Rauschecker

Center for Neuroengineering, Georgetown University and TU Munich

Like all mammalian sensory systems, the auditory system depends on learning and plasticity well into adulthood. This is especially evident for higher cognitive functions like language and music. While my laboratory at Georgetown University does work on the evolution of communication, in both humans and nonhuman primates, today's talk will focus a clinical topic, tinnitus. Bringing my engineering background to the question of "what is tinnitus", I will tackle the problem as one of a broken noise cancellation system, characterized as auditory-limbic dysregulation" in a fronto-striatal gating system.

I will present an overview of the changes in brain structure and function of tinnitus patients based on neuroimaging results from our lab. Auditory and limbic brain regions, as well as cortico-limbic connections are relevant for the chronic perception of the tinnitus signal. In contrast, changes in the insula, cingulate cortex, frontal cortex and the precuneus can be seen in relation to the perceived tinnitus distress. Future research should aim at providing further evidence to understanding the underlying pathophysiology of chronic tinnitus and thereby identifying suitable target regions for neuromodulatory approaches.

Talk 2:

Neuromagnetic brain-computer interfaces for restoration of motor function and beyond

Surjo Soekadar

Charité - Universitätsmedizin Berlin

Brain-computer interfaces (BCIs) translate electric, magnetic or metabolic brain activity into control signals of external devices, robots or machines. Besides allowing for assistive applications, including communication or restoration of movement in severe paralysis, it was shown that repeated use of BCIs can trigger neurological recovery. Over the last years, BCI-controlled exoskeletons were developed that use electroencephalography (EEG) that are now ready for broad clinical application in neurorehabilitation of stroke and spinal cord injury. However, such EEG-based BCIs have several critical limitations, including low spatial resolution and low signal-to-noise at high frequency bands. In contrast, neuromagnetic BCIs based on magnetoencephalography (MEG) can provide much higher spatial resolution and signal-to-noise. In my talk, I will provide an overview of the current state-of-the-art in neuromagnetic BCIs and explain how magnetometry using novel sensors, such as optically-pumped magnetometers (OPMs) or nitrogen-vacancy (NV) centers in diamond, can advance the field. Special emphasis will be placed on the scientific and clinical perspective to establish bidirectional neuromagnetic BCIs that also integrate magnetic stimulation.

Talk 3:

The cognitive neurophysiology of speech comprehension

Yulia Oganian

Center for Integrative Neuroscience, University Tübingen

Understanding Speech is central to human communication and the most important input for our auditory system. As speech unfolds rapidly in time, a critical prerequisite for speech comprehension is the ability to identify informational units, such as syllables or words, within this continuous acoustic signal. It is well established that fluctuations in the overall speech amplitude are an acoustic correlate for the timing and salience of single syllables (/sam/-/ba/). Yet, both the information content of the speech amplitude envelope and its neural representation are highly debated. In my talk, I will present a series of studies on the neurocognitive role of the speech amplitude envelope.

First, using high-density intracranial recordings, I will show that neural populations in human speech cortex sparsely encode rising amplitude edges in the continuous envelope signal, and that these edges mark the timing and internal structure of syllables. Second, I will present results from magneto-encephalography recordings and computational modeling, that together reveal that cortical responses to the speech envelope reflect evoked responses to rising amplitude edges rather than oscillatory entrainment. Finally, I will then show how neural encoding of rising amplitude edges lays the basis for perception of syllabic stress and its relationship to reading development. Taken together, this line of work showcases the central role of rising amplitude edges - a sparse, landmark-based representation of the continous amplitude envelope of speech - in speech comprehension.

Talk 4:

The energetic costs of the human brain

Valentin Riedl

Friedrich-Alexander University Erlangen-Nuremberg

Across evolution, information processing in the brain has been rather tuned for energy than processing efficiency. Still, the majority of cortical energy is allocated towards information processing. We recently studied the energy demands along the brain connectome in humans and showed that slow chemical signaling is a major consumer in humans as compared to non-human primates.

Talk 5:

Interpersonal synchrony: Neurobiological mechanism, methodological considerations and potential pathways towards mental health interventions

Kerstin Konrad

RWTH Aachen, Jülich Research Centre

From the play of a baby and parent to coordinated dancing, singing together in a choir or the la-ola wave in stadiums, our social behaviors are tightly synchronized with those of other people. This talk will introduce the concept and theories of interpersonal synchrony, exploring how our actions, emotions, physiological and neural states align with those of others in various social contexts.

We will critically discuss the evidence for a causal role of interpersonal neural synchrony and delve into the potential neurobiological mechanisms underpinning these processes, examining the role of neural circuits, neurotransmitters involved, mirror neurons, and oscillatory brain activities. Methodological challenges which are crucial for capturing the dynamic and reciprocal nature of social interactions will be addressed. In the second part of the talk, we will explore the translation of interpersonal synchrony into mental health interventions. This includes its role in familiar transmission of psychopathology, resilience, stress contagion in groups, as well as direct therapeutic manipulations, such as hyper-neurofeedback. By understanding and leveraging the mechanisms of interpersonal synchrony, we will discuss its potential for innovative interventions to enhance social connectedness and address mental health issues. This talk aims to bridge basic research with practical applications, offering pathways towards improved mental health outcomes.

Talk 6:

Neural dynamics and computations constraining music and speech processing

Benjamin Morillon

Institut de Neurosciences des Systèmes, Aix Marseille Université, INSERM

I will depict the neural dynamics underlying music perception and speech comprehension, focusing on time scales and adaptive processes.

First, I will present an account of why humans spontaneously dance to music. I will present behavioral and neuroimaging evidence that motor dynamics reflect predictive timing during music listening. While auditory regions track the rhythm of melodies, intrinsic neural dynamics at delta (1.4 Hz) and beta (20-30 Hz) rates in the dorsal auditory pathways encode the wanting-to-move experience (groove). Critically, neural dynamics are organized along this pathway in a spectral gradient, with the left sensorimotor cortex coordinating groove-related delta and beta activity. Combined with predictions of a neurodynamic model, this suggests that spontaneous motor engagement during music listening is a manifestation of predictive timing effected by interaction of neural dynamics along the dorsal auditory pathway.

Second, to investigate speech comprehension, we developed a framework capitalizing on the concept of channel capacity. We behavioral examined the respective influence of seven acoustic and linguistic features on the comprehension of compressed speech. We show that comprehension is independently impacted by all these features, but at varying degrees and with a clear dominance of the syllabic rate. Complementing this framework, we integrate human intracranial recordings to study how neural dynamics in the auditory cortex adapt to different acoustic features, allowing for parallel sampling of speech at both syllabic and phonemic time scales.

These findings underscore the dynamic adaptation of neural processes to temporal characteristics in speech and music, enhancing our understanding of language and music perception.

Talk 7:

Structuring knowledge across reference frames

Roberto Bottini

Center for Mind/Brain Sciences (CIMeC), University of Trento

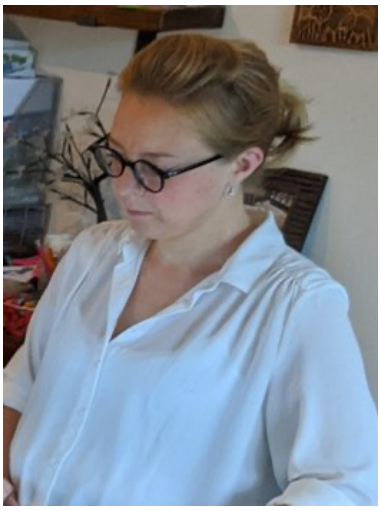
In humans, the hippocampal-entorhinal system represents both spatial and nonspatial knowledge in the form of allocentric cognitive maps that are crucial for flexible behavior and generalization. In this talk, I will argue that hippocampal maps are only one face of the coin, and that conceptual relationships are represented in the human brain across complementary allocentric and egocentric reference frames encoded in hippocampal and parietal regions. I will present fMRI data showing the interplay of allocentric and egocentric coding during conceptual navigation as well as eye-tracking and neuroimaging results suggesting that conceptual spaces are navigated via spatial attentional movements. These results contribute to our understanding of how humans organize and search for conceptual information in memory, and support the proposal that, in our species, the brain's navigation system can be repurposed to represent knowledge across different reference frames

Talk 8:

The interdependence of statistical learning and perception

Clare Press

University College London



Our sensory world contains statistical regularities and we use those regularities to shape what we perceive. In this talk, I will present psychophysical, modelling and neuroimaging (EEG and 7T MRI) work from the lab that considers how. The proposed mechanisms involve using predictions about what is likely to be there to render perception (1) accurate in the face of continuous streams of noisy information, and (2) optimised for future learning. How humans achieve optimisation on both fronts is a tricky puzzle to solve, and I will present the possibilities we are examining.

Talk 9:

Self and Other in Joint Action

Natalie Sebanz

Central European University, Department of Cognitive Science, Vienna

People relate to and interact with each other in many different ways. While some social interactions are characterized by a merging of self and other and a lack of self-other distinction, other interactions require us to keep mental states, feelings, and actions of self and other apart. In this talk, I will discuss what we can learn about representations of self and other by studying joint action, our ability to coordinate actions with others in space and time to achieve shared goals.

First, I will review evidence suggesting that in planning joint actions, we integrate others' actions in our planning much as if they were our own. This ability to engage in joint action planning develops early and may constitute a kind of default way of being together. I will also discuss consequences of acting in synchrony, including increases in pro-social behavior and changes in attitudes towards out-group members. Then, I will focus on moments in joint action where self and other need to be clearly distinguished and kept apart, such as turn-taking or keeping different rhythms. I will review the cognitive and neural mechanisms involved in keeping self and other apart and discuss why this is often challenging.

Talk 10:

The body from inside out

Beatrice de Gelder

Maastricht University

Traditionally face and body perception have been studied with the same approach that visual science has developed for object perception. Basically, one (or a few) category selective areas are localized that compute an entry level representation for the target category. These representations then serve for the purpose of calculating e.g. intention, action and expression. But so far it is unclear just what is computed in category selectivity and what serves as input to higher order computations.

We will discuss a different approach using data driven methods that jointly addresses category selectivity and expression perception. As a step towards this, we found clear evidence for species specificity in the brain representation of whole-body movements. The network of body-sensitive areas exhibits specificity for human bodies compared to monkey bodies (Li et al., 2022), and the same specificity is observed in EEG of humans in the gamma band (Chesley et al., 2024). Unpublished studies in monkeys suggest a similar bias, with human videos triggering lower activity in the monkey brain compared to monkey videos. We are currently developing this approach further by investigating biomechanical constraints and determining where in the visual system biomechanical constraints are coded. In this talk we will also explore the link between body perception and interoception

POSTER ABSTRACTS

1 Tinnitus is robustly characterized by aberrant auditory prediction patterns

Lisa Reisinger[1]
[1]University of Salzburg, Austria

Phantom perceptions occur without any identifiable environmental or bodily source. The mechanisms and key drivers behind phantom perceptions like tinnitus are not well understood. The dominant framework suggesting that tinnitus results from neural hyperactivity in the auditory pathway following hearing damage, has been difficult to investigate in humans and has reached explanatory limits. As a result, researchers have tried to explain perceptual and potential neural aberrations in tinnitus within a more parsimonious predictive-coding framework. In two independent magnetoencephalography (MEG) studies, participants passively listened to sequences of pure tones with varying levels of regularity (i.e. predictability) ranging from random or ordered. Next to being a replication of the first study, the pre-registered second study ensured rigorous matching of hearing status, as well as age, sex, and hearing loss between individuals with and without tinnitus. Despite some changes in the details of the paradigm, using multivariate pattern analysis approaches, both studies revealed an analogous group difference prior to target sound onset. Our results make a strong case that individuals with tinnitus engage differently anticipatory auditory predictions as compared to controls. While the effect is robust and generalizable, the precise neurocognitive mechanism underlying this group difference needs to be further elucidated. Furthermore, future longitudinal studies need to determine whether dysregulated predictive processes are a consequence of tinnitus or rather pose a risk factor for developing this condition.

2 Won't get fooled again: EEG does not reflect the manifestation of cognition, but action

Tzvetan Popov[1]
[1]University of Zurich, Switzerland

EEG components such event induced potentials and oscillations are consistently and continuously linked to cognitive constructs. Among these constructs, arguably the most fundamental are socio-affective perception and emotion. The N170, the late positive potential (LPP), and the power reduction of alpha oscillations are consistently and unequivocally interpreted as the 'neural underpinnings' of these hypothetical constructs to the extent that the N170 measure is now the first psychiatric biomarker for social impairment accepted in the FDA Biomarker Qualification Program.
Evidence from two experiments (N= 50 each) is presented demonstrating that this conclusion is premature. Neither component directly links to the studied phenomenon. The P1-N170 latency of approximately 100 ms is indicative of the well-established 100 ms saccade reaction time necessary for the vector code neural operation observed in the superior colliculus, visual parietal, and frontal cortex. Conversely, the LPP and the sustained reduction of alpha oscillation indicate the continuous ongoing exploration of the presented stimulus. These results have been consistently replicated, even in images generated by DALL-E, where participants reported 100% confidence in detecting the artificial nature of the images. In such cases, automatic, evolutionary preserved socio-affective cortical responses do not provide a plausible explanation.
Instead, the consistency of experimental design across labs worldwide, which typically includes a baseline fixation period preceding the actual stimulus presentation, provides a common ground for the conjecture that EEG components in psychophysiological experiments relate to cognition indirectly through their actual relationship with oculomotor action: a requirement in all cognitive experiments.

