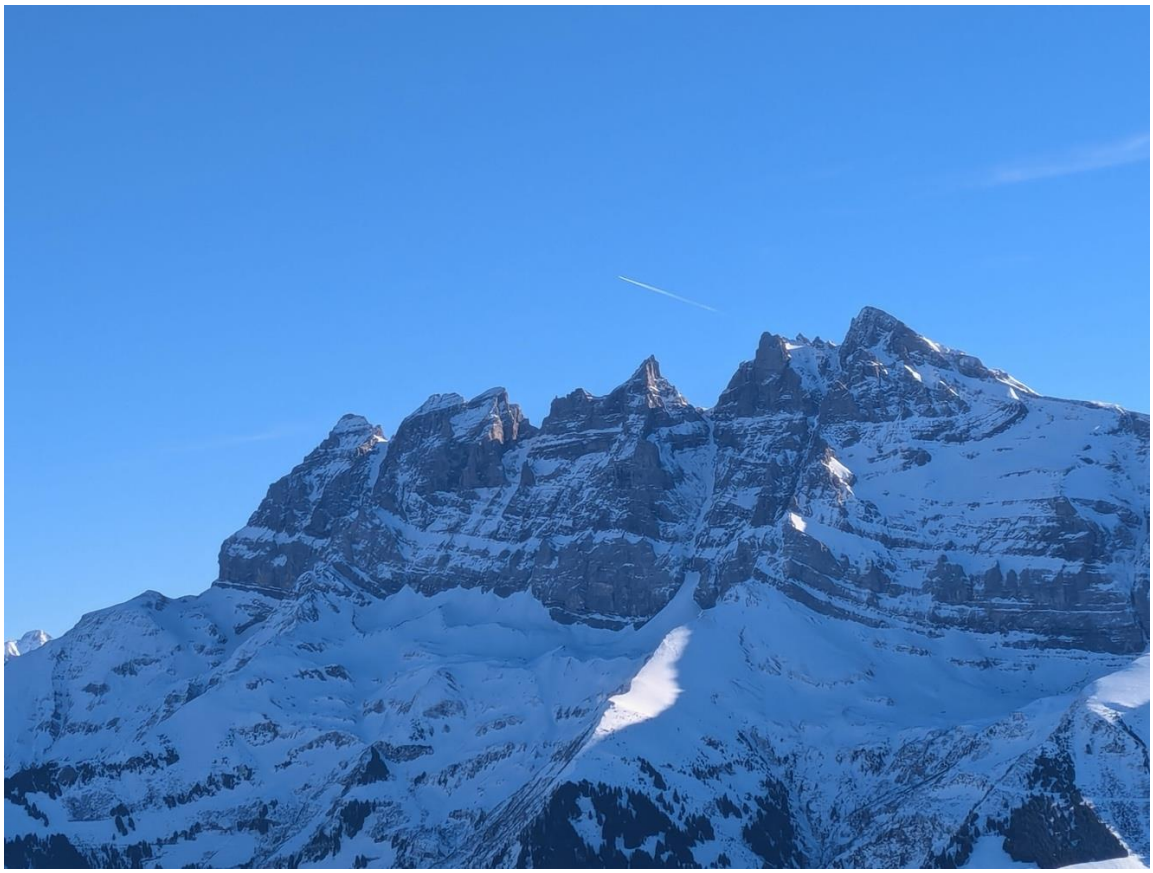
Alpine Brain Imaging Meeting

Champéry, Switzerland, January 12-16, 2025

P R O G R A M



http://www.unige.ch/ABIM/

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Alpine Brain Imaging Meeting

Champéry 2025

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Patrik Vuilleumier

Locations:

Registration, opening keynote lecture and welcome reception on Sunday will be held at the *Hotel Suisse*. Talks and poster sessions during the week will take place at the *Palladium Sport and Conference Center* (see map for details).

For more information, see website: http://www.unige.ch/ABIM/

GENERAL INFORMATION

Registration will take place at the *Hotel Suisse* (Rue du Village 55; see map) on Sunday, the 12th of January from 16:00 to 17:30. During the following days, participants can register in the conference room at the *Palladium* conference center (Route du Centre Sportif, 1), only during meeting hours, from 15:00 to 20:00. Additional information can also be obtained at the *Hotel Suisse* outside these hours.

The **opening keynote lecture** (Sunday at 17:30) will be held at the *Hotel Suisse* (Rue du Village 55) and will be followed by an informal **welcome reception** with wine & snacks. All other **talks** and **poster sessions** during the week will take place at the *Palladium* conference center (see program). Posters should be exposed throughout the conference from Monday to Wednesday to allow sufficient viewing time for all participants. **Three poster sessions** will be held on Monday 13th, Tuesday 14th and Wednesday 15th of January in the afternoon (see program and poster map). Speakers are invited to check their presentation in the conference room no later than at 15:00 on the day of their lecture.

Free **internet access** by WiFi is available in the lounge and in the café of the *Hotel Suisse*, as well as in the *Palladium* conference room.

There are several **restaurants** in Champéry, including one at the *Palladium* (which is open all day including evenings). Since many restaurants in town are relatively small, you are encouraged to book a table in advance, especially if you go with a large group. The staff at the *Hotel Suisse* or at the *Palladium* can help you with this. The kitchen closes generally around 21.30.

A **farewell dinner** is planned on Thursday night at the restaurant *Le Gueullhi* (Route de la Fin 11). The dinner will be free for all registered participants, excluding drinks. Please refer to the staff at the registration desk before Tuesday January 14th for any changes regarding your participation to the

dinner. A **prize ceremony** will be held with best poster and best presentation awards.

Ski slopes can be reached from two places, either using the cable car leaving from Champéry or the chairlift leaving from the Grand-Paradis (see map). Ski-passes of four days (Mon-Thu) can be bought at the *Hotel Suisse* with a group discount (announced during registration on Sunday evening) or individually at the cable car departure. Public buses are available for going to or coming back from the Grand-Paradis.

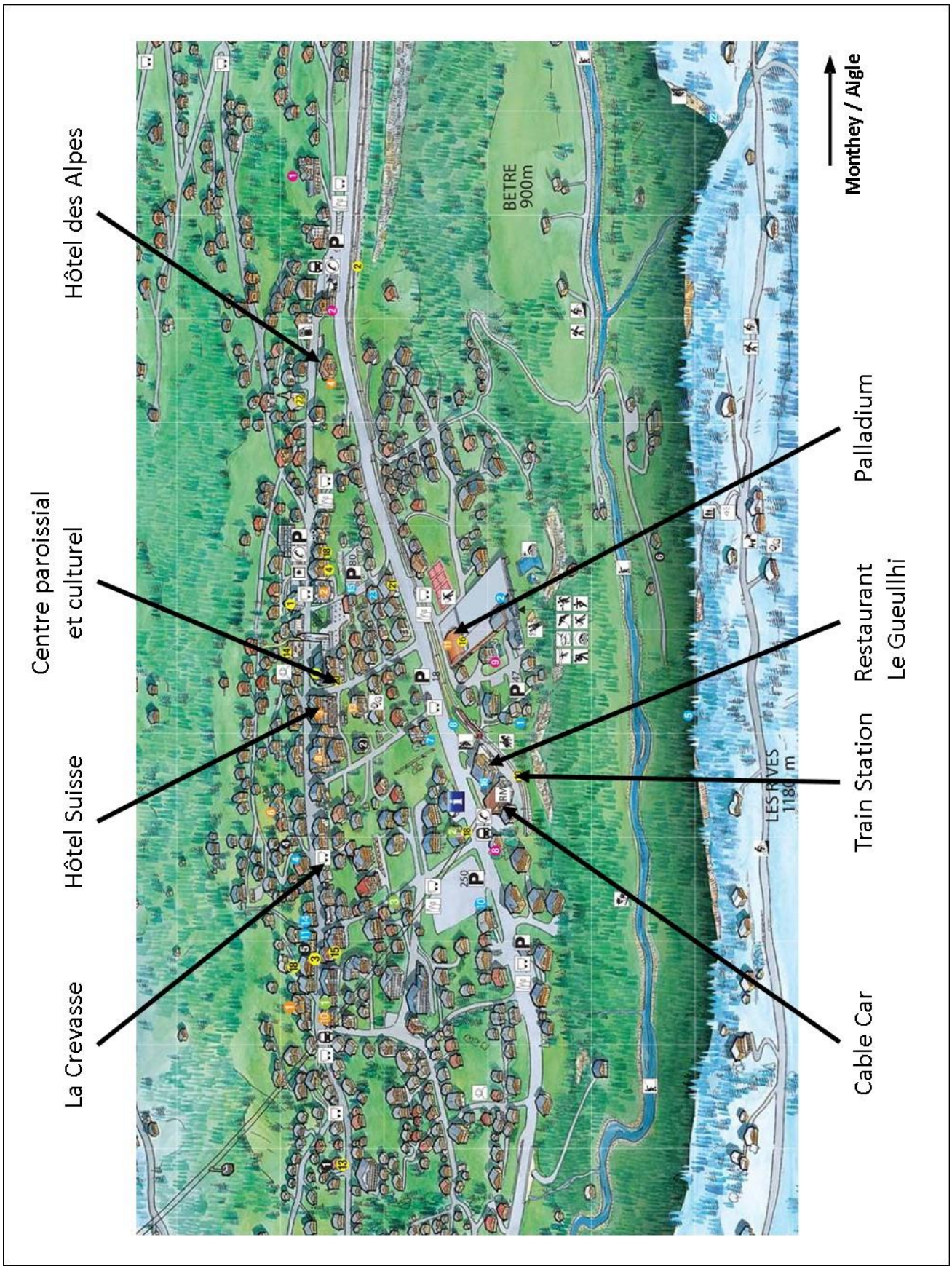
A **swimming pool** and **skating arena** can also be found at the *Palladium*.

The abstracts of the talks are listed in this book in order of appearance.

A ☆ marks presentations from invited speakers. Poster abstracts are ordered according to their category and day of presentation.

More information is available on http://www.unige.ch/ABIM/

MAP


Hôtel des Alpes
Centre paroissial et culturel
Hôtel Suisse
La Crevasse
Palladium
Restaurant Le Gueullhi
Train Station
Cable Car
Monthey / Aigle
BETRE 900m
LES RIVES 1180 m

Alpine Brain Imaging Meeting

PROGRAM 2025

SUNDAY, January 12th

OPENING LECTURE

16:30-17 :30 **Registration** (Hotel Suisse)

17:30 **Opening Keynote Lecture** (Hotel Suisse Conference Room)

Charan RANGANATH | University of California, Davis, USA

- *The boundaries of memory: How cortico-hippocampal interactions at event boundaries support memory and prediction*

18:30-20:30 **Welcome Reception** (Hotel Suisse) *sponsored by* CIBM Center for Biomedical Imaging

Methods and Perception

15:00 Welcome Coffee & posters

15:30 **Federico DE MARTINO** | Maastricht University, Maastricht, The Netherlands

- *Unraveling the past present and future in the auditory brain with UHF fMRI*

16:15 **Paul TAYLOR** | Ludwig Maximilians University, Munich, Germany

- *Decoding the identity of real-world scenes from the shape of steady state evoked potentials*

16:35 **David CORREDOR** | University of Helsinki, Finland

- *Graph signal processing for identifying structure-function coupling using multimodal brain-imaging with fMRI and MEG*

16:55 **Coffee Break**

17:25 **Martin HEBART** | Justus Liebig University, Giessen, Germany

- *Revealing the axes of representational space in brains, behavior, and artificial intelligence*

18:10 **Karsten RAUSS** | University of Tübingen, Germany

- *Mismatch responses in human early visual cortex activity*

18:30 **Ilaria RICCHI** | École polytechnique fédérale de Lausanne, Switzerland

- *Spine-Print: Transposing the Brain Fingerprinting to the Spinal Cord*

18:50 **Poster Blitz Presentations**

19:00 - 20:15 **Poster Session: Methods 1, Perception with apero**

Affective and Clinical Neurosciences

15:00 Welcome Coffee & posters

15:30 **Carmen MORAWETZ** | University of Innsbruck, Austria

- *Neuroscience of Emotional Balance: New Insights into the Neural Mechanisms of Emotion Regulation*

16:15 **Corrado CORRADI DELL'ACQUA** | University of Trento, Italy

- *Generalizable lesion dysconnectivity patterns for affective theory of mind deficits in temporal pole*

16:35 **Kinga IGLOI** | University of Geneva, Switzerland

- *Interactions between physical exercise, associative memory, and genetic risk for Alzheimer's disease*

16:55 **Coffee Break**

17:25 **Philip KRAGEL** | Emory College of Arts and Sciences, Atlanta, USA

- *Understanding Amygdala Contributions to Human Emotion: Insights from Neuroimaging and Artificial Neural Networks*

18:10 **Liane SCHMIDT** | Institute du Cerveau, Paris, France

- *Neural and cognitive outcomes of motivational interviewing in participants with healthy weight, overweight and obesity*

18:30 **Edgar CELEREAU** | Lausanne University Hospital, Switzerland

- *Voxel-based analyses in High-resolution Whole-brain Magnetic Resonance Spectroscopic Imaging in youth at risk for psychosis*

18:50 **Poster Blitz Presentations**

19:00 - 20:15 **Poster Session: Clinical Neuroscience, Emotion & Motivation with apero** *sponsored by*

WEDNESDAY, January 15th

Language and Development

15:00 Welcome Coffee & posters

15:30 **Ghislaine DEHAENE-LAMBERTZ** | University Paris Saclay, France

- *The infant's symbolic mind*

16:15 **Théo DESBORDES** | Neurospin, Paris, France

- *Tracking the neural codes for words and phrases during semantic composition, working-memory storage, and retrieval*

16:35 **Stefano IOANNUCCI** | University of Fribourg, Switzerland

- *Sound-to-Sight: representations of sound symbolic words in visual brain areas*

16:55 **Coffee Break**

17:25 **Alex CLARKE** | University of Warwick, UK

- *Contextual modulation of neural object recognition in the lab and real-world environments*

18:10 **Mathias SABLE-MEYER** | University College London, UK

- *A Neural Mechanism for Representing Nested Repetition in Humans*

18:30 **Jenifer MIEHLBRADT** | University of Geneva, Switzerland

- *Multimodal online assessment of neural activity sustaining auditory statistical learning*

18:50 **Poster Blitz Presentations**

19:00-20:15 **Poster Session: Methods2, Language & Music, Learning & Memory**

with apero *sponsored by* nccr evolving language NATIONAL CENTRE OF COMPETENCE IN RESEARCH

THURSDAY, January 16th

Neuromodulation

15:00 Welcome Coffee & posters

15:30 **Gregor THUT** | CNRS and University of Toulouse, France

- *Human brain oscillations for perception and attention: A mosaic of perceptually relevant rhythms is concealed in the "canonical" alpha band*

16:15 **Shadee THIAM** | University of Geneva, Switzerland

- *Using perceptual load to limit distractibility: A novel ERP marker sensitive to attention deficit hyperactivity disorder (ADHD) symptomatology*

16:35 **Lionel NEWMAN** | All Here, Geneva, Switzerland

- *Alpha Suppression as a Marker of Meditative Depth: Expertise-Driven Variations in EEG Alpha Power*

16:55 **Coffee Break**

17:25 **Michelle HAMPSON** | Yale School of Medicine, USA

- *Real-time fMRI neurofeedback for treating and studying neuropsychiatric disorders*

18:10 **François STOCKART** | Université Grenoble Alpes, France

- *Shared subcortical arousal networks across perceptual modalities*

18:30 **Eugénie CATALDO** | University of Geneva, Switzerland

- *This is not my body: a network-based approach for disruptive body ownership*

18:50 **Elisabeth FRIEDRICH** | University of Sustainability, Vienna, Austria

- The Predictive Social Brain: "Seeing" Social Responses That Aren't There

19:10 **Poster Blitz Presentations** | Travel Grant Awards *sponsored by* FNSNF Fonds national suisse Schweizerischer Nationalfonds Fondo nazionale svizzero Swiss National Science Foundation

- **Charline PEYLO** | University of Zurich and Ludwig Maximilian University, Munich, Germany

  Frontal eye field transcranial direct current stimulation has no effect on visual search performance

- **Ilaria MIRSILENNA** | University of Turin, Italy

  The Social Nature of Interpersonal Distance: a comprehensive investigation of the behavioral and physiological underpinnings

- **Hugo JOURDE** | Concordia University, Montreal, Canada

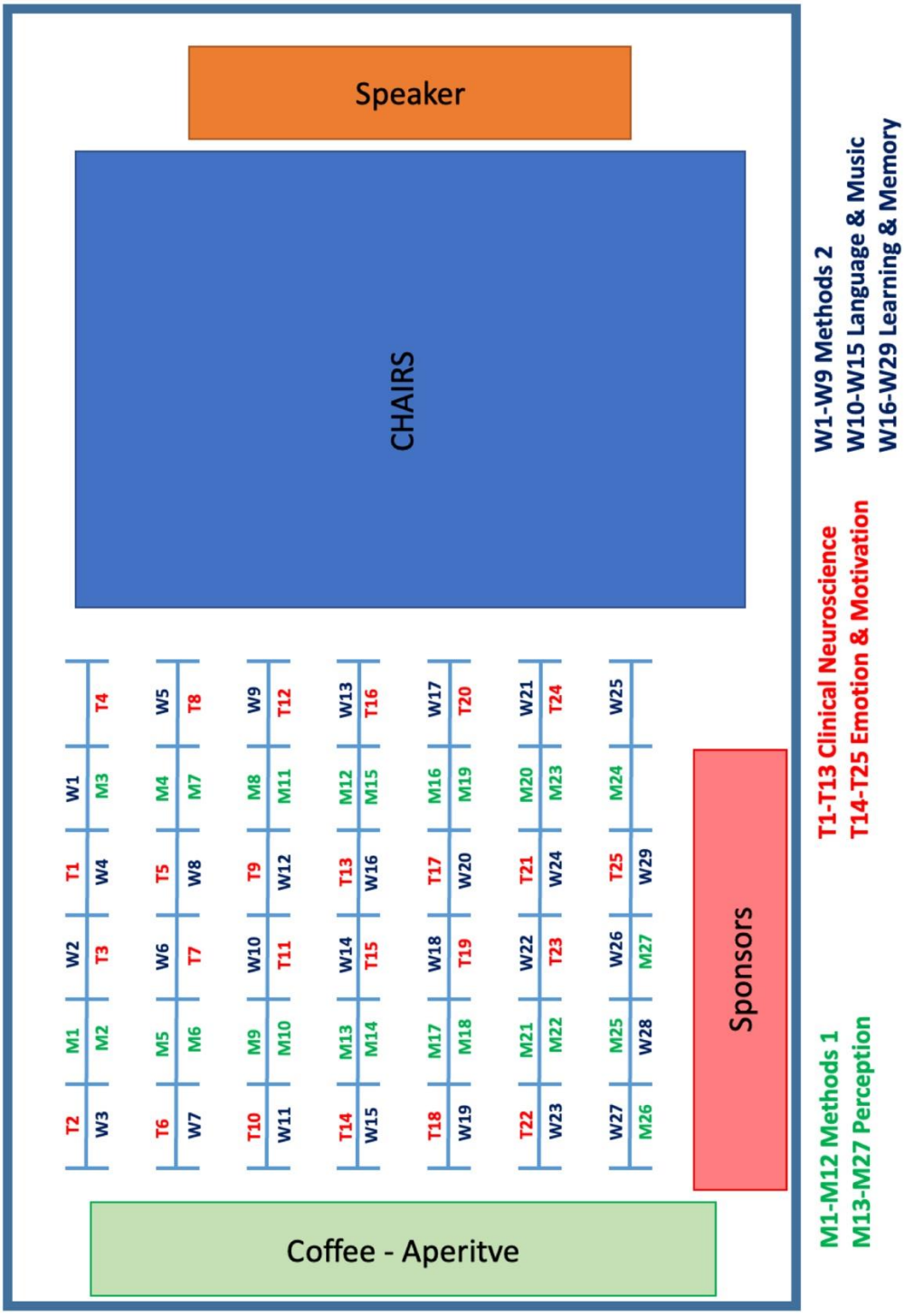
  Closed-loop neuroimaging: causally investigating the roles of sleep spindles

20:00 **Farewell dinner** *sponsored by* UNIVERSITÉ DE GENÈVE SWISS CENTER FOR AFFECTIVE SCIENCES

with prize ceremony *sponsored by* Springer

- *Restaurant "Le Gueullhi"*

POSTER MAP


Speaker
CHAIRS
Sponsors
Coffee - Aperitve
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W23 M22 T23 W24 M23 T24
W27 M25 W26 T25 M24 W25
M26 W28 M27 W29
M1-M12 Methods 1
M13-M27 Perception
T1-T13 Clinical Neuroscience
T14-T25 Emotion & Motivation
W1-W9 Methods 2
W10-W15 Language & Music
W16-W29 Learning & Memory

ABSTRACTS OF ORAL PRESENTATIONS

The themes of the days are:

Sunday: OPENING LECTURE

Monday: METHODS AND PERCEPTION

Tuesday: AFFECTIVE AND CLINICAL NEUROSCIENCES

Wednesday: LANGUAGE AND DEVELOPMENT

Thursday: NEUROMODULATION

The abstracts of the talks are listed in this book in order of appearance. A ☆ marks presentations from invited speakers.

