ABIM

Alpine Brain Imaging Meeting

20th Anniversary Edition
January 11-15, 2026

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

SPONSORS

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Alpine Brain Imaging Meeting

Champéry 2026

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Locations:

Registration, talks and poster sessions will take place at the *Palladium Sport and Conference Center.* The Sunday Reception after the keynote will be held at *Hotel Suisse*.

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

GENERAL INFORMATION

Registration (badge retrieval and/or on-site registration) will take place at the *Palladium* conference center (Route du Centre Sportif, 1) on Sunday, the 11th of January from 16:30 to 17:30. During the following days, participants can register in the same place 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 *Palladium* conference center (Route du Centre Sportif, 1) and will be followed by an informal **welcome reception** with wine & snacks at the *Hotel Suisse* (Rue du Village 55). All other **talks** and **poster sessions** during the week will take place at the *Palladium* conference center (see program). **Three poster sessions** will be held on Monday 12th, Tuesday 13th and Wednesday 14th of January in the afternoon (see program and poster map). Posters should be exposed only on the day of the poster presentation and removed after the poster session. 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.

Many special activities are planned for this 20th anniversary edition!
A **ski race** is planned for Wednesday morning. All details on logistics will be given at the conference. Everybody is encouraged to join: it will be possible to either compete in the race, or attend as public.

A **gala night** is planned on Thursday night at Palladium. It will start with an apero on ice, followed by a dinner and disco party. The dinner will be free for all registered participants, excluding drinks. Please refer to the staff at the registration desk <u>before Tuesday January 13th</u> for any changes regarding your participation to the dinner. A very special guest presentation by the multiple world record alpine athlete Richard Parks will be given before 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. 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 the day of presentation and their category.

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

Scientific Program

SUNDAY, January 11th

OPENING LECTURE

16:30-17 :30 **Registration** (Palladium)

17:30 **Opening Keynote Lecture** (Palladium)

Ray DOLAN | University College London, London, UK

- *Neural replay and the remembered present*

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

Time and Consciousness

15:00 Welcome Coffee & posters

15:30 **Melanie BOLY** | University of Wisconsin, Madison, USA

- *Brain connectivity and the quality of experience*

16:15 **Jean-Claude DREHER** | CNRS, Institute of Cognitive Science, Lyon, France

- *Brain mechanisms engaged in social interactions*

16:35 **Nicolas CLAIRIS** | University of Geneva, Geneva, Switzerland

- *Mindfulness induces the reconfiguration of the somato-motor and default mode networks*

16:55 **Coffee Break - with sponsor booth announcements**

17:25 **Hal BLUMENFELD** | Yale University School of Medicine, USA

- *Dynamic subcortical modulation unifies perceptual and volitional conscious events*

18:10 **Monika STASYTYTE** | All Here SA, Geneva, Switzerland

- *Mapping the depths of meditation: EEG microstates as neural benchmarks of contemplative states*

18:30 **Emmanouela KOSTELETOU-KASSOTAKI** | University of Barcelona, Barcelona, Spain

- *Mapping subcortical fear pathways in the human brain: thalamo-amydgala connections revealed by high-resolution tractography*

18:50 **Poster Blitz Presentations**

19:00 - 20:15 **Poster Session with drinks and snacks**

TUESDAY, January 13th

Neural methods to predict behavior

15:00 Welcome Coffee & posters

15:30 **Davide FOLLONI** | Icahn School of Medicine at Mount Sinai, New York, USA

- *Ultrasound neuromodulation of the deep brain: From brain states to decision-making circuits*

16:15 **Karolis J. DEGUTIS** | University of Geneva and École Polytechnique Fédérale de Lausanne, Genève, Switzerland

- *Layer-specific functional gradients reveal intrinsic network organization and feedback processing*

16:35 **Anna SHPEKTOR** | University of Oxford, Oxford, UK

- *A hierarchical coordinate system for sequence memory in human entorhinal cortex*

16:55 **Coffee Break**

17:25 **Daniel MARGULIES** | University of Oxford, Oxford, UK

- *Cortical gradients of functional integration*

18:10 **Ashleigh DAVIES** | King's College London, London, UK

- *Morphometric INverse Divergence (MIND) networks from MRI capture timing of key structural network emergence in the developing brain*

18:30 **Bin WAN** | Geneva University Hospitals, Thonex, Switzerland; University of Geneva, Geneva, Switzerland; Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany; Research Center Jülich, Jülich, Germany

- *EigenBrain: a spatial framework for reconstructing individual brain molecular architecture from multimodal magnetic resonance imaging*

18:50 **Poster Blitz Presentations**

19:00 - 20:15 **Poster Session with drinks and snacks**

sponsored by

Commune de Champéry

WEDNESDAY, January 14th

Language and AI

15:00 Welcome Coffee & posters

15:30 **Jean Remi KING** | Ecole Normale Supérieure, Paris, France

- *Emergence of language in the human brain*

16:15 **Wolfram HINZEN** | Institut Català de Recerca i Estudis Avançats (ICREA) & Universitat Pompeu Fabra, Barcelona, Spain - **Rui HE**| Institut Català de Recerca i Estudis Avançats (ICREA), Barcelona, Spain