3 Effects of a novel combination training on reading and visual exploration in simulated hemianopia

Inara Makhkamova[1], Thomas Schenk[1]
[1]Ludwig-Maximilians-Universität in Munich, Germany

Homonymous hemianopia often results in significant impairments in reading and visual exploration. Patients typically do not utilize effective strategies to compensate for their functional deficits, rendering appropriate training or therapy necessary. While compensatory therapy approaches are supported by evidence and are most effective in treating hemianopia, it remains unclear whether such approaches facilitate a transfer between improvements in visual exploration and reading skills. The current study introduces a novel combination training and examines its effectiveness in enhancing both skills in healthy participants with simulated right-sided hemianopia. The training combined visual exploration and reading elements, while exploration training without a reading component served as the control condition. Additionally, the effect of training duration was assessed in both training groups by offering training on three consecutive days and testing reading and visual exploration abilities at the end of each day. Results indicate that both training types lead to improvements in reading and visual exploration. However, the combination training results in more significant improvements in reading skills, positively impacting both reading speed and accuracy. Additionally, it leads to further reading improvements after the second day of training. On the other hand, the exploration training does not improve reading accuracy, nor does it result in further reading improvements with longer training duration. Overall, combination training appears to be more effective than exploration training alone, warranting further evaluation in hemianopic patients.

4 Neural signatures of contingency awareness

Yuri Pavlov[1]
[1]University of Tübingen, Germany

The recognition of the conditioned-unconditioned stimulus (CS-US) association in human fear conditioning is referred to as contingency awareness. A common view is that such simple forms of associative learning are independent of awareness. We challenge this view in an experiment where only some participants learned the association between CS and US. In this preregistered study (https://osf.io/vywq7), the participants heard words paired with tactile stimulation followed by either a neutral sound (CS-) or unpleasant loud noise (CS+). The condition depended on the word+vibration side compound. The participants were only instructed to listen carefully. Based on structured interviews, the participants were divided into aware (N=50) and unaware (N=31) groups. Questionnaires were administered to explore potential predictors of contingency awareness. Only the aware group showed signs of learning as expressed in a larger CS+/CS- difference in stimulus preceding negativity developing shortly before the US. In terms of oscillatory brain activity, the aware group showed stronger alpha-beta suppression before and in response to the vibration. Moreover, the aware group scored higher on the intolerance to uncertainty scale and had a narrower distribution of trait anxiety. These findings support the notion that associative learning cannot occur without contingency awareness. We conclude that contingency awareness is indexed by generally amplified neural patterns reflecting expectation of an aversive event and informative cues, as well as violation and confirmation of the expectation.

5 Social expectation formation in the dog temporal lobe

Magdalena Boch[1], Christoph Völter[2], Rogier B. Mars[3], Ludwig Huber[2], Claus Lamm[1]

[1]University of Vienna, Austria, [2]University of Veterinary Medicine Vienna, Austria, [3]University of Oxford, United Kingdom

One reason for humans' advanced social interaction skills is their capacity to continuously make predictions about the state of mind of others. Predictions (or expectations) about one's social environment can be formed based on the perception of others' actions, knowledge, and beliefs. A key region for this complex social ability in humans is the temporoparietal junction, and recent evidence suggests that the evolutionary origin of this area was already present in their close primate ancestors. Like humans, dogs are also sensitive to others' actions or intentions, but the neural mechanisms supporting this complex social ability remain unstudied. To close this research gap, we used a series of functional MRI tasks with awake and unrestrained pet dogs (N = 22-28). Preliminary results indicate that observing social interactions recruits a complex occipital-temporal-parietal network in dogs similar to humans. The network includes face- and body-responsive brain areas and areas sensitive to dynamic aspects of social cues and action features in the dog suprasylvian and sylvian temporal cortex. Unlike observations in humans and non-human primates, the temporal lobe was predominant in supporting social cognition for dogs. Our findings further show how the dog's temporal lobe responds to observing social interactions that take unexpected turns (e.g., interruption by another event) and that they elicit a social prediction error analogous to observations in humans and non-human primates. We provide new insights into the neural mechanisms supporting dogs' complex social abilities and show whether social behaviours arise similarly in these species.

6 Dynamic alpha power modulations and slow negative potentials track spatio-temporal attention

Charline Peylo[1], Carola Romberg-Taylor[2], Larissa Behnke[1], Paul Sauseng[1]

[1]University of Zurich, Switzerland, [2]Ludwig-Maximilians-Universität in Munich, Germany

Alpha power modulations and slow negative potentials have previously been associated with anticipatory processes in spatial and temporal top-down attention. In typical experimental designs, however, neural responses triggered by transient stimulus onsets can interfere with attention-driven activity patterns and our interpretation of such. Here, we investigated these signatures of spatio-temporal attention in a dynamic paradigm free from potentially confounding stimulus-driven activity using electroencephalography. Participants attended the cued side of a bilateral stimulus rotation and mentally counted how often one of two remembered sample orientations (i.e., the target) was displayed while ignoring the uncued side and non-target orientation. Afterwards, participants performed a delayed match-to-sample task, in which they indicated if the orientation of a probe stimulus matched the corresponding sample orientation (previously target or non-target). We observed dynamic alpha power reductions and slow negative waves around task-relevant points in space and time (i.e., onset of the target orientation in the cued hemifield) over posterior electrodes contralateral to the locus of attention. In contrast to static alpha power lateralization, these dynamic signatures correlated with subsequent memory performance (primarily detriments for matching probes of the non-target orientation), suggesting a preferential allocation of attention to task-relevant locations and time points at the expense of reduced resources and impaired performance for information outside the current focus of attention. Our findings suggest that humans can naturally and dynamically focus their attention at relevant points in space and time and that such spatio-temporal attention shifts can be reflected by dynamic alpha power modulations and slow negative potentials.

7 Analysis of the EEG signal complexity in the antisaccade task for various age groups

Julia Klaudia Byrska[1,2]
[1]University of Warsaw, Poland, [2]University of Trento, Italy

The study was performed to examine and compare the complexity of electroencephalographic (EEG) data obtained from younger and older participants during the performance of an antisaccade task. The purpose of applying different complexity measures, such as multiscale entropy (MSE) and detrended fluctuation analysis (DFA), to the analysis of EEG signals was to indicate significant differences in signal complexity correlated with age. Specifically, it was proposed that the analysis should focus on the precise time interval and brain region during the antisaccade task to capture and explore the inhibitory control mechanism. This targeted approach revealed noticeable differences between the younger and older groups, suggesting that differences in the complexity of the EEG data may reflect changes in cognitive function associated with aging. Moreover, the detection of significant correlations between MSE and DFA highlighted their effectiveness in capturing complementary aspects of EEG signal complexity. These findings support the hypothesis that EEG complexity indices may act as biomarkers of aging-related changes in cognitive function.

8 Ultra-high frequency visual stimulation can induce hippocampal ripple oscillations

Julian Keil[1], Victor Hernandez-Urbina[2], Liam Doherty[2], Fabian Queisner[2], Markus Müschenich[2]

[1]University of Potsdam, Germany, [2]Ababax Health GmbH, Berlin, Germany

Flickering visual stimulation can evoke steady-state visual evoked potentials (SSVEPs), which can potentially influence ongoing brain activity. Recent experimental evidence indicates that Gamma-band (40 Hz) SSVEPs do not propagate beyond visual cortical areas. However, electrophysiological recordings of ripple oscillations (80-180 Hz) showed that ripple oscillations occur in the neocortex and the hippocampus, that they phase-synchronize across long distances, and that neocortical ripples often precede hippocampal ripples during wakefulness. Thus, it may be possible for ultra-high frequency neocortical oscillations to propagate beyond sensory areas and influence ongoing brain activity in subcortical areas. To test this hypothesis, we conducted one MEG experiment (N=10) and one ECoG experiment (N=4) in humans, using a recently developed ultra-high frequency visual stimulation paradigm to evoke neocortical ripple oscillations. While hippocampal sharp-wave ripples (SWRs) mostly occur during quiet rest periods or slow-wave-sleep, we aimed to increase their abundance during visual stimulation. In the MEG experiment, we used beamformer source analyses to create virtual hippocampal channels, in the ECoG experiment, we examined direct hippocampal recordings. In both experiments, we observed a higher number of SWRs during periods of stimulation compared to a resting state baseline. This indicates that ultra-high frequency visual stimulation can be used as a noninvasive tool to influence hippocampal oscillations.

9 The ‘Ocular Response Function’ for encoding and decoding oculomotor related neural activity

Juliane Schubert[1], Quirin Gehmacher[2], Aaron Kaltenmaier[2], Nathan Weisz[1], Clare Press[2]

[1]University of Salzburg, Austria, [2]University College London, University of London, United Kingdom

In recent years, oculomotor related signals in neuroimaging have evolved from a mere confound towards a variable of interest when investigating cognitive processes across various areas in neuroscience. From attention to memory, eye movements provide an easily accessible window into important aspects of human cognition. However, their role and contribution with regards to underlying neural processes is largely unknown due to anatomical and temporal overlap with concurrent stimulation. We thus aimed to develop a method to understand the role of eye movements in links between experimental variables and neural processes. Here, we use simultaneous human magnetoencephalographic (MEG) and eye tracking recordings in combination with temporal response functions during the resting state to establish transfer functions from oculomotion to neural codes. We use these source-projected ‘Ocular Response Functions (ORF)’ to reliably predict eye movement behaviour from MEG recordings. Afterwards, we show that ORFs can also be used to predict oculomotor related neural activity (and underlying sources) during experimental tasks. ‘Generic ORFs’ (i.e. averaged across participants) are then applied to open-source datasets to replicate oculomotor effects based on brain data and vice versa. We consider the insights into cognitive processes that could be gleaned with this method and hope to provide a useful new tool for understanding the complex role of oculomotor related signals in human cognition.

10 Impact of Aging on Theta-Phase Gamma-Amplitude Coupling During Learning: A Multivariate Analysis

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Aging is associated with cognitive decline and memory impairment, but the underlying neural mechanisms remain unclear. Phase-amplitude coupling (PAC) between theta (5 Hz) and gamma (>50 Hz) oscillations is a proposed marker for parallel storage of multiple items in working memory. However, research has mainly focused on young individuals and epilepsy patients, with only a few studies on aging populations. Moreover, these studies have relied on univariate PAC methods, which can be flawed by potential spurious or biased PAC estimates due to non-stationarity of EEG signal.
To address these gaps, we employed multivariate PAC (mPAC) through generalized eigendecomposition (GED) analysis, which avoids the pitfalls of non-sinusoidal oscillations. Over 100 young and 100 older healthy participants engaged in a sequence learning paradigm, in which they learned a fixed sequence of visual stimuli over repeated observations, allowing us to track the mPAC during the incremental process of learning.
Behavioral results revealed that younger participants learned significantly faster than older participants. Neurophysiological data showed that mPAC increased over the course of learning in both age groups and could significantly predict fast and slow learners. However, older participants exhibited lower mPAC compared to younger counterparts, which suggest compromised parallel storage of items in working memory in older age. These findings shed light on the age-related differences in memory formation processes and may guide interventions to enhance memory performance in older adults.

11 Enhancing memory in humans via MEG-closed-loop Rhythmic Sensory Stimulation (RSS) tuned to the frequency of hippocampal theta oscillations

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Hippocampal theta oscillations are considered critical for binding multisensory information into episodic memories. Recent studies suggest that entraining theta oscillations through 4-Hz audio–visual Rhythmic Sensory Stimulation (RSS) can significantly enhance memory performance in humans. This "one-size-fits-all" approach, however, neglects the differences in brain activity among individuals, which could account for the variability in results. To address this limitation, we developed a new pipeline designed to estimate the individual hippocampal theta frequency during a memory task and dynamically align the stimulation parameters to it.

The pipeline involves extracting the hippocampal signals during a MEG measurement using an LCMV beamformer. Then, theta activity is separated from the broadband signal applying a Generalized Eigenvalue Decomposition (GED). Finally, the Cyclic Homogeneous Oscillation detection method (CHO) is applied to detect the presence of an oscillation and identify its centre frequency. This frequency is then used to adjust the flickering frequency of the sensory stimuli. As the first step, we validated the feasibility of the pipeline on rodent LFP data, aiming to replicate the well-established correlation between running speed and hippocampal theta frequency. The results indicate that the pipeline was able to reproduce previous findings. After that, the pipeline was tested offline on a MEG dataset involving 4-Hz RSS during an associative memory task. Here, our objective was to assess whether the pipeline could accurately identify the entrainment effect induced by the stimulation. Our results indicate that hippocampal oscillations during the stimulation were significantly closer to 4-Hz compared to the pre-stimulus window.