Sunday

Opening Lecture

O1 ☆

The boundaries of memory: How cortico-hippocampal interactions at event boundaries support memory and prediction

Charan Ranganath[1]

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In neuroscience, episodic memory is depicted as a process of activating "engrams" in the hippocampus that provide a static and faithful record of the past. In reality, behavioral research has established that human memory is dynamic and constructive, such that we do not replay the past, but rather, we rely on prior knowledge about events, along with a small amount of retrieved information to imagine how the past could have been. Drawing from this work, I propose a radical alternative to the dominant view in systems neuroscience: Rather than recording every moment of experience, the brain might reconstruct past events from prior knowledge and a small amount of event-specific information encoded at moments of high uncertainty or prediction error called “event boundaries". Our data are consistent with the view that the hippocampus and neocortex serve as complementary learning systems, with the former playing a role in recording snapshots of cortical activity at event boundaries, and the latter involved in using prior knowledge to understand and reconstruct past events. Beyond episodic memory, this division of labor might be computationally optimal for spatial navigation, prediction, and decision-making

Monday

Methods and Perception

O2 ☆

Unraveling the past present and future in the auditory brain with UHF fMRI

Federico De Martino[1]

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To deal with dynamic changes in the soundscape and adjust our behaviour accordingly, a key function of our brain is to predict future states of the world. This has led to a transformative way of thinking about brain function. That is, what we perceive does not reflect the sensory stimulus itself, but rather a combination of the stimulus and an internal (generative) model of its causes. This idea has led to several theoretical advances some of which are capitalized by Predictive Coding (PC). PC assumes that generative models are formed through the exchange of prediction errors (feedforward) and predictions (feedback) across hierarchical processing stages. In addition, PC assumes that prediction errors are modulated by the precision of currently available predictions. Results from invasive animal and human electrophysiological studies support the relevance of predictions for neural processing at different hierarchical levels. Nevertheless, especially in humans the evidence grounding PC principles onto fundamental neurocomputational units (i.e. cortical layers, subdivisions of subcortical structures) is limited and this hampers our understanding of how PC supports the processing of sounds in context in the human brain. Ultra-high field fMRI at high spatial resolution offers a unique opportunity to investigate how computations are embedded in the mesoscopic (cortical) architecture of the human brain (in vivo and non-invasively). Laminar fMRI has already been used to investigate predictive processes in the human visual cortex. In this talk I will describe recent advances in imaging the auditory pathway at UHF and results from studies investigating how predictions and prediction errors are processed in auditory cortical layers. I will also show how ultra-high field fMRI can be combined with biophysical and computational approaches as well as other imaging modalities (MEG) to gain further insights into the computations underlying our perceptual abilities.

Methods and Perception

O3

Decoding the identity of real-world scenes from the shape of steady state evoked potentials

Paul Taylor[1], Inés Martín Muñoz[1, 2], James Dowsett[3]

[1]Department of Experimental Psychology, LMU Munich, Munich, Germany, [2]Institute for Cognitive Systems, Technical University Munich, Munich, Germany, [3]Division of Psychology, University of Stirling, Stirling, UK

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Recent applications of decoding techniques aim to infer what someone sees from their brain activity alone. However, traditional approaches usually analyse the pattern of responses from adjacent electrodes or voxels, using well-controlled but artificial stimuli, and need long data collection for reliable results. We present a new way to decode which real-world scene participants are viewing, from their steady-state visual evoked potentials (SSVEPs). Participants viewed six real world scenes freely for 30s each, wearing flickering glasses and a mobile electroencephalography (EEG) setup. We found that average SSVEP responses from real world scenes are surprisingly complex and have distinct shapes: they differ markedly across scenes and participants but are consistent within individuals, even across sessions. Since the shape varies so greatly between stimuli, but is reliable, decoding works even with a single electrode, and even with less than a second's data. Gamma-band oscillations (~40 Hz) were an important component of the SSVEP response. Gamma responses were present not only during gamma-frequency flicker but also during lower-frequency flicker, like 10 Hz, suggesting an important function in visual processing. These findings implicate 40 Hz oscillations in encoding real-world scenes and show that the SSVEP's temporal profile is a rich source of information for decoding. This method allows studying brain activity in naturalistic settings. SSVEP waveforms from real-world scenes have the potential to improve brain-computer interfaces and deepen our understanding of visual processing.

Methods and Perception

O4

Graph signal processing for identifying structure-function coupling using multimodal brain-imaging with fMRI and MEG

David Corredor[1, 2], Wenya Liu[1, 2], Paula Partanen[1, 4], Maria Vesterinen[1, 3], Samanta Knapic[2], Joonas Juvonen[2], Alexandra Andersson[1], Antti Salonen[2], Lauri Lukka[2], Erkki Isometsä[2, 5], Matias Palva[1, 2], Satu Palva[1, 2, 6]

[1]Neuroscience Center, HiLIFE, University of Helsinki, Finland. , [2]Department of Neuroscience and Biomedical Engineering, Aalto University, Finland. , [3]BioMag laboratory, HUS Medical Imaging Center, Helsinki, Finland. , [4]VISE, University of Oulu, Finland, [5]Department of Psychiatry, University of Helsinki and Helsinki University Hospital, Finland. , [6]Centre for Cognitive Neuroimaging, University of Glasgow, UK.

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How the brain structural connectome (SC) constrains the flow of signals throughout the brain, the structure-function coupling (SFC), is of primary importance to understand further the neuronal dynamics underlying cognition and behavior in healthy and clinical subjects. Convergent evidence from functional magnetic resonance imaging (fMRI) shows that the brain structure-function coupling is regionally heterogeneous, with stronger correspondence in unimodal cortices and weaker in transmodal cortices. Yet, less is known about how the brain connectome is related to electrophysiological measures and its similarity with fMRI results. Using graph signal processing (GSP), a method to investigate how a signal is constrained on top of a network structure, we investigated the relationship between the structural connectome and the rich spectrotemporal dynamics of electrophysiological data using magnetoencephalography (MEG). More precisely, we adapted the GSP for estimating the SFC focusing on MEG source-reconstructed brain oscillation dynamics in 75 healthy subjects. Then, we compared the obtained pattern of SFC in MEG with the one obtained using fMRI data to identify their correspondence. Our findings reveal how the rich spectrotemporal patterns from MEG data relate to the SC in a frequency-specific manner. Additionally, we show the correspondence and differences of the frequency-dependent SFC with the fMRI SFC across brain functional networks. These results provide new insights into how the structural connectome constrains functional brain dynamics, highlighting the interplay between distinct imaging modalities in understanding brain function.

Methods and Perception

O5 ☆

Revealing the axes of representational space in brains, behavior, and artificial intelligence

Martin Hebart[1, 2]

[1]Justus Liebig University, Giessen, Germany, [2]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany

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A central aim of cognitive neuroscience is to understand the nature of our mental and neural representations. These representations can be conceptualized as points in representational spaces, where similar objects are close and dissimilar objects far away from each other. Previous research on these representations has advanced our understanding of the information that can be decoded from brain and behavioral data and what are the representational similarities to cognitive and computational models. However, it has remained challenging to address the central question of what are the fundamental axes that span these representational spaces, due to dataset limitations and computational constraints.

In this talk, I will present our group's recent efforts to address these challenges. First, I will introduce the THINGS initiative, which provides a a comprehensive framework of the representative sampling of object representations across domains. Second, I will discuss how we use these data to uncover the core dimensions of our mental and neural object representations and what these dimensions can tell us about the nature of mental and neural object representations. Finally, I will highlight how extending this approach to the study of artificial intelligence models highlights both parallels with human representations and a mismatch in the representational alignment with humans. Together, this work underscores the importance of moving beyond the study of global representations to understand the nature of representational spaces.

Methods and Perception

O6

Mismatch responses in human early visual cortex activity

Karsten Rauss[1], Xiu Miao[1, 2], Ninorte Dadak[1], Jan Born[1, 3, 4, 5]

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One of the most bacis functions of the central nervous system is the detection unexpected changes in the environment. In humans, this function is often examined using oddball sequences in which a series of frequent standard stimuli is interrupted by rare deviants, i.e., oddballs. A large body of evidence indicates that deviants elicit a mismatch negativity (MMN) response in the event-related potential from approximately 100 ms to 200 ms after stimulus onset. Despite its thorough characterization in both healthy and clinical populations, the temporal evolution of the MMN remains poorly understood, particularly in the visual modality. Using high-density EEG recordings in healthy volunteers, we tested whether visual mismatch responses can be traced back to the earliest stages of processing in primary visual cortex (V1). To minimize stimulus-specific adaptation, we used arrays of high-contrast bars whose orientations varied randomly across trials. Our findings reveal that mismatch responses can be detected at the level of the C1, the earliest cortical component of the visual evoked potential (VEP). This indicates that mismatch detection affects initial stimulus-evoked activity in V1 and suggests that information integrated over several seconds can modulate the C1 component in a top-down fashion.

Methods and Perception

O7

Spine-Print: Transposing the Brain Fingerprinting to the Spinal Cord

Ilaria Ricchi[1, 2], Andrea Santoro[1, 3], Nawal Kinany[1, 2], Caroline Landelle[5], Olivia Kowalczyk[6], Julien Doyon[5], Robert Barry[4], Dimitri Van De Ville[1, 2]

[1]Neuro-X Institute, École Polytechnique Fédérale de Lausanne (EPFL), Geneva, Switzerland, [2]Department of Radiology and Medical Informatics, University of Geneva, Geneva, Switzerland, [3]CENTAI Institute, Turin, Italy, [4]Martinos Center and MGH, Harvard-MIT Health Sciences & Technology, Massacchussets, United States & NIH, [5]McConnell Brain Imaging Centre, Department of Neurology and Neurosurgery, Montreal Neurological Institute, McGill University, Montreal, QC, Canada, [6]Department of Neuroimaging, Institute of Psychiatry, Psychology & Neuroscience, King's College London, London, United Kingdom

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The human brain exhibits a unique "fingerprint" identifiable through functional connectivity (FC) patterns. We investigate whether similar FC fingerprints exist in the spinal cord, a key part of the central nervous system (CNS). Using two independent resting-state datasets, we examined this hypothesis. Dataset 1 included 18 participants (288 volumes, TR = 2.08s) scanned at Martinos Center (Boston) with a 3T Philips scanner across two sessions. Dataset 2 involved 19 participants (360 volumes, TR = 2.5s) scanned at Campus Biotech (Geneva) in a single session split into two parts. Time series were parcellated into 14 axial subdivisions of gray and white matter across three rostrocaudal levels (C4-C6 for Dataset 1, C5-C8 for Dataset 2), yielding 42 and 48 regions of interest (ROIs), respectively.

We constructed "identifiability matrices" to quantify inter-subject FC similarities and computed identifiability scores using Amico et al.'s method. We achieved subject identification accuracies of 78% and 100% for the two datasets, respectively.

To further investigate the uniqueness of spinal cord fingerprints, we are analyzing two additional datasets: (i) 31 participants scanned over two days at King's College (London) and (ii) simultaneous brain and spinal cord acquisitions from McConnell Brain Imaging Centre (Montreal).

Our findings provide the evidence of a functional fingerprint in the spinal cord, suggesting that individual-specific FC patterns extend beyond the brain. However, further studies are needed to confirm its robustness. This work provides a broader perspective on CNS functional organization, opening new avenues for studying subject-specific FC across brain and spinal cord regions.

Tuesday

Affective and Clinical Neurosciences

O8 ☆

Neuroscience of Emotional Balance: New Insights into the Neural Mechanisms of Emotion Regulation

Carmen Morawetz[1]

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Emotion regulation is fundamental to daily life, shaping our mental health, relationships, and resilience. This talk provides insights into how individuals manage the intensity and duration of their emotions, emphasizing the importance of effective emotion regulation in fostering psychological well-being. Research highlights that difficulties in emotion regulation are significant risk factors for mental health conditions such as depression, bipolar disorder, and anxiety. In a series of fMRI studies, we investigate critical questions: What are the neural mechanisms underlying effective emotion regulation? Which personal and environmental factors modulate our capacity for regulation? Can emotion regulation serve as a transdiagnostic factor, potentially forming its own RDoC domain? How do social contexts impact our regulatory abilities? Finally, we explore distinctions between intra- and interpersonal regulation. Our findings support a neuroscience-informed model of emotion regulation, considering modulating factors such as stress, personality traits, and social support. This model offers practical insights for enhancing resilience, reducing negative emotions, and promoting well-being in both clinical and everyday contexts.

Affective and Clinical Neurosciences

O9

Generalizable lesion dysconnectivity patterns for affective theory of mind deficits in temporal pole.

Fabio Campanella[1], Roberta Ronchi[2, 3], Shira Cohen-Zimerman[4, 5], Arnaud Saj[6], Miran Skrap[1], Patrik Vuilleumier[2, 3, 7], Jordan Grafman[4, 5], Corrado Corradi-Dell'Acqua[7, 8]

[1]Neurosurgery Unit, Presidio Ospedaliero Universitario 'S. Maria della Misericordia', Udine, Italy., [2]Neuropsychology Unit, Neurology Department, University Hospital of Geneva, Geneva, Switzerland., [3]Laboratory of Behavioural Neurology and Imaging of Cognition, Department of Neuroscience, University Medical Center, University of Geneva, Geneva, Switzerland., [4]Cognitive Neuroscience Laboratory, Brain Injury Research, Shirley Ryan Ability Lab, Chicago, IL, USA., [5]Department of Physical Medicine and Rehabilitation, Northwestern University, Chicago, IL, USA., [6]Department of Psychology, University of Montréal, Montréal, QC, Canada., [7]Swiss Centre for Affective Sciences, University of Geneva, Geneva, Switzerland., [8]Center for Mind/Brain Sciences, University of Trento, Rovereto, Italy.

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Neuroimaging studies and large-sample meta-analyses systematically converge in implicating regions like temporal pole, amygdala, insula and prefrontal cortex in inferring other people's emotions, an effect that dissociates from more general cognitive Theory-of-Mind (ToM) functions allowing us to infer people's beliefs or intentions. Instead, neuropsychological studies on brain damaged patients show lesser convergence, something exacerbated by the inherent difficulty in testing large cohorts, and by discrepancies in patients' clinical characteristics and tasks employed. Furthermore, neuropsychological investigations often correlate behavioural impairments only with the lesion site, an approach which penalizes the investigation of those functions (like ToM abilities) represented on distributed networks.

Here, we took a network-based approach, and investigated lesion patterns in three separate cohorts (N = 337 patients), characterized by different aetiology (stroke, tumour, trauma), chronicity, and engaged in different tasks testing affective and cognitive ToM. By combining lesion information with normative connectome data from matched typical individuals, we estimated lesion-induced dysfunctions across the whole brain, and modelled them in relation to patients' behaviour. We found an overlap between networks centred in temporal pole and inferior frontal gyrus, whose dysfunctions led to selective impairments in inferring emotions. Furthermore, regression-based multivoxel pattern analysis confirmed how, in temporal pole, models optimized at predicting affective ToM deficits in one cohort, could generalize to the other two.

Overall, our data provide novel and transdiagnostic evidence of generalizable networks underlying deficits in social inferential abilities.

Affective and Clinical Neurosciences

O10

Interactions between physical exercise, associative memory, and genetic risk for Alzheimer's disease

Kinga Igloi[1, 2], Blanca Marin Bosch[1], Sophie Schwartz[1]

[1]Fundamental Neurosciences Department, University of Geneva, [2]Internal Medecine and Rehadaptation Service, University Hospital Geneva

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The ε4 allele of the APOE gene heightens the risk of late onset Alzheimer's disease. ε4 carriers, may exhibit cognitive and neural changes early on. Given the known memory-enhancing effects of physical exercise, particularly through hippocampal plasticity via endocannabinoid signaling, here we aimed to test whether a single session of physical exercise may benefit memory and underlying neurophysiological processes in young ε3 carriers (ε3/ε4 heterozygotes, risk group) compared with a matched control group (homozygotes for ε3). Participants underwent fMRI while learning picture sequences, followed by cycling or rest before a memory test. Blood samples measured endocannabinoid levels. At the behavioral level, the risk group exhibited poorer associative memory performance, regardless of the exercising condition. At the brain level, the risk group showed increased medial temporal lobe activity during memory retrieval irrespective of exercise (suggesting neural compensatory effects even at baseline), whereas, in the control group, such increase was only detectable after physical exercise. Critically, an exercise-related endocannabinoid increases correlated with task-related hippocampal activation in the control group only. In conclusion, healthy young individuals carrying the ε4 allele may present suboptimal associative memory performance (when compared with homozygote ε3 carriers), together with reduced plasticity (and functional over-compensation) within medial temporal structures.

Affective and Clinical Neurosciences

O11

Understanding Amygdala Contributions to Human Emotion: Insights from Neuroimaging and Artificial Neural Networks

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Emotion is central to human behavior through its ability to guide learning, memory, decision-making, and social interactions. Research in cognitive and affective neuroscience shows that the amygdala is involved in these diverse functions by participating in multiple brain networks. Due to this functional diversity, most accounts of amygdala function focus on a small number of variables such as valence, arousal, salience, or relevance, rather than its computational role in circuit-level function. In this talk, I will present work from my lab using fMRI and artificial neural networks to model amygdala contributions to human emotion, as reflected by reinforcement learning, emotion recognition, and self-reported experience. I will also discuss how adopting a systems identification framework can provide a more complete understanding of human emotion by modeling how the brain transforms sensory inputs into low-dimensional variables useful for adaptive behavior.

Affective and Clinical Neurosciences

O12

Neural and cognitive outcomes of motivational interviewing in participants with healthy weight, overweight and obesity.

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Communication-based behavioral change interventions such as motivational interviewing target the ambivalence between changing and sustaining unhealthy addiction-like habits. However, the depth of outcomes has yet to be discovered. Here, we hypothesized that shifting between reasons for and against change should recruit behavioral and neural mechanisms of cognitive control. Eighty participants (35(1.5) years, 78% female) with healthy to obese body mass indexes (29(1.0) kg/m2; 17 – 51 kg/m2) generated statements about changing and sustaining their eating behavior during a motivational interviewing session with a dietician. One week later, they listened to these statements when making incentive-compatible dietary choices, and their choice-related brain activity was measured using functional magnetic resonance imaging. Participants considered the healthiness more after change and the tastiness more after sustained talks ($\chi 2$=5.7, ß = -0.04, SE= 0.01, p = 0.02). This effect of the type of talk varied as a function of food addiction and BMI ($\chi 2$= 3.8, p = 0.05). It was underpinned by stronger psycho-physiological interactions between the ventromedial and dorsolateral prefrontal cortex during choices made after change compared to sustain talks in participants with overweight and obesity (PFWE<0.05 cluster level), but not in participants with healthy BMIs. In conclusion, listening to reasons favoring behavioral change versus sustaining behavioral eating habits generated cognitive and neural outcomes. The ambivalence was reflected by a moderation of cognitive control mechanisms by energy status, such as weighing long-term health and short-term taste rewards and alterations in neural dynamics within the brain's valuation and cognitive control systems.

Affective and Clinical Neurosciences

O13

Voxel-based analyses in High-resolution Whole-brain Magnetic Resonance Spectroscopic Imaging in youth at risk for psychosis

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Metabolic quantification and distribution in the brain has long been limited by poor spatial resolution, suboptimal signal quality or prolonged acquisition times. Building on a recently developed high resolution whole-brain magnetic resonance spectroscopic imaging sequence (3D-MRSI, customer sequence acquired on two 3T MAGNETOM Prisma or Trio, Siemens Healthineers, Forcheim, Germany), we demonstrate a new technique to perform voxel-based analyses (VBA) on maps of N-acetylaspartate (NAA), Myo-inositol (Ins), Choline components, Glutamine+Glutamate, Creatine+Phosphocreatine (Cre). Using non-parametric cluster-based corrections (significant clusters: $p < 0.05$), we analyzed two cohorts: healthy adolescents (n=61, age 13–15) and young adults at risk for psychosis alongside matched controls (n=34, age 16–31).

Our findings reveal consistent concentration variations across brain structures in standard space, demonstrating the reproducibility of our registration technique. NAA to Cre ratio were higher in males compared to females in both populations on a large grey-matter cluster, reflecting potential sex differences in metabolic profiles. Results on the cohort of patients at risk for psychosis show an increased NAA concentration in the grey-matter of patients, alongside an increased Ins concentration in the post-central gyrus of patients, compared to controls. This increase in NAA could highlight a potential prognosis biomarker for at risk for psychosis patients (higher in all patients despite no transition to psychosis in our cohort) and Ins a disease biomarker (higher in schizotypy than in Ultra High Risk). These results illustrate the feasibility and sensitivity of our high-resolution 3D-MRSI technique and VBA analysis for detecting neurometabolite signatures both in healthy participants and psychiatric patients.

Wednesday

Language and Development

O14 ☆

The infant's symbolic mind

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Human adults commonly use symbolic systems (e.g. speech, numbers, writing code, algebraic formula) to represent aspects of the external world, and they easily and flexibly go from symbols to objects and vice-versa. This “symbolic mind” might be related to a distinct human neural architecture, in particular, the expansion of the associative areas and the development of new long-distance fiber tracts, such as the arcuate fasciculus. More efficient connections to and from the frontal lobe and a longer memory buffer may lead to the discovery of more abstract structures, and ultimately enable to represent the external world with a symbolic system.
This neural architecture is in place at full-term birth and brain imaging studies have revealed that higher-level associative regions, such as frontal areas, are involved in infant’s cognition from start. We may thus expect that infants might share the same symbolic competence than adults. To support this claim, I will present brain imaging data showing the infants’ structural and functional brain architecture but also behavioral and ERP data revealing symbolic and logical computation in young infants.

Language and Development

O15

Tracking the neural codes for words and phrases during semantic composition, working-memory storage, and retrieval

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The ability to compose successive words into a meaningful phrase is a characteristic feature of human cognition, yet its neural mechanisms remain incompletely understood. We analyzed the cortical mechanisms of semantic composition using magnetoencephalography (MEG) while participants read one-word, two-word, and five-word noun phrases and compared them with a subsequent image. Decoding of MEG signals revealed three processing stages. During phrase comprehension, the representation of individual words was sustained for a variable duration depending on phrasal context, ie, words remained explicitely represented in neural activity for a longer duration when they had to be combined with upcoming words. During the delay period, the word code was replaced by a working-memory code whose activation increased with semantic complexity, quantified by the number of unique words in the phrase. Finally, the speed and accuracy of retrieval depended on semantic complexity and was faster for surface than for deep semantic properties, suggesting that computations are necessary to retrieve specific properties of the memoranda. In conclusion, we propose that the brain initially encodes phrases using factorized dimensions for successive words but later compresses them in working memory and requires a period of decompression to access them. These results place strong constraints on the nature of the mental representations of phrases in the human brain.

Language and Development

O16

Sound-to-Sight: representations of sound symbolic words in visual brain areas

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Sound symbolism, known as the "bouba-kiki effect," shows that humans make consistent associations between meaningless speech sounds and visual shapes. People typically associate “bouba” with rounded shapes and “kiki” with angular shapes, suggesting a cross-modal link between speech sounds and visual features.
While behavioral experiments have demonstrated sound symbolism extensively, its neural basis remains poorly understood. Building on research showing that the early visual cortex responds selectively to auditory stimuli, we investigated whether visual cortices represent implicit shapes conveyed by sound-symbolic speech.
We conducted an fMRI study with 21 blindfolded adults who listened to sound-symbolic words (rounded, spiky, and mixed) and rated their associated shapes. Using multivariate pattern analysis, we examined neural activity patterns in visual, auditory, and control regions.
Behavioural results confirmed the bouba-kiki effect within the MRI scanner, with participants consistently matching "rounded" words to rounded shapes and "spiky" words to angular shapes. The fMRI analysis revealed successful decoding of "round" versus "spiky" sounds in both primary visual cortex (V1) and auditory cortex. A whole-brain analysis also showed successful decoding in the left intraparietal cortex. These findings demonstrate that V1 and intraparietal cortex can represent shape information from speech sounds even without visual input, suggesting that sound symbolism reflects genuine sensory and cross-modal associations in the brain rather than a linguistic phenomenon. This supports the view that visual and parietal regions process both visual input and represent auditory information.