- *The grip of grammar on meaning uncertainty: cross-linguistic evidence, neural correlates, and clinical relevance*

16:35 **Thomas DIGHIERO-BRECHT** | Institut du Cerveau; Hôpital de La Pitié Salpêtrière and Université Paris-Saclay, Paris, France

- *Distinct cortical patches for semantic composition and syntactic binding in the human brain*

16:55 **Coffee Break**

17:25 **Laura GWILLIAMS** | Stanford University, Stanford, USA

- *Neural algorithms of human language*

18:10 **Aline-Priscillia MESSI** | New York University, New York, USA

- *The influence of structure and speed on MEG responses to narratives*

18:30 **Lina TEICHMANN** | Institutes of Health, Bethesda, USA; University of Geneva, Geneva, Switzerland

- *Rapid emergence of category responses to AI-generated visual anagrams with identical visual features*

18:50 **Poster Blitz Presentations**

19:00-20:15 **Poster Session with drinks and snacks**

sponsored by nccr evolving language NATIONAL CENTRE OF COMPETENCE IN RESEARCH

THURSDAY, January 15th

Brain, Mental health and Lifestyle

15:00 Welcome Coffee

15:30 **Charles HILLMAN** | Northeastern University College of Science, Boston, USA

- *Fit body, sharp mind: How childhood physical activity can boost brain and cognition*

16:15 **Blitz Presentations** | Travel Grant Awards *sponsored by* Swiss National Science Foundation

- **Alexis GIFF** | Harvard Medical School, Boston, USA; Massachussetts General Hospital, Charlestown, USA

  Structural and functional connectivity correlates of clinical response to electroconvulsive therapy in major depressive disorder

- **Ryan LAW** | University of Cambridge, Cambridge, UK

  Single word conceptual specificity, not phrasal composition, drives anterior temporal lobe during semantic processing: evidence from combined EEG/MEG

16:25 **Mini Coffee Break**

16:35 **Hilleke HULSHOFF POL** | Utrecht University, Utrecht, The Netherlands

- *Influences of genes and environment on changes in brain health and mental health*

17:20 **Blitz Presentations** | Travel Grant Awards *sponsored by* Swiss National Science Foundation

- **Martina T. CINCA-TOMÀS** | University of Barcelona, Barcelona, Spain

  An auditory 'low road' for threat in humans sensitive to rapid temporal modulations: multimodal insights from EEG, fMRI, DWI, and peripheral measures

- **Davide ORSENIGO** | Università degli Studi di Torino and CENTAI Institute, Turin, Italy

  Preserved unimodal-transmodal functional hierarchy differentiation in patients with blindsight

20th Anniversary Special Celebration

17:30 **Disco on Ice at Palladium!**

Join us for an aperitif on the ice, with or without skates

19:30 **Talk by Special Guest: Richard Parks**

Richard Parks is an award-winning author, BAFTA Cymru nominated filmmaker, multiple world record holding Polar and Alpine athlete, and father.