12 The brain-body dynamics supporting supramodal conscious perception

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Is our conscious perception of seeing a flash, hearing a sound or feeling a touch associated with one common core brain activity pattern or a specific brain-body interactive state? Here, I present novel MEG, cardiac and respiratory data that investigate such supramodal neural correlates of conscious perception and its relationships to ongoing dynamics in the body. On each trial, different visual, auditory or tactile stimuli were shown at individual perceptual thresholds, such that about half of the stimuli were consciously detected, while the other half were missed. Four different stimuli per modality were used, in order to subsequently leverage representational similarity analysis (RSA) for differentiating modality-specific, sensory processes from supramodal conscious processes, which are similar across the senses. As expected, the neural data showed stronger evoked MEG-activity for detected stimuli in the respective sensory cortices. Conversely on missed trials, there was greater alpha-frequency band power for all three modalities. Moreover, the RSA was capable of distinguishing brain activity patterns related to modality-specific processes shortly after stimulus onset (<0.5 s) from later supramodal conscious processes (>0.5 s). Subsequent analyses investigate the relationship between modality-specific and supramodal brain activity patterns with the participants' concurrent cardiac and respiratory activity. Our work aims for a multi-stage model for conscious experiences, involving alpha oscillations, modality-specific processing upon stimulus onset and then later supramodal conscious perception. This temporal processing cascade in the brain may be further modulated by ongoing state changes in the body, to serve the optimal integration of conscious experiences with the perceiver.

13 Own-gender bias for facial feature recognition yields sex differences in holistic face processing

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Sex and menstrual cycle related differences in holistic and detail-oriented processing strategies are well-documented across cognitive domains such as pattern recognition, navigation, and object location memory. This study is the first to employ a part-whole face recognition task while controlling for sex hormone status to investigate a potential role of strategy differences in the formation of face representations. We assessed 140 participants (49 luteal, 18 non-luteal, 73 males) and found significant sex differences in the part-whole effect between males and luteal cycle phase females. In particular, this sex difference was based on luteal phase females exhibiting higher face-part recognition accuracy than males. As this advantage was further exclusively observed for female stimulus faces, we discuss a potential relation to the own-gender bias in face recognition. In addition, exploratory analyses suggest that testosterone levels may partly mediate the observed sex differences while eye-tracking during the face recognition phase revealed more frequent eye fixations on the central interocular face region in males, indicating a stronger reliance on holistic processing strategies.

14 Predictive neural representations of naturalistic dynamic input revealed by dynamic RSA

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In dynamic environments (e.g., traffic or sports), our brain is faced with a continuous stream of changing sensory input. Adaptive behavior in such environments requires our brain to predict unfolding external dynamics. While theories propose such dynamic prediction, empirical evidence is limited to static snapshots and indirect consequences of predictions. We apply a dynamic extension to representational similarity analysis (dRSA) that captures neural representations of unfolding events across hierarchical levels of processing (from perceptual to conceptual), by investigating the match between a temporally variable stimulus model at a given time-point and the neural representation across time. Using this novel approach, we find empirical evidence for neural predictions in MEG data across hierarchical timescales, with high-level conceptual stimulus features predicted earlier in time and low-level perceptual features predicted closer in time to the actual sensory input. Second, we demonstrate that reducing stimulus familiarity by either inversion (up-down) or temporal piecewise scrambling of simple action videos, impairs neural predictions in a hierarchical level-specific manner, such that inversion selectively impairs predictions at the highest hierarchical level, while piecewise scrambling impairs all predictions. Last, we show preliminary data of naturalistic movie watching which suggests that familiarity with the movie results in earlier perceptual predictions. To conclude, using dRSA we demonstrate how neural representations across hierarchical levels – from perceptual to conceptual – are predictive in nature, how predictions at different hierarchical levels can be manipulated independently, and how this new approach can be used to study the effect of stimulus familiarity on perceptual predictions.

15 Microsaccades impact visual perception and electrophysiology in humans

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Humans rely heavily on their vision to explore the environment. By making saccades, humans move their fovea to increase acuity while fixating. However, even when fixating, the eyes never remain completely still. Among such fixational eye movements, microsaccades have been indicated to play an important role in visual attention and perception. Here, we ask whether and how microsaccades modulate the neural correlates of visual perception and influence performance in humans. We simultaneously recorded scalp EEG and eye tracking while participants performed a near-threshold visual detection task to detect the orientation of a brief, masked visual target stimulus. The time interval between target and mask was adapted to the participant's individual detection threshold following a 2-up-1-down staircase procedure. Focusing on the time interval prior to target onset, we observed that microsaccades were adjusted to upcoming task demands. Strikingly, the occurrence of microsaccades close to target onset significantly reduced detection accuracy. We also found phase alignment of low-frequency brain activity when locking the data to the onset of microsaccades, similar to previous findings with large saccades. In the next step, we will examine whether the pre-stimulus phase predicts detection performance, an observation called phase bifurcation. Here, we will explore how phase bifurcation varies with the occurrence of microsaccades in relation to target onset. Together, we show that microsaccades modulated human electrophysiology and affected visual detection performance, indicating that the interaction of eye movements and neural activity jointly predicts behavior.

16 Temporal presence in computer-mediated social encounters modulates neural but not behavioral and electrodermal indices of empathy for pain

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In recent years, social interactions have increasingly shifted to computer-mediated, online settings, with unclear implications for cognitive and affective processes. In our study, we asked how the social presence of another person influences pain empathy. We manipulated temporal presence as one dimension of social presence, which reflects the synchronicity and opportunity for interactivity within a social situation. We assumed that temporal presence affects behavioral and neural responses to others' pain.
To investigate this, we conducted an empathy for pain experiment comparing reciprocal interaction via video camera and a unidirectional condition where a pre-recorded video was presented. Thirty-five participants alternately served as targets and observers of painful electric stimulation, while their behavioral ratings, heartbeat, skin conductance response (SCR), and electroencephalogram were recorded.
We found that observers' perceived the immediacy and closeness of the unidirectional condition as reduced compared to the interactive condition. Nevertheless, no differences in empathic accuracy or unpleasantness ratings were found. Mu suppression, a neural index of empathy, did not differ between conditions either. However, low frontal theta activity (3-5 Hz) was reduced in the unidirectional video condition, presumably reflecting reduced processing of the aversive, salient stimuli. Observers' SCR was increased with higher shock intensity, but did not differ between presence conditions.
In sum, our data showed that temporal presence did not modulate behavioral and electrodermal correlates of pain empathy, but had only subtle effects on empathy-related frontal theta activity. Future studies will have to clarify whether this applies also to more complex, naturalistic social interactions.

17 Identification of feedforward/feedback contributions to age-dependent hearing loss and tinnitus using OPM-MEG

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Acquired auditory processing disorders including age dependent hearing loss, speech discrimination deficits, tinnitus or hyperacusis, require a personalized diagnosis to assign the individual cause within the auditory hierarchy to either the periphery, subcortical or distinct cortical or cortico-fugal neuronal dysfunctions. The well-functioning feedforward and feedback PV-IN network is an essential precondition for temporal intracortical network function in audition that above all senses relies on high speed of information flow (Zajac IT and Nettelbeck T, 2018). We hypothesize disease-specific deficits in temporal intracortical network function in auditory circuits. Therefore, the diagnostic of those should have a special significance. We used time-sensitive MEG-OPM measurements and aimed to study different auditory stimulus paradigms to detect fast auditory processing in different groups of tinnitus with and without hyperacusis or presbycusis. We expect this method to become an efficient diagnostic strategy to fathom peripheral or central contribution of the distinct auditory impairments in the future to improve individualized targeted interventional therapies. Here we will present preliminary results demonstrating the usability and function of the OPM-MEG for hearing research.

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18 Acting Jointly is not just Acting Side-by-Side: A Dual EEG Study

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Anyone who has ever walked, cooked, or crafted with a friend knows that acting jointly is not just acting side-by-side. Unlike acting side-by-side, where agents pursue individual goals, acting jointly requires that a collective goal guide their actions. Yet previous studies have largely ignored this difference, thereby failing to isolate what is distinctive of acting jointly.

Our study used a dual EEG approach to investigate the brain markers of action planning and execution specific to joint action. We recruited twenty dyads of participants and had them play a joystick video game. The game involved grabbing and transporting one object, either jointly (Joint-Action Condition, JA) or in parallel but individually (Parallel-Action Condition, PA). We designed the tasks to ensure equal coordination demands across conditions. Our behavioral measurements included success rate, reaction times (RT), movement velocity, and movement direction, while our EEG measurements focused on two event-related potentials (ERPs) —late Contingent Negative Variation (CNV) and Motor Potential (MP), following Kourtis et al., 2014. 2019.

While the two tasks exhibited non-significantly different success rate, the mean variability of RT, velocity, and direction, were significantly lower in JA than in PA. Strikingly, the mean CNV and MP amplitudes were also significantly lower in JA than in PA.

Overall, our results suggest that, in joint action, acting toward a collective goal facililitates interpersonal coordination, compared to acting side-by-side. In fact, joint action appears more predictable (as suggested by reduced behavioural variability) and less demanding (as highlighted by reduced CNV and MP) than parallel action.

19 Sharp-wave ripples transmit hippocampal to neocortical information. A human single-neuron study.

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Memory consolidation is assumed to rely on fine-tuned communication within and between hippocampal and cortical neuronal circuits during offline brain states. Sharp-wave ripples (SWRs) have been proposed as the pivotal signature for consolidation, triggering hippocampal replay and information transfer to cortical sites. Critically, although SWRs are precisely coupled to the cardinal NREM sleep-related brain rhythms (i.e., cortical slow oscillations and thalamocortical spindles), evidence for a link between SWRs and directed information transfer is scarce. Here, we leveraged the rare opportunity of nocturnal single-unit and LFP recordings in neurosurgical patients to uncover the SWR-triggered information flow by tracking the impact of SWRs on single-neuron activity along the hippocampal output network, including entorhinal and parahippocampal cortex.

Preliminary results indicate a consistent pattern of temporally precise increases in neuronal firing rate (FR) synchronized with hippocampal SWRs. Importantly, FR increases were not confined to local hippocampal neurons but also became apparent in single neurons in distant, downstream regions, suggesting an interregional impact of SWRs. The temporal delay along the hippocampal-neocortical pathway suggests a causal directionality, with the hippocampus as the driving hub. Interestingly, we found that concept neurons involved in a pre-sleep memory task were selectively activated at downstream targets. Finally, we show that these processes were finely tuned to cortical SO-Up-states that shaped time windows of high excitability among MTL neurons during which SWRs emerged. Together, our findings support the idea of a causal relationship between SWRs and hippocampal-neocortical information transmission during sleep, underpinning their essential mechanistic function in systems consolidation.

20 The bodily-emotional experience of time: temporal interval perception is modulated by anxiety

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Time perception is crucial in our life, and emotions can modulate it. Interoception influences emotional experiences, and the insula plays a key role in this process. However, the neural representation of the relationship between time, emotions, and body remains unclear. We investigated the effect of anxiety on time perception, considering individual variations in interoception and trait-anxiety. We hypothesized that better interoception would predict more intense anxiety, disrupting time perception. This would be mirrored in a modulatory effect of the amygdala on the integrative function of the insula. Thirty participants performed an auditory temporal reproduction task while undergoing fMRI. In half of the blocks, they were at risk of hearing random screams (threat blocks), whereas in the other half, they were ensured that no screams would be presented. Interoceptive accuracy and trait-anxiety were assessed outside the scanner. Our paradigm successfully induced affective changes, with higher anxiety perceived (state-anxiety) in the threat blocks (SE=1.51, t=6.22, p<.001). Higher interoceptive accuracy (SE=1.45, t=2.66, p=.008) and higher trait-anxiety (SE=4.17, t=2.36, p=.02) were also related to increased state-anxiety. In turn, increased state-anxiety predicted lower accuracy in temporal reproduction (SE=.006, t=-2.11, p=.03). Higher interoceptive accuracy also predicted lower accuracy in the reproduction of longer durations (9sec: SE=.005, t=-5.61, p<.001, 14sec: SE=.005, t=-4.98, p<.001). To determine the interaction effect of emotions and temporal experience at a neural level, we looked at the functional interplay between the amygdala and insula. These results suggest a disruptive effect of anxiety on temporal perception, considering variations in interoception. Exploring the neural underpinning of this process can inform how the brain-body interaction modulates affective and cognitive processes.