Language and Development

O17 ☆

Contextual modulation of neural object recognition in the lab and real-world environments

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How do we understand what we see? Recognising objects depends on dynamic transformations of neural states, from those reflecting visual inputs to semantic representations. Models of meaningful object recognition have tended to focus on the perception of specific objects without considering how the preexisting environment might shape those neural processes. But in the real world, we don't see objects in isolation. When we see an object, we are already in a complex and rich environment, which leads to expectations about the kind of things we may see. Based on our recent studies, I will show that the expectations generated by the visual environment modulate the semantic processing of objects, as seen in neural activity both in the lab (using EEG and MEG) and in the real world – using mobile EEG and augmented reality. Across studies, we find that low-frequency theta and alpha activity is modulated by contextual congruency, with such effects localised to the ventral visual pathway. Pattern similarity analysis further suggests that oscillatory phase patterns within these frequencies relates to higher-level object properties, and that pattern similarity effects are further modulated by contextual congruency. These studies demonstrate that both in-lab and real-world contexts impact how we recognize objects, pointing towards a fundamental limitation of traditional models of object recognition.

Language and Development

O18

A Neural Mechanism for Representing Nested Repetition in Humans

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The Language of Thought (LoT) hypothesis posits that high-level mental representations are best theorized as program-like [1]. How do neurons implement this? Recent work has uncovered a mechanism called Structured Memory Buffer (SMB) to represent repeating sequences of items. When mice perform a task with repeating sequences like "abcd-abcd-[...]", a neuronal population in the medial frontal cortex codes for a snapshot of the entire sequence centered on the current item, with lags corresponding to future items' orders: "next item," "next-plus-one item," etc. (as opposed to global indices: "item 1," to "item k"). This representation is cyclical and rotates to remain veridical with progress, making planning efficient [2]. Building on this work, I consider the representation of sequences with nested repetition: "abc-abc-def-def-abc-abc-def-[…]". There are only 6 items to remember, but a non-hierarchical SMB will require 12 slots. There are several possible ways to incorporate hierarchy in SMBs: I adjudicate between different candidate representations by performing decoding and representational similarity analysis of 19 adults performing a sequence memory task with hierarchical sequences while recording with MEG. I find evidence for hierarchical SMBs in humans, with one SMB allocated to "abc" and another to "def", plus a non-SMB mechanism to keep track of which SMB to attend to. This mechanism effectively implements a generic "repetition" primitive, a first step towards providing a neural implementation of concrete LoT propositions.

[1] Quilty-Dunn, J., … & Mandelbaum, E. (2023). The reemergence of the language-of-thought hypothesis across the cognitive sciences. BBS.

[2] El-Gaby, M., ... & Behrens, T. (2024). A cellular basis for mapping behavioural structure. Nature.

Language and Development

O19

Multimodal online assessment of neural activity sustaining auditory statistical learning

Jenifer Miehlbradt[1], David Romascano[1], Sophie Delale[1], Frédéric Grouiller[2], Jonathan Wirsich[2], Petra Hüppi[1]

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Statistical learning describes the ability to perceive regularities from the environment, and has been quantified through neural entrainment of EEG activity and the ability to identify the underlying structure. However, the dynamic progression of this perception has only been scarcely evaluated. An alternative approach lies in the variability of the BOLD signal (BOLD-SD), which has been associated with local neural flexibility and knowledge representation. Here we propose to compare EEG entrainment and BOLD-SD as online markers of auditory statistical learning.

In a joint EEG-fMRI acquisition,18 adult participants were exposed to auditory streams consisting of 12 syllables presented randomly or with an underlying triplet structure (‘words’), while asked to detect a target syllable. Following the exposure, they performed a recognition task on the 4 ‘words’, 4 pseudo-words and 4 random triplets.

We found significant correlations between the EEG entrainment at the triplet frequency over the right temporal electrodes with the recognition score overall, for the pseudo-words and the random triplets. Moreover, partial least squares correlation (PLSC) revealed one significant latent component where a lower final reaction time (RT), larger RT reduction and higher overall recognition score were associated with higher BOLD-SD in the temporal cortices and the right inferior frontal gyrus, and lower BOLD-SD in the fusiform, occipital and calcarine gyri.

Both the BOLD-SD and the neural entrainment in auditory areas were associated with the triplet recognition performance. Conversely, only the BOLD-SD showed a significant correlation with the RT improvement during task execution, suggesting a better sensitivity to online progression monitoring.

Thursday

Neuromodulation

O20 ☆

Human brain oscillations for perception and attention: A mosaic of perceptually relevant rhythms is concealed in the "canonical" alpha band

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Brain oscillations in the alpha-band over posterior areas have been linked to specific processes in attention and perception. In particular, decreases in alpha-amplitude have been thought to reflect activation of perceptually relevant brain areas for visual target engagement, while increases in alpha-amplitude have been associated with inhibition for distractor suppression. Traditionally, these alpha changes have been viewed as two facets of the same process. However, more recent evidence calls for revisiting this interpretation. This talk will cover recent research indicating that there is more than one alpha-rhythm with perceptual relevance. I will illustrate what we have learned by simultaneously recording MEG and EEG, while tracking fixational eye-movements, or combining EEG with frequency-tuned rhythmic brain stimulation in an attempt to work towards a mechanistic account of alpha-oscillations in sensory evidence accumulation. The data show that separate alpha-rhythms distinctively relate to visual sensitivity and the participants' confidence in their percept, and this through interacting with distinct post-stimulus processes for sensory evidence accumulation. We also have recent evidence that separate alpha-rhythms are associated with more reflexive versus endogenously controlled attention processes, while dissociating in terms of their relationship to directional micro-saccades. Hence, there is a multitude of alpha-oscillations within the canonical alpha-band that will need to be dissociated for a refined account of their roles in perception and attention.

Neuromodulation

O21

Using perceptual load to limit distractibility: A novel ERP marker sensitive to attention deficit hyperactivity disorder (ADHD) symptomatology

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Perceptual load has been shown to be a significant modulator of distractibility. By exhausting one's perceptual capacity, and thus limiting resources available for processing distractors, higher perceptual load can counter interindividual differences in distractibility, even equating groups with attention deficit hyperactivity disorder (ADHD) to control groups (Fisher et al., 2023).

Here we ask whether perceptual load can also be seen to modulate the impact on distractibility of ADHD symptomatology within the general population - as assessed by the Adult ADHD Self-report Scale.

Participants were tested on a novel auditory oddball task comprising frequent standard tones, rare target tones that required a button-press response, and importantly rare task-irrelevant novel sounds that served as distractors. This task, coupled with EEG recording, was performed under a low load condition while fixating a fixation cross and under high load while playing an action video game.

Focusing on the frontal novelty P3, a suggested EEG-marker of ADHD in Marzinzik et al. (2012), we show greater amplitude responses to distracting auditory novels as ADHD scores increase at low load; yet, as predicted by the load theory, this effect was significantly diminished at high load. This was the case despite no detectable behavioral differences with ADHD symptomatology (as indexed by auditory target RTs or D-prime).

Such increased amplitudes under low load of the frontal novelty P3 in individuals with higher ADHD symptomatology is in line with the hypothesis of reduced frontal inhibitory control in ADHD.

Neuromodulation

O22

Alpha Suppression as a Marker of Meditative Depth: Expertise-Driven Variations in EEG Alpha Power

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Meditation has long been associated with profound changes in brain structure and function, yet the neural dynamics underlying these effects remain incompletely understood. While previous research has focused on trait-level changes in novice practitioners—often reporting enhanced alpha and theta activity during cognitive and social tasks—the role of alpha dynamics during meditation itself has been less clear. A review of 40 studies revealed inconsistent findings during Focused Attention Meditation (FA-M): 16 studies reported increased alpha power, 8 observed decreases, and 16 found no significant changes (Lieberman, 2024).

State-level changes during meditation, particularly in advanced practitioners, hold the potential to shed light on these inconsistencies. However, such research is limited by the challenge of recruiting meditators with extensive experience in comparable practices.

To address this gap, we analyzed EEG data from an advanced yogic Samadhi practitioner, 11 Theravada Jhana experts, and 10 less experienced meditators practicing FA-M. Across all groups, meditation was marked by significant alpha suppression compared to baseline, with the degree of suppression strongly correlating with the level of expertise. Notably, expert practitioners also exhibited increased infraslow, delta, and gamma activity during meditation.

These findings suggest that alpha suppression may be a defining feature of meditative expertise, providing a potential resolution to the inconsistencies reported in the literature. Furthermore, they indicate that changes in alpha and other brain dynamics evolve with meditative practice, offering valuable insights into the neural mechanisms underlying meditation's transformative effects.

Neuromodulation

O23 ☆

Real-time fMRI neurofeedback for treating and studying neuropsychiatric disorders

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Over the past two decades fMRI neurofeedback has developed rapidly from an emerging technique into an intervention with clinical promise for a multitude of neuropsychiatric disorders. Basic science studies have provided compelling evidence that fMRI neurofeedback can alter brain function in a targeted manner. Furthermore, the effects induced by fMRI neurofeedback have been found to persist, or even grow, once training is complete. Although these data suggest great clinical promise, translation of the technique into a clinically useful tool has faced a number of challenges. These include the need to control for placebo effects in an ethical and rigorous manner, as well as regulatory frameworks that can make exploratory research challenging. However the most critical challenge lies in our limited understanding of the neural substrates of neuropsychiatric illness and our need for brain biomarkers with strong and causal relationships to clinical symptoms. Fortunately, fMRI neurofeedback has unique potential to advance that knowledge: it provides a perturb-and-measure approach to studying human brain function that has yet to be fully leveraged for characterizing the brain patterns that give rise to neuropsychiatric symptoms. In this talk, I review past (and ongoing) efforts to develop fMRI neurofeedback as a clinical tool, describing the challenges but also highlighting notable domains of success and exciting new developments.

Neuromodulation

O24

Shared subcortical arousal networks across perceptual modalities

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Subcortical arousal systems are known to influence long-lasting states such as sleep/wake and sustained attentional vigilance. However, the role of these subcortical systems in dynamic short-term modulation of conscious perceptual awareness has not been fully investigated. To identify subcortical networks that are shared across sensory modalities, we first analyzed fMRI data from large publicly available visual, auditory and taste perception data sets (N=1556). We performed model-free fMRI analysis using a spatiotemporal cluster-based permutation test to detect changes at task block onset and with individual task events. Conjunction analysis revealed a common network of subcortical arousal systems shared across perceptual modalities, including transient fMRI increases in midbrain tegmentum, thalamus, and basal forebrain. Cortical salience and top-down attention network regions were also shared across modalities, although cortical modality-specific changes were also observed. Next, we investigated visual perception using a report-independent paradigm, employing pupil, blink and microsaccade metrics with machine learning to detect consciously perceived stimuli without overt report (N=65). We again found transient fMRI increases in the same subcortical arousal networks including midbrain, thalamus and basal forebrain for consciously perceived stimuli, independent of task report. Finally, to directly measure subcortical signals during perceptual awareness we recorded from the intralaminar thalamus centromedian nucleus (CM) in patients with implanted electrodes. In both visual (N=7) and auditory (N=1) threshold perceptual awareness tasks, we found a thalamic event-related potential specific for conscious perception, peaking ~450ms after perceived stimuli. These findings suggest that subcortical arousal circuits participate in dynamic phasic modulation of conscious perception across sensory modalities.

Neuromodulation

O25

This is not my body: a network-based approach for disruptive body ownership

Eugénie Cataldo[1], Eda Tipura[2], Corrado Corradi-Dell'Acqua[3], Thomas Martin[4], Fabien Albert[4], Frédéric Assal[4, 5], Patrik Vuilleumier[1, 4], Roberta Ronchi[1, 4]

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Disownership is a condition in which brain-damaged patients experience that one or more body parts do not belong to them. This syndrome is usually assessed with a semi-structured interview (overt disownership), but recent findings suggest that a more subtle (covert) form of disownership can be detected using a non-declarative tool. Here, we provide evidence of the presence, frequency, clinical and neural characteristics of both overt and covert forms of disownership in the acute phase post-stroke. 105 patients and 55 healthy controls were recruited and underwent a neurological and cognitive evaluation including overt and covert measures of ownership. Region-based and network-based lesion analyses were done, applying robust lesion analyses. Our results indicate that 3.8% of our sample showed overt, while 25.7% exhibited a covert form of disownership, emphasizing the importance of sensitive tools to overcome the limitations of declarative interviews. Second, we found that patients may experience this symptom for different body parts including the face, previously unexplored in this context. Importantly, covert disownership occurred after right, but also left brain-damage, therefore affecting the left or right hemi-body, respectively. Lesion analyses confirmed the role of structures such as the right insula and basal ganglia for upper limb ownership. Network-based structural connectivity data highlighted disconnections between temporo-occipital and parietal networks associated with the presence of disownership for the upper limb. Altogether, our results suggest an underestimated frequency of body part disownership in the acute phase of brain-damage, and point to a modular representation of bodily self, linked to complex bilateral brain networks.

Neuromodulation

O26

The Predictive Social Brain: "Seeing" Social Responses That Aren't There

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Prior experiences lead to predictions that shape our social perceptions, sometimes leading us to "see" responses that aren't there—a phenomenon termed "seeing Bayesian ghosts".

In our first study, we examined the neural basis of this social illusion using electroencephalography (EEG). Participants viewed a light-point figure making communicative or individual gestures, followed by either a second masked figure responding or random noise dots. When the initial communicative gesture activated the sensorimotor cortex, participants often "saw" a second agent, even in its absence. This pre-activation in alpha and beta bands suggested that the brain generated predictions – based on communicative actions- strong enough to override sensory evidence.

In a second study, we applied real or sham transcranial magnetic stimulation (TMS) to inhibit the left premotor cortex. As predicted, participants reported more false alarms (i.e., Bayesian ghosts) in the communicative than individual condition in the sham TMS session, but this effect vanished with real TMS.

In a third study, we used the experimental design for participants with Schizophrenia. In line with our hypothesis, individuals with Schizophrenia showed the "Bayesian ghost" effect, suggesting that they might rely more on their predictions than on sensory information.

Our findings demonstrate that we do not simply react to others in social interactions but that our brain actively anticipates others' behavior. These findings are also significant for psychiatry, as they provide a foundation for understanding mental illnesses characterized by challenges in social interactions and perceptual illusions.

POSTER ABSTRACTS

Ordered according to these categories:

Methods 1 (M1-M12)

Perception (M13-M27)

Clinical Neuroscience (T1-T13)

Emotion & Motivation (T14-T25)

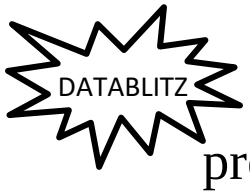
Methods 2 (W1-W9)

Language & Music (W10-W15)

Learning & Memory (W16-W29)

The letter preceding the abstract number indicates the day of presentation:

M: Monday, T: Tuesday, W: Wednesday



Indicates that this abstract will be presented during poster blitz presentation

Methods

M1

A platform for multi-scale investigations of the neuronal basis of epileptic seizures in human

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Given their unpredictability, seizures are one of the greatest burden for patients with epilepsy and caregivers. Reliable seizure detection and prediction could enable on-demand treatment and increase patients' quality of life, however it remains challenging. Recently, thanks to the MicroEPI project in collaboration with the University of Geneva and HUG, we have gained the unprecedented possibility to record the cerebral activity at the level of individual neurons. This allows to investigate the degree to which human seizures are characterized by stereotypical sequences of activity among populations of cortical neurons. To preprocess the huge amount of data collected (48 microwire contacts, sampled at 30 kHz) and stereo-EEG, we are developing a novel platform for the automatic preprocessing and synchronization of these data and include semi-unsupervised spike-sorting pipelines to automatically identify the activity of individual neurons. A synchronization module, which establishes a common timeline for both microwire and stereo-EEG sources, allows to interpolate the data at the desired frequency. Microwire data are then submitted to a preprocessing pipeline including a 50Hz comb notch and high pass filters and bad epochs removal. Clean data are then be submitted to a set of spike-sorting algorithms (including Kilosort, Spiking Circus, Tridesclous etc.), tweaked by means of spike-interface. A set of Application Programming Interfaces (APIs) will then be established to serve the data to external applications. Thanks to this platform we expect to provide novel, patient-specific biomarkers for the detection of epilepsy at the microscopic level, thus improving on-demand therapies such as deep-brain stimulation.

Methods

M2

An Innovative Framework for Integrative fMRI-Photometry Analysis of Noradrenergic Brain Modulation

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Preclinical MRI offers unique insights into whole-brain dynamics, enabling the exploration of neural mechanisms inaccessible in humans. This study combines fiber photometry and fMRI to investigate noradrenergic activity in the locus coeruleus (LC) and its influence on brain-wide connectivity. Using a 14.4T MRI scanner and a fiber photometry system, we simultaneously recorded Gradient-Echo fMRI and calcium signals from urethane-anesthetized mice expressing GCaMP in the LC. Precise synchronization ensured alignment between LC activity and fMRI signals, allowing detailed analysis of dynamic neural states.

Photometry signals were segmented into 5-minute intervals and analyzed using the HCTSA framework, extracting over 7000 temporal and spectral features per segment. Clustering algorithms applied to these features identified temporally stable LC activity patterns, with adjacent segments often grouped into the same cluster, reflecting similar dynamics. Concurrently, independent component analysis (ICA) of fMRI data identified robust resting-state networks, demonstrating stable configurations and high image quality.

The integration of clustering with advanced feature extraction highlights distinct LC states and their correspondence with brain-wide fMRI connectivity patterns. This approach establishes a novel framework for characterizing LC-driven modulation of neural networks, particularly in conditions resembling specific sleep stages induced by urethane anesthesia. By linking photometry-based clustering with fMRI, this study provides a powerful tool to explore the neuromodulatory role of the LC in regulating brain states. These findings have implications for understanding neural dynamics across sleep and wakeful conditions, offering a foundation for future investigations of LC activity and network interactions.

Methods

M3

Disentangling mono-synaptic connectivity from cortico-cortical evoked potentials

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Brain network neuroimaging is an emerging field of neuroscience that aims at understanding brain function and diseases by considering one's brain as a set of interconnected regions; i.e. a graph. Current approaches often consider symmetric relationships between regions but not directed ones and while recent invasive acquisition techniques such as stereo-encephalography can now provide directional information of electrical propagation within the brain, such information isn't representative of solely the immediate influence from a region to another i.e the mono-synaptic connectivity, but also includes all other paths connecting these two regions, which we term poly-synaptic connectivity.

Here, we propose a directed brain graph informed by cortico-cortical evoked potentials, where edges represent mono-synaptic or effective delay. To do so, we present a regression model that extracts direct communication between brain regions by disentangling the contribution of effective connections from the poly-synaptic ones. We integrate as well in our modelling of the communication delays, two components that respectively account for the axonal conduction and the synaptic constant respectively.

In our results we find regressed axonal delays in the range of 10-60 ms. Additionally, we observe a coherent synaptic delay constant of around 30 ms and an average axonal conduction speed of ~2 m/s. All our results indicate ranges of values reflecting literature findings, thus constituting a first model validation.

Methods

M4

Directed-graph communities of the human connectome

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Processes of brain function can be extracted from the topological feature of its network representation (i.e. connectome). These models however usually fail to capture how information is transmitted within the brain, as brain graphs often describe symmetric relationships between regions. We showcase a novel framework for community detection in directed graphs introducing "bicommunities" that we extract from a directed human connectome obtained from electrophysiology. Bicommunities reveal patterns of directed communication that would remain unseen by conventional community detection. A directed human connectome is built by aggregating white-matter bundles and cortico-cortical evoked potentials from stereo-encephalographic of the F-TRACT database. Directed connectivity strengths are derived by redistributing the graph weights to the outgoing or incoming connection based on the ratio of outgoing or incoming communication probability. Brain bicommunities are identified through the bimodularity framework that separates a network into sending patterns and their corresponding receiving clusters. K-means is applied to graph edges projected on embeddings that maximize bimodularity. We highlight (k=12) bicommunities through the maximization of bimodularity. Patterns with high contribution to bimodularity show the interconnectivity within both hemispheres. Bicommunities with negative bimodularity however distinguish inter-hemispheric connectivity from left to right and from right to left respectively. Bicommunities of the human brain show coherent networks with a novel perspective. Our method distinguishes the directed relationship both within and between hemispheres. This stresses the potential of bimodularity as an innovative approach to disentangle the complex pathways of neural communication.

Methods

M5

Can we resolve deep brain sources using MEG?

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Magnetoencephalography (MEG) enables the study of widespread brain networks with high temporal resolution, yet its ability to resolve signals from deep neural sources, such as central thalamic structures, remains uncertain. Functional connectivity methods have shown promise in enhancing resolution but are rarely applied beyond the cortex. In this study, we investigated functional connectivity in MEG with the thalamo-cortical sleep spindle as a test case, leveraging its well-characterized circuitry. We recorded simultaneous MEG and EEG data from 19 participants during a 2-hour nap opportunity, identifying time periods with and without sleep spindles. Functional connectivity was computed across a network of regions implicated in spindle generation, using coherence (COH) and imaginary coherence (ICOH) metrics. Graph theory was also applied to identify maximally and minimally connected network hubs. As anticipated, connectivity increased during spindles across a broad thalamo-cortical-hippocampal network for both COH and ICOH metrics. Connectivity patterns distinguished among proximal thalamic nuclei based on interactions with the cortex, though topographical differences emerged based on metric choice and connectivity contrasts. Graph theory analyses further revealed distinctive cortical, thalamic, and hippocampal contributions to fast (13-16 Hz) and slow (10-13 Hz) sigma band connectivity during spindles. Our findings show that functional connectivity approaches in MEG can effectively distinguish activity originating from deep brain regions, including the thalamus, extending time-resolved neuroimaging tools to subcortical structures. By clarifying factors that influence these measurements, our results also offer guidance for MEG research design and analysis, supporting interpretation of network activity throughout the brain.

Methods

M6

SISMIK: Deep Learning-Assisted Motion Artifact Correction in Brain MRI from Spin-Echo to Turbo Spin-Echo

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Magnetic resonance imaging (MRI) is a powerful medical imaging modality, but motion artifacts remain a major challenge, particularly in sequences like Turbo Spin-Echo (TSE), which are highly sensitive to patient movement and lack any correction methods. Motion artifacts can obscure clinically relevant structures, compromising diagnostic accuracy. To address this, we propose SISMIK: Search In Segmented Motion Input (in) K-space, an innovative motion-correction approach that combines deep learning and model-based (classical) methods.