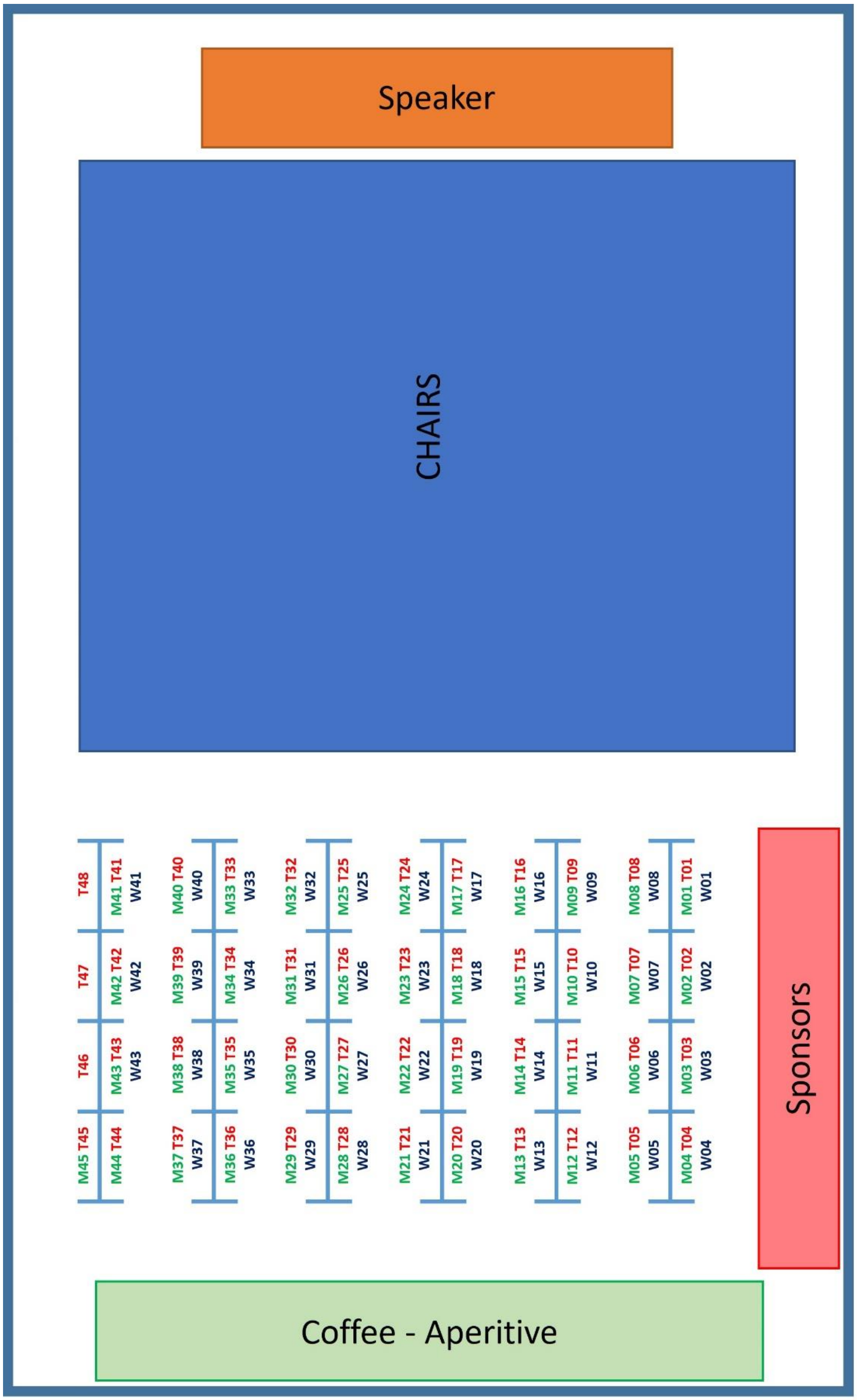
Richard has a background in biology and science from Studying Dentistry at university. For almost 2 decades he has partnered with multiple universities and brands to better understand human performance, particularly the relationship between cognition and stress. Even using an oxygen less ascent on Everest to explore the mechanisms underpinning vascular Dementia. Each project and expedition has been underpinned and driven by research, education, or social legacy.

20:00 **Gala Dinner at Palladium** *sponsored by* Université de Genève – Swiss Center for Affective Sciences; Commune de Champéry

with prize ceremony *sponsored by* Springer

23:00-3:00 **Disco Night at Palladium**

POSTER MAP



Clinical Neuroscience: M01-M13, T01-T12, W01-W11
Emotion & Motivation: M14-M19, T13-T17, W12-W16
Language & Music: M20-M23, T18-T20, W17-W21
Learning & Memory: M24-M28, T21-T26, W23-W26
Methods: M29-M39, T27-T38, W27-W36
Perception: M40-M45, T39-T48, W37-W43

ABSTRACTS OF ORAL PRESENTATIONS

The themes of the days are:

Sunday: OPENING LECTURE

Monday: TIME AND CONSCIOUSNESS

Tuesday: NEURAL METHODS TO PREDICT BEHAVIOR

Wednesday: LANGUAGE AND AI

Thursday: BRAIN, MENTAL HEALTH AND LIFESTYLE

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

Sunday

Opening Lecture

O1 ☆

Neural replay and the remembered present

Ray Dolan[1]

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A major challenge in cognitive neuroscience relates to the question of what precisely we encode and retrieve from memory. I will propose that what we encode are disentangled representations that enable us to make better sense of the present and better prediction regarding the future. I will go on to argue that this is realised is the brain via neural replay, by which I mean the sequential, fast, reactivation of acquired representations of world. In so-doing I will introduce an approach to the non-invasive measurement of neural replay in humans and go on to show how neural replay exploits disentangled representations to meet current task demands. I will also touch on the potential role of neural replay as an in-vivo neurophysiological marker of early neurodegenerative disease.

Time and Consciousness

O2 ☆

Testing Theories, Expanding Minds: A Roadmap for Consciousness Science

Lucia Melloni[1, 2, 3]

[1]Predictive Brain Department, University Alliance Ruhr, Faculty of Psychology, Ruhr-Universität Bochum, Germany, [2]Department of Neurology, NYU Grossman School of Medicine, New York, USA, [3]Canadian Institute for Advanced Research (CIFAR), Brain, Mind, and Consciousness Program, Toronto, ON, Canada