21 Connecting gaze and memory via phase alignment of electrophysiological signals in the human medial temporal lobe

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Motion plays a crucial role in shaping brain processes, for example in how the brain anticipates the consequences of its own actions. By monitoring self-generated motion signals, the brain can predict and prepare for incoming stimuli. Because humans predominantly combine eye and head movements to direct their gaze to relevant stimuli in the environment, a coordination of brain activity and gaze behavior seems highly adaptive.

Previous studies suggest that eye movements and brain activity align, and that the alignment is linked to cognitive functions: in the hippocampus of non-human primates, saccade-related phase alignment of low frequency activity has been shown to predict performance in a memory task. It remains, however, unclear whether such motion-induced alignment predicts memory performance in humans, and how the specific contributions of head and eye movements are constituted.

This study investigates these questions by analyzing intracranial electrophysiology recorded in epilepsy patients who directed their gaze towards screens positioned in a semi-circle around them, while memorizing and later recalling images displayed on these screens. Initial findings indicate that successfully remembered images show increased low-frequency phase alignment post head movement in the medial temporal lobe. Ongoing analyses focus on dissecting the contributions of saccades and head movements to phase alignment across brain regions to understand the dynamic nature of gaze-brain interactions. Our preliminary results support the idea of motion-triggered alignment of brain activity that aids memory formation. By exploring interactions between gaze and brain oscillations, we shed light on the critical connection between motion and higher-order brain processes.

22 The impact of respiration on associative memory retrieval

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Respiration has been shown to modulate both brain oscillations and memory retrieval processes in humans. However, the extent to which respiration directly influences retrieval-related neural oscillations and memory reactivation remains unclear. In this study, we reanalyzed an existing dataset comprising scalp electroencephalography (EEG) and respiration recordings throughout an experiment in which participants (N = 18) engaged in an episodic learning task across two experimental sessions. During each session, participants associated verbs with images of objects or scenes (counterbalanced). We found that the phase of respiration significantly influences EEG amplitudes in the alpha/beta range as well as behavioral retrieval success. In turn, retrieval-related alpha/beta power decreases and accompanying memory reactivation were tightly locked to the exhalation troughs occurring after trial onset. While these results highlight the putative role of respiration in modulating both behavioral and neural aspects of memory retrieval, upcoming analyses will assess whether respiration directly impacts memory reactivation, hence the neural substrate underlying conscious remembering.

23 (Perceived) Social Support of Mothers and Fathers During the COVID-19 Pandemic

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Social support is crucial for mental well-being in the postpartum period, and the pandemic's measures may have influenced how social support is received and perceived, necessitating the identification of key predictors.

Between May 18, 2021 and July 1, 2021, an online survey was conducted to gain insight into becoming parents during the COVID-19 pandemic in Germany and Austria. This report includes only families in which both parental figures completed the survey and membership to the family could be identified (n = 100 couples). Factors assessed included perceived stress, coping mechanisms, receiving help, partner support, and subjective social support.

For mothers, significant predictors of social support included coping mechanisms ($\beta = .29$, $p < .001$), partner support ($\beta = .36$, $p < .001$), and help from family/friends ($\beta = .29$, $p = .001$), with $R^2adj. = .31$ ($p < .001$). For fathers, significant predictors were coping mechanisms ($\beta = .19$, $p = .036$) and partner support ($\beta = .45$, $p < .001$), with $R^2adj. = .24$ ($p < .001$). 65% of mothers and 58% of fathers reported receiving assistance from grandparents and/or extended family and friends. Among couples, 66% agreed on their “help status,” while 31% showed mild disagreement, and 3% had higher disagreement.

The results indicate that coping mechanisms and partner support significantly predict social support scores for both mothers and fathers, while help from extended family and friends is only significant for mothers. These findings highlight variability in family support during the pandemic and potential communication gaps within partnerships.

24 The Role of Alpha Power Lateralization in auditory processing: Insights from an EEG Neurofeedback Study

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Auditory spatial attention, the ability to focus selectively on specific sounds while ignoring others, is crucial for various cognitive tasks and daily activities. Neural oscillations in the alpha frequency band (8-12 Hz) have been implicated in attentional modulation, especially in visual perception. However, their functional role in auditory spatial attention remains unclear.

This study explored the relationship between alpha activity and auditory spatial attention using EEG neurofeedback (NF). Participants were trained to increase alpha power over left relative to right parieto-occipital sensors and vice versa. The training was implemented as a computer game, where participants were rewarded for modulating the lateralization of alpha power in the desired direction. During neurofeedback, auditory probes were presented from different spatial directions (-90°, -45°, 45°, and 90°) to assess whether changes in alpha lateralization had immediate effects on auditory processing. Further, the impact of neurofeedback on auditory attention and resting-state alpha lateralization was assessed prior and after NF Training.

First results indicate that NF training effectively modulates alpha power lateralization towards the trained hemisphere. The data present a pattern where the average evoked potential (i.e. absolute difference between the P1 and the N1 component) in response to auditory probes presented contralaterally to the trained hemisphere is smaller as compared to the evoked potentials elicited by ipsilateral probes. However, this NF Training x Probe direction interaction was not statistically significant.

The study provides initial evidence that neurofeedback can modulate alpha power lateralization. The potential influence on auditory sensory processing has still to be determined.

25 Influence of the sensorimotor system on auditory cortical activity in tinnitus patients

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Tinnitus is the perception of a phantom sound. Research has shown that the sensorimotor system can influence tinnitus perception (Shore et al. 2016), how the sensorimotor system, however, interacts with auditory activity on a cortical level remains largely unsolved. We here investigate how auditory perception is modulated by the sensorimotor system in the brain.

23 tinnitus patients who performed relaxing versus tensing jaw exercises and subsequently listened to their tinnitus/four different tinnitus-like sounds, while brain activity was measured with Magnetoencephalography. Differences in oscillatory activity were identified with sensor-based cluster-based permutation tests and a beamformer approach. Connectivity between regions was estimated using Partial Directed Coherence and linear mixed effects models (lmes) were used to determine how brain activity and ratings interact.

Participants experienced their tinnitus, but not tinnitus-like sounds, less loud and more pleasant ($p<.05$) after relaxing versus tensing exercises. Tinnitus reduction was accompanied by a significant increase of alpha-band connectivity directed from the somatosensory to the auditory cortex and a significant gamma power reduction in the auditory cortex. Interestingly, only the right auditory gamma power decrease after relaxation was evident when patients heard tinnitus-like sounds instead of their tinnitus.

We suggest that the increase in directed alpha-band connectivity from somatosensory to auditory cortex is most likely reflecting the transmission of inhibition from somatosensory to auditory cortex during relaxation, where, in parallel, probably tinnitus-related, gamma power reduces. The lmes will give further insights into why the sensorimotor system interacts with auditory cortical activity differently during perception of external tones.

26 Combining Insomnia Therapy with Sleep Tracking Using Wearables: Effects of a CBT-I-based App on Sleep – A RCT study

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Due to the gap in treatment, validated digital solutions are urgently needed. Here, we evaluate an innovative smartphone-app, combining i) a CBT-I-based sleep training with ii) subjective as well as iii) objective sleep monitoring via a heart rate (HR) sensor, and iv) feedback based on objective sleep.

In this RCT study, fifty-seven self-reported poor sleepers (20-76 years; M=45.67±16.38; 39 female) were randomly assigned to an experimental group (EG, n=28) or a waitlist control group (CG, n=29). During a 6-week intervention phase, the EG used the CBT-I-based app program including sleep monitoring as well as feedback on their sleep, while the CG used sleep monitoring only. Sleep was measured i) subjectively with questionnaires (Insomnia Severity Index, ISI; Pittsburgh Sleep Quality Index, PSQI), ii) objectively with ambulatory polysomnography (PSG), and iii) continuously via HR sensor and sleep diaries.

Analyses revealed interactions for ISI ($p=.003$, $\eta 2part=.11$) and PSQI ($p=.050$, $\eta 2part=.05$), indicating training-specific improvements for EG, yet not for CG. While PSG-derived outcomes appear to be less training-specific, a tendential reduction in wake after sleep onset (WASO) was found in EG ($p=.061$, $d=0.55$). Regarding changes in subjective-objective sleep discrepancies (SOSD), results indicate a reduction during intervention for total sleep time in both groups, while improvements for sleep efficiency, sleep onset latency and WASO were found in EG only ($p's \leq .022$, $d \geq 0.46$).

The findings indicate beneficial effects of an innovative smartphone app on sleep and SOSD. More scientific evaluation of such digital programs is needed in order to ultimately help provide effective, low-threshold treatment options.

27 Resilience and vulnerability of neural speech tracking after cochlear implantation in congenitally and acquired deaf children

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Infants are born with biological biases that favor language acquisition. One is the auditory system's ability to track the envelope of continuous speech, a pivotal feature for spoken language comprehension in adulthood. However, to which extent neural speech tracking relies on postnatal auditory experience remains unknown. We studied children with or without access to functional-hearing in the first year of life after they received cochlear implants (CIs). We measured neural speech tracking in CI users with a congenital deafness (CD) or who developmentally acquired it (AD; minimum auditory experience 12 months), as well as in hearing controls (HC; listening to original or vocoded-speech). Remarkably, neural speech tracking in children with CIs was unaffected by the absence of perinatal auditory experience. Regardless of deafness onset, CI users and HC exhibited a similar speech tracking magnitude at short-timescales ~50–130ms; however, the tracking was delayed, and its timing depended on the age of hearing restoration in CI users. Conversely, at longer timescales ~150–250ms, speech tracking was substantially dampened in CIs, accounting for their comprehension deficits. These differences were not accounted by the degraded acoustic stimulation as revealed by the speech tracking in HC listening to vocoded-speech. These findings highlight (i) the resilience of sensory components of speech tracking to the lack of hearing in the first year of life, (ii) the crucial role of when hearing restoration takes place in mitigating the impact of atypical auditory experience, (iii) the vulnerability of higher hierarchical levels of speech processing in CI users.

28 Long-term acoustic contexts determine if non-speech contexts induce rate normalization effects in speech perception

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Auditory word perception depends on contextual speech rate. In German, a fixed vowel duration is perceived as long following fast speech, but as short following slower speech, known as rate normalization (RN). For example, perception of /ban/ changes from 'Bahn' ('train', long /a/) to 'Bann' ('spell', short /a/) in slower contexts. However, whether non-speech context also drives RN is controversial. Here we investigated the conditions for non-speech contexts to induce RN. In Experiment 1, we hypothesized that greater spectro-temporal similarity to speech strengthens RN. We compared a speech context to low-pass-filtered speech and isochronous sequences of either complex (/u/ vowels) or pure (440 Hz) tones. All contexts were presented at fast (5.7 Hz) and slow (2.8 Hz) rates in counterbalanced order. RN effects were comparable for speech, complex and pure tone contexts, whereas low-pass-filtered speech did not induce RN. Surprisingly, when complex tones were presented before other contexts in Experiment 2, their effect vanished. A re-analysis of Experiment 1 by condition order suggested that this may be due to experimental context: Complex tones induced RN only when presented after low-pass-filtered speech. In contrast, low-pass-filtered speech induced RN before exposure to complex tones but not after, suggesting that long-term context may affect RN. Experiment 3 tested this hypothesis. It showed that complex tones did not induce RN regardless of condition order, and replicated that low-pass-filtered speech induced RN before but not after exposure to complex tones. Overall, our findings suggest that RN effects of non-speech stimuli depend on long-term acoustic contexts.

29 The Neural Impact of Hearing Loss on Spatial Attentional Filtering

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Target selection and distractor suppression are critical subprocesses in auditory spatial attention. It is known that individuals with hearing loss (HL) often struggle to focus on target listeners in crowded multi-talker environments. However, it remains unclear if these cognitive mechanisms - target selection, distractor suppression or both - are affected by hearing impairment and aging brain. For this stage 1 approved pre-registered report, we recruited three groups varying in age and hearing loss levels to investigate whether any of these neural subprocesses of attention are diminished in listeners with HL. While conducting an auditory attention task, we used electroencephalography (EEG) to measure alpha activity (8-12 Hz), which serves as a neural indicator of spatial selective attention. At the current state of data acquisition (the study employs an optional stopping approach), our results indicate that alpha oscillations implement distractor suppression independently of target selection. We observed alpha power decreasing contralaterally and increasing ipsilaterally to the target, and the opposite pattern for distractors. Current findings do not indicate any group differences. This suggests that elderly with and without HL exhibit as efficient neural filtering as NH listeners.