Initially applied to classical Spin-Echo (SE) acquisitions, SISMIK employs a deep neural network (DNN) to estimate motion artifacts directly in k-space (i.e., the raw MRI measurement space), in a relative and referenceless manner. This estimation informs a model-based correction step grounded in Fourier theorems, ensuring accurate artifact removal without the risk of introducing "deep hallucinations" — artificial features or the omission of true anatomical structures introduced by neural network-based reconstructions.

Building on its established success in SE acquisitions, current efforts focus on adapting SISMIK for Turbo Spin-Echo (TSE) sequences. This includes simulation of large datasets of corrupted TSE k-spaces to train new DNN architectures tailored to the specific challenges of TSE imaging. These challenges arise from the distinct k-space sampling patterns of TSE compared to Spin-Echo acquisitions, requiring novel strategies to ensure reliable artifact correction.

SISMIK paves the way for addressing motion artifacts in Turbo Spin-Echo sequences — a "workhorse" sequence in MRI — offering the potential to significantly reduce rescan costs and improve patient experience.

Methods

DATABLITZ

M7

Predicting behaviour through multi-spectral fingerprints of MEG functional connectivity at rest

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The concept of a functional connectome, a wiring diagram of interactions among brain regions, is well established for understanding mechanisms of large-scale communication. At the group-level, normative connectomes are robust, publicly available, and useful for a range of clinical/scientific applications. However, an important open question is whether these connectomes represent individual biomarkers subserving cognitive/behavioral performance to be exploited for individualized treatment. Here, we considered the behavioral performance during a motor task, as assessed through manual dexterity, a long-term skill allowing to efficiently interact with the environment. Specifically, we investigated whether manual dexterity was encoded in functional connectivity at rest. We considered MEG data in three frequency bands (alpha, beta_low and beta_high) from 51 subjects. Based on their dexterity scores, we trained a Machine Learning and we tested a large amount of candidate features. The optimal ones consisted of the Participation Index from a small fraction (6%) of the considered connectome, i.e. nine hubs. These led the Machine Learning to correctly identify subjects as good vs bad performers, with an high accuracy, namely 86%. Of note, these features were multi-frequency, i.e. in the optimal set, features from both alpha and beta bands contributed. These findings suggest that the manual dexterity is encoded through a small set of hubs acting at different frequency bands. Finally, we assessed the resiliency of the adopted model by hierarchically perturbating the identified hubs. We assessed the corresponding damage in terms of ML accuracy. Notably, the accuracy fell below chance level when just three hubs were attacked.

Methods

M8

Transfer Learning in Neuroimaging Normative Models: Sample Size and Covariates Distributions Requirements for Reliable Adaptation and Valid Clinical Interpretations in Alzheimer's Disease

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Understanding individual variability in brain structure is a central objective in neuroscience, with significant implications for advancing precision medicine. Normative modeling has become a powerful and increasingly valuable tool in achieving this goal.

However, one of the major challenges in normative modeling lies in ensuring that pre-trained models generalize effectively to new clinical datasets. Adaptive transfer learning offers a promising solution by enabling fine-tuning of these models for datasets with limited sample sizes. However, unresolved questions remain regarding the influence of sample size and covariate distributions on the adaptation of these models. This study aimed to determine the conditions enabling reliable performance, focusing on model robustness and clinical validity.

We adapted normative models trained on UK Biobank data (n = 42,747) using Warped Bayesian Linear Regression for 181 neuroanatomical regions. These models were transferred to new datasets through subsampling of healthy controls (HCs) with sizes ranging from 5 to 200. Sub-sampling strategies included representative, age-skewed distributions, and gender imbalances. We evaluated model performance and clinical interpretation validity in Alzheimer's Disease (AD) subjects. Experiments were replicated on two independent AD datasets.

Results showed reliable adaptation stabilizes with around 50 participants. Age-skewed distributions identified outliers effectively when aligned with the target population's age range, highlighting the importance of matching covariate distributions. In contrast, sex imbalances had minimal impact on outlier detection.

Our study provides a roadmap for adaptive transfer learning in normative modeling, highlighting the importance of age distribution alignment and adequate sample sizes for optimal model performance and generalizability.

Methods

DATABLITZ

M9

The hidden risks of averaging event-related potential (ERP) data

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The mean is the cornerstone summary measure of science. However, its apparent simplicity can be misleading, particularly when applied to time series data. For instance, averaging heterogeneous EEG waveforms can distort meaningful patterns, such as smoothing out peaks. In previous studies, we observed a significantly reduced N1 peak amplitude in schizophrenia patients compared to healthy controls during a backward masking task. This group-level reduction was initially attributed to a cognitive deficit. Instead, a recent re-analysis revealed that the lower amplitude resulted from greater inter-trial variability in N1 latency among patients. More precisely, realigning single-trial N1 peaks using independent component analysis (ICA) reduced the group-level difference. In a second study, while analysing longitudinal data from the same visual task, we found that the full time course of individual-level waveforms varied greatly between subjects, but remained strikingly stable within-subject over 5- and 10-year intervals. This suggests that the individual differences in ERP contain reliable information about the participants, potentially reflecting variations in anatomy and/or cognition. Together, our findings underscore the need to critically assess otherwise implicit assumptions about averaged ERPs: if the aggregated time series are not sufficiently homogeneous, there is a risk of drawing unrepresentative or misleading conclusions.

Methods

M10

MEEGPyPE: MEG & EEG Python Pipelines

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Magnetoencephalography (MEG) is an increasingly popular neuroimaging technique that records the magnetic flux generated by neuronal activity. It provides very high temporal resolution and is especially valued for its potential spatial resolution, which is on the order of millimetres. To maximise the potential of MEG for superior spatial resolution, researchers typically combine MEG data with participants' anatomical MRI images to generate an individualised and consequently more accurate model for estimating the sources of neural activity within the brain.
Successfully exploiting individual anatomical data for accurate source localisation requires several preprocessing steps to align and integrate different neuroimaging modalities effectively. Access to reproducible workflows is essential for ensuring the accuracy and reliability of source-space analyses. MEEGPyPE is an advanced collection of preprocessing pipelines designed to provide an accessible, state-of-the-art interface for preparing source-level analyses in MEG/EEG studies. These pipelines are modular, interconnected, and can function as BIDS applications (BIDS Apps), streamlining workflows for researchers.
Key features of MEEGPyPE include: BIDS-compatible input handling, MRI preprocessing and coregistration to templates (using sMRIprep), MRI/MEG coregistration, MEG preprocessing, Source space generation (surface and/or volume), forward modelling (using MNE-Python) and brain parcellation utilising individual or template-based atlases (using FreeSurfer/Connectome Workbench)
MEEGPyPE leverages Nipype, a workflow engine enabling seamless iteration over diverse inputs while taking advantage of advanced caching mechanisms. The pipelines are containerised, facilitating straightforward installation and integration with institutional high-performance computing (HPC) systems. Overall, MEEGPyPE is tailored to reduce the complexity of MEG/EEG preprocessing while ensuring reproducibility and high-quality outputs for M-EEG source-level analyses.

Methods

M11

Timescales of the brain: time-embeddings to reveal brain processes of different natures

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Dynamics from neuroimaging data have proven instrumental to understand brain function, with popular approaches including sliding window and network analysis. In magnetoencephalography, hidden Markov models successfully extracted "brain states" predictive of task structure and subject behaviour, using time-embedded representations to describe space-time dependencies across the brain. In this work we take a closer look at the interpretation of the HMMs produced by such embeddings, which rely on two key parameters: the temporal lags that implicitly encode timescale, and the (necessary) PCA compression. A systematic analysis of different choices of these parameters shows their role in revealing HMM states highlighting different brain circuitry and interactions. In particular, we show that embeddings at faster timescales reveal segregation of sensory processes, while those at slower timescales reveal integration by recurrent networks.

Methods

M12

Dynamical analysis of spiking-neuron networks

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Accurately modeling and interpreting the complex recurrent dynamics of neuronal spiking networks is essential to understanding how they implement behavior and cognition. Nonlinear Hawkes process models can successfully capture a large range of spiking dynamics in single-neuron and recurrent neuronal networks but remain difficult to analyze and interpret. To address this challenge, we derive an analytical continuous approximation of these models. We analyzed the approximated model with standard tools of dynamical system theory, and derived stability conditions and dynamical properties for single-neuron and network models. Our approach offers an intuitive dynamical perspective on the neuronal spiking repertoire, which is demonstrated for the canonical responses of single-neuron models, and for winner-take-all and traveling wave dynamics in neuronal networks. We finally apply this approach to human and non-human primate recordings of neuronal spiking activity during speech processing and motor tasks, respectively, and reveal the latent low-dimensional structure underlying the recorded neuronal dynamics. Our dynamical analysis approach provides a powerful framework to study neuronal population dynamics directly fitted to neuronal spiking data.

Perception

DATABLITZ

M13

Multisensory integration in Peripersonal Space indexes consciousness states in sleep and disorders of consciousness

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Neural theories of consciousness mainly focus on the awareness of external objects, but self-consciousness also requires a representation of the embodied subject of experience. This representation is thought to arise from multisensory integration between external and body-related stimuli, which is mediated by the Peripersonal Space (PPS) system.
Here, we aimed to investigate the link between PPS representation and consciousness, by testing whether electrophysiological markers of PPS representation are related to changes in consciousness occurring during wakefulness and sleep. To assess PPS representation, we delivered tactile, auditory and audiotactile stimuli near or far from participants, while recording high-density EEG. This was done during wakefulness and sleep, where subjective reports about the state of consciousness were collected through a serial awakening protocol.
During wakefulness, we observed a centro-parietal decrease in high-beta power specific for audiotactile stimuli near the body. Such high-beta response pattern was used to define a PPS index, an electrophysiological marker of PPS representation. We found such PPS index to be present as in wakefulness during dreaming, conscious periods, and absent during dreamless, unconscious periods.
We then investigated whether the PPS index could also detect consciousness alterations occurring following brain damage, by adapting our paradigm to low-density EEG bedside recordings. Our marker correlated with behavioural measures of consciousness, and predicted the long-term outcome of patients.
These findings highlight a new electrophysiological marker of PPS processing, and link it to the presence of conscious experience in healthy and pathological populations, carrying significant theoretical implications and potential clinical applications.

Perception

M14

Anterior human temporal voice areas are sensitive to chimpanzee vocalizations

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In recent years, research on voice processing in the human brain—particularly the study of temporal voice areas (TVA)—was dedicated almost exclusively to conspecific vocalizations. To characterize commonalities and differences regarding primate vocalization representations in the human brain, the inclusion of closely related nonhuman primates—namely chimpanzees and bonobos—is needed. We hypothesized that neural commonalities would depend on both phylogenetic and acoustic proximities, with chimpanzees ranking closest to Homo. Presenting human participants (N=23) with the vocalizations of four primate species (rhesus macaques, chimpanzees, bonobos and humans) and regressing-out relevant acoustic parameters using three distinct analyses, we observed within-TVA, sample-specific, bilateral anterior superior temporal gyrus activity for chimpanzee vocalizations compared to: all other species; nonhuman primates; human vocalizations. Our results provide evidence for a subregion of the anterior TVA that responds specifically to phylogenetically and acoustically close nonhuman primate vocalizations, namely those of chimpanzees.

Perception

M15

Biosignal sharing during social interaction modulates psychophysiological states and perceived interpersonal closeness

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Measuring physiological bodily signals such as electrocardiography (ECG) and electrodermal activity (EDA) has become accessible and popular in the last decade. Recent research, primarily qualitative, has explored whether sharing these biosignals in social settings can impact social interactions. Here, we quantitatively investigated whether social biosignal sharing affects the psychophysiological states and the underlying psychological traits influencing these effects.

We present data from 18 sex-matched pairs of strangers whose ECG and EDA were measured while they were interacting face-to-face. Participants shared their heart rate and skin conductance levels (displayed on a monitor) either unidirectionally, bidirectionally, or not at all. We examined the effect of biosignal sharing on various indices of autonomic nervous system activity (e.g., RMSSD, skin conductance level, number of ski conductance responses and their amplitude), alongside correlations with psychometric items evaluating empathic traits, social interaction anxiety, and perceived closeness with the experiment partner.

Our findings revealed that bidirectional biosignal sharing significantly reduced the number of SCRs compared to face-to-face interactions without biosignal sharing and to unidirectional sharing. Additionally, a higher number of SCRs during face-to-face interaction positively correlated with the change in the perceived interpersonal closeness. In contrast, during bidirectional sharing (normalized to face-to-face), the number of SCRs negatively correlated with the change in closeness ratings, while perceiving a higher focus on one's biosignals by the task partner correlated positively with the number of SCRs.

These results suggest that biosignal sharing can modulate psychophysiological responses and interpersonal perceptions, with potential applications in social psychology, human-computer interaction, and therapeutic practices.

Perception

M16

Neural Adaptation in Response to Novel Statistical Regularities in Spatial Sensorimotor Integrations

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From an early stage in life, humans learn to recognize statistical regularities—such as cause-and-effect relationships—through environmental interactions. These sensorimotor interactions, whether active or passive, are often inherently multisensory and defined by distinct spatiotemporal features. However, how humans respond to novel spatial configurations during body-environment interactions remains unclear. To explore this, we used virtual reality (VR) to create artificial regularities within the motor-somatosensory loop. Our training protocol relocated tactile feedback from interactions involving the right hand to the contralateral left foot (CF-Training) or the ipsilateral right foot (IF-Training). Before and after the training, we recorded participants' somatosensory-evoked potentials (SEPs) at the hand (via the median nerve) and foot (via the tibial nerve) during passive exposure to a virtual ball approaching the hand. The results showed no significant differences in hand-level responses, though the CF group exhibited a trend toward reduced N140 amplitudes after foot training. Instead, SEP responses at the tibial nerve level differed between CF and IF training, with CF affecting early potentials (70-110ms) and IF influencing late potentials (160-300ms). Compared to baseline assessment, IF training increased responses in the congruent condition, while CF training decreased responses in the incongruent condition. Exploratory resting-state analyses further revealed increased alpha-band connectivity between the right sensorimotor cortex and the left parietal lobe in CF training group. These findings demonstrate the human sensorimotor system's rapid adaptability, guided by regularities that characterize body-environment interactions

Perception

M17

Contrast-Induced Variability in Gamma Oscillations and Eye Movements: A Pilot Study

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It is generally assumed that brain rhythms reflect the neural processes required to perform the cognitive operations demanded by the task. This assumption has led to theories assigning a specific role of gamma oscillations involved in information binding, thereby enabling higher-order cognitive functions. However, it remains unclear as to why gamma activity variation in the visual cortex primarily depends on stimuli properties. It has been reported that perception of gratings entails eye movements across the contrast border. Assuming the premise that oculomotor action control is a continuous process monitored by brain circuits, it appears relevant to consider to what extent eye movements and the control thereof bears some informative value of why and how contrast and spatial frequency of the stimulus affects measures of gamma oscillations.

In this pilot study, combined electroencephalography and eye-tracking was utilized while 10 participants viewed grating stimuli. By varying the contrast at constant spatial frequency, we aimed to explore whether different contrast conditions are associated with variation of eye movements and gamma oscillations. To this end, scalp-level peak power and frequency of the gamma band (30-90 Hz) as well as variation in gaze and microsaccade metrics were used as dependent variables.

Preliminary results indicate potential trends in the relationship between eye movements and gamma oscillations, with variation observed across contrast conditions. These exploratory findings highlight a potential connection between gamma oscillations and oculomotor control, suggesting directions for future research to better understand the role of eye movements in modulating brain activity during cognitive tasks.

Perception

M18

Structural correlates of cerebral face- and voice-preferential responses

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Faces and voices are central social cues in human life. The existence of specialized cerebral modules specifically responding to these cues (e.g., the fusiform face area [FFA] and the temporal voice area [TVA]) reflects the importance of faces and voices for human communication. While many studies have investigated the various properties of these areas, it remains unclear if their functional preferentiality for faces/voices finds also a structural correlate in the human brain.
168 healthy individuals participated in a 3T-fMRI study. Standard localizer experiments identifying the FFA and TVA and combinedly voice- and face-preferential regions in the posterior superior temporal sulcus (pSTS-FVA) were followed by an anatomical structural measurement. Voxel-based morphometry (VBM) was then used to identify areas were grey matter density correlated with individual face-/ voice-preferentiality.
While a structural correlate of voice-preferentiality was observed only for the left pSTS-FVA in the supplementary motor area (SMA), face-preferentiality was reflected both within the FFAs as well as mainly ipsilaterally with the cerebellum. These results not only demonstrate that the functional characteristic of face- and voice-preferentiality is also structurally imprinted within the brain but also highlight the cerebellum in this respect. While evidence for an implication of this structure in the processing of emotional facial expressions was brought forward previously, this is the first study to indicate a potential role of the cerebellum in basic face processing to be further clarified in future research.

Perception

M19

The bodily-emotional experience of time: neural evidence of the effect of anxiety on temporal perception

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Emotions significantly alter our perception of time, making it seem to either drag or fly by. Variations in the ability to perceive bodily changes (interoception) can shape emotional experiences. However, the neural mechanisms linking emotions, time perception, and interoception remain unclear. This study investigated how anxiety influences time perception while considering variations in interoception. We hypothesized that better interoception would increase anxiety, which in turn would impair time perception. Using fMRI, we focused on brain regions involved in temporal and emotional processing, such as the insula and amygdala.

Thirty participants (mean-age=21.75±4.28) completed an auditory temporal reproduction task during fMRI. Participants listened to a sound of varying durations and subsequently reproduced it while experiencing either threat (by delivering unpredictable screams) or safe conditions. Anxiety traits and interoceptive accuracy were assessed outside the scanner.

Our results showed that higher anxiety was perceived in the threat blocks, and increased interoceptive accuracy was associated with higher anxiety. A significant interaction between anxiety state and trait predicted poorer temporal accuracy. Results from a whole-brain and ROI analysis revealed greater activation in insula and amygdala during the threat condition (FDR-corr $p<.01$). We found a positive correlation between interoception and activation in the same regions when reproducing the sound. Furthermore, the interaction of anxiety state and trait predicted increased insula activation when hearing the first sound.

These findings provide new insights into how emotions shape our experience of time, suggesting that anxiety disrupts time perception, with interoceptive skills influencing the activity of temporal and emotional processing regions.

Perception

M20

Towards investigating salience: an awake oddball preclinical fMRI study

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Sensory stimuli, including auditory, visual, or tactile inputs, elicit varied brain and bodily responses contingent upon their novelty and salience levels. A common paradigm to study the salience value of a stimulus is the oddball task, where infrequent target stimuli (deviants) are embedded in a sequence of frequent, non-target stimuli (standards). Single-unit recordings across animal models show increased neuronal activity in the thalamic and sensory processing areas in response to novel stimuli, a phenomenon referred to as deviant stimulus preference (DSP). However, these recordings are limited in scope, lacking whole-brain coverage. To tackle this, we introduce a novel experimental framework combining awake functional MRI with an auditory oddball task in a rat model, enabling a more comprehensive exploration of salience processing across the brain. Male adult rats underwent a 10-day habituation protocol, involving head/body restraint with training sessions lasting up to 60 minutes. During the oddball task, auditory stimuli consisted of standard (5kHz) and deviant (10kHz) tones presented in a 4:1 ratio. Each tone was delivered for 5s (0.1s ramp) using a Yamaha AG03 soundboard (196 kHz) and Kemo L010 ultrasonic speakers near the rat ear. Preliminary results show that bilateral auditory stimulation significantly engaged the auditory cortex for both standard and deviant tones. However, deviant tones also engaged subcortical regions, including the inferior colliculus and medial geniculate body, as well as the thalamus, supporting their role in novelty processing. Establishing this paradigm lays the groundwork for further research into how neuromodulatory signals such as noradrenaline modulate attention and sensory processing in response to salient stimuli.

Perception

M21

Decoding visual contrast sensitivity with Steady State Visually Evoked Potentials

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Traditional tests of visual contrast sensitivity rely on human responses, e.g., a button press to report whether or not a stimulus is present. These responses are used to estimate psychometric functions and perceptual thresholds, but are affected by subjective biases and other confounds.
As an alternative objective method, steady-state visually evoked potentials (SSVEP) are used to derive neurometric functions, where thresholds are estimated based on the EEG responses to the stimuli. In these paradigms, participants passively watch the stimuli without giving a response. Despite this advantage, current SSVEP-based methods face challenges in accurately estimating neurometric functions and thresholds, complicating their direct comparison with psychometric functions.
To address these limitations, we introduce a novel EEG-decoding-based approach. In our paradigm, a visual stimulus flickering at two different frequencies was presented with its contrast systematically variying across 18 logarithmically spaced levels. A machine learning decoder classified the flicker frequency for each contrast level, enabling the fitting of a neurometric function mapped between 0 and 100% classification accuracy. This neurometric function directly corresponds to a psychometric function in the neural decoding space, allowing the derivation of perceptual thresholds from neural data.
We propose that this method provides a robust and objective framework for estimating contrast sensitivity via an EEG-based psychometric function, addressing the limitations of traditional psychophysical and current SSVEP techniques.

Perception

M22

Anatomical Correlates of Navigational Map-Assisted Wayfinding in Virtual Environments

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This study investigates the relationship between brain morphology and wayfinding performance using a navigational map in an unfamiliar virtual environment. Thirty-three participants navigated through seven locations in a simulated urban setting while their visual behaviors were recorded. Structural MRI data were analyzed to identify associations between brain regions and navigational performance. Key predictors included the right posterior hippocampus, retrosplenial cortex, inferior frontal gyrus, superior frontal gyrus, and cerebellar lobule VIIB. High performers demonstrated greater grey matter density in the right posterior hippocampus, supporting its critical role in route planning, and less density in the anterior hippocampus, suggesting distinct functional specializations. Time spent gazing at the map was positively correlated with performance, emphasizing the utility of external aids in navigation. These findings reveal how structural brain adaptations underpin wayfinding capabilities and highlight the hippocampus' regional specificity in navigational tasks. This study provides insights into the neural substrates of spatial navigation and the impact of navigational aids on cognitive processes.