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Consciousness remains one of the deepest mysteries in science. We still lack answers to fundamental questions: how and why we feel the way we feel; why we experience the world in the rich, structured manner we do; and why millions of patients lose and regain consciousness every day, while countless others never recover it. At the same time, urgent debates about AI consciousness, the risk of ascribing experience where there is none, and the moral cost of overlooking the experiences of animals or other nonverbal beings make the scientific study of consciousness more pressing than ever.
In this talk, I will introduce two ongoing lines of work that aim to reshape how the field advances: (i) open-science adversarial collaborations designed to test competing theories of consciousness and accelerate scientific convergence, and (ii) emerging efforts to build a science of consciousness that is not anchored exclusively in adult neurotypical minds but instead embraces the diversity of minds found across development, species, and even artificial systems. Such an approach requires us to acknowledge from the outset that consciousness may manifest in ways unfamiliar to us, and that beings who cannot speak, fetuses, infants, nonhuman animals, AI systems, and perhaps even engineered biological collectives, may (or may not) nevertheless instantiate forms of experience worth understanding.
Together, these efforts aim to move the field toward a more rigorous, collaborative, and inclusive framework, one in which theories are openly tested, assumptions are examined rather than inherited, and the full spectrum of possible conscious minds is taken seriously.

Time and Consciousness

O3

Brain mechanisms engaged in social interactions

Jean-Claude Dreher[1]

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The brain computations engaged in social learning have started to be investigated in dyadic interactions and in small groups. Yet, little is known about the mechanisms used by the brain when individuals interact in social networks. First, I will present a taxonomy of different types of computations used by the brain for learning and inferences made during social interactions. I will illustrate how this taxonomy is useful to understand the computations underlying four types of social interactions. In particular, I will show recent model-based functional MRI results showing how the human brain adapts to fluctuating intentions of others when the nature of the interactions (to cooperate or compete) is not explicitly and truthfully signaled. Second, I will present recent theoretical and experimental work shedding light on the computations people use to integrate and transmit information in social networks. I will also show how the brain decides whether to share extra information with others, depending upon one's own confidence about the reliability of information and upon one's beliefs concerning the preferences of receivers. Together, these results pave the way towards developing a mechanistic understanding of social learning mechanisms used by networked individuals interacting dynamically in real time, that shape collective performance and consensus.

Time and Consciousness

O4

Mindfulness induces the reconfiguration of the somato-motor and default mode networks

Nicolas Clairis[1], Luigi Saccaro[1], Zeynep Celen[1], Claudia Cachet[1], Camille Serquet[1], Francesca Saviola[2], Patrick Vuillemier[3], Françoise Jermann[4], Serge Rudaz[5], Camille Piguet[1, 4]

[1]Psychiatry Department, Faculty of Medicine, University of Geneva, Geneva, Switzerland, [2]Neuro-X Institute, École Polytechnique Fédérale de Lausanne (EPFL), Geneva, Switzerland, [3]Department of Neurosciences, Faculty of Medicine, University of Geneva, Geneva, Switzerland, [4]Hôpitaux Universitaires de Genève, Geneva, Switzerland, [5]School of Pharmaceutical Sciences, University of Geneva, Geneva, Switzerland

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Mindfulness interventions are known to enhance emotion regulation and stress management. However, the underlying biological mechanisms through which mindfulness produces these benefits remain poorly understood. Healthcare students are frequently exposed to highly stressful situations, making them a particularly vulnerable group to psychological distress and in need of effective coping strategies. This study aimed to investigate how a Mindfulness-based Cognitive Therapy for Life (MBCT-L) intervention affects their metabolism and neural activity. A total of 159 healthcare students from the University of Geneva participated, with 57 (39 females; mean age 23 ± 5 years) undergoing resting-state functional magnetic resonance imaging (fMRI) at 3 Tesla before and after the intervention. Resting state and an adapted version of the Montreal Imaging Stress Task (MIST) were recorded with fMRI. Participants were randomly assigned to either a mindfulness intervention group (comprising eight 2h online sessions and home practice) or a control group with no intervention. Analysis of functional connectivity patterns via co-activation pattern (CAP) analysis of resting-state fMRI revealed a Group*Time interaction: post-intervention, the mindfulness group showed decreased activation of the default mode network, indicating reduced mind-wandering and rumination, and increased activation of visual and somato-motor regions, suggesting heightened environmental awareness. Additionally, during the stressful MIST task, increased activity was observed in the somato-motor network following mindfulness training. This study confirms that mindfulness can effectively enhance stress resilience by promoting increased somato-motor network activity and reduced default-mode network activation, supporting its role as a valuable tool for emotional regulation and stress management.

Time and Consciousness

O5 ☆

Brain Connectivity and the Quality of Experience

Melanie Boly[1]

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Why are certain parts of the brain important for the presence of consciousness and its contents, but not others that have even more brain cells and are just as complicated? Integrated information theory (IIT) is an attempt to answer these and other questions in a principled manner. IIT starts not from the brain, but from consciousness itself – by identifying phenomenological properties that are true of every conceivable experience. It then uses a causal mathematical framework to translate these phenomenological properties into predictions about physical properties that a system should have to be conscious. As a next step, IIT uses the same consciousness-first, causal approach to also generate predictions about neural substrates that can support specific experiences such as spatial extendedness, temporal flow, hierarchical/categorical contents, and modality-specific qualities such as colors and sounds. The results of this exploration can account for many empirical findings, lead to counterintuitive predictions that can be challenged by neuroscientific experiments, and has motivated the development of promising new tests for the practical assessment of consciousness in non-communicative patients, as well as some new empirical predictions, currently under test, linking brain activity and connectivity patterns to different contents of experience.