30 Neural synchronization with audiovisual speech relies on a sensitive period

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Proper stimulations at specific time windows are crucial for shaping infants' development (Werker, Hensch, 2015). At the behavioral level, auditory deprivation in the first years of life can alter the ability to integrate audiovisual speech cues once hearing is restored with Cochlear implants (CI; Schorr et al., 2005). Yet, it's unclear if neural circuitries responsible for audiovisual speech integration have a developmentally sensitive period in which auditory information is required. With the EEG, we measured the neural tracking of auditory-only and audiovisual speech) in children with congenital (CD) or acquired (AD) deafness and in hearing controls (HC). Because CD and AD groups differed in their lack or presence of functional hearing in the first year of life, this allowed assessing the role of audiovisual experience within this phase of brain development. For both HC and AD groups, when the speaker's face was visible, speech tracking was anticipated at short timescales, ~30–150ms. This facilitatory effect was absent in the CD group. Additionally, HC and AD groups exhibited higher dissimilarity between auditory-only and audiovisual neural responses, compared to the CD group. Results suggest that early acoustic deprivation hampered fast integration of audiovisual speech signals. Importantly, despite the differences of neural tracking, AD and CD groups had comparable speech comprehension enhancements with audiovisual compared to auditory speech, highlighting that neural adaptations to different deafness onsets can lead to similar behavioral outcomes. Hence, early audiovisual experience is fundamental for developing neural circuitries subtending low-level audiovisual speech signals integration.

31 Taking a look at memory retrieval: investigating the relationship of eye-movements and alpha/beta desynchronization

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Humans mainly rely on vision to obtain knowledge about the world. Research has repeatedly identified links between eye-movements – such as saccades, fixations and their sequential patterns – and episodic memory. Successful memory formation has been associated with more visual exploration and alpha/beta (~8-30Hz) power decreases during initial viewing of a stimulus. Recent studies additionally observed a positive correlation between eye-movements and alpha/beta desynchronization in various tasks. Here, we investigate whether this link holds true during memory retrieval. In a free-viewing episodic memory task, participants were asked to visually explore naturalistic scenes. After a distractor task, they judged the novelty of both the previously seen (old) and new scenes. EEG and eye-tracking data were recorded simultaneously throughout the task. In line with the so-called repetition effect, less saccades were observed for old as opposed to new scenes. Participants also made less saccades during hits (correctly recognized old scenes) as compared to correct rejections (correctly recognized new scenes) and misses (not recognized old scenes). EEG time-frequency analyses revealed the typical alpha/beta desynchronization after stimulus onset. However, we did not observe robust differences in the previously mentioned contrasts. These findings indicate that the relationship between alpha/beta desynchronization and eye-movements found during encoding might not generalize to recognition memory tests. To further elucidate the relationship of eye-movements and electrophysiology during different memory processes, we are analyzing similarities of eye-movements patterns. Previous studies suggested that gaze pattern reinstatement facilitates remembering, but whether and how these similarities are reflected in alpha/beta activity is not known.

32 A Novel Thalamic Oscillation distinguishes Natural Brain States in Humans

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The thalamus plays a key role in regulating brain states by gating the flow of information between the sensory periphery and the cortex as well as between the different regions of the cortex. However, electrophysiological correlates of such regulating mechanisms remain severely underexplored, especially in humans. We here used the rare opportunity to record from the human thalamus in epilepsy patients implanted with Deep Brain Stimulation electrodes to probe the thalamus across different brain states - wakefulness, Rapid Eye Movement (REM) sleep, and Non Rapid Eye Movement (NREM) sleep. In line with previous literature, we find that the mesoscale thalamic field potential during NREM sleep is dominated by sleep spindles. However, during wakefulness and REM sleep, sleep spindles are replaced by a hitherto unreported oscillatory signal at ~25-50 Hz. This mesoscale oscillatory signal is robustly detected in the individual thalamic recordings of 14 participants. The thalamic oscillations during wake and REM sleep occur in bursts, much like sleep spindles. Indeed we find that the duration and shape of the bursts during REM sleep and wake correlate with those of sleep spindles during NREM sleep, indicative of a generation mechanism common to both oscillations. We further find that the strength of the oscillation correlates strongly with eye movement during phasic REM but anti-correlates with eye blinks during wakefulness. Overall, the presence of this hitherto unreported thalamic oscillation distinguishes natural states of consciousness and likely plays a role in regulating the flow of information during both wakefulness and phasic REM.

33 Motor planning is necessary and sufficient to bias subsequent motor performance

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It is well established that our motor actions are influenced by recent, previous movements. These motor history effects are evident as biases in movement characteristics (e.g., reach direction, movement speed) and in response latencies. The prevailing but untested view holds that these effects emerge from prior planning-related activity. Here, we provide experimental evidence that planning but not executing a movement is critical for the emergence of history-dependent effects. For two successive movements, the second movement is initiated faster when the same hand is used ("hand repetition effect"). First, in an effector-choice reaching task, the hand repetition effect manifested only if the preceding movement was actively planned and executed, but not when it was passively performed by a robotic device (execution only); it manifested, albeit in reduced size, when the first movement was inhibited (planning only). Second, in an obstacle-avoidance reaching task, reach trajectories were strongly biased by obstacle location, both when the previous movement was planned and executed and when it was only planned. Bias declined with increasing response latencies and was absent when no motor plan was created, suggesting that it reflects a temporal decay of planning-related activity. These results support the view that motor planning is necessary and can even be sufficient to bias subsequent motor performance.

34 Miniature head movements reflect successful remembering

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Recent studies indicated a functional relationship between microscopic movements (e.g., microsaccades) and cognitive processes during attention and working memory tasks. It is, however, not known whether similar links exist between micromovements and long-term memory processes in humans. In this study, we asked whether micromovements reflect successful remembering in human episodic memory. Twenty-five healthy subjects participated in a scalp EEG study. They learned to associate 168 items (images of objects) with distinct head orientations by turning their head to face one of four screens where the image appeared. After a night of sleep, their memory for items was tested in a recognition test followed by an associative memory test where they were asked to recall the head orientation corresponding to the items. Importantly, participants looked straight ahead during the entire memory test. During recognition memory, alpha-beta desynchronization distinguished between retrieving familiar stimuli and processing new stimuli. Additionally, a significant difference in beta desynchronization for hits versus misses was found. During associative memory retrieval, microscopic head movements indicated successful remembering, as captured by motion-tracking signals and increased high-frequency EEG power. Event-related potentials also differed between items that were presented on left side screens and items presented on right side screens during learning. This difference correlated with the participants' memory performance. Together, these findings suggest that experience-related muscle activities are recapitulated during remembering, indicating their putative reactivation from memory. Our study aims to contribute to the understanding of successful reactivation of spatial memories, particularly highlighting the role of microscopic movements for cognitive processes.

35 Mechanisms underlying sustained visual entrainment

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The functional role of neural oscillations across frequency bands is poorly understood, and interestingly, different claims have predominated across sensory domains. In the auditory domain, with speech as its prominent example, one exciting proposal is that low-frequency (delta, theta) oscillations 'entrain' to the dynamics of the input stream such that peaks of processing align with peaks of information. In vision, it is proposed instead that low-frequency oscillations are fixed across time, individuals, and species, but these conclusions are derived from studies with no information fluctuations across time. The present MEG study examines whether we could obtain visual low-frequency entrainment. We also ask whether such entrainment hinges on the sensory rhythm remaining relevant beyond its conclusion. To measure entrainment during and after visual stimulation, participants will fixate on 7 or 8 cycles of Gabors flashing at either 1.3 or 2Hz, before a 'silent' interval with the length of a further 3 cycles. We will test whether the frequency of stimulation determines oscillatory processing in the silent window and thereby whether visual low-frequency entrainment can be obtained. Each trial finishes with a target Gabor which, depending on the block, participants have to judge in terms of its orientation or timing. By comparing entrainment between these two tasks, we will test whether (sustained) entrainment requires the rhythm to be task-relevant. Our findings will determine importantly whether and how dynamic information flow determines the function of oscillations in the visual system, and provide a stepping stone to understanding oscillatory function across domains.

36 How do enhancement and suppression interactively shape selective attention?

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Human environments comprise a plethora of auditory events, some of which are relevant targets while others are irrelevant distractors. In auditory attention research, our understanding of capture and suppression in distractor processing is premature. A suitable control condition to delineate target enhancement from distractor suppression has often been missing. We fill this gap by introducing a baseline and directly comparing neural and behavioral responses between neutral versus task-irrelevant and target sounds, inferring mechanisms of target enhancement, distractor suppression and capture. Additionally, negative priming, the impaired processing of a target that shares features with a previous distractor, serves as a sensitive index of active distractor suppression.

In a behavioral pilot study (N=7), listeners reported the pitch direction of an amplitude-modulated (AM) contour. Three different contour types (target, non-/salient distractor) were presented by assigning trial-wise unique temporal and spatial positions. Distraction was evidenced by lower accuracy in trials with the salient distractor present versus absent. Distractor suppression was indicated by lower accuracy when the current target appeared at the position of the previous distractor (i.e., negative priming).

Building on these findings, we are currently establishing a novel electroencephalography (EEG) paradigm: Participants report the identity of an AM target sound while ignoring simultaneously presented salient and non-salient distractors from three separate spatial locations. We will leverage neural signatures associated with attention capture (e.g., N1 amplitude) and distractor suppression (e.g., Pd amplitude, alpha oscillations) to investigate how neural enhancement and suppression interactively shape selective attention.

37 Mu-desynchronization during motor imagery of a motor sequence task - preliminary results

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Aim: Investigating EEG mu-desynchronization (8-13 Hz) during motor imagery (MI) of a gross- motor-sequence-learning task as a potential marker of imagery ability and sleep-related performance gain.
Design: 31 younger ($\bar{x}$=22.2, SD=2.54, 19 females) and 9 older adults ($\bar{x}$=70.7, SD=3.91, 8 females) were tested over 7 days, including two nights of ambulatory polysomnography. Participants learned a sequential footstep task, either in the morning (AM-group) or in the evening (PM-group). Following the training participants of the MI-group practiced the sequence via MI, while the control-group listened to an audiobook. Physical performance was tested before (pre-test) and after MI/audiobook (post-test 1) and retested 12 (post-test 2) and 24 hours (post-test 3) later, followed by a second MI-session within the MI-group. EEG activity was recorded throughout all sessions. Mu-desynchronisation was computed as a decline in spectral mu-power during MI compared to mu-power during rest. MI-ability was assessed via questionnaires.
Results: Mu-desynchronisation during MI was strongest over parietal sites. Only subjects in the MI-group practicing in the evening increased their performance from post-test 1 to post-test 3 ($t(25)=-6.79$; $p<.001$). Mu-desynchronisation during the second MI correlated positively with sleep-related performance gain ($r(13)=.45$; $p=.094$). Both, immediate ($r(13)=.55$; $p=.034$) and delayed motor performance gain ($r(13)=.58$; $p=.03$) correlated with kinesthetic MI ability of the second MI session.
Conclusion: MI-training, accompanied by parietal mu-desynchronization, promotes performance gain, especially when followed by sleep compared to wakefulness. Results suggest that improvements in physical task execution benefits task imagery ability and can be reflected in changes of the EEG mu-rhythm during MI.

38 Tactile entrainment reveals a detailed categorization of digit representation and lateralization

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Tactile interactions involve continuous processing of non-stationary inputs that change in location, duration, and intensity. Here, we aimed to demonstrate the possibility of objectively measuring how the somatosensory system synchronizes to continuous and unpredictable tactile stimulation. We computed a Temporal Response Function (TRF) at the individual level and investigated whether this measure of stimulus-brain synchronization could dissociate digit representation and digit lateralization, a pivotal feature of the somatosensory cortex.

Twenty-seven young adults (F=15) were passively stimulated with a random series of continuous and gentle brushes on single fingers of each hand, which were covered from view. An encoding model measured the degree of synchronization between brain activity and these continuous series of tactile inputs.

A clear TRF emerged for each fingers even when accounting for auditory and visual confounds. Results highlighted a central and contralateral positive response (50-170ms) a central bilateral negativity (200-300ms) (pclusts<0.05). Our results highlighted that TRF topographies clearly dissociated neural synchronization for stimulations to left and right-hand thumbs and pinkies between 50 and 380 ms (pclusts<0.05). Strikingly, topographies of the tactile TRF were also sensitive to finger stimulations within each hand between 50 and 250 ms (pclusts<0.05).

Our results demonstrated for the first time the possibility of using EEG to measure the neural synchronization or neural tracking of an ecological, unpredictable, and continuous stimulation in the somatosensory domain. Crucially, this method distinguishes digit lateralization and representation, linking the activity of the somatosensory system with individualized, idiosyncratic stimulations of a specific finger.

39 The mediating role of childhood motor skills on the association between error correction and social pragmatic communication in adulthood

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Early motor function is important for emerging social pragmatic communication (SPC) skills in both typical and atypical development. However, the nature of motor impairments relevant for higher-level communication is not well understood. Inefficient cerebellar error correction might directly cause both developmental coordination disorder (DCD) symptoms and SPC difficulties, through the extensive communication between cerebellar zones and brain-wide sensorimotor and higher-order networks. DCD symptoms related to cerebellar deficits could also impact SPC through affecting the developmental trajectory of social development, which requires motor skills. This study aimed to test the hypothesis that error correction deficits affect SPC outcomes through childhood DCD symptoms, by using contemporary causal inference methodology. We used a finger tapping task and computational modeling to measure cerebellar error correction in adult participants (n = 138), and quantified childhood DCD symptoms and SPC skills using psychometric measures. The results confirmed that error correction ability likely affects SPC skills, and indicated that childhood motor skills significantly mediated this. These results argue against a direct effect of domain-general error correction deficits on SPC, and instead suggest that cerebellum-related DCD symptoms affect sociocommunicative development more directly through motor deficits during development. Further research is required to test whether cerebellar error correction could be used as an early marker to identify children in need for early SPC interventions.