TRAVEL GRANT

M23

Frontal eye field transcranial direct current stimulation has no effect on visual search performance

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Top-down attention for the goal-directed (de-)prioritization of information is fundamental for successful everyday-life behavior and poses tremendous problems when negatively impacted by disease. Attention-targeting enhancement and rehabilitation attempts using non-invasive brain stimulation techniques like transcranial direct current stimulation (tDCS) are therefore of major importance. tDCS-driven excitation of the left frontal eye field (FEF; a key region within fronto-parietal attention networks) has recently been suggested to improve attention-guided visual search with stronger effects for lower baseline performers. Here, we report two preregistered tDCS experiments with open data and analyses to test 1) whether the previously observed visual search improvement could be boosted through stimulation over the allegedly more dominant right FEF and 2) whether tDCS-related visual search improvements might depend on search field size. To this end, in experiments one and two, N=29 and N=31 healthy participants performed a visual search task, in which they searched for an upside-down 'T' amongst upright 'T's and 'L's within small or large search fields, before and during the application of anodal (excitatory) or sham (control) tDCS over the right or left FEF, respectively. In contrast to previous studies, in both experiments (i.e., independent of stimulation site and search field size) we found neither tDCS-specific (anodal > sham) visual search improvements, nor stimulation-specific baseline dependencies (larger improvements for lower baseline performers were observed in both tDCS conditions, suggesting rather stimulation-unspecific effects like regression to the mean). Together, our results provide evidence against reliable top-down attention-guided visual search improvements through FEF tDCS.

Perception

M24

Neural correlates of embodied and vibratory mechanisms associated with vocal emotion production

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Although much research has explored the psychological and neural mechanisms of vocal emotion perception, fewer studies have focused on the processes involved in emotional voice production. In particular, the vibrations originating from the vocal cords and their role in vocal expression of emotions remain understudied. In the present study, twenty-five participants were instructed to produce angry, happy and neutral emotional vocalizations under different production conditions—'normal,' 'whisper,' and 'articulate'—while lying in a 3T MRI scanner. Vibrations near the vocal folds were recorded with a tri-axis accelerometer placed on the skin of the throat. Vibrations were only present in the 'normal' production condition as vocal cords were not recruited during 'whisper' or 'articulate' conditions. Our results showed that emotional expressions activated the bilateral temporal voice areas, the inferior frontal gyri, as well as motor and supplementary motor regions. The vocal production condition and its interaction with emotions revealed significant activations in motor and somatosensory cortices, insula, and inferior frontal cortex. Exploratory analysis of brain activity associated with the expressions' vibrations revealed significant correlations with regions involved in multisensory integration and vibrotactile processing, including the insula, inferior frontal cortex, and cerebellum. These results highlight the contribution of vibrotactile feedback to vocal emotion production. They suggest that vibrations play a key role in bodily self-consciousness and related neural mechanisms during vocal emotion production.

Perception

M25

Temporal dynamics of subjective auditory presence and absence: an sEEG study

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Perceptual consciousness is generally studied in experiments where participants are required to detect or pay attention to the presence of a stimulus. Here, we inquire whether (1) neural correlates of subjective stimulus presence are tied to perceptual consciousness itself or to task demands and (2) whether they are also recruited when participants experience stimulus absence.

To do so, we recorded high gamma activity in 16 individuals with epilepsy implanted with stereo-electroencephalography electrodes. Participants were presented with a babble noise sound sequence that varied in intensity around their auditory threshold. They listened to these audio streams that faded in and out of consciousness and (1) pressed a button while they perceived sounds, (2) pressed while they perceived silences or (3) listened passively (no-report condition). The strength of their button press was collected as an implicit measure of subjective perception, possibly linked to confidence. The speed of button presses tracked stimulus intensity, offering a promising avenue to quantify fine-grained aspects of perception implicitly.

We found shared high-gamma responses to both sounds and silences. A large proportion of sEEG channels showing such modulations also displayed responses in the no-report condition. These channels were widespread, including the superior temporal and prefrontal cortices. Some channels in the same brain regions showed an effect of detection, indicating an encoding of participants' perception and not just of stimulus strength. Task-unrelated, content-invariant responses of neuronal populations displaying shared modulations to the perception of sounds and silences indicate a critical role in perceptual consciousness.

Perception

M26

Sound and action representations in early visual cortex of sighted and blind individuals

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Early visual cortex has traditionally been assigned a predominantly visual function of processing basic visual features from retinal input. In recent years, evidence has accumulated that early visual cortex also receives and represents non-visual and higher-level information from the rest of the brain. I will give an overview about several of our fMRI studies demonstrating that different types of semantic sound information as well as hand actions can be decoded from fMRI activity patterns in early visual cortex of both blindfolded sighted and congenitally blind individuals. All these studies used machine-learning based multivariate pattern analysis to decode non-visual information content from fMRI activity pattern in visual and auditory regions and across the whole brain. Our results suggest that, in the sighted, early visual cortex represents semantic sound information, mostly independent of visual mental imagery, and potentially for the purpose to predict incoming visual information. Congenitally blind individuals also represent sound and action information in early visual cortex, in an eccentricity specific manner (i.e. with different representations in foveal and peripheral visual areas), suggesting that the eccentricity organisation of early visual cortex is preserved despite lifelong absence of visual input. In the blind, eccentricity specific sound and action representations may help to represent the spatial outline of the environment or may support more general cognitive functions.

Perception

M27

Multi-sensory entrainment of visual-somatosensory alpha coherence and its effect on visual-tactile integration

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Successful communication between distinct brain areas has previously been suggested to rely on neural coherence (i.e., phase alignment of neural oscillations across said brain areas). Multi-modal integration, for example, has been associated with alpha (8-12 Hz) coherence across relevant sensory and/or motor cortices. The causal role, potential phase-dependency and underlying mechanism of alpha coherence for multi-modal integration, however, remain ambiguous. To bridge this gap, we will combine electroencephalography with a newly designed multi-sensory entrainment paradigm that uses 10 Hz visual flicker and 10 Hz vibrotactile stimulation to manipulate the presence (rhythmic vs. arhythmic) and phase lag (in-phase vs. anti-phase) of visual-somatosensory alpha coherence while/before participants compare intensity changes/locations across the visual and tactile domain. We propose that rhythmic visual-somatosensory stimulation will enhance alpha coherence in respective brain areas, which should then, in turn, lead to better performance compared to arhythmic stimulation. Moreover, this improvement should be more pronounced for optimal in-phase compared to sub-optimal anti-phase coherence. Lastly, if the mechanisms underlying entrainment extend beyond oscillation-input alignment, we would expect behavioral effects that outlast the entrainment phase and potentially outweigh sub-optimal stimulus timing. Together, this study (first data will be available by January) will shed new light on the mechanisms behind multi-modal integration and the involvement of alpha coherence therein.

Clinical Neuroscience

T1

Electrophysiological correlates of the temporal dynamics of Parkinson's disease motor and non-motor symptoms following acute levodopa administration

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Dopaminergic replacement therapy (DRT), routinely used as an efficient symptomatic treatment of Parkinson's disease (PD) is often associated with motor and non-motor fluctuations which have a severe impact on patient's quality of life. While changes in EEG resting-state power have been reported following L-DOPA administration, the temporal dynamics of the transition between the OFF and ON stage in terms of motor and non-motor state and EEG oscillatory activity has not been investigated.

In the current poster, we report results from 23 patients, who underwent high-density EEG recordings during the 60 minutes following levodopa administration. After 6 minutes OFF-state resting-state, during the experiment duration, 5 minutes eyes-closed resting state sessions were followed by a 5 minutes monitoring session with a motor assessment and administration of a non-motor symptoms scale. Time-frequency analysis was then performed on the resting-state periods using as baseline the average OFF resting-state power.

Motor and non-motor transition profiles presented striking differences between patients with differential onsets of motor and non-motor ON state. Generalized linear mixed model analysis points to a preferred covariance of fronto-central gamma band with the decrease of OFF non-motor symptoms, beta-band with the increase of ON non-motor symptoms and lower frequencies with motor state improvements (theta, alpha, beta bands).

Altogether, these results suggest an asynchronous motor and non-motor transition as well as for ON and OFF non-motor symptoms in the OFF to ON dopaminergic state, paving the road to a better understanding of the oscillatory correlates subtending motor and non-motor symptoms of PD.

Clinical Neuroscience

T2

Resting state EEG microstates in ARFID reveal alterations in salience and sensory brain network

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Avoidant/Restrictive Food Intake Disorder (ARFID), introduced in DSM-5 2013, is a psychiatric condition marked by extreme food avoidance and failure to meet nutritional needs, resulting in weight loss, nutritional deficiencies, and psychosocial impairment. Despite its clinical significance, research on ARFID remains limited, with emerging evidence suggesting a neurobiological basis contributing to symptoms like sensory sensitivity, low appetite, and fear of aversive consequences. This study provides preliminary evidence of altered resting-state brain networks in children and adolescents with ARFID, utilizing EEG microstate analysis to investigate large-scale network dynamics. We recorded high-density EEG of 18 ARFID patients and 18 healthy controls (HC) age- and sex-matched. Between-group differences in brain activations were then assessed using microstate analyses. Across all subjects, we identified four microstate maps—A, B, C, and D. Significant group differences emerged for Map C, with the ARFID group exhibiting higher global explained variance (GEV) and mean duration compared to HC. Additionally, ARFID patients showed decreased transition probabilities from microstate B to A and increased probabilities from B to C. These findings highlight altered brain activity patterns in ARFID, particularly in microstate C, which is associated with the salience network and its transitions from the sensory network. This study provides preliminary evidence of altered brain network dynamics in ARFID, advancing our understanding of its neurobiological basis and highlighting potential avenues for neurophysiological interventions.

Clinical Neuroscience

T3

BOLD Variability Changes and Cognitive Outcomes from Newborn to School-Age in Very Preterm Children

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Premature birth is associated with structural and functional brain alterations, increasing the risk of cognitive impairments later in life. BOLD-variability can be seen as a predictor of cognitive performance, and thus may be relevant in assessing high-risk populations such as preterm infants. This study assesses how RS-fMRI regional BOLD-variability changes from newborn to school-age in very preterm-born (VPT) children compared with full-term (FT) controls both longitudinally and cross-sectionally to further understand brain functional maturation and its impact on cognitive performance. MRI was acquired in 55 VPT and 27 FT infants at term-equivalent age, and 14 VPT and 20 FT school-age children, of which 11 VPT and 9 FT children had longitudinal MRI. School-age children also completed the General Ability Index (GAI) from the WISC-IV. Mean BOLD-variability increased significantly from newborn to school-age only in VPT children ($p=0.007$) Significant regional increases in VPT children BOLD-variability were observed in attention and default mode networks in preterm children, linked to cognitive performance. Mean GAI-WISC scores did not significantly differ between VPT and FT at school-age. However, general linear modeling revealed BOLD-variability as a significant predictor of WISC scores at school-age within-group, accounting for 26% of the variance ($p=0.0246$), with higher BOLD-variability predicting higher WISC scores. Our findings provide insight into the neurodevelopment of very preterm children during the first decade of life. Positive correlation of increased BOLD-variability with cognitive scores suggests that the observed longitudinal increase in BOLD-variability in VPT children may support cognitive performance to align with FT peers.

Clinical Neuroscience

T4

Safety and feasibility of home-based transcranial alternating current stimulation (tACS) in Mild Cognitive Impairment (MCI) patients

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Mild Cognitive Impairment (MCI) is the transitional stage between normal aging and dementia, affecting 10-20% of adults aged 65 and older. Despite its prevalence, effective treatments for MCI are lacking. Targeting the MCI stage of cognitive decline offers a unique opportunity for early detection and intervention, which could delay or prevent progression to dementia or other neurodegenerative diseases. Transcranial alternating current stimulation (tACS), a non-invasive brain stimulation technique, can enhance cognition and memory in adults by modulating cortical oscillations. This randomized, sham-controlled, parallel-arm, and double-blind MemStim clinical trial examines whether 4 weeks (20 sessions) of home-based, caregiver-led 40Hz tACS can be an effective and feasible tool for preventing and treating memory decline in MCI patients. We used a 6-electrode, MRI-personalized tACS montage over the left angular gyrus, one of the hub regions reflecting dementia-related memory deficits. Our interim results show that 20 MCI patients and 20 caregivers could fully comply with the daily tACS sessions, and there was 100% adherence to the tACS protocol. Side effects (e.g., headache, scalp pain) of tACS were mild and well tolerated. While the clinical trial is still blinded, we found changes in the Montreal Cognitive Assessment (MoCA), a standardized tool used for MCI diagnosis, from the baseline to 4 weeks after tACS in half of the MCI patients. These preliminary results show that this clinical trial is safe and feasible and encourages the pursuit of further MCI patient recruitment.

Clinical Neuroscience

T5

Audiovisual speech integration in children born preterm: a behavioral and fMRI study

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Audiovisual integration is a crucial ability to function well in our complex environment, especially for efficient communication. The impact of prematurity on this ability has only been scarcely studied and to our knowledge its neural basis has never been investigated.

Testing a speech in noise and McGurk task in behavioral and fMRI settings, this study aimed at investigating whether very preterm school-aged children (PT, n=20) exhibit similar audiovisual integration capacities compared with full-term age-matched children (FT, n=22). Participants viewed videos with incongruent McGurk audiovisual (AV), congruent AV, audio-only (Ao), and visual-only (Vo) stimuli in different levels of auditory noise and were asked to repeat the syllable. A subset of these stimuli (90trials) was presented in an fMRI sequence.

Analysis of the McGurk effect showed that both groups similarly experienced the McGurk illusion while the speech in noise task revealed that PT children experienced a more pronounced decline in accuracy in the Ao condition (FT slope difference between AV and Ao: $t(42) = -1.07$, $p > 0.05$; PT: $t(37) = -2.86$, $p < 0.005$). Correlation analyses between brain activation and the latter behavioral result showed that, in PT children, activity in the left somatomotor cortex as well as left superior and middle temporal regions was associated with improved performance (preterm: Pearson's $\rho = 0.77$, $p < 0.001$).

Our findings show that prematurity does not impair multisensory integration per se but may require additional neural engagement in key brain regions for preterm children to perform similarly to full-term children in noisy environments.

Clinical Neuroscience

T6

Functional temporal dynamics and spatial heterogeneity of the fusiform gyrus in autism

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Autism is characterized by social difficulties. Differences in the way autistic individuals process faces have been examined in core regions of the face processing network, such as the fusiform gyrus (FFG). While fMRI studies report differences in activation and connectivity within the FFG in autism, prior research mainly addressed static functional properties across the whole FFG. How activity within the functional subdivisions of the FFG dynamically reconfigures with the rest of the brain in autistic males and females remains unclear. Using a recent extension of a dynamic functional connectivity (dFC) approach (microCAPs), we aimed to characterize both spatially and temporally the functional reconfigurations of the FFG with the rest of the brain in autistic males and females. We included 286 autistic individuals (208 males) and 228 non-autistic individuals (NAI; 146 males), aged 6–30years. Using resting-state fMRI and the FFG as seed region, we derived six microCAPs co-activating with the ventral and dorsal attention, somatomotor, visual central and peripheral, limbic, and default mode networks (DMN). Dice coefficient and permutation testing revealed large spatial overlap across all microCAPs between diagnostic groups ($p>0.05$). There was a significant sex-by-diagnosis interaction ($t=2.61$, $p=0.009$, $pFDR=0.05$) with NAI females exhibiting fewer occurrences of the DMN microCAP than NAI males ($t=3.79$, $p=0.001$), whereas autistic individuals did not show such sex difference ($t=0.17$, $p=0.99$). These findings suggest that the typical sex differences in the dFC of face processing networks are attenuated in autism, highlighting the importance of considering sex-related variability in autism.

Clinical Neuroscience

T7

Identifying depression biotypes with resting-state MEG

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Major depressive disorder (MDD) is a highly heterogeneous disorder characterized by a broad spectrum of symptoms. Aberrations in neuronal oscillation dynamics and their couplings have been implicated in MDD, yet no previous studies have utilized magnetoencephalography (MEG)-based oscillatory mapping to identify depression subtypes. This study aimed to uncover pathophysiological oscillatory dynamics associated with a wide range of depressive symptoms and identify distinct MDD biotypes. 15-min resting-state MEG recordings were obtained from 263 MDD patients and 75 healthy controls. Data were source reconstructed and collapsed to 200 parcels of the Schaefer atlas. Two intrinsic modes of functional connectivity, phase synchrony (PS) and amplitude correlations (AC), were computed with weighted phase lag index and orthogonalized correlation coefficient, respectively. We applied the partial least square correlations method to extract the latent brain-behavior associations between PS/AC and symptoms, and two significant latent components (LC) were obtained, one derived from PS and the other from AC. The PS-derived LC reflected the overall severity of depressive symptoms, with alpha and beta frequency bands contributing most prominently. The AC-derived LC was associated with specific symptom dimensions, including rumination, anhedonia, PTSD, and substance abuse, dominated by theta and beta bands. Using these LCs, Leiden clustering identified five distinct MDD subtypes, each characterized by discrete symptom profiles. These biotypes demonstrated differences in connectivity strength, particularly at alpha and beta frequency peaks. This study highlighted the utility of resting-state MEG in identifying electrophysiological biomarkers of MDD biotypes, offering a valuable approach to understanding depression heterogeneity and advancing transdiagnostic approaches.

Clinical Neuroscience

T8

Interaction Between Slow Oscillations- ECG R Peak Coupling, Spectral Slope, and Morning Cortisol: Insights into Sleep-Dependent Brain-Heart-Endocrine Regulation

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Introduction: Slow oscillations (SOs; 0.2.6–1.25 Hz) during NREM sleep are key neural events that support recovery. The coupling of SOs with ECG R peaks reflect brain-heart integration, while the spectral slope (1–45 Hz) provides a marker of central arousal, with steeper slopes indicating reduced cortical excitability. Morning cortisol, a hypothalamic-pituitary-adrenal (HPA) axis marker, reflects sleep-related stress recovery. This study investigates the relationship between SO-ECG coupling, spectral slope dynamics during NREM, and morning cortisol levels to explore their interdependence. Methods: Polysomnographic recordings and morning salivary cortisol samples were collected from 18 healthy adults. SOs were identified from EEG channel Fz, R peaks were extracted from ECG data using Kubios. R -peaks were time locked to peak locked SO events. Further we calculated spectral slope between 1-45 Hz as a central marker of arousal. Finally, morning cortisol levels were measured as area under the curve of 2 morning salivary cortisol samples.Linear regressions between SO-ECG coupling and cortisol levels and SO-ECG coupling spectral slope were calcuated. Results: Stronger SO-R peak coupling during NREM significantly correlated with lower spectral slope ($F(1,16)=16.6$, adjusted $R2=0.47$, $b=-1.8$) and lower morning cortisol levels ($F(1,16)=6.52$, adjusted $R2=0.24$, $b=-0.3$). Discussion: The findings highlight a dynamic relationship between neural, autonomic, and endocrine systems during NREM. SO-ECG coupling and spectral slope steepness may jointly modulate stress recovery, with disruptions potentially contributing to dysregulated arousal and cortisol secretion. Future studies should examine these mechanisms in stress-related and sleep-disordered populations.

Clinical Neuroscience

T9

From pre- to post-natal brain asymmetry: callosal contribution and relationships with cognitive and genetic factors

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The human brain, despite initial symmetry, exhibits intriguing asymmetrical features. Strong associations have been established between brain asymmetry and corpus callosum structure. Prenatal brain asymmetries appear around 11-13 weeks of gestation, reflecting early genetic-developmental left-right axis formation. These asymmetries affect cognitive and socio-emotional processes, with implications for neurodevelopmental and psychiatric disorders. However, the developmental trajectory of brain asymmetry from prenatal to postnatal stages, its interaction with corpus callosum integrity, and its effects on cognitive and socio-emotional development remain unclear.

This study aims to trace anatomical brain asymmetry from pre- to postnatal periods in typically developing (TD) children and those with corpus callosum dysgenesis (CCD). Using longitudinal, multimodal data from Lausanne and Geneva University Hospitals, it will evaluate relationships between callosal biomarkers, cognitive and socio-emotional development, and genetic origins. The study includes T2-weighted foetal brain MRI scans acquired between 20-35 gestational weeks and follow-up data (T1-weighted MRI, neuropsychological tests, questionnaires and saliva DNA sampling) at school age (6-12 years) from 90 children (60 TD, 30 CDD) born between 2012 and 2021.

Brain images will be segmented using FoetalSynthSeg and SynthSeg to calculate hemispheric asymmetry indexes. Genetic analysis will focus on TUBB3 Single Nucleotide Polymorphisms, linked to callosal formation and brain asymmetry. Random effects models will assess group differences and asymmetry maturation. Associations between asymmetry indexes, cognitive and socio-emotional outcomes, and SNPs will be examined using sparse partial least squares correlations. This study leverages unique longitudinal data to enhance understanding of brain asymmetry development and its relationships to cognition and genetic variations.

Clinical Neuroscience

T10

Clinical neuroradiological exams using 7T Terra.X MRI

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In Autumn 2023, the Neuroradiology division of the HUG started using the 7T Terra.X MRI for neuroradiological exams. The ultra-high field scanner along with the parallel transmission technology enhances signal-to-noise ratio which can be traded to increase spatial resolution. Acquiring images with finer structural details would be a valuable tool for the diagnosis of specific neurological disorders such as epilepsy. Consequently, we have optimised sequence parameters in order to acquire high-quality images with sub-millimetric resolution within clinically-acceptable acquisition times. This work aims at presenting the optimised sequences and showing the benefits of 7T in a few clinical cases. The sequences that were optimised for clinical exams and that will be presented here are the 3D MP2RAGE, 2D T2-weighted TSE, 3D T2-weighted FLAIR SPACE, 2D SWI and 3D TOF. Those sequences improved the diagnosis of patients with multiple sclerosis, epilepsy, tumours, cerebral amyloid angiopathy and aneurysm. We will show examples of lesion and venous malformation detection in patients with multiple sclerosis, detection and characterisation of an aneurysm and detection of epileptic focus. We will also compare 3T and 7T images where relevant. Future use of the 7T Terra.X MRI will benefit from advances in acceleration techniques and a broader application of artificial intelligence, which will improve protocol efficiency allowing for shorter scan times while mitigating image quality loss.