Time and Consciousness

O6

Mapping the Depths of Meditation: EEG Microstates as Neural Benchmarks of Contemplative States

Monika Stasytyte[1], Chuong Ngo[1], Lionel Newman[1], Erkin Bek[1], Christoph Michel[1, 2]

[1]All Here SA, Geneva, Switzerland, [2]Faculty of Medicine, University of Geneva, Switzerland

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Identifying robust neural benchmarks for meditation depth is essential for grounding contemplative practice in neuroscience. EEG microstate analysis—capturing transient, quasi-stable topographies in brain activity—offers a temporally resolved tool for assessing meditative cognitive dynamics.

We applied microstate segmentation to high-density EEG data from a large, diverse sample of experienced meditation practitioners representing several Yogic traditions (N=15; N=14; N=22), as well as experienced lay practitioners and meditation-naïve novices who followed audio-guided attention-focused meditation (N=29). Participants engaged in silent meditation compared to eyes-closed resting baseline.

Results revealed consistent neural signatures of meditative depth. Microstate C occurrence consistently decreased during meditation, while microstates D and E increased. Source localization linked microstate C to hippocampal and parahippocampal structures associated with episodic memory and mental time travel; its reduction reflects decreased autobiographical rumination—what meditation explicitly aims to reduce. Microstate D involved posterior cingulate cortex and precuneus, indicating enhanced attention regulation and non-narrative awareness. Microstate E engaged temporal-parietal junction and superior frontal regions, suggesting increased embodied, spatially-grounded self-awareness rather than conceptual self-reflection, the sense of "I am here, in this place, in this body".

These findings establish EEG microstate analysis as a sensitive method for characterizing meditative states across levels of expertise. By examining diverse contemplative practices, we provide objective neurophenomenological benchmarks for meditation depth, bridging ancient contemplative wisdom with contemporary cognitive neuroscience.

Time and Consciousness

O7

Mapping subcortical fear pathways in the human brain: thalamo-amygdala connections revealed by high-resolution tractography

Emmanouela Kosteletou-Kassotaki[1, 2], Liu Mengxing[3], Martina T. Cinca-Tomás[1, 2], Pedro M. Paz-Alonso[4, 5], Judith Domínguez-Borràs[1, 2]

[1]Brainlab – Cognitive Neuroscience Research Group, Department of Clinical Psychology and Psychobiology, University of Barcelona, Spain, [2]Institute of Neurosciences, University of Barcelona, Spain, [3]Department of Neuroscience, Tufts University School of Medicine, Boston, MA, USA, [4]BCBL. Basque Center on Cognition, Brain and Language, Donostia-San Sebastián, Spain, [5]Ikerbasque, Basque Foundation for Science, Bilbao, Spain,

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Influential models of emotion have postulated the existence of several direct subcortical pathways, or "low roads", that convey fast sensory thalamic inputs to the amygdala for affective processing. In rodents and non-human primates, specific thalamo-amygdala connections have been identified and linked to fear responses. These connections mainly originate in three thalamic nuclear groups (posterior, intralaminar, and medial) and project to the basolateral amygdala (BLA). However, the existence of similar thalamo-amygdala pathways in humans remains uncertain. Here, aiming to reproduce subcortical amygdala connections previously described in the non-human animal literature, we mapped those tracts in a sample of 113 human participants. Implementing an advanced high-resolution tractography protocol, we reconstructed white matter tracts connecting thalamic nuclei to the BLA, and assessed their reproducibility across test-retest sessions to evaluate their anatomical plausibility. Among the posterior thalamic nuclei, projections from the medial geniculate nucleus (MGN) and the medial and inferior pulvinar to the BLA emerged as the strongest and most robust thalamo-amygdala pathways. In turn, the mediodorsal nucleus within the medial group exhibited a prominent connection to the BLA, with a high number of streamlines and moderate-to-high reliability across sessions. Finally, intralaminar thalamic nuclei (parafascicular, central medial, and centromedian) showed more modest but consistent connections to the BLA, with higher intrasubject variability and moderate-to-low reproducibility. Together, these findings provide a comprehensive anatomical framework for multiple direct thalamo-amygdala pathways in the human brain, and support the existence of distinct evolutionarily conserved routes for subcortical affective processing.