40 Familiarization with previously unknown music leads to decreased theta and gamma ERD

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Repeated listening to unknown music leads to gradual familiarization with musical sequences. Passively listening to musical sequences could involve an array of dynamic neural responses in reaching familiarization with the musical excerpts. This study elucidates the dynamic brain response and its variation over time by investigating the electrophysiological changes during familiarization with initially unknown music. Twenty subjects were asked to familiarize themselves with previously unknown 10 s classical music excerpts over three repetitions while their electroencephalogram was recorded. Time-frequency analyses reveal sustained theta event-related desynchronization (ERD) in the frontal-midline and the left prefrontal electrodes, which decreased gradually from the 1st to the 3rd time repetition of the same excerpts. Similarly, sustained gamma ERD decreased in the frontal-midline and bilaterally frontal/temporal areas. During familiarization, the decrease of theta ERD is superior in the first part (1–5 s), whereas the decrease of gamma ERD is superior in the second part (5–9 s) of music excerpts. The results suggest that decreased theta ERD is associated with successfully identifying familiar sequences, whereas decreased gamma ERD is related to forming unfamiliar sequences.

41 Normative Modeling of Resting-State MEG Data: Insights into Aging Brain Dynamics

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Normative modeling has recently emerged as a powerful framework for decoding the heterogeneity inherent in neuropsychiatric disorders. However, deriving lifespan normative ranges of functional imaging-derived phenotypes (fIDPs), such as magnetoencephalography (MEG) recordings, presents several technical challenges due to data and modeling complexities. In this study, we benchmark various configurations of the hierarchical Bayesian regression (HBR) algorithm for their potential in modeling non-linear, skewed, and heteroscedastic aging effects on several fIDPs in resting-state MEG data. We utilized the Cambridge Centre for Ageing Neuroscience (CamCAN) dataset, which includes more than 600 participants aged 18-88. The normative ranges are derived for periodic components (absolute and relative power spectrum in canonical and individualized frequency bands) and aperiodic components (offset and exponent) of the signal at the coarse sensor level. Our results show an overall decreasing trend in Alpha oscillations and an increasing trend in Beta oscillations with aging, while Theta and slow Gamma oscillations remain stable. Our observations further highlight the importance of i) adjusting the periodic power spectrum for the aperiodic component, especially for the Gamma band, and ii) using model selection to address the diverse effects of aging on different fIDPs. Overall, our findings confirm the feasibility of deriving reliable aging charts from MEG data. We plan to extend our model by i) incorporating additional datasets, ii) deriving normative ranges at finer spatial resolutions in the source space, and iii) benchmarking the model on clinical populations.

42 EEG correlates of multimodal feedback assisted movement learning

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Human motor learning is facilitated by action-perception loops (APLs) that develop from birth. Learning any new movement involves the reorganization and refinement of these loops. Perception can be limited to a single modality; however, the most effective learning is ensured by feedback from multiple modalities (visual, auditory, haptic perception). Knowledge about the neural background of APLs and particularly the interaction with multimodal perception is still limited.

To understand the relationship between motor learning and multimodal perception an experiment was conducted on adult participants while recording EEG. The participants had to navigate an "invisible maze" by moving their hands over a table. A neural network-based model identifies hand positions. The hand position is compared to a map and auditory and/or visual feedback is given if the participant hits the “wall” of the maze. Solving the maze requires learning a specific sequence of movements. Learning performance is measured in several procedurally generated mazes. Learning is operationalized as an increase in the accuracy and speed of repeated task performance, as well as the neural-motor synchronization observed during movement repetition and its changes.

Hypotheses were (1) learning can be detected from changes in functional brain networks during task performance and from changes in EEG-movement synchronization, (2) the effect of auditory and visual varies while there is a transfer between modalities. Preliminary results show that trial success can be predicted from EEG-movement synchronization and functional networks differ between feedback modalities.

43 Fluctuations in neural sensory encoding and prior expectation jointly account for biased auditory decision-making

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Perceptual decisions depend on integrating sensory evidence over time. Yet, human perceptual performance reveals different sources of suboptimality: Prior expectations introduce perceptual biases; neural sensory encoding fluctuates; and not least the sensory evidence get weighted unequally over time. Here we ask how these processes jointly impact auditory decision-making and its metacognitive corollaries.

In this EEG study (N=32, 18–33 yrs), participants listened to 1-sec trains of 20 clicks, each presented to either left or right ear (adapted from [1]). A Bernoulli process randomly presented clicks to either ear. Using a joystick, participants decided which side had more clicks. Prior expectations were manipulated via a preceding visual cue: For half of the trials, an informative (80% valid) cue indicated which ear was more likely to receive more clicks in a given trial.

We here report evidence for cue-related alterations at different levels: Psychophysical analysis showed a symmetric shift in response bias for informative vs. neutral cues. A psychophysical kernel ("reverse correlation") analysis revealed more optimal (i.e., more uniform) temporal integration following informative cues. Cue-related changes in perceptual decisions were in part explained by fluctuations in neural sensory encoding, with lower neural encoding accuracy predicting less optimal decision-making.

In sum, our results show how suboptimal perceptual performance arises from biases situated along different stages of the processing hierarchy.

44 Topographical relocation of sleep spindles and their relation to internalizing problems: a longitudinal approach

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Introduction:
Research has established a strong link between affective disorders and sleep problems. Specifically, lower sleep spindle activity has been connected to internalizing Problems (IP) in children and adolescents. However, most studies have focused on examining this relationship at a single point in time. Here, we investigated the topographical developmental trajectories of sleep spindles and tested, whether deviations from these patterns predict IP.
Method:
We conducted polysomnographic recordings and measured IP via questionnaires across 15 years in a sample of subjects (N =28, 19 female) at three time points: (1) childhood (~9.5yrs), (2) adolescence (~16yrs), and (3) young adulthood (~22.5yrs). Two nights were recorded at each time point (adaptation and experimental night). To assess the topographical spindle pattern, we measured slow (11-13Hz) and fast (13-15Hz) spindle densities (N/min) during N2 sleep.
Results:
Frontal slow spindle density remained stable between childhood and adolescence ($t(27) = 0.65$, $p = .677$, MD = 0.19). A stronger individual decrease in frontal slow spindle density was associated with higher IP scores in adulthood (rsp = - .44, $p = .018$). Conversely, slow spindle density typically decreased from adolescence to adulthood ($t(27) = 7.88$, $p < .001$, MD = 1.57). During this period, a greater decline predicted lower levels of IP in adulthood (rsp = .44, $p = .020$).
Conclusion:
Our results study provide evidence that frontal slow spindle development is associated with IP during adulthood. We found this association to be dynamic, with the direction of the effect being dependent on the developmental period.

45 Grab it when off guard: State-level approach bias predicts eating under low top-down control

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The tendency to approach food faster than to avoid it (i.e., approach bias) is thought to facilitate actual food intake, particularly when it comes to foods that conflict with one's dietary goals. However, this relationship has been difficult to demonstrate, which potentially relates to an ongoing debate about whether such cognitive-behavioral biases represent stable traits or rather fluctuating states. Here, we thus investigated the temporal fluctuations of food approach bias (1), its within-participant association with food craving (2) and intake (3), as well as the role of top-down control in this bias intake association (4). A total of 76 participants, completed an impulsivity questionnaire and were asked to perform a smartphone-based approach-avoidance task on nine separate days. Additionally, they reported their daily craving, intake, and dietary intention for 12 personalized foods they wanted to eat less or more often over the whole study period. Multilevel models analyses showed that approach bias varied considerably within individuals (1), correlated with craving (2) and with intake (3), but the latter effect was only present for individuals with generally weak dietary intentions or high impulsivity (4). Results emphasize the need to re-conceptualize approach bias as comprising both state and trait components, and they indicate that top-down processes gate the relationship of approach bias with intake. Findings explain why single-session approach bias measures often do not predict distal outcomes such as body weight. Furthermore, interventions targeting approach bias may be tailored to certain timepoints (high-risk situations) and individuals (those with weak intentions and high impulsivity).

46 Preliminary results: The impact of alterations in NREM sleep and progesterone on overnight memory consolidation during early pregnancy

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Aim: Investigating memory-related sleep parameters and their association with progesterone in early pregnancy.

Design: Five women (MAge = 28.60 +/- 1.67) in their first trimester of pregnancy and nine non-pregnant women (MAge = 25.70 +/- 3.00) in their luteal phase participated in a seven-day experimental block. Polysomnography was recorded during two nights. Progesterone levels were assessed by saliva samples. A declarative word-pair learning task was performed before the experimental night. Sleep architecture, as well as the density of slow (11-13 Hz) and fast (13-15 Hz) sleep spindles, slow oscillations, and their coupling were analyzed.

Results: Pregnant women showed less N3 sleep in the second and third quarters of the night than non-pregnant women. They also tended to have reduced slow sleep spindle density and frontal slow oscillation positive peak amplitudes. Fast sleep spindle density and the precise coupling of spindles with slow oscillations were not altered. Frontal sleep spindle coupling with slow oscillations was positively correlated with overnight memory consolidation in pregnant and non-pregnant women. Progesterone was negatively correlated with fast and slow sleep spindle density in non-pregnant women. Furthermore, the association between progesterone and positive peak amplitudes of slow oscillations at frontal and central sites tended to follow a U-shape. Pregnant women showed comparable overnight memory consolidation to non-pregnant women.

Conclusion: Pregnant women already showed deviations in sleep architecture and memory-related sleep parameters during the first trimester. Some of these parameters were related to progesterone. However, these changes did not significantly impact overnight memory consolidation in this sample.

47 Intact auditory processing of low-level stimulus features but disrupted pre-stimulus prediction-related and feature-specific processing during human sleep

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As attentional resources are naturally minimised in sleep, recent studies have sought to determine the extent to which the brain engages in the predictive processing of auditory inputs. Here, for the first time, we examine the brain's ability to predict or pre-activate the low-level stimulus features of an expected stimulus prior to its actual presentation. In a passive listening paradigm, 34 participants listened to tone sequences comprising of four simple tones (i.e., low to high-pitch), while recording simultaneous EEG and MEG brain activity during wakefullness (20 mins) and a 2.5 hour nap. We presented the tones continuously at a fixed presentation rate (3 Hz), to establish strong temporal predictions, and manipulated the tone transition probabilities to create predictable and unpredictable/random sequences. Using multi-level pattern analysis (MVPA), we show that the low-level stimulus properties of the four tones remain decodable in light non-REM N1 and non-REM N2 sleep. However, compared to wakefulness decoding accuracies dropped significantly and were less sustained over time. In addition, we find that in wakefulness the feature-specific neural activations of an expected tone are even decodable before its actual presentation. Going beyond previous findings, we show that these neuronal prediction or pre-activation patterns are still evident in light N1 sleep, but cease during N2. Altogether, the data suggest that stimulus-specific auditory processing is retained despite the fading of consciousness, while stimulus-specific anticipatory processing is dependent upon minimal levels of conscious processing such as in transitory N1 sleep.

48 The impact of vibrotactile stimulation on the neural tracking of speech

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In the current study, we investigated whether vibrotactile stimulation derived from the speech temporal envelope can facilitate the neural tracking of speech in normal-hearing listeners. Magnetoencephalographic (MEG) activity from 30 French-speaking participants was recorded while they attended to videos of native French speakers reciting stories with neutral content. The heard audio was presented either in silence or embedded in multi-talker noise, with (Audiotactile [AT] condition) or without (Audio-only [A] condition) vibrotactile stimulation. During the AT conditions, vibrotactile envelope-based stimulation was delivered to the participants' left palm either congruently (i.e., in synchrony) or incongruently with the speech signal of the attended speaker. Neural tracking was then assessed per condition using speech-brain coherence at the phrasal and syllabic levels (0.2 – 1.5 Hz and 2 – 8 Hz, respectively). Results indicate a robust enhancing effect of the congruent vibrotactile stimulation on the neural tracking of speech. This vibrotactile benefit was present at the syllabic-level tracking and was significantly more pronounced in the right hemisphere. Moreover, the effect of vibrotactile input was particularly enhanced under noise conditions. Contrastingly, no effect of the vibrotactile stimulation was found on the neural tracking of speech at the phrasal level. Vibrotactile input also impacted behavioral performance, with comprehension in noise being significantly improved by congruent vibrotactile input compared with audio-only or incongruent AT conditions.

This study provides novel insights into the mechanisms of proven haptic enhancement of speech comprehension in silent and noisy auditory conditions, with potential implications in the design of haptic auditory devices.