Clinical Neuroscience

T11

Morphological Alterations in Mild Cognitive Impairment

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Mild Cognitive Impairment (MCI) is characterized by cognitive decline in various domains, including memory, but relatively preserved daily functioning. An additional prominent feature of MCI lies in an accelerated grey matter (GM) volume decline profile in the fronto-temporal regions, including the hippocampus. Yet, relationships between specific brain atrophy patterns associated with MCI and behavioral manifestations of the disorder remain still unclear. As part of the MemStim randomized clinical trial, we took advantage of magnetic resonance T1-weighted imaging data to evaluate Grey Matter volume differences between 32 MCI and 58 gender and age-matched healthy controls (HC) using voxel-based-morphometry analysis. As expected, we found group differences at the Montreal Cognitive Assessment (MoCA), a standardized test used for MCI diagnosis. MCI patients showed lower performance compared to HC. In line with the literature, preliminary exploratory whole-brain analysis of GM volume revealed a widespread pattern of frontotemporal atrophy in MCI patients, centered on the left hippocampus-amygdala complex (HC > MCI, $p < 0.001$, uncorrected for multiple comparisons). Significant clusters were located in the hippocampus, subgenual cingulate gyrus, orbitofrontal cortex and inferior temporal gyrus ($p < 0.05$, FWE corrected for multiple comparisons). These preliminary results encourage the pursuit of morphometry investigations such as cortical thickness but also the evaluation of pathological protein load differences, and network connectivity changes, as well as the relationships between those multimodal brain features and global behavioral performance including executive functions and memory tasks.

T12

Improvement in negative symptoms in patients with psychotic disorders is associated with an increase in resting-state activation and gray matter volume within the medial orbitofrontal cortex

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Patients with psychotic disorders may exhibit negative symptoms and cognitive deficits in addition to delusions and hallucinations. The innovative MOSAIC psychotherapy combines individual cognitive behavioral therapy and group training for social skills and cognition over eight months to improve negative symptoms, social cognition and social functioning. Sixty patients with psychotic disorders participated in a randomized controlled trial comparing MOSAIC with SUPPORT (supportive conversations and pleasant group activities with equal duration and frequency). Besides assessment of negative symptoms, changes in resting state network activation (rs-fMRI) and gray matter volume were evaluated using SPM12 (www.fil.ion.ucl.ac.uk/spm, CONN-Toolbox, CAT12-Toolbox, $p < 0.05$). Statistical analysis revealed no significant differences between MOSAIC and SUPPORT regarding improvement in negative symptoms ($p = 0.36$, Cohen's $d = 0.1$). However, pre-post comparisons showed reduction in negative symptoms with medium to large effect sizes within each group. Mean PANSS negative scores decreased by 4.7 ± 5.8 points for MOSAIC ($p < 0.001$, $d = 0.82$) and by 4.1 ± 7.7 points for SUPPORT ($p = 0.005$, $d = 0.53$). At neural level, improvement in negative symptom severity correlated with increased gray matter volume in the medial orbitofrontal cortex and left temporal pole. Regarding the resting-state network, the medial orbitofrontal cortex also showed an increase of mean activation and an elevation of resting-state connectivity to the left Caudate. These results indicate a link between clinical improvement and neuroplastic changes in regions contributing to social cognition and emotional processing.

Clinical Neuroscience

T13

Load-dependent relationships between fNIRS hemodynamic signals and cognitive performance after caffeine intake in healthy young adults: A data-driven PLSC approach

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Caffeine, a widely consumed psychoactive substance, is thought to enhance brain and cognitive functions primarily by antagonizing adenosine receptors. These mechanisms influence cortical hemodynamics, which can be measured using functional near-infrared spectroscopy (fNIRS) through changes in oxygenated hemoglobin concentration ([HbO]).

Despite substantial research, the relationship between caffeine intake, fNIRS signals, and cognition remains unclear. While some studies suggest that caffeine reduces frontal cortex hemodynamics and improves performance, results are inconsistent, likely due to individual differences (e.g., age, caffeine tolerance) or suboptimal experimental designs (e.g., insufficient task load manipulation). Moreover, most studies rely on univariate analyses of fNIRS channels, which may overlook the region-specific effects of caffeine on cortical hemodynamics during cognitive tasks.

To address these gaps, we conducted a randomized, double-blind, incomplete crossover study with 36 young adults (aged 25–35), all moderate caffeine consumers. Participants received two of three interventions (placebo, 180 mg caffeine, or a caffeine-based mix; data for the latter not reported) and performed n-back tasks at three load levels. Changes in [HbO] were measured across 30 NIRS channels spanning the fronto-parietal regions. Behavioral partial least squares correlation (PLSC), a multivariate analysis, was used to explore interactions between regional hemodynamic responses, caffeine intake, and cognitive performance across load levels.

Overall, findings suggest that caffeine improves 0-back accuracy and reduces frontal hemodynamic responses 45 minutes post-consumption, indicating that caffeine may reduce brain metabolic demands during simpler tasks, enhancing cognitive efficiency. These results highlight the importance of task load manipulation and advanced analysis methods in understanding caffeine’s effects.

Emotion & Motivation

T14

Sensitivity to disgust modulates hypothalamic connectivity and immune responses following exposure to virtual infectious avatars

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Recent research showed that approaching infectious avatars, entering the peripersonal space (PPS) in virtual reality (VR), modulate innate lymphoid cell (ILC) activation. Here, we aimed at investigating the role of individual disgust sensitivity in the neuroimmune mechanisms underlying such phenomenon. Disgust sensitivity is a crucial component of the behavioral immune system (BIS), aiding in pathogen avoidance and potentially pre-activating immune responses. Our study investigates the interplay between disgust, immune signaling, and brain activity in two cohorts exposed to infectious threats in VR. Using a bio-behavioral approach, we assessed how susceptibility to disgust influences immune reactivity, specifically ILC activation markers. Results showed that higher disgust susceptibility was associated with reduced ILC activation in response to infectious avatars.

To investigate functional connectivity (FC), we defined a seed in the hypothalamus, given its central role in regulating innate immune responses via the hypothalamic-pituitary-adrenal (HPA) axis. Significant FC modulation within brain networks was observed following VR exposure to infectious stimuli. Connectivity between the hypothalamus and visual areas was influenced by disgust levels, with high-susceptibility individuals displaying increased connectivity towards regions associated with the salience and PPS network. These findings suggest that disgust modulates the neuroimmune crosstalk through a HPA signaling cascade, potentially pre-activating immune defenses against infectious threats detected through PPS and saliency networks.

These findings underscore the role of high-level personality traits, such as disgust sensitivity, in modulating brain-body defensive pathways. Future work aims to deepen understanding of this brain-immune crosstalk, paving the way for an integrated approach to the immune system.

Emotion & Motivation

T15

Differential Engagement of Associativo-Limbic and Sensorimotor Regions of the Cerebellum and Basal Ganglia in Explicit vs. Implicit Emotional Processing

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Emotional prosody processing involves multiple brain regions, but the specific roles of the cerebellum and basal ganglia in explicit (conscious) and implicit (incidental) tasks are not well known or understood. This study investigated how the cerebellum and basal ganglia contribute to explicit (emotion categorization) and implicit (gender categorization) processing of emotional prosody. Twenty-eight healthy French-speaking participants underwent high-resolution functional MRI while performing a vocal emotion processing task under such implicit and explicit conditions. Behavioral data analyses indicated greater accuracy in the gender discrimination task (implicit processing). Neuroimaging partially supported our hypothesis according to which explicit emotion processing yielded to increased activations in associativo-limbic regions (e.g., inferior frontal gyrus, Crus I and caudate) linked to higher-order functions, while implicit emotion processing engaged sensorimotor regions (primary motor cortex, primary somatosensory cortex) and areas associated with automatic processing (putamen, posterior insula, cerebellar lobules VIIIa-b and IX). Unexpected activity during task conditions suggests motor preparation effects and more complex brain network dynamics. These results challenge modular views of brain function and highlight the need to consider emotional processing as complex, dynamic, network-based interactions.

T16

DATABLITZ

Fast pupillary and auditory responses to high temporally modulated emotional sounds suggest a human magnocellular auditory pathway for threat detection

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Neural models for emotional processing in vision suggest the existence of ultrafast magnocellular routes to the amygdala, allowing efficient threat detection and subsequent adaptive behavior in humans. These routes are known to mediate coarse visual processing, eliciting differential responses to threat than other more fine-grained pathways. In the auditory domain, animal evidence suggests the existence of similar routes for threat detection, but they remain unknown in humans. Using fear conditioning, a procedure that depends on amygdala response, we investigated whether magnocellular pathways to the amygdala, particularly sensitive to high temporal modulations, mediate auditory and pupillary responses to threat in humans that may differ from parvocellular pathways, sensitive to low temporal modulations. Electroencephalography and pupillometry data were recorded from 28 healthy participants while they detected voices. Voices were either paired (conditioned) or unpaired (not conditioned) with an unpleasant white noise, which determined their threatening significance. Results suggest that fear conditioning was effective, and threatening stimuli at high temporal modulations elicited earlier auditory and pupillary responses than those presented at low temporal modulations. In turn, early pupillary threat responses to high amplitude modulated emotional sounds, in interaction with participants' trait anxiety levels and stimulus valence ratings explained variations in d-prime scores. These results are compatible with faster cortical responses to threat when encoded through magnocellular inputs to the amygdala and suggest the existence of auditory routes for threat detection in humans, similar to that in vision.

Emotion & Motivation

T17

The Neurobiological Craving Signature predicts social craving and responds to social isolation

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Social connection is a basic human need. Recent work has proposed that social isolation activates similar brainstem circuits then fasting from food intake. However, it remains unclear whether whole-brain activation patterns as measured by fMRI are similar for social isolation and food deprivation, and whether social craving—our need for social interaction—is predicted by the same brain pattern as food or drug craving. Here, we tested the Neurobiological Craving Signature (NCS)—a recently developed whole-brain pattern that predicts drug and food craving and separates patients with substance use disorder from matched controls with high out-of-sample accuracy—on an existing fMRI dataset (N=40) of brain responses to pictures of food, social, and control cues after social isolation, fasting, or no deprivation. Our results showed that the NCS significantly predicted self-reported craving for food and social cues, but not control cues, providing first evidence that this neuromarker, trained to predict drug and food craving, also predicts the degree to which humans crave social interaction. Further, NCS responses were increased for food cues after fasting, and to social cues after social isolation, indicating that it responds specifically to deprived and motivationally relevant stimuli. Future research could test how social isolation and stress may increase craving, overeating, and drug use.

DATABLITZ

T18

Fearful faces guide eye gaze earlier than neutral faces before reaching awareness

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Emotional faces can guide eye gaze based on their emotional expression even without visual awareness, suggesting emotion processing in the absence of awareness and a dissociation between eye movements and visual awareness (Vetter, Badde, Phelps & Carrasco, 2019). However, how early the eyes detect emotional faces that later reach awareness remains unclear. Using continuous flash suppression (CFS), we rendered fearful and neutral faces invisible from observers' awareness. Participants were instructed to localize the face image as soon as they started seeing any part of the image. Additionally, participants reported its emotional expression, and the image's visibility at the time of localization. Meanwhile, their eye movements were tracked. Behaviorally, fearful faces broke into awareness more often and earlier than neutral faces, consistent with previous studies. Eye-tracking revealed that even before observers became aware of the suppressed face, their eyes moved earlier towards suppressed fearful than towards suppressed neutral faces. When the faces were not suppressed but superimposed on the flashing mask, neither manual reaction times nor oculomotor responses differed between fearful and neutral faces. These novel results confirm that fearful faces have prioritized access to awareness, avoiding the potential confounds of decision criteria and response biases associated with classical CFS breakthrough paradigms. We suggest that fearful faces' advantage in guiding oculomotor responses in the absence of awareness might be a mechanism facilitating their prioritized perceptual detection.

Emotion & Motivation

T19

The curious brain: dissecting the brain mechanisms of curiosity and reward

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Curiosity is a fundamental component of human activities, aiming at reducing ignorance and uncertainty. Researchers have distinguished two types of curiosity: on the one hand, instrumental curiosity (IC) refers to the exploration of the environment to learn its rules; on the other hand, non-instrumental curiosity (NIC) refers to spontaneously seeking epistemic knowledge in the absence of clear utility. Both forms of curiosity are important sources of motivation, whose relief might be rewarding. A dopaminergic frontal-striatal brain network plays a key role in reward processing. Recently, it has been hypothesised that curiosity-driven information appetite might rely on similar brain networks, but research on curiosity is still scarce. We developed a novel cognitive task including reward, IC and NIC, allowing us to study for the first time the shared neural networks of these conditions, in the same subjects, at the same time. We measured task-related brain activity through high-resolution 7T fMRI in 50 healthy participants. We compared brain activity related to reward, IC relief and NIC relief to the absence of reward. Rewards activated a large prefrontal-striatal network largely including the vmPFC, while IC and NIC reliefs correlated with increased activity of bilateral striatum and frontal-parietal networks. Next, we explored the overlapping of brain regions involved in reward, IC and NIC, and we found shared bilateral dorsal striatum and right ventral striatum activations. Our findings show that curiosity relief and monetary reward are similarly coded in the striatum, indicating that knowledge is intrinsically rewarding, whether it is utilitarianly beneficial or not.

Emotion & Motivation

T20

Exploring shared networks between vocal emotion production and perception

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In affect perception and empathy research, processing another's emotions is often argued to involve the vicarious experience of these emotions. Indeed, neuroimaging data relating to the perception of vocal emotions have shown brain activations in common with studies of emotion production; however, very few studies have attempted to establish a direct neural relationship between these two facets of affective communication. In this fMRI study, participants both produced and listened to two-syllable pseudo-words with emotional prosodies (Happy and Neutral) in a sparse-imaging design. The conditions of production and perception were identical, and each participant heard the words produced by the preceding participant, to ensure that any joined activity between the two conditions was directly mediated by the stimuli uttered. Preliminary evidence based on a sample of 18 participants suggests that contrasting Happy versus Neutral words elicit activations in the cerebellum, auditory cortices, and specific part of the superior temporal cortex in both production and perception conditions. Non-common activations included adjacent but non-overlapping STC regions, as well as motor and visual regions during production, and anterior insula during perception. These results provide a first look into a shared neural experience between speaker and listener in affective communication. More generally, this paradigm acts as a proof of concept to investigate shared emotional networks, empathy, and embodied perception, to be further developed by introducing greater samples and a more diverse set of emotions.

TRAVEL GRANT

T21

The Social Nature of Interpersonal Distance: a comprehensive investigation of the behavioral and physiological underpinnings

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Interpersonal Distance (IPD) is defined as the physical distance that individuals maintain between themselves and others to ensure comfortable interactions. While previous research has laid the foundation for understanding the behavioral correlates of IPD, the implicit, non-modulable physiological underpinnings remain less explored. Additionally, no study has examined IPD as a dynamic, bidirectional process requiring a continuous evaluation of the other social agents in naturalistic interactions. In a series of three experiments, we collected both behavioral (IPD preferences) and physiological (Electrodermal Activity) measures from 86 participants performing different versions of the Stop Distance Paradigm. Our aims were to (a) compare different approaches to daily interactions, (b) target the physiological components of space invasion, (c) isolate the intrinsic social nature of IPD, and (d) investigate the role of the interlocutor's subjective attitude in IPD modulation. Our findings indicate that individuals maintain shorter distances when actively approaching others rather than being approached, in association with greater autonomic activation. Additionally, we found invasion of personal space to trigger an implicit physiological response. While we observed behavioral similarities in the interaction with human and non-social agents, these were not reflected at the physiological level, suggesting implicit responses to IPD to be social-specific. Finally, we found IPD to vary based on whether individuals focus on their own comfort zone or the other's comfort zone, and to be influenced by the interlocutor's attitude. Overall, our findings provide a comprehensive understanding of IPD as a dynamic, intrinsically social, and bidirectional process characterized by distinct behavioral and physiological markers.

Emotion & Motivation

T22

Designing an fMRI Study to Map Odor-Elicited Feelings in the brain: A Protocol Overview

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Olfaction holds a distinctive position among sensory modalities in eliciting emotions, given its close association with the limbic system and a direct connection between the primary olfactory cortex and the amygdala. Although previous imaging studies in humans have explored representations of affective valence and arousal, these dichotomous dimensions may not adequately capture the richness of odor-evoked emotions. We aim to assess how the neural representation of olfactory feelings is organized, using a model with six specific dimensions (i.e., the Geneva Emotion and Odor Scale, GEOS). This tool was designed and validated to collect odor-related emotions, reflecting diverse adaptive functions. We hypothesize that distinct and unique neural patterns will be associated with each GEOS dimension, providing insight into the functional characterization of brain regions involved in the processing of odor-elicited feelings, beyond the hedonic dimension. To test this, 100 healthy adults will participate in a functional Magnetic Resonance Imaging (fMRI) study where they will be exposed to 50 everyday odors (e.g., foods, products, cosmetics) with varying olfactory profiles. Participants will rate each odor using GEOS during scanning, to capture the elicited feelings, which will then be analyzed using Representational Similarity Analysis to relate multivoxel measures of fMRI activity to these odor-elicited feelings, across the whole brain using a searchlight approach. Covariates related to personality traits and emotional abilities will be collected through pre-scanning questionnaires assessing the perceived importance of olfaction, environmental sensitivity, emotional intelligence, mood states, while olfactory function will be evaluated using a psychophysical test.

DATABLITZ

T23

EEG microstates of emotional processing during a psychotherapeutic intervention

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Background & Objective: Emotions are our greatest friends and sometimes our worst enemies. Emotion Focussed Therapy (EFT) aims to foster emotional resolution by reactivating memories associated with maladaptive emotions and introducing new adaptive emotional responses. Our study aims to answer whether EEG microstates can differentiate the activation of neural networks related to maladaptive and adaptive emotions and explore which emotional states show significant microstate differences.
Methods: EEG data was collected from 19 healthy subjects during an empty-chair intervention addressing "unfinished business". Therapy sessions were video recorded and coded for active emotions based on a sequential model of emotional processing from maladaptive to adaptive emotions. Multidimensional scaling (MDS), confirmatory factor analysis (CFA), and a variance-covariance matrix (VCM) were calculated to identify neurophysiological patterns corresponding to maladaptive and adaptive emotions. Linear mixed-effects modeling (LMM) and post-hoc comparisons assessed neurophysiological differences between emotional states.
Results & Discussion: MDS and CFA indicated two distinct groups of emotions (maladaptive and adaptive) with few exceptions. ANOVA yielded significant results only for
GFP. Pairwise post-hoc comparisons revealed significant differences among four pairs of emotional states across all four EEG microstate variables. These findings indicate distinct neurophysiological correlates of emotions and inform hypotheses for potential refinement of the sequential model of emotional processing during personal change processes.

Emotion & Motivation

T24

Tracking the neural dynamics underlying variations in flow/attentional states at the timescale of second

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Flow is characterized as an optimal experience of deep concentration and engagement. Existing methods to capture flow fluctuations primarily rely on experience sampling, whose temporal sparsity limits exploring the neural dynamics of flow variations. Here we propose a novel dual-task paradigm designed to track flow fluctuations on a second timescale. In our flow paradigm, participants are challenged by a gamified finger-pressure task, while having to perform an auditory oddball detection task. As expected, we find that participants are more error prone on the finger pressing task when an auditory oddball target is also present as compared to standard sounds. More relevant to the hypothesis that flow states index times of high performance, we demonstrate that on pressing trials which co-occur with the auditory targets, participants performance on both tasks covary positively, being either fast and accurate on both tasks, or slow and more error prone on both tasks. Such flow variations as the experiment proceeds were further measured with rare, self-declared flow probe questions, and we confirm lower self-reported flow after several failures on the pressing task. Next, modeling flow level through increasing or decreasing saturating functions for respectively successes or failures at the pressing task, we show that we can model in each participant their flow fluctuations as the task proceeds. Our goal is now to implement this dual-task setup in the MEG using the auditory-evoked responses from the oddball task to track the neural bases of high-flow and low-flow state.

Emotion & Motivation

T25

Introspection dependent, epiphenomenal learning signatures in self-reported affect

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Do people learn to predict their feelings over time, and does it manifest in corresponding behavior? Feeling ratings track with what we do. A better understanding of their properties may thus help elucidate behavior. Inspired by reinforcement learning frameworks, differences between expected and experienced feelings—affective prediction errors—have recently been added to the toolkit of behavioral prediction. But the extent of the analogy between affective prediction errors and conventional prediction errors about outcomes in the environment is unknown. Across a reanalysis of existing data (N = 4607) and three pre-registered experiments (N = 968), we document and dissect a core analogy: Learning reflected in decreasing (affective) prediction errors over time. We found such decreases to depend on introspection, as prior experience with a task absent affective reports did not yield the same decreases (Experiment 1). Participants interveningly forced to alter their choices showed increased affective prediction errors, ruling out simple response alignment (i.e., to report feeling "as predicted"; Experiment 2). Decreases in affective prediction errors transferred across similar tasks (i.e., stealing versus giving money; Experiment 3). Although affective prediction errors often tracked with behavior overall, their absolute decrease over time did not. In sum, we present evidence for convergence (i.e., learning and transfer) and divergence (i.e., introspection dependence and partial epiphenomenality) between affective prediction errors and conventional forms of prediction errors.

Methods

W1

Mutual information for studying electrophysiological recordings of the brain: when it works and when it does not

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Understanding the relationships between electrophysiological signals is crucial in neuroscience. These signals carry information about brain function but are often obscured by noise, artifacts, and overlapping effects. Extracting meaningful insights requires quantifying relationships between signals effectively.
Pearson correlation is one of the most widely used metrics for quantifying pairwise similarity. However, its effectiveness is limited to highlighting linear relationships, which are not always sufficient when studying electrophysiological data. Mutual information, an information-theoretic measure, offers a more versatile alternative as it can capture both linear and non-linear relationships. Despite its versatility, mutual information is harder to estimate, especially in the case where the data is continuous (i.e., assumes value in a continuous range), as it requires knowledge of the full statistical distribution of the signals. Different estimators have been proposed for this use, based on different hypotheses, which may be more or less suitable depending on the research question.
In our work, we evaluate the most commonly used mutual information estimators for continuous data, using simulated electrophysiologically realistic signals. We compare these estimators against Pearson correlation to assess their performance under different conditions. The findings highlight the advantages and challenges of using mutual information as a metric for understanding pairwise relationships in electrophysiological data. Specifically, we identify scenarios where mutual information provides superior insights into signal relationships, offering guidelines for its practical use in neurophysiological studies.