Neural methods to predict behavior

O8 ☆

Ultrasound Neuromodulation of the Deep Brain: From Brain States to Decision-Making Circuits

Davide Folloni[1, 2]

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Understanding the relationships between brain and behavior is one of the main goals of neuroscience and is crucial for the development of novel rehabilitative technologies. When it comes to humans, however, we still lack an established tool able to modulate activity in deep brain areas with millimetric resolution and in a non-invasive and reversible manner. Beyond neurorehabilitation, the understanding of the functional role of a brain area can be established only through causal inference, that is by manipulating its activity and observing associated behavioral and state changes. Current reversible neuromodulation methods, however, are limited in both the spatial resolution they can achieve and the depth they can effectively target within the brain. Novel focused transcranial ultrasound stimulation (TUS) protocols rely on the strong interactions between low-intensity sound waves and brain tissue to transiently modulate brain states and neural activity non-invasively, reversibly and with high spatial precision. Through a series of experiments, I will discuss how TUS can focus sound waves on small regions deep within the brain without affecting the overlying cortex, achieving results that, until now, are possible only with surgically implanted electrodes and invasive procedures.

Neural methods to predict behavior

O9

Layer-specific functional gradients reveal intrinsic network organization and feedback processing

J. Karolis Degutis[1, 2], Jennifer Miehlbradt[3], Manon Durand-Ruel[3], Petra S. Hüppi[3], Dimitri Van De Ville[1, 2]

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The cortical microcircuit has a distinct laminar input-output organization for feedforward and feedback processing. Although task-based laminar fMRI has revealed dissociations consistent with the microcircuit, whole-brain intrinsic laminar connectivity has not yet been thoroughly investigated due to methodological limitations. Here, we use submillimeter whole-brain 7T resting-state fMRI in 21 subjects to map layer-resolved functional organization across superficial, middle, and deep cortical layers. We derive whole-brain spatial gradients - low-dimensional axes that summarize connectivity patterns - and characterize laminar organization with two complementary indices. The inter-regional index captures how different each region's laminar connectivity profile is from all other regions when considering all layers jointly, providing a measure of regional distinctiveness. The intra-regional index instead assesses laminar connectivity differences within a region by quantifying how much the connectivity profile of each layer diverges from that region's average profile. Inter-regional dissimilarity is highest in visual, default-mode, and limbic cortices and lower in somatomotor and attentional networks, whereas intra-regional dissimilarity peaks in visual, somatomotor, and dorsal attention networks. Layer-specific intra-regional profiles dissociate canonical resting-state networks and relate to cortical functional hierarchy: regions with distinct deep-layer connectivity are senders, while regions with more distinct superficial-layer are receivers. This is consistent with a feedback-dominant connectivity profile at rest. Finally, inter- and intra-regional dissimilarity correlate with the BigBrain sensory-limbic microstructural gradient, linking laminar functional connectivity to cytoarchitectonic differentiation. Together, these laminar indices discriminate resting-state networks, align with cortical microstructure, and predict hierarchical signal flow, providing a mesoscale account of laminar connectivity across intrinsic functional networks.

Neural methods to predict behavior

O10

A hierarchical coordinate system for sequence memory in human entorhinal cortex

Anna Shpektor[1]

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Grid cells in rodent entorhinal cortex (EC) support a coordinate system for space, enabling robust memory and powerful flexibility in spatial behaviour. This coordinate system is abstract - with the same grid cells encoding position across different sensory environments; and hierarchical - with grid modules of increasing spatial scale occupying increasingly ventral locations in the EC. Recent theories suggest that a similar abstract coordinate system could offer the same benefits to general memories that are not sequences drawn from a 2D surface. Here we show that an abstract hierarchical coordinate system supports arbitrary sequences in the human medial temporal lobe (MTL). In single-unit recordings from MTL, we find abstract, coordinate-like coding of a simple sequential memory task. In an fMRI experiment with more complex hierarchical sequences, we discover an abstract hierarchical representation in EC: the coordinate representations at distinct levels in the hierarchy are arranged on an anatomical gradient along the EC's anterior-posterior axis, homologous to the ventro-dorsal axis in rodents. These results therefore mirror the anatomical gradient of grid cells in the rodent EC but now for arbitrary non-spatial sequences. Together they suggest that memories are scaffolded on a hierarchical coordinate system using common neuronal coding principles, aligned to preserved anatomy, across domains and species.

Neural methods to predict behavior

O11 ☆

Cortical gradients of functional integration

Daniel Margulies[1]

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Understanding how the cerebral cortex transforms distinct sources of information into cohesive experiences requires knowledge of how functional integration emerges from cortical structure. Insights into functional processing streams indicate that cortical areas are arranged stepwise, representing functional gradients along the cortical surface. Having been largely restricted to describing processing within specific sensory modalities, how do these principles generalize and extend to the surrounding association cortex? Building on work characterizing a principal axis of cortical organization, I will present a line of research that investigates the role of cortical geometry in enabling convergence across distinct modalities. By describing how the spatial layout of the cerebral cortex shapes its function, this line of research proposes a framework for understanding structural constraints that contribute to the integrated nature of cognition.