49 Foraging in conceptual spaces: neurophysiological mechanisms of mental search in semantic memory

Giuliano Giari[1], Simone Viganò[1], Roberto Mai[2], Christian F. Doeller[3], Roberto Bottini[1]

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The medial temporal lobe (MTL) represents both spatial and abstract relational information. However, how do we search and access stored knowledge? During navigation the hippocampal formation displays rhythmic oscillatory activity in the theta band (3-10 Hz), conveying information about traveled distance and velocity. Here we asked if this physiological signature of physical exploration also extends to mental exploration of abstract spaces, such as when recalling concepts from memory.

We used stereo-EEG to record local field potentials from the MTL of epileptic patients performing a categorical verbal fluency task, randomly "foraging" for concepts from different categories (animals, professions, or famous cities).

Preliminary results from 11 patients indicate that, in the period preceding the utterance of a word, theta power in MTL was significantly higher than during or after word pronunciation. This effect was independent of the semantic category that was mentally explored, and was more pronounced in the MTL than lateral temporal cortices. Furthermore, we used linear mixed models to test whether theta power was modulated by semantic distances between words, modeled using distributional semantics. We observed significant modulation from -1000 to -600 ms relative to word onset when considering high-dimensional semantic distances. In contrast, low-dimensional semantic distances more strongly modulated theta power in the time interval from -300 to -100 ms.

Although preliminary these results suggest that physiological signatures of hippocampal activity during physical exploration might also extend to mental exploration of abstract spaces, and potentially reveal novel mechanisms underlying the access of conceptual information from memory.

50 CAUSAL NEURAL SYNCHRONY IN ATTENTIONAL SIGNAL TRANSMISSION: TMS-EEG EXPERIMENT

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Neural synchronization has been suggested as a mechanism for information flow, with slower alpha/beta frequencies associated with feedback signals and gamma frequencies linked to feedforward propagation. Combining Electroencephalography (EEG) and online Transcranial Magnetic Stimulation (TMS) can provide insights into these dynamics by examining their causal role. To this purpose, EEG activity was measured in 32 participants performing a near-threshold visuospatial cueing task while single-pulse TMS was applied to key nodes of the attentional network (FEF, V5, and a control site, foot area) during the orienting period. Addiontally, sine gratings with concentric motion were presented in the half of the trials to enhance feedforward propagation. Time-frequency amplitude and intertrial phase coherence (ITPC) were calculated relative to the TMS pulse. The control condition, a no-attentional cue, was used to isolate the TMS effect on the neural fingerprints of attention, being subtracted from each spatial cue (left and right). Alpha/beta and gamma bands' amplitude and ITPC were analyzed in pre- and post-TMS pulse windows using a four-way repeated measures ANOVA. Preliminary results indicate an interaction between the time window and stimulus presence, with alpha amplitude reduced after the TMS pulse only in trials with stimulus presentation. This suggests that FEF TMS disrupts the attentional feedback process when feedforward propagation is previously enhanced. Further analysis of control site data will determine if the effect of stimulation depends on the brain's attentional state and the role of brain oscillations in information flow.

51 Temporal Prediction in Non-Deterministic Continuous Environments: investigating the role of oscillatory entrainment and interval learning

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Interaction with our continuously changing environment relies on anticipating timing of events, enhancing information processing efficiency. Abundant research has investigated temporal prediction in deterministic environments such as isochronous rhythms, where the presumed mechanism is Oscillatory Entrainment (OE) to external rhythms. However, in everyday life, continuous streams lack fully-deterministic temporal regularities. Previous research of temporal prediction in uncertain environments has focused on isolated intervals, suggesting a Distributional-Learning (DL) model. However, in non-deterministic streams, if and under which conditions either of these mechanisms drives prediction is unclear. To address this, we combined computational modeling of the two mechanisms (OE and DL) and human behavioral experiments. In our simulation modelling, we found that while models are affected differently by the degree of variability in the environment, they lead to more overlapping predictions in lower degrees of variability. In our behavioral experiment (speeded response task), we presented specific streams from our simulation in which the predictions of the two mechanisms were differentiated the most, with targets happening at either timepoint of the predictions. Participants' behavior followed predictions of either of the models, depending on the degree of variability and context of the environment. Overall, our results highlight the role of inherent differences between OE and DL mechanisms and the environmental context in dealing with temporal prediction in uncertain environments.

52 From Movement to Mind - Physical Activity does not affect Cognitive Functioning in Older Age

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Background: The World Health Organization highlights the importance of physical activity for physical and mental health, indicating its essential role in preventing age-related cognitive decline in aging populations. Understanding how and to what extent physical activity influences cognition and aging is crucial. However, most existing studies are cross-sectional, providing only limited and short-term insights into the relationship between physical activity and cognitive health. This study aimed to investigate long-term effects by examining various measures of physical activity and their impact on cognitive functioning in older adults using longitudinal data.

Methods: Data from the Berlin Aging Study (BASE), a multidisciplinary investigation involving psychological and medical examinations of older adults in West Berlin, were used. Multiple regression analyses were conducted to predict cognitive performance (memory and intelligence). Analyses included current activity status, total duration of physical activity across the lifespan, frequency, past physical activity, activity at different age phases, and control variables such as baseline cognitive ability, gender, BMI, education, and sleep. The final sample included N = 206 participants, aged 68-97 at baseline (M = 78.68) and 73-103 at follow-up (M = 83.67).

Results: After controlling for covariates, none of the physical activity measures significantly predicted cognitive functioning at follow-up. While some cross-sectional and minor longitudinal associations were found between years of exercise and cognitive performance in different life phases, these preliminary results indicate no definite causal, long-term effects of physical activity on cognitive functioning in older age.

Discussion: The relationship between physical activity and cognitive functioning is complex. Future research should include diverse samples and begin in earlier life stages to better understand the long-term effects of physical activity on cognitive functioning.

53 Action-Related Hub in the Left Lateral Occipitotemporal Cortex (LOTC): Spatial Arrangement and Gradual Abstraction

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Various types of action-related information were found to be represented in the left lateral occipitotemporal cortex (LOTC). Studies on basic and biological motion, bodies, body parts, tools, action perception, performance, and action verbs demonstrate selective LOTC recruitment. However, differences in tasks, participants and methods between studies prevent direct task comparisons. We aimed to directly compare several tasks within the same participants to identify a consistent spatial arrangement of action-related selectivity and the similarity of representations across LOTC in this study.

FMRI data for eight localizer experiments (Motion, Biological Motion, Bodies & Tools, Body Parts, Action Observation, Action Performance, Verbs, and Higher-Level Retinotopic Mapping) using visual stimuli in 21 participants were collected. Participants viewed pictures, videos, or words and performed tasks appropriate for the different localizers. We analyzed the data with eleven random-effects general linear model (RFX GLM) contrasts and threshold-free cluster enhancement (FSL). Peak t-values were determined in the occipital and temporal lobes for each participant and contrast, and mean peak coordinates and confidence intervals for peak location reliability across participants were calculated.

Results indicated that basic motion and body perception primarily activated posterior areas of the LOTC, while tools and action observation were localized in more central regions, and verbs and action performance activated anterior regions. Peak distributions were consistent across participants, with confidence intervals indicating overlap among different functional localizers. Action observation and verbs elicited focal activation, whereas biological motion showed greater variability across the occipital and temporal lobes.

Overlapping clusters of multiple action-related functions were found within the LOTC. The distribution of peaks suggests a gradient of abstraction, where posterior regions encode concrete perceptual representations, while anterior areas are involved in more abstract cognitive tasks. We propose that subregions of the LOTC specialize in evaluating specific aspects of action, while the broader region integrates diverse information sources to form a more abstract representation of action understanding.

54 The Austrian NeuroCloud - FAIR data operations for Cognitive Neuroscience

Barbara Strasser-Kirchweger and the ANC Team[1]
[1]University of Salzburg, Austria

The Austrian NeuroCloud (ANC) is a FAIR-enabling platform for sustainable research data management in Cognitive Neuroscience. The ANC offers tools and services to archive, manage, and share neurocognitive data flexibly and according to community standards. Scientists have full control over what they share (e.g., full original datasets or data derivatives), how they share it (by choosing from a selection of licensing models), and with whom (e.g., by using the ANC's adjustable User Agreement templates).

The ANC provides persistent DOIs for data releases and operates in accordance with European GDPR. Moreover, the ANC fully supports the mission of the EOSC and is committed to the EU's open science policy, legal standards, and best open science practices. Accordingly, the ANC aspires to facilitate FAIR data operations along the entire data lifecycle, actively supporting the ongoing shift in research culture towards increased transparency, data reusability, and result reproducibility.

55 PyRASA - Spectral parameterization in python based on IRASA

Fabian Schmidt[1], Thomas Hartmann[1], Nathan Weisz[1]
[1]University of Salzburg, Austria

The electric signals generated by physiological activity exhibit both activity patterns that are regularly repeating over time (i.e. periodic) and activity patterns that are temporally irregular (i.e. aperiodic). In recent years several algorithms have been proposed to separate the periodic from the aperiodic parts of the signal, such as the irregular-resampling auto-spectral analysis (IRASA; Wen & Liu, 2016). IRASA separates periodic and aperiodic components by up-/downsampling time domain signals and computing their respective auto-power spectra. Finally, the aperiodic component is isolated by averaging over the resampled auto-power spectra removing any frequency specific activity. The aperiodic component can then be subtracted from the original power spectrum yielding the residual periodic component. Here, we present a new Python toolbox that is building upon and extends the IRASA algorithm. The toolbox allows the user not only to separate power spectra, but also contains functionality to further parametrize the periodic and aperiodic spectra, by means of peak detection and several slope fitting options (eg. spectral knees). We can show that the tool performs as well in detecting variations in aperiodic components as the current gold-standard (specparam; Donoghue et al. 2020), while requiring less parameter tuning and being more robust in detecting “true” oscillatory activity. Furthermore, we extend the IRASA algorithm to the time-frequency domain allowing for a time-resolved spectral parameterization using IRASA.

56 Neuromagnetic Dynamics in Migraine: Comparing Periodic and Aperiodic Activity in Patients and Controls

Vanessa Frey[1], Stefan Leis[1], Eugen Trinka[1,2], Nathan Weisz[1,2], Gianpaolo Demarchi[2]

[1]Paracelsus Medical University, Salzburg, Austria, [2]University of Salzburg, Austria

Migraine is a highly prevalent neurological disorder that significantly impacts both individuals and society. This study investigates the differences in periodic and aperiodic brain activity between migraine patients and healthy controls using magnetoencephalography (MEG). The research involves 25 migraine patients and 25 healthy controls. Within the patient group, further analysis differentiates between those with migraine with aura (MA, n=15) and without aura (MoA, n=10).

Traditional MEG analyses often focus solely on periodic oscillations. However, recent advancements highlight the potential significance of aperiodic activity, which may provide valuable insights into the brain's excitation-inhibition (E-I) balance. Aperiodic components, often excluded from traditional analyses, can reveal underlying neural dynamics that are not captured by periodic oscillations alone. By utilizing advanced methods such as FOOOF (Fitting Oscillations and One Over F) and IRASA (Irregular-Resampling Auto-Spectral Analysis), our study performs a comprehensive full power spectrum analysis, incorporating these often-neglected aperiodic components.

We hypothesize that migraine patients exhibit a higher imbalance in the E-I proportion, reflecting increased cortical excitability, compared to healthy controls. Additionally, we expect this imbalance to be more pronounced in MA patients compared to MoA patients. This exploratory project involved MEG data collected on healthy subjects, and patients without migraine at the time of the measurements. The results could reveal crucial differences in the neuromagnetic characteristics between these groups, advancing our understanding of migraine pathophysiology and potentially guiding the development of more effective treatment strategies. This study has the potential to uncover novel neurophysiological information that could lead to more targeted and effective therapeutic interventions for migraine sufferers.

57 Eye Movements in Silent Visual Speech track Unheard Acoustic Signals and Relate to Hearing Experience

Kaja Rosa Benz[1], Anne Hauswald[1], Nina Suess[1], Quirin Gehmacher[2], Fabian Schmidt[1], Gudrun Herzog[3], Sebastian Rösch[4], Nathan Weisz[1]

[1]University of Salzburg, Salzburg, Austria, [2]University College London, United Kingdom, [3]University Hospital Salzburg (SALK), Salzburg, Austria, [4]University of Regensburg, Regensburg, Germany

Behavioral and neuroscientific studies have shown that watching the movements of a speaker's lips aids speech comprehension. Intriguingly, even when videos of speakers are silently presented, various cortical regions have been shown to track auditory features, such as the envelope. However, the cause and function of silent neural speech tracking have remained elusive. Recently, we have shown that when attentively listening to speech, eye movements track low-level acoustic information. If also present during processing of silent videos of speakers, eye movements could offer a parsimonious explanation for cortical speech tracking. Yet, whether ocular speech tracking can also be observed in silent visual speech and how this influences cortical speech tracking is unknown. Here, not only hearing but also congenitally and acquired deaf individuals were investigated to test how auditory deprivation (early vs. late onset) affects neural and ocular speech tracking in silent lip-reading. In this magnetoencephalography (MEG) study, we investigated the electrooculogram (EOG) and neural speech tracking of 73 participants observing silent videos of a speaker played in a forward and backward manner. Our main finding is a clear ocular speech tracking effect to the unheard auditory envelope with a dominance <1 Hz, that was not present for the lip movements. Similarly, we could show a <1 Hz effect of unheard auditory envelope tracking in temporal regions for hearing participants. Importantly, in this study neural tracking is not directly linked to ocular tracking. Strikingly, across different listening groups, deaf participants with auditory listening experience show higher ocular speech tracking than hearing participants, while for congenital deaf participants in a very small sample, no ocular speech tracking effect was revealed. This study extends our previous work in showing the involvement of eye movements in speech processing even in absence of acoustic input. While underscoring the role of eye movements in speech processing, this study simultaneously raises numerous questions for future research, especially regarding their functional relevance.