Methods

DATABLITZ

W2

A Whole-Brain Model of the Aging Brain During Slow Wave Sleep

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Age-related brain changes affect sleep and are reflected in properties of sleep slow-waves, however the precise mechanisms behind these changes are still not completely understood. In particular, previous research has shown, that the observed changes -- slow waves becoming less frequent, lower in amplitude, and more variable -- can be explained in spiking network model by a reduction in the excitatory drive. Here, we explore to which extent the decrease of the excitatory drive is compatible with the age-related white matter changes. For this purpose, we adapt a previously established whole-brain model relating structural connectivity changes to resting state dynamics across the healthy aging trajectory, and extend it to a slow-wave sleep brain state. In particular, starting from a representative connectome of the subjects at the beginning of the aging trajectory (age 55-63 years), we have gradually reduced the inter-hemispheric connections, and simulated sleep-like slow-wave activity using a brain network model. We show that the main empirically observed trends, namely a decrease in duration and increase in variability of the slow waves are captured by the whole-brain model. Furthermore, comparing the simulated EEG activity to the source signals, we suggest that the empirically observed decrease in amplitude of the slow waves is caused by the decrease in synchrony between brain regions. Altogether, our results support the notion that alterations in slow-wave characteristics result from reductions in cortical excitatory drive—here facilitated by the inter-hemispheric connections. This model serves as a robust foundation for extensions to population studies and interventional work.

Methods

W3

Constructing The Human Metabolic Brain Connectome: Construction, Stability, Topology and Biological Interpretation

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The emergence of network science in neurobiology has significantly advanced our understanding of brain networks, revealing the self-organizing, scale-invariant patterns underlying its structural and functional connectivity. While various neuroimaging modalities have facilitated the mapping of structural and functional connectomes, their inability to capture metabolic dynamics has left a critical gap in connectomics. Assuming that these networks are fundamentally underpinned by biochemical components, such as the pivotal role of oxidative glucose metabolism in maintaining neural function, metabolic imaging presents a promising avenue for exploring brain network organization from a biochemical perspective. In this study, we employ advanced 3D proton magnetic resonance spectroscopic imaging (MRSI), which facilitates whole-brain, multi-metabolite imaging with high spatial resolution and significantly reduced acquisition times, enabling the construction of the first human brain metabolic connectome. Using data from 68 healthy adolescents, further validated on an independent cohort (N=13), we developed a pipeline for generating metabolic similarity matrices and demonstrated their stability, reproducibility, and biological significance. Our findings reveal that metabolic networks exhibit natural topological features, modular organization, and homotopic patterns, reflecting functionally integrated yet spatially distinct systems. Additionally, we demonstrate that the centrality of structural hubs correlates with metabolically active nodes and that the topology of the metabolic network aligns with cytoarchitectonic and genetic co-expression patterns, suggesting a neurodevelopmental basis for the metabolic network. This work establishes metabolic homotopy as a hallmark of the brain's complex biochemical organization, providing a foundation for incorporating MRSI into the broader domain of connectomics and its potential applications in health and disease.

Methods

W4

Carbon-wire loops-based real-time regression preserves EEG signal from irregular artifacts — A correction pipeline for EEG-based neurofeedback during simultaneous fMRI

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EEG recorded during fMRI is a magnificent manner to understand cognitive processes, yet, subjected to MRI-related artifacts. Methods to reduce MRI-related artifacts are crucial to ensure correct representation of EEG signal. They become considerably more challenging to implement when using EEG-based neurofeedback, as artifacts must be removed in real time. Among the MRI-related artifacts, the gradient artifact, induced by the time-varying magnetic field gradient is efficiently removed. However, eliminating irregular artifacts (e.g. pulse artifacts - PA) is still challenging, especially in real-time. A recent hardware improvement consisting of carbon wire loops (CWLs) placed on the EEG cap, records the external environment in real-time. The CWL regression approach has been shown to reduce the impact of pulse artifacts on EEG signal. We investigated whether PA correction is needed, or whether the CWL approach could replace it to deal with irregular artifacts

The validation of real-time EEG-fMRI correction method was carried out by replaying EEG data acquired during fMRI acquisitions (4min of resting state eyes-open and eyes-closed) with RecView (commercial) and NeuXus (open source) combined with an in-house developed CWL signal regression. The EEG quality was compared with that generated by offline correction (Analyzer) and to reference data acquired outside of the scanner.

The EEG quality after real time CWL corrections (RecView and Neuxus) is comparable to offline correction (Analyzer) and is similarly close to the reference. PA correction provides negligible improvement. We developed a pipeline to remove artifacts in real-time and provide a clean EEG suitable as neurofeedback input during fMRI.

Methods

W5

EEG Infraslow Waves in Meditative Deep States: Artefacts or Meaningful Markers?

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Meditative deep states are associated with altered states of consciousness and profound changes in brain activity. Among the biomarkers of these states, infraslow waves (ISW), characterized by frequencies below 1 Hz and often regarded as signal artifacts, have emerged as a noteworthy yet underexplored phenomenon in meditation research (Dennison, 2019).

Using 64-channel EEG with equidistant electrode placement, alongside synchronized ECG and respiratory measurements, we recorded brain activity from expert meditators engaged in Theravada Jhana practices and advanced Yogic Samadhi states. Our findings revealed significant increases in ISW amplitude, which correlated with participants' experience levels and subjective reports of profound meditative absorption. These ISW changes were accompanied by alterations in other frequency bands, including delta, alpha, and gamma, which have been more extensively reported in the literature. Additionally, ISW appeared to coincide with a sympathetic physiological response, evidenced by increased heart rate and body temperature.

In conclusion, we propose that ISW observed during meditative deep states warrants greater scientific attention and rigorous investigation to better understand its role and implications in meditation research.

Methods

W6

Towards deep neural networks to deconvolve BOLD fMRI into brain functional networks

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Advances in functional magnetic resonance imaging (fMRI) analysis methods have significantly enhanced our ability to capture dynamic aspects of brain function. Among these techniques, the innovation-driven co-activation patterns (iCAP) framework has established itself as an effective approach, particularly suited for analyzing resting-state fMRI data. The iCAP framework leverages the identification of time points exhibiting significant activity transients to reconstruct brain networks with spatial and temporal integration [1]. This is achieved through three key steps: (1) a deconvolution strategy relying on spatial and temporal regularization to identify activity transients, (2) temporal clustering to group time points with consistent across-voxel transient patterns into components, and (3) spatiotemporal regression to map the transient-based components back to their underlying activity-related signal. Despite its effectiveness, several challenges remain unresolved, including the high computational complexity and the limited ability to generalize to signals acquired under varying conditions, such as different TRs and voxel sizes. Here, we present preliminary results of a deep neural network (DNN)-based approach to address these limitations. Specifically, the deconvolution problem is reformulated into a DNN framework that integrates the spatial and temporal characteristics of the original signal, which are then jointly leveraged for the estimation of spatiotemporal brain dynamic components. These steps represent a promising first approach toward enhancing the computational efficiency and generalizability of dynamic brain activity modeling.

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Methods

W7

Temporal Mechanisms of Inhibitory Control Decline in Healthy Aging

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Age-related changes in brain structure and function affect inhibitory control, but the neurophysiological dynamics underlying these changes in response inhibition remain poorly understood. This study examined age-effects of temporal dynamics of inhibitory control in a large sample of young and old adults (N = 200) by combining high-density EEG and eye-tracking during an antisaccade task. ERP and time-frequency analyses were conducted and statistically analyzed using mass univariate linear mixed-effects models focusing on interactions between age condition (pro- vs. antisaccade) and saccadic reaction time.

Both stimulus-locked and saccade-locked analyses revealed distinct spatiotemporal patterns across midfrontal, centroparietal, and occipital electrode clusters. Stimulus-locked analysis showed age-related differences in early visual processing and response preparation, particularly in the occipital cluster (150-350 ms post-stimulus), with younger adults demonstrating stronger neural activity modulation and more pronounced reaction time-dependent effects. Time-frequency analyses revealed that these results were mainly driven by differences in theta power. Saccade-locked data revealed differential activation patterns between age groups during response execution, with older adults showing reduced midfrontal activation (-200 to 0 ms before the saccade) during antisaccade trials. In the centroparietal cluster, younger adults exhibited stronger preparatory activity preceding successful antisaccades, with both age groups showing reaction time-dependent modulation of this activity, though this modulation was more pronounced in younger adults. These findings suggest age-related alterations in both preparatory and execution phases of inhibitory control, providing new insights into the temporal dynamics of neural mechanisms supporting inhibitory control in aging.

Methods

W8

Integrated TMS and Spinal Cord fMRI Reveal Intensity-Dependent Modulation of Spinal Circuits

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The spinal cord plays a crucial role in mediating sensorimotor functions through intricate neural pathways. However, a comprehensive understanding of these mechanisms remains a developing field. In this study, we utilize a multimodal approach combining transcranial magnetic stimulation (TMS) for precise motor cortex activation with functional magnetic resonance imaging (fMRI) of the spinal cord. Blood oxygenation level-dependent (BOLD) signal changes in the cervical spinal cord were assessed across three TMS-intensity conditions (low, medium, and high, relative to the individual's resting motor threshold) in two sessions, session-1 (n = 12) and session-2 (n = 16). Electromyography (EMG) was used to record motor evoked potentials (MEPs) from the left hand muscles in response to different TMS intensity conditions. Data were preprocessed using a standard pipeline. Given the challenges with SNR in spinal cord fMRI, we applied the total activation (TA) framework to enhance the detection and interpretation of task-related spinal activity. Utilizing a GLM approach, spinal activation maps were derived via a block-based design. We observed that in both sessions, the activations spanned relevant rostro-caudal segments, from C5 to T1. Within the gray matter, group-level activations showed a progressive increase in spatial extent from low to high conditions. In both sessions, these activations were localized to functionally relevant regions, with higher TMS intensities engaging sensory and motor neuron pools more prominently than the low-intensity condition, aligning with the corresponding MEP recordings. Our findings demonstrate that TMS can modulate spinal cord activity in an intensity-dependent manner, offering insights into sensory and motor circuits involved.

Methods

DATABLITZ

W9

Excitation-inhibition balance is dynamically influenced by cognitive load level

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Glutamate and GABA are essential neurotransmitters for cognitive functions, with their ratio, known as the Excitation-Inhibition balance (EIB), playing a crucial role in brain connectivity. Despite its importance, how EIB shifts with cognitive load impacting functional connectivity dynamics is not well understood.

Here, we leverage innovative methodologies by interleaving functional edited-Magnetic Resonance Spectroscopy (fMRS) and functional Magnetic Resonance Imaging (fMRI) bridging the gap between neurometabolic processes and higher-order cognitive functions. Thirty-six subjects underwent scans across four runs: a baseline resting-state and three tasks with increasing mental workload (0-back, 1-back, 2-back). We assessed EIB kinetics within the dorsolateral-prefrontal cortex by analyzing excitatory (Glx) and inhibitory (GABA+) components with visibility graph. Simultaneously, we examined time-varying functional connectivity of executive networks through Co-Activation Patterns.

Our investigation focused on the temporal profiles of reciprocal modulation between EIB and network dynamics during working memory tasks. The findings reveal that prefrontal EIB kinetics scale with increasing cognitive load, correlating with the stability of networks crucial for cognitive functioning. We demonstrate how high-order cortical areas adapt to cognitive challenges by shifting towards more focused and sustained neural activity patterns in terms of connectivity. Furthermore, we explore how imbalances favoring excitation might impact cognitive adaptability, establishing a vital link between EIB kinetics, brain network dynamics, and cognitive performance.

Time-resolved analyses elucidate the co-oscillating nature of executive networks and EIB kinetics in healthy volunteers. This approach highlights the importance of understanding the temporal interaction between metabolism and vascular response for the adaptive reconfiguration of brain networks in information processing.

Language & Music

W10

Maternal singing synchronizes the preterm infants' brain: Effects of Binaural Presentation and Gamma Stimuli

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Singing to infants is a universal practice in human parenting, characterized by shared features across cultures, but the impact of prematurity on the preterm infant's perception of maternal singing and music perception remains under investigated. In the present study, 12 preterm infants underwent high-density EEG testing at 37.27 weeks of gestational age. Newborns were exposed to six blocks of auditory stimuli. The stimuli included the same melody sung by the infant's mother, a stranger's mother, played by an instrument, or to a background music, along with additional gamma beats.

Our findings reveal that the mother's singing voice in monaural presentation enhances low-frequency brain synchrony (theta, alpha and beta bands) across the entire scalp. Notably, binaural presentation decreases low-frequency (alpha and beta) synchrony, particularly in the frontocentral region, while additional gamma beats elicit whole-spectrum (including broadband gamma) responses in the whole scalp of the preterm neonatal brain.

Maternal singing remains a salient stimulus for preterm newborns in the atypical auditory environment of the neonatal intensive care unit. Furthermore, responses to gamma stimuli, typically present in term born infants, shows promise in reestablishing equilibrium among brain frequencies, which is impaired by immature thalamocortical connections in the preterm brain.

Future research perspectives. Exploring cardiac event-related potentials (ERP) alongside high-density EEG in preterm infants during exposure to auditory stimuli could offer novel insights into the integration of auditory and autonomic responses to familiar and emotionally salient stimuli, potentially revealing new mechanisms underlying early brain perception and emotional regulatory processes.

Language & Music

W11

Resting-state functional connectivity and behavioral changes due to musical training in preadolescents

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The onset of adolescence is a time of profound physical, biological, behavioral and cerebral changes. It is thought to be marked by an imbalance between a hyperactive subcortical network and an immature prefrontal network underlying risk-taking and impulsive behaviors. In a context of mounting interest in interventions facilitating brain and behavioral development during this critical period, learning to play an instrument is notable for its multifaceted demands, engaging auditory, motor and inhibitory control processes. Despite evidence reporting structural and functional brain changes associated with musical training in children, its impact on the preadolescent's brain and behavior remains underexplored.

To address this gap, we conducted a 5-month longitudinal study using functional magnetic resonance (fMRI) in preadolescents (8-13 years old), who followed musical training (music group) or no training (passive control group). Using a longitudinal pre- post- design, we examined brain reorganization in resting-state functional networks linked to emotion-cognition interaction and auditory-motor processes, along with behavioral changes in inhibitory control and musical abilities with a Rhythm Synchronisation Task.

We found an increased auditory-motor coupling at rest in the music group after the training relative to the control group, as well as better rhythm synchronization scores. Moreover, we showed a decreased connectivity between emotional-cognitive brain areas, and no improvement in the inhibitory control measures.

Our results suggest an accelerated maturation of functional brain architecture in preadolescents learning to play an instrument and highlight its possible efficacy to facilitate brain development.

Language & Music

W12

Long-term stability of acoustic features during naturalistic speech perception and production

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Understanding the neural mechanisms underlying speech perception and production in natural conversations is a crucial step towards a complete neurobiological model of language. Here, we present preliminary analysis of extensive intracranial electroencephalography (iEEG) and simultaneous conversational speech datasets recorded continuously over two weeks. This ecological design allows us to capture neural responses during naturalistic dialogue. However, a significant challenge is the scale and complexity of the collected speech datasets, which need to be transcribed and aligned. To address this challenge, we developed an AI-driven data processing pipeline, employing Whisper for speech-to-text transcription and the Montreal Forced Aligner for precise phonetic alignment. The extracted acoustic and phonetic features were used in an encoding framework based on multivariate temporal response functions (mTRF) to correlate neural activity with speech features. Preliminary results reveal robust temporal generalizations over day-long time periods and distinctive neural population tuning to specific acoustic and phonetic features for speech perception versus production. These findings provide insights into how the brain dynamically processes and produces speech during real-world interactions. Future work will refine these models and expand the analysis using diverse sets of features including semantics and syntax, as well as inter-speaker dynamics and predictive mechanisms in conversation. This study highlights the potential of combining advanced AI tools with neural recordings to elucidate the complex interplay between speech and brain activity in natural settings.

Language & Music

W13

How early neural entrainment induced by rhythmic emotional vocal and motor stimulation impacts predictive processes in prematurely and term-born infants

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Social synchrony and newborns' socio-emotional development depend on prediction mechanisms. These abilities are thought to be already at work at an early stage of development and are strongly related to neural entrainment induced by rhythmical patterns (e.g. nonverbal vocalization, speech). During interactions in the early stage of development, adults communicate with infant-directed speech, which is slower than adult-directed speech, mainly in delta frequency. In preterm infants, early predictive difficulties can lead to subsequent communication and social issues. Therefore, this study aims to investigate the neural mechanisms of short-term prediction processes in very to late preterm and term infants at 6 months of (corrected) age. Infants were EEG-recorded while presented with auditory delta or theta rhythmic patterns from a parent or stranger in an omission paradigm. Rhythmic and vocal training was also provided for young children. We have predicted a differential effect of the rhythm in each auditory condition and an impact of prematurity, with reduced predictive abilities in preterm infants. This research allows us to distinguish the roles of rhythmic and vocal training on infants' predictive responses. Preliminary results showing brain rhythms entrainment will be presented. This study will improve our understanding of the predictive mechanisms of human voice processing and our knowledge of short-term predictive brain pathways at an early stage of development in at-risk newborns, to develop initial interventions to support early interpersonal communication skills.

Language & Music

W14

Adapting expectations to speaker variability: speaker identity shapes phonological prediction

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Prediction models usually assume that highly constraining contexts allow the pre-activation of phonological information. However, evidence for pre-activation of phonological information is mixed and controversial. We capitalized on the fact that foreign speakers typically make systematic phonological errors to investigate whether speaker-specific phonological predictions are made based on speaker identity (native-vs-foreign).

EEG data was recorded from 42 healthy native Italian speakers. Participants were asked to read sentence fragments after which a final word was spoken by either a native- or a foreign-accented speaker. The spoken final word could be predictable or not, depending on the sentential constraint. The identity of the speaker (native-vs-foreign) may or may not be cued by an image of the face of the speaker.

Cueing the identity of the speaker is associated with less negative amplitude (300-500 ms) after word onset. The effect of the face cue is observed when the word is predictable and not when it is not predictable. Speech prediction relies on flexible and finely tuned processes capable of accommodating interindividual phonological variability, suggesting that lexical information is pre-activated at the phonological level.

Language & Music

W15

tRNS evidence of a causal role for articulatory motor cortex involvement in supporting recognition of spectrally degraded speech

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Although the human speech perception system is robust in the face of acoustic challenges such as reverberation, noise and degraded transmission resulting from hearing loss, overcoming these challenges requires significant top-down processes to restore intelligibility. Previous work has suggested that, beyond the auditory cortices' role in resolving speech in noise, one source of supporting processes for speech comprehension is articulatory motor cortex. In this study, we applied transcranial random noise stimulation (tRNS) over either left auditory cortex or left premotor cortex while listeners performed a degraded-speech transcription task. Speech materials were well-formed but semantically unpredictable French sentences, degraded by embedding in speech-shaped noise (SIN) or by noise-vocoding (NV, a degradation of spectral content). Amplitude of the tRNS was modulated by the amplitude envelope of the target speech stimuli, shifted in phase through 0, 60, 120, 180, 240 and 300º. We predicted that auditory cortical stimulation enhances speech in noise recognition by driving speech-brain synchrony, aiding in target-masker separation. We expected stimulation of articulatory motor areas to drive enhanced recognition of NV speech, by providing top-down support for reconstructing missing spectral information. Analysis of participant word report accuracy indicated that an optimal phase of stimulation exists, per participant, that improves word report performance for NV but not SIN when articulatory motor, but not auditory, cortex, is targeted with tRNS. Further analysis shows that the effect is phase-dependent, confirming a relationship between tRNS and behaviour. This dissociation suggests that articulatory motor cortex is causally implicated in overcoming the challenge of spectral reduction but not separating a speech target from noise.

W16

Investigating the role of the primary motor cortex as the neurophysiological driver of memory guided action planning

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In our daily lives, we constantly transform abstract ideas from past sensations to concrete action plans and execute the behaviour the moment it becomes relevant. This selection and prospective planning of upcoming actions can be tracked by sensory-motor rhythms (13-17Hz) over motor areas. So far, this line of research relied exclusively on behavioural and EEG findings. Therefore, it remains unclear whether sensory-motor rhythms over the motor cortex serve as the neurophysiological mechanism causing memory-guided action planning. By applying repetitive transcranial magnetic stimulation (rTMS) at 13Hz we tried to transiently disrupt the distinctive pattern of sensory-motor rhythms during initial action selection in a visual-motor working memory task. We hypothesized that (i) during trials with rTMS delivered to the primary motor cortex, accuracy and reaction times would decrease compared to trials with placebo rTMS. (ii) This difference between rTMS and placebo rTMS was expected to be more pronounced in trials where memory was interfered with during memory retention, compared to trials without interference. A preliminary analysis with a subsample revealed that the transient rTMS lesion in the primary motor cortex did not significantly affect behavioural outcomes as hypothesized. This suggests that the neurophysiological signatures observed in the EEG may originate not from the primary motor cortex, but potentially from other motor regions such as the premotor area. Alternatively, the results might be explained by insufficient stimulation duration and/or incorrect timing relative to the task. This study suggests that the primary motor cortex might not be the neurophysiological driver of guided action planning.

W17

Investigating the effective connectivity of working memory in 131 primary school children

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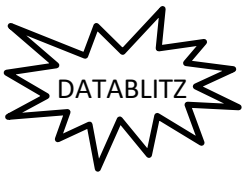
Working memory (WM), a core executive function, undergoes significant developmental changes throughout childhood. Neuroimaging studies showed age-related changes in the frontoparietal working memory network, with stronger involvement of the parietal lobes and a shift toward right-hemisphere lateralization as children grow. However, the development of neural mechanisms underlying WM performance in early/middle childhood remain poorly understood. We investigated the influence of age on WM performance and effective connectivity patterns using dynamic causal modeling (DCM). 131 children, aged 6–8 years, were divided into two groups based on median age split: 66 younger ($\bar{x}$ = 6.6 years) and 65 older children ($\bar{x}$ = 8.0 years). Participants performed a functional magnetic resonance imaging (fMRI) WM n-back task with two cognitive load levels (0-back and 2-back). We found significant age-related differences in accuracy, but not in reaction time, with older children outperforming their younger peers only in the high-load condition. Classical activation maps and the group comparison will be presented. Six regions of interest from the WM network were selected based for the DCM analysis: left and right medial frontal gyri, superior parietal lobes, and anterior cingulate cortices. We will present connectivity pattern models, testing two main model families: directionality (forward, backwards, lateral) and laterality (left versus right for inter-hemispheric origin). Bayesian model selection will be used to compare these model families and identify the best-fitting model for each age group.