Neural methods to predict behavior

O12

Morphometric INverse Divergence (MIND) Networks from MRI Capture Timing of Key Structural Network Emergence in the Developing Brain

Ashleigh Davies[1], Vyacheslav Karolis[2], Tomoki Arichi[2], Sarah Morgan[1]

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The perinatal period is a critical window for structural brain network development, during which disruptions can lead to a range of neurodevelopmental problems [1, 2]. Morphometric INverse Divergence (MIND) networks derived from MRI capture structural similarity between pairs of cortical regions and are sensitive to development across the lifespan [3, 4]. Here, we use MIND networks from N = 752 neonates to identify when synchronised structural networks emerge and when they may be most vulnerable. First, we fitted splines to the age trajectories of individual MIND network edges and characterised each edge by the timing of its emergence and maturation, before clustering edges with similar trajectories to reveal synchronised structural networks. We then trained a connectome-based predictive model using MIND networks at birth to predict behavioural outcomes at 18-months [5], including Bayley III motor, cognitive and language scores [6], and the Quantitative Checklist for Autism in Toddlers (Q-CHAT) [7]. Finally, we interpreted the developmental timing of behaviour-predictive edges in view of the developmental clusters they belonged to. The timing of edge emergence matched known developmental ordering: salience, sensorimotor and primary visual networks emerged first, followed by association and then language networks. MIND networks at birth significantly predicted all four behavioural outcomes (language: $p < 0.001$; motor: $p < 0.001$; cognition: $p < 0.001$; Q-CHAT: $p = 0.002$). Behaviour-relevant networks followed a consistent ordering, with motor development predicted by early-emerging edges, followed by cognition, language, then Q-CHAT. Ultimately, these finding demonstrate that tracking synchronised structural brain development can identify vulnerable windows for key behavioural networks in neonates.

Neural methods to predict behavior

O13

EigenBrain: a spatial framework for reconstructing individual brain molecular architecture from multimodal magnetic resonance imaging

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Understanding the relationship between molecular architecture and macroscale brain function is central to systems neuroscience and biological psychiatry. However, comparing molecular and macroscale features remains difficult in the human brain. In vivo molecular measurements currently rely on positron emission tomography (PET), which is impractical for widespread or multi-tracer use, creating a critical need for magnetic resonance imaging (MRI)-based surrogate markers. Here, we present EigenBrain, a spatially constrained framework that integrates cortical geometry, and structural wiring, and functional organization to link MRI-derived connectomic eigenvectors with molecular PET maps. Group-level reconstructions of 20 neurotransmitter receptor and transporter maps from Neuromaps were performed using MRI eigenmaps from the Human Connectome Project. Individual-level reconstructions were performed for cerebral metabolic rate of glucose (CMRglc), amyloid-β accumulation, and tau deposition. To generalize the framework, we developed a deep learning model to predict CMRglc maps. EigenBrain reconstructed 20 group-level neurotransmitter receptors and transporters explaining 92-98% of variance. Subject-specific reconstruction of CMRglc achieved 91–95% variance explained. The deep learning model generalized to the external dataset with moderate to strong correlations between true and predicted CMRglc maps ($r = 0.516$-0.721). The individual reconstructions of amyloid-β and tau achieved 91–97% and 83–95% variance explained, respectively, which was not related to the Alzheimer's Disease scores. Together, EigenBrain shows excellent reconstructions for neurotransmitters, and glucose metabolism, amyloid-β, and tau maps, through a biologically principled bridge between molecular architecture and macroscale brain function. It offers promising applications to neurodevelopment and neurodegeneration and has the potential to inform individualized molecular profiling for precision therapeutic targeting.

Wednesday

Language and AI

O14

Emergence of Language in the Human Brain

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Deep learning has made major progress in natural language processing. Beyond these technical performance, these algorithms offer new methods to understand and model how language is processed in the human brain. Using both encoding (representation -> brain) and decoding (brain -> representations), we show that the comparison between modern speech and language models effectively accounts for brain responses to natural speech as recorded with EEG, MEG, iEEG and fMRI, including in children between 2 and 12 years old. This systematic comparison provides an operational foundation to model language in the adult and developing brain, and thus offers a new path to understand the neural and computational bases of this human-specific ability.

Language and AI

O15

The grip of grammar on meaning uncertainty: cross-linguistic evidence, neural correlates, and clinical relevance

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Isolated word meanings are inherently uncertain, but this uncertainty reduces when they are anchored by context in sentences. We propose meaning uncertainty is optimized through grammar in a way that generalizes cross-lingually, is reflected in brain, and selectively disrupted in disorders. Using naturalistic narratives from 20 languages, we quantified uncertainty reduction as the proportional decrease from non-contextual surprisal (estimated from lexical frequencies) to contextual surprisal (from grammar-sensitive language models). Across all languages, contextual surprisal was reliably lower than frequency surprisal, and the magnitude of uncertainty reduction tracked the surprisal cost of reversing word order, linking this form of compression directly to grammatical structure. Greater uncertainty reduction was associated with more complex syntactic structure, and with semantic spaces that were lexically richer yet geometrically more compressible. These uncertainty measures were related to brain activity in two fMRI datasets, one during spontaneous recall of TV episodes and another during naturalistic listening to one recall recording. During comprehension, contextual surprisal and surprisal reduction were expressed in fronto-temporal and temporo-parietal regions extending into the default-mode system, and subcortically in the basal ganglia, thalamus, and amygdala. During recall, all surprisal measures engaged sensorimotor and medial frontal regions, but surprisal reduction additionally recruited the cortico-basal-ganglia-thalamic loop. Finally, in spontaneous speech patterns across different tasks, clinical cohorts and pathologies, uncertainty reduction was selectively attenuated in aphasia, dementia and psychosis, which covaried with language and cognitive affectation. Together, these findings support the new concept of uncertainty optimization as a core grammatical computation, with specific neural and clinical correlates.

Language and AI

O16

Distinct cortical patches for semantic composition and syntactic binding in the human brain

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Human capacity for language depends on a language network of frontal and temporal brain regions, functionally defined among others by its strong selectivity for linguistic over non-linguistic input. Recent studies argued that lexical-semantic and combinatorial processes are tightly integrated across all areas of the language network during both comprehension and production. This stands in contrast to theories proposing that syntactic processing is spatially distinct from lexical-semantic processing and other language functions.
To test the latter hypothesis, we conducted an fMRI reading experiment using a 7-Tesla scanner with 20 participants performing two tasks. The first task, serving as a functional localizer for the language network, involved exposure to semantically rich sentences presented serially across five categories of increasing linguistic complexity. In the second task, participants viewed short, semantically impoverished three-word sentences presented in a single glance. We manipulated the syntactic complexity of these mini-sentences; by varying the degree of syntactic
movement.
Our results reveal two functionally dissociable networks within the language system: one supporting syntactic binding in the absence of meaning and the other dedicated to semantic composition. This dual-network architecture was consistently observed across all participants, though the precise anatomical localization of each network varied between individuals. Importantly, these two systems displayed markedly different responses when processing the three-word mini-sentences.
In conclusion, we argue that high-resolution functional imaging can reveal a division of labor within the classical language network, distinguishing systems for syntactic binding and semantic composition, which are situated within overlapping anatomical regions yet demonstrate striking functional differences.

Language and AI

O17 ☆

Neural algorithms of human language

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For the first time in history, there exist systems other than the human brain that can process speech and language, extract meaningful symbolic structure, and produce complex and appropriate responses. I will present studies from my lab that use these large speech and language models to generate algorithmic hypotheses of the biological implementation of language understanding. The work uses neural timeseries data across different spatial scales: From population ensembles using MEG and intracranial EEG, to the encoding of speech properties in individual neurons across the cortical depth using Neuropixels probes in humans. The results provide insight into what representations and operations serve to bridge between sound and meaning in biological and artificial systems, including how information at different timescales is nested, in time and in space, to allow information exchange across hierarchical structures. Together, the findings represent a new era of scientific inquiry to understand system-level implementations of human language.

Language and AI

O18

The Influence of Structure and Speed on MEG Responses to Narratives

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How the brain constructs meaning across large, extended contexts remains poorly understood. While neural responses to words and sentences are well characterized, much less is known about the brain mechanisms behind narrative comprehension. Sentence-level studies suggest that neural activation increases with the integration of word-meanings into sentence-level meaning. At the larger discourse level, theories propose that narratives rely on broader situation models possibly supported by networks beyond core language regions, including the Default Mode Network (Barnett & Bellana, 2025). Since narrative comprehension unfolds over longer timescales, processing time is a potential bottleneck. In this MEG study, we test how the size of a representation and presentation speed shape neural responses by manipulating structure (words, sentences, stories) and the presentation speed of 2-5 word text chunks. Our results show that there is an early story driven effect in superior frontal regions in the right hemisphere (RH) as well as bilateral sensitivity to both a three-way contrast between word lists, sentences and stories, as well as a two-way distinction between non-composing (wordlists) and composing stimuli (sentences and stories). Faster speed eliminated the RH story effect: only a left-hemisphere cluster showing a threeway distinction between the structure levels was significant in the Fast condition. We additionally found an incremental context effect in the Slow condition which led to a decrease in neural responses as the story progressed. This effect did not replicate for the Sentence condition or the Fast condition, suggesting that it reflects temporally constrained story-specific comprehension.

Language and AI

O19

Rapid emergence of category responses to AI-generated visual anagrams with identical visual features

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Specific regions of occipitotemporal cortex have been shown to respond preferentially to different categories of visual stimuli, including faces and objects. Because these categories often differ systematically in their visual features (e.g. a face is round, a computer is rectangular), it has been challenging to disentangle neural responses driven by visual features from those reflecting category perception itself. Here, we uncoupled category perception from visual features by collecting neuroimaging data (MEG and fMRI) while participants n=21 viewed AI-generated images termed "visual anagrams", that are perceived to belong to one category (i.e., people) when upright and to another category (i.e., objects) when inverted. Time-resolved decoding of MEG