Information

The SAMBA-Meeting takes place at the ***Faculty of Natural and Lifesciences (NAWI)***

University of Salzburg
NAWI
Hellbrunnerstraße 34
5020 Salzburg, Austria

How to get to the venue?

By car

Motorway A10 exit Salzburg Süd/Anif (in the direction Salzburg Zentrum). Go along *Alpenstraße* for about 6 km. Turn left in the *Friedensstraße*. Turn right in the *Hellbrunner Straße* after about 500 m

Parking areas at or nearby the venue (with costs):

- Parkplatz Akademiestraße (5-minute-walk)
- Tiefgarage Zentrum Herrnau (Alpenstrass 48, 3-minute-walk)

Public transport

Bus tickets can be purchased at kiosks (so called "Trafik"), vending machines or if you directly ask the bus driver (which is a little more expensive). To find the perfect connections via public transport in Salzburg please go to salzburg-verkehr.at/en.

Bus stations near the venue:

- Faistauergasse (6-minute-walk)
- Michael-Pacher-Straße (directly in front of the NAWI, only bus line 22)

From the main train station

Take the bus line 3 *(in the direction of Salzburg Süd)* until *Faistauergasse* (14 min, 8 intermediate stops). The NAWI is ~550 m walking distance.

From the airport

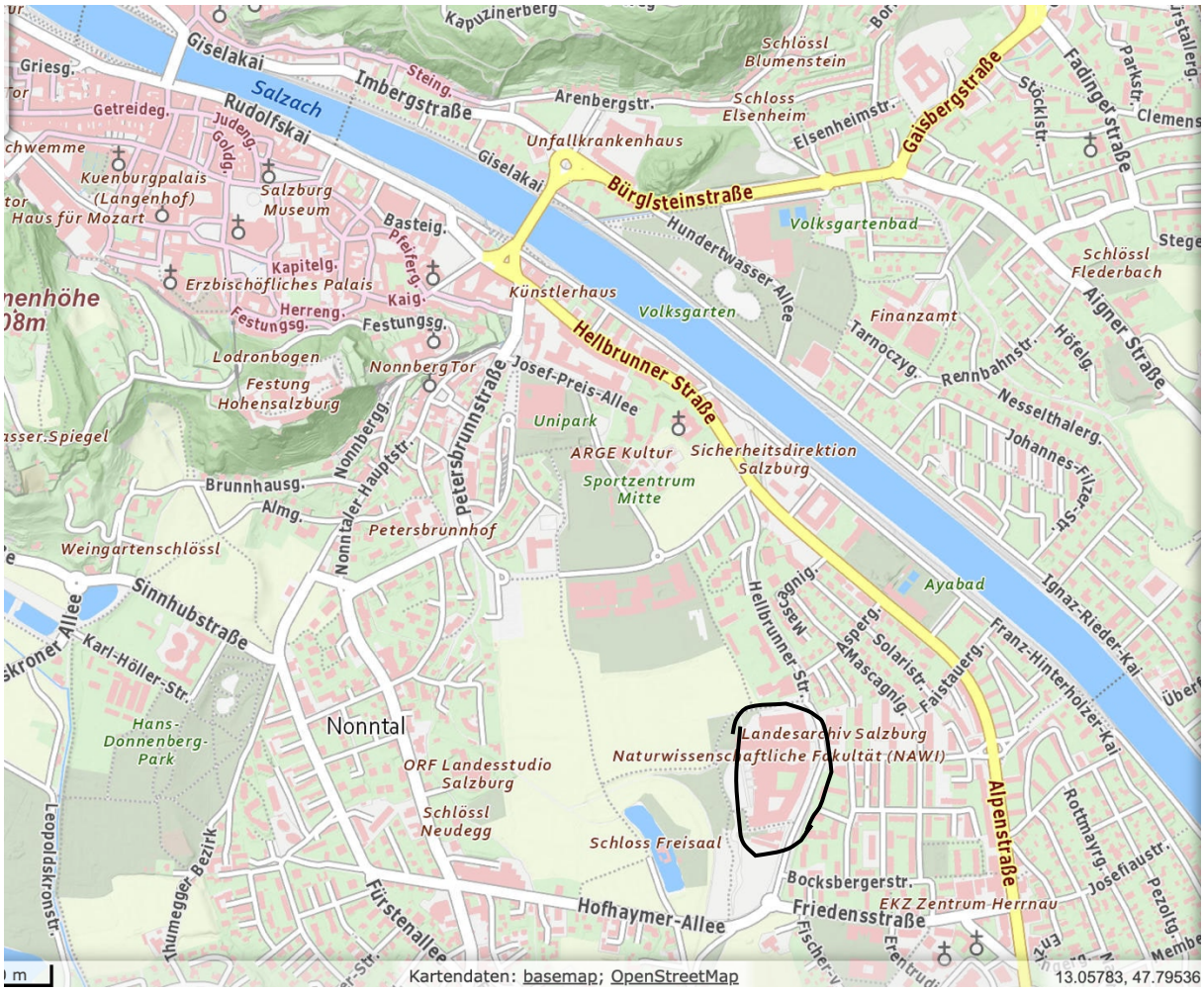
Option 1: Take the bus line 10 *(in the direction of Sam)* until *Ferdinand-Hanusch-Platz* (17 min, 10 intermediate stops). Then take bus line 3 or 8 *(in the direction of Salzburg Süd)* until *Faistauergasse* (6 min, 4 intermediate stop). The NAWI is in ~550m walking distance.

Option 2: Take the bus line 2 *(in the direction of Obergnigl)* until *Salzburg Aiglhof LKH West* (11 min, 6 intermediate stops). Then take bus line 8 *(in the*

direction of Salzburg Süd) until *Faistauergasse* (16 min, 10 intermediate stops). The NAWI is in ~550m walking distance.

Local Supply

The venue is very close to the city center, which offers lots of opportunities.



Nearby spots for lunch

- Mensa (directely at NAWI)
- Zentrum Herrnau (*Alpenstraße 48, 5020 Salzburg*):
- Raschhofer Herrnau
- Resch (Bakery)
- MyIndigo
- La Cantinetta

Bars / Restaurants

Some places we recommend for having a good Austrian meal:

- Bärenwirt (city centre)
- Kastners Schenke (city centre)
- Restaurant Stieglkeller (city centre)
- Raschhofer Herrnau (10-minute-walk from the venue)
- Pauli Stubm
- Zum Zirkelwirt (10-minute-walk from the venue)
- Imlauer Sky Bar & Restaurant (25-minute-walk from the venue)
- Gasthof Überfuhr (25-minute-walk from the venue)
- Stadtalm (30-minute-walk from the venue)

To have a drink after the meeting we recommend:

- Times Bar
- The Dubliner Irish Pub
- Celtic Spirit
- Alchimiste Belge
- Whiskey Museum
- Darwin‘s
- Schnaitl Bier + Bar
- Mentor`s Bar
- Glüxfall Café – Bar
- Wein & Co

Hotels / Hostels

Salzburg offers several accommodations. Some of them are listed below. You may also be interested in Airbnb.

- Via Roma
- Arcotel Castellani
- Motel One Alpenstraße
- Austria Classic Hotel Hölle
- A&O Salzburg Hauptbahnhof
- Eduard-Heinrich Haus (hostel)

Poster prints

If you need to print your poster directly in Salzburg, you can do it in one of the local copy shops. We recommend contacting the copy shop before your arrival and ask for the exact conditions and prices.

- University of Salzburg Printcenter (printcenter@sbg.ac.at)
- Colibri (nonntal@colibri-print.at)
- Copyprint (office@copypoint.at)

Social event

WHEN:

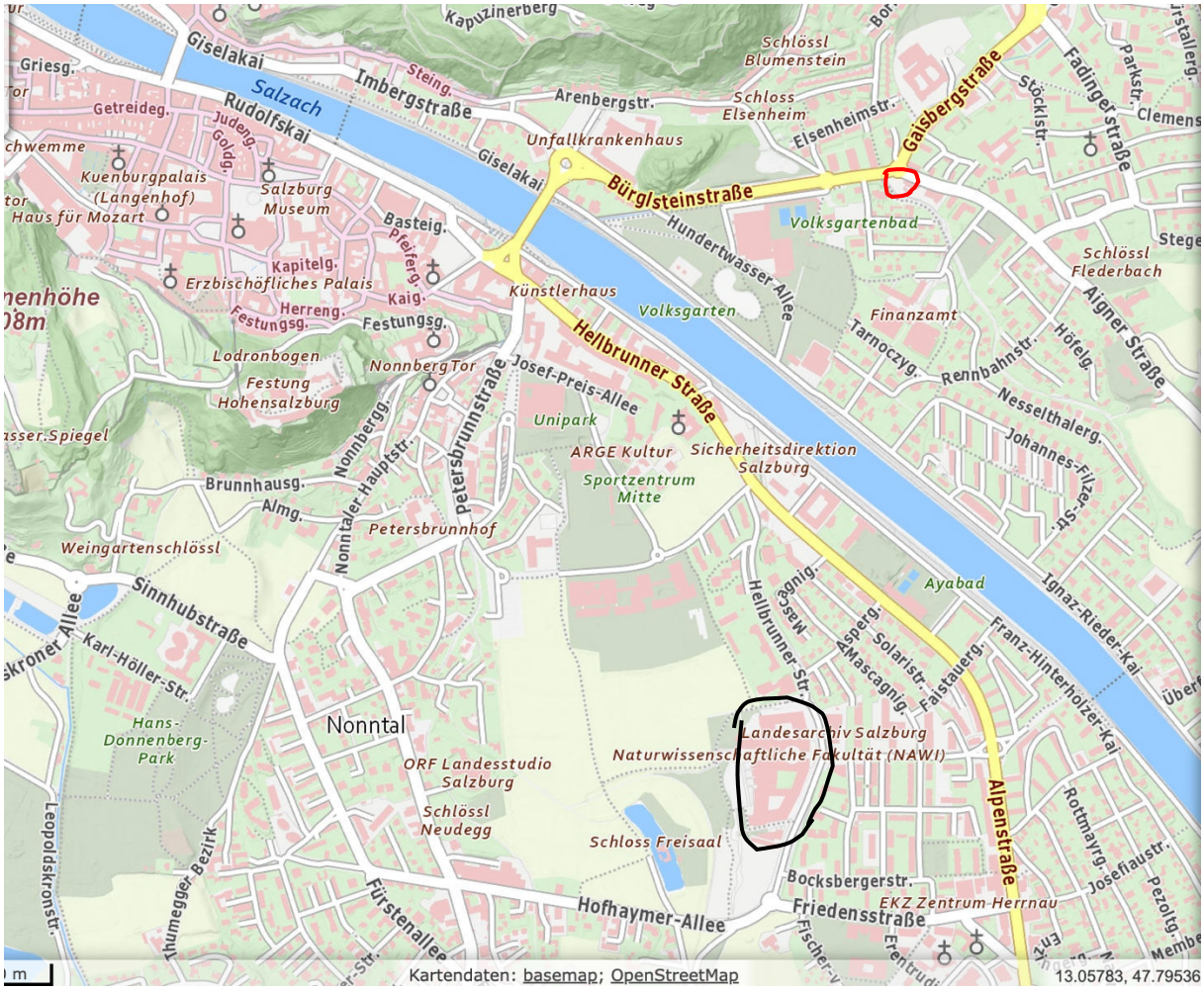
Friday, July 12th 2024, starting at 7:00 pm

WHERE:

“Steinlechner”

Aigner Str. 4

5020 Salzburg, Austria



WHAT DO I GET?

A three course menu and three drinks.

Please bring your name badge and your ticket with you!

You will need to give your ticket to the staff at “Steinlechner”.

WI-FI AND LINKS

You can use the following credentials for WiFi at the venue:

SSID: eduroam
User: v1108253
PW: lv3W18./<L

Find us online at:

University of Salzburg

SAMBA

CCNS

Salzburg Brain Dynamics Lab

@Salzburg_SAMBA