Learning & Memory



W18

Flexible and abstract cognitive map representations facilitate zero-shot inferences

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Cognitive maps or graphs allow the brain to infer new relationships and support flexible decision making by efficiently representing multidimensional relationships as a relational structure. While the entorhinal cortex (EC), hippocampus (HC), and medial prefrontal cortex (mPFC) have all been suggested to contain cognitive map representations, their respective roles and contributions remain unclear. We designed a novel 'wine space' task that decoupled abstract "positions" from item contents to test to what extent these regions' representations are context-dependent (specific and flexible) or context-invariant (abstracted and generalizable), facilitating current decisions and generalization across decision contexts, respectively. Participants learned a 2D wine attribute space and then used this knowledge to flexibly select the best wine for different "market" contexts while fMRI data were acquired. Blood oxygen-level-dependent (BOLD) univariate activity associated with the decision-relevant rank difference (the decision variable) was identified in the mPFC and HC, pointing to the flexible use of task-relevant values for choices. Representational similarity analysis (RSA) revealed an abstraction hierarchy within these regions, with EC showing the most abstract and generalizable and mPFC, the most context-specific coding. In a second fMRI session, new wines' ranks were learned through specific neighboring rank comparisons, and remarkably, subjects were able to immediately infer all the remaining unseen rank comparisons, demonstrating zero-shot inferences. RSA revealed these new items were rapidly integrated into existing map representations in EC and HC. Collectively, these findings suggest a transformation between abstract, generalizable representations in EC to context-dependent representations for inference decisions in HC and mPFC through their coordination.

W19

Development of inhibition networks between 6 and 8 years old and associations with cognitive performance in 135 children

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Inhibition is a key function in the development of executive functions (EF). However, the neural networks supporting its development during early school years remains underexplored. The aim of this study was to investigate the relationship between white matter structural connectivity and inhibition, within the framework of EF development, across two age groups. 135 participants aged from 6-8 years were recruited and divided into two groups (younger and older) based on a median split by age. Diffusion tensor imaging (DTI) was used to examine potential links between fractional anisotropy (FA), the number of tracts connecting different brain regions, and performance on cognitive tasks, including inhibition, working memory and flexibility tasks. Bayesian network analysis including cognitive task performances as nodes revealed lower sparsity across age groups; the cognitive inhibition was the central node in terms of betweenness in the younger age group, while it was working memory in older children. Inhibition task performances were not associated in the older group. Preliminary DTI analysis of 20 participants showed higher mean FA in the older group within the left orbitofrontal region, the right anterior thalamus, and the right para-hippocampus. In addition, numerous significant differences were observed in inter-regional connectivity between the two age groups. These preliminary findings suggest an increasing differentiation of EF with age, with the inhibition components becoming independent around the age of 7. Future work will incorporate connectivity measures into the behavioral network analysis to unravel how structural neural network development contributes to changes in executive abilities in children.

W20

Categorical and continuous neural representations of orientations during working memory

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Visual working memory (VWM) is a cognitive function that involves neural representations distributed across the cortex. VWM representations can be either categorical or continuous in nature, as evidenced by behavioural and fMRI studies. In this study, we explore the nature of orientation coding in VWM, aiming to distinguish between categorical and continuous neural representations by using cvCrossMANOVA, an MVPA analysis technique, combined with encoding models. To begin, we employ simulations to refine methods for analysing fMRI data, focusing on differentiating between the two types of neural codes. Using a newly developed toolbox designed for simulating neural activity patterns, we evaluate whether cvCrossMANOVA can reliably identify the most suitable encoding model—categorical or continuous—for the simulated data. The simulation outcomes confirm that this approach provides a robust and accurate framework for distinguishing continuous and categorical neural representations with the help of encoding models. Next, we apply the cvCrossMANOVA analysis in combination with continuous and categorical encoding models to empirical fMRI data. The neuroimaging data was collected during a delayed recall VWM task involving orientation stimuli. Our findings reveal a relative, not absolute, distinction in neural coding across cortical regions. Specifically, posterior brain areas (V1 and V3AB) exhibit a preference for continuous encoding models, whereas anterior regions (IPS and FEF) favor categorical models. These results suggest that orientation representations during a WM task are more categorical in anterior cortices and more continuous in posterior ones.

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W21

Cognitive enrichment through art: a randomized controlled trial on the effect of music or visual arts group practice on cognitive and brain development of young children: a study protocol

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This randomized controlled trial (RCT) assesses the effects of intensive arts training—specifically, "Orchestra in Class" (OC) and Visual Arts (VA), on cognitive and brain development in children initially aged 6-8, over two years. The study focuses on enhancing executive functions (EF), emotion regulation, and brain plasticity, with outcomes compared to a minimally enriched control group (CG) that participates in periodic cultural outings, capturing natural developmental trajectories.

132 children were randomly assigned to OC, VA, or CG based on age, gender and socioeconomic status. The interventions consist of weekly intensive group sessions led by professional artists, with additional home training, while the CG experiences six annual cultural events. Assessments occur through psychometric testing, structural and functional neuroimaging, quarterly skill assessment videos, demographic data collection and school results. Analyses will compare EF, brain development, and behavioral changes across groups and timepoints, using a priori hypothesis testing and machine learning to create integrative models of EF and brain data across timepoints and groups.

This study hypothesizes that OC will yield more substantial EF gains than VA, due to its multisensory and interactive nature, but that VA may enhance visuospatial skills. The expected outcomes include improved EF, academic performance, and marked brain plasticity, with anticipated greater functional and structural brain changes in the OC group, followed by VA and CG (OC > VA > CG). This research could support the inclusion of intensive arts education in school curricula, highlighting the unique cognitive benefits of musical versus visual arts training in early childhood development.

Learning & Memory

TRAVEL GRANT

W22

Closed-loop neuroimaging: causally investigating the roles of sleep spindles

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The majority of non-invasive neuroimaging studies in healthy human populations are not able to provide direct causal evidence of the functional roles of specific neural activity. Closed-loop auditory stimulation (CLAS), in which quiet sounds are time-locked to neural events so as to enhance or disrupt them, has recently shown promise in both fundamental research and clinical applications. Of particular interest is targeting neural events such as sleep spindles, which are involved in learning and memory and which degrade in old age. In recent work, we have 1) investigated the mechanisms by which the auditory system can influence endogenous oscillations in sleep using source-localized magnetoencephalography, 2) developed and validated a deep learning-based tool to stimulate spindles in real-time, 3) educed evidence that auditory input to the cortex is not blocked at the thalamus during spindles, and 4) shown that neurophysiological changes follow CLAS to spindles. In the present work, we present electroencephalography nap data from 102 human adults, examining the effects of spindle CLAS in comparison to slow oscillation CLAS, undisturbed sleep, and waking rest. Relationships between stimulation-evoked responses and memory performance were assessed across three tasks: a procedural motor sequence task, a declarative grid location task, and an ecologically relevant complex piano-learning task. Our findings offer insights into how non-invasive brain stimulation affects learning and memory, and offer tools and a framework for linking neurophysiology with function. Combined with advancements in real-time, localized, time-resolved neuroimaging, this work will expand our ability to understand causal relationships in the human brain.

Learning & Memory

W23

Reenacting our past: on the role of motor cortex in memory re-experiencing

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Episodic memory retrieval is often accompanied by autonoetic consciousness (ANC)—the vivid feeling of mentally re-experiencing past events. However, the neural mechanisms underlying such phenomenological experience are still poorly understood. The hippocampus is central to memory retrieval, coordinating the reactivation of cortical regions which were involved during event encoding. Such reinstatement effects have been shown to take place in the visual and auditory domains. While prior research has largely focused on sensory processes, the specific role of motor inputs in ANC remains unknown. This study explored whether the motor cortex is reengaged during memory retrieval through hippocampal-neocortical trace reactivation and whether this contributes to ANC. Thirty participants encoded real-life-like events in a 3D immersive environment, performing motor actions. Participants' brain activity was recorded while they freely retrieved each of these events in the fMRI scanner one day after encoding. We observed memory-related activations in regions such as the hippocampus, parahippocampus, angular gyrus, and critically, the motor cortex during retrieval. Additionally, activity in motor areas was linked to the intensity of participants' re-experiencing of events. We also observed that events requiring more complex motor actions at encoding elicited higher activity in the precuneus and angular gyrus compared to simpler actions, at retrieval. Finally, we showed that hippocampus to motor cortex functional connectivity was significantly enhanced during free retrieval. This study underscores the role of motor context in shaping memory retrieval and suggests motor reengagement as a key factor in the phenomenology of ANC.

Learning & Memory

W24

Longitudinal Links Between Dopamine Decline and Cognitive Aging: Preliminary Results from the 10-Year COBRA Follow-Up

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Dopamine is a key neuromodulator in the striatum, the input structure of the basal ganglia, which supports a wide range of cognitive functions. Dopamine D2 receptors (D2DR) decline with normal aging and have been hypothesized to contribute to cognitive decline. However, most findings on age-related D2DR differences and their links to cognition are based on cross-sectional studies that cannot assess whether age-related changes in D2DR and cognition are indeed associated. We used longitudinal data from the Cognition, Brain, and Aging (COBRA) Study to estimate age-related changes in D2DR and their association with age-related changes in cognition. Using Positron Emission Tomography (PET) with [11C] raclopride, 10-year changes in D2DR were assessed in a sample of healthy older adults, aged 64–68 years at baseline, across three evenly spaced measurement occasions. Of the initial 181 participants, 93 remained at the final occasion. Bayesian structural equation modeling revealed mean decline as well as individual differences in decline in both striatal D2DR and cognition, and a positive change-change correlation, indicating that decline in D2DR is associated with decline in general cognitive ability. Longitudinal estimates of mean 10-year D2DR decline rates were in the lower range of previously published cross-sectional estimates. Our findings provide important longitudinal empirical evidence on individual differences in rates of striatal D2DR decline and their coupling to cognitive decline in healthy older adults.

W25

No differences at alpha and gamma amplitudes in ventral and dorsal visual streams between visual spatial versus visual object working memory

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Brain oscillations have long been established as markers of cortical activation and inhibition. For visual working memory, using magnetoencephalography Jokisch and Jensen (2007; J Neurosci, 27: 3244-51.) have presented an influential paper demonstrating that retention of object information in working memory led to increased (inhibitory) alpha activity over the dorsal visual stream, while retention of visuo-spatial information was associated with increased (excitatory) dorsal gamma activity. In the present study, we investigated whether such effects were also observable in the human electroencephalogram (EEG) during a more continuous 2-back working memory task, in which encoding, retention and retrieval of information were temporally overlapping. Brain activity was recorded using a 64-channel EEG system in healthy volunteers performing a 2-back task consisting of blocks of an object identity or object location task supposedly engaging the ventral and dorsal visual stream, respectively. Contrary to expectations, we only found task differences at alpha (8-12 Hz) amplitude at frontal areas and the dorsal anterior cingulate cortex; no effects were obtained for dorsal or ventral visual streams. Neither did we find significant differences between tasks for lower (30-50 Hz) or higher (70-90 Hz) gamma amplitudes. However, at the theta frequency band (4-8 Hz), we obtained increased frontal activation for both spatial and object processing compared to a control condition, in line with previous studies (e.g., Berger et al., 2019, Nat Commun, 10:4242.). Further research will have to establish whether our negative findings are due to differences in tasks, measurement, or analysis procedure compared to Jokisch and Jensen's work.

W26

Distinct Neural Mechanisms of Egocentric and Allocentric Strategies in VR-Based Imagined and Actual Spatial Navigation

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Daily navigation relies on spatial strategies rooted in egocentric and allocentric reference frames. While neural mechanisms for these strategies are well-studied, their roles in imagined navigation during route planning and differences from actual navigation in virtual reality (VR) environments remain unclear.

We recruited 40 right-handed, young, healthy participants for VR-based navigation tasks; 38 participants (20 females, aged 24.3±3.3 years old) were included after excluding two due to dizziness and low accuracy (<70%). Tasks included encoding, imagination, and retrieval phases in two blocks: repetition and retracing. In the repetition block, participants passively navigated a virtual car (30 m/s) through three intersections with unique landmarks before reaching a red telephone box. During imagination, they planned routes using either an egocentric perspective (from the car's position) or an allocentric perspective (from an intersection). Retrieval involved resuming navigation and selecting directional responses (left, right, forward). The retracing block required participants to navigate back to the car's parking spot.

Behaviorally, egocentric navigation showed significantly faster reaction times than allocentric navigation ($t = -5.90$, $p < 0.001$), with high accuracy (>80%) in both conditions. fMRI results revealed that egocentric navigation engaged the precentral gyrus, postcentral gyrus, and superior parietal lobule in both imagined and actual navigation. Allocentric navigation consistently activated the fusiform, lingual cortex, and parahippocampus.

These findings demonstrate distinct neural mechanisms for egocentric and allocentric strategies during imagined and actual navigation, advancing our understanding of spatial planning in the brain.

W27

Surprise Signals in the Anterior Insula: An Experimental Stereoelectroencephalography (sEEG) Instrumental Task Study

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The anterior insula (AIns) has been implicated in adaptation under uncertainty, but its specific function remains unknown. In an ongoing exploratory study with sEEG, we investigate two potential roles. H1) Aligned with traditional reinforcement learning, the AIns could track surprise as salience to modulate the learning rate (e.g. Behrens et al., 2007), ensuring that reward learning becomes approximately Bayesian (Nassar et al., 2010). H2) We posit robust control in the form of Model-Reference Adaptive Control (MRAC) as an alternative, whereby the AIns moderates the reward learning system, evaluating its outcomes against a generic reference model and interfering when performance is surprising. Here, surprise is measured by autocovariance of prediction errors rather than their salience (Bossaerts, 2018). In d'Acremont and Bossaerts (AB, 2016), MRAC explained participants' choices significantly better than the Bayesian hypothesis.

We test these hypotheses using sEEG recording and stimulation during a task where epilepsy patients must continuously re-center a randomly moving target subject to frequent outliers that either revert (Treatment T, high uncertainty in which participants typically underperform) or indicate a bias shift away from the centre (Treatment F, low uncertainty). Preliminary results show under-performance in Treatment T relative to F, confirming AB, but error size and frequency was significantly reduced upon stimulation to the left AIns where previous fMRI analysis revealed risk prediction errors (Preuschoff et al., 2008). Additionally, overall sEEG in the AIns under treatment T following outlier and post-outlier trials is higher than under F despite equal overall salience, aligning with H2 and AB's findings.

W28

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 mid-frontal theta (5 Hz) and occipital gamma (>30 Hz) oscillations was proposed as a 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 signals. To address these gaps, we employed multivariate PAC (mPAC) through generalized eigendecomposition (GED), 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 identify fast and slow learners. However, older participants exhibited lower mPAC compared to younger counterparts, suggesting compromised parallel storage of items in working memory in older age. Finally, stratification analysis revealed that mPAC effects persist across performance groups with similar mid-frontal theta levels, suggesting that theta alone does not account for these effects. These findings shed light on the age-related differences in memory formation processes and may guide interventions to enhance memory performance.

W29

Alpha Traveling Waves during Working Memory: Disentangling Bottom-up Gating and Top-down Gain Control

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While previous works established the inhibitory role of alpha oscillations during working memory maintenance, it remains an open question whether such an inhibitory control is a top-down process. Here, we attempted to disentangle this issue by considering the spatio-temporal component of waves in the alpha band, i.e., alpha traveling waves. We reanalyzed two pre-existing and open-access EEG datasets (N = 180, 90 males, 80 females, 10 unknown) where participants performed lateralized, visual delayed match-to-sample working memory tasks. In the first dataset, the distractor load was manipulated (2, 4, or 6), whereas in the second dataset, the memory span varied between 1, 3, and 6 items. We focused on the propagation of alpha waves on the anterior-posterior axis during the retention period. Our results reveal an increase in alpha-band forward waves as the distractor load increased, but also an increase in forward waves and a decrease in backward waves as the memory set size increased. Our results also showed a lateralization effect: alpha forward waves exhibited a more pronounced increase in the hemisphere contralateral to the distractors, whereas the reduction in backward waves was stronger in the hemisphere contralateral to the targets. In short, the forward waves were regulated by distractors, whereas targets inversely modulated backward waves. Such a dissociation of goal-related and goal-irrelevant physiological signals suggests the co-existence of bottom-up and top-down inhibitory processes: alpha forward waves might convey a gating effect driven by distractor load, while backward waves may represent direct top-down gain control of downstream visual areas.

PARTICIPANTS

Poster abstracts are preceded by a 'M', 'T' or 'W' depending on the presentation day.
Talk abstracts are preceded by a 'O'.
* Presenter abstracts

BARCELLINI	FRANCESCA	M2* M20
BAVELIER	DAPHNÉ	O21 M11 T24
BEHNKE	LARISSA	W16*
BENIS	DAMIEN	T1* W10 W13
BERTONI	TOMMASO	M13* M16 T14
BHADRA	KINKINI	T2*
BOEHRINGER	ANDREW	T3*
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BOLLINGER	LIA	W17*
BOORMAN	ERIE	W18*
BORGHESANI	VALENTINA	
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BRÉCHET	LUCIE	T4 T11
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CACHET	CLAUDIA	
CANTOU	PAULINE	W11*
CATALDO	EUGÉNIE	O25*
CELEREAU	EDGAR	O13*
CERAVOLO	LEONARDO	M14* M24 T15 T20
CERESETTI	ROMAIN	W19*
CHAN	CHUN HEI MICHAEL	M3* M4
CHAUHAN	ISHAN	
CINCA TOMAS	TRISIA	T16*
CIONCA	ALEXANDRE	M3 M4 T15*
CLARKE	ALEX	O17*
COFFEY	EMILY	M5* W22
CONSTANTIN	IOANA MEDELEINE	T15
CORRADI-DELL'ACQUA	CORRADO	O9* O25
CORREDOR	DAVID	O4*
COTRONEO	SILVIA FEDERICA	W1*
DABROWSKI	OSCAR	M6*
DE MARTINO	FEDERICO	O2*
DE PASQUALE	FRANCESCO	M7*
DEBRACQUE	CORALIE	

DEHAENE	STANISLAS	O15
DEHAENE-LAMBERTZ	GHISLAINE	O14*
DESBORDES	THÉO	O15*
DESCHANET	CHLOE	
DORDIJEVIC	MARTINA	
DURAND-RUEL	MANON	T3 T5*
EGOROVA	KSENIA	M15*
ELLEAUME	CAMILLE	M8* T6
FAGGELLA	MELISSA	M9*
FERAT	VICTOR	M10* W4
FLEURY	VANESSA	T1
FLORIS	DOROTHEA	M8 T6*
FOUSEK	JAN	W2*
FRIEDRICH-HIGGS	ELISABETH	026*
GIRONDINI	MATTEO	M16*
GRANDJEAN	DIDIER	M24 T15 T20 W10 W13
GROUILLER	FRÉDÉRIC	O19 M6 T10 W4
GUEDJ	CAROLE	W17 W19 W21
GUI	ANDREEA	W20*
GUIBERT	FABRICE	M11*
HAMPSON	MICHELLE	O23*
HANSEN	ARNE	M17*
HÀ-VINH LEUCHTER	RUSSIA	
HEBART	MARTIN	O5*
HERVAIS-ADELMAN	ALEXIS	M10 W15
HU	JUNCHAO	T18*
HUPPI	PETRA	O19 T2 T3 T5 W10
IGLOI	KINGA	O10*
IOANNUCCI	STEFANO	O16*
JAMES	CLARA	W17 W19 W21*
JANATA	PETR	
JOURDE	HUGO	M5 W22*
KELLER	FRANZISKA	
KOBAN	LEONIE	O12 T17
KOENIG	THOMAS	T23
KRACK	PAUL	
KRAGEL	PHILIP	O11*
KREIFELTS	BENJAMIN	M18* T12
LAPOMARDA	GAIA	M19*
LAVEZZO	LAURA	W10
LEONE	GIOVANNI	T19* W2
LINDENBERGER	ULMAN	W24
LIU	WENYA	O4 T7*

LUCCHETTI	FEDERICO	O13 W3*
LUNDGREN	ERIK	W24*
MARIE	DAMIEN	T11 W17 W19 W21
MARZILIANO	PINA	
MAUCHAND	MAËL	T20*
MICHEL	CHRISTOPH	O22 W5
MIEHLBRADT	JENIFER	O19* T5 W10
MIKUTTA	CHRISTIAN	T8*
MIRLISENNA	ILARIA	T21*
MOHAMMADI	NOSRATULLAH	M12*
MOLOCHIDIS	NIKOLAOS	M20*
MORAWETZ	CARMEN	O8* M19
MOREA	MARTINA	M21*
MOYNE	MAËVA	W4*
MÜLLER	LENNART	W25*
NABÉ	MAMADY	W12*
NACCACHE	LIONEL	
NAVARRO	JORDAN	M22*
NEWMAN	LIONEL	O22* W5*
PALVA	SATU	O4 T7 T7
PEREIRA	MICHAEL	M25
PETRUSO	FLAVIA	W6*
PEYLO	CHARLINE	O26 M23* M27 W28
PIGNAT	JEAN MICHEL	
PLOMECKA	MARTYNA	W7*
POUGET	ALEXANDRE	
PRETI	GIULIA	
PROIX	TIMOTHÉE	M12 W12
RAMBOSSON	ISABELLE	W13*
RAMON	MEIKE	
RANGANATH	CHARAN	O1*
RAUSS	KARSTEN	O6*
REYNAUD	EMANUELLE	M22
RICCHI	ILARIA	O7*
RONCHI	ROBERTA	O9 O25
SABLÉ-MEYER	MATHIAS	O18*
SALA	MARCO	W14*
SALAGNON	MATHILDE	T22*
SANI	ILARIA	W26
SAREEN	EKANSH	W8*
SAUSENG	PAUL	O26 M23 W16 W25 W28 W29
SAVIOLA	FRANCESCA	W9*
SCHMIDT	LIANE	O12*

SCHMIDT	LÉA	T9*
SELOSSE	GARANCE	M24*
SKULTETY	VIKTOR	
SLAATS	SOPHIE	
SLEIGHT	EMILIE	M6 T10*
SONG	JIE	W26*
SOOTER	NINA	W27*
SOULIÉ	PAOLA	
STASYTYTE	MONIKA	O22 W5
STOCKART	FRANCOIS	O24* M25*
STRZELCZYK	DAWID	T6 W28*
TAYLOR	PAUL	O3*
THIAM	SHADEE	O21*
THUT	GREGOR	O20*
TIAN	BOHAO	T24*
TOUSSAS	KONSTANTIN	T4 T11*
VAN DE VILLE	DIMITRI	O7 M3 M4 M11 T3 T7 T13 W6 W8 W9
VARANO	ENRICO	W15*
VETTER	PETRA	O16 M26* T18
VOLLBERG	MARIUS	T25*
VUILLEUMIER	PATRIK	O9 O25 T19 T22 W4 W26
VULLIEMOZ	SERGE	M3
WILDGRUBER	DIRK	M18 T12*
WIRSICH	JONATHAN	O19 W4 W19
YONELINAS	ANDREW	
ZAHAR	SELIMA	T13*
ZENG	YIFAN	W29*
ZERBI	VALERIO	M2 M20
ZIMMERMANN	NOÉ	M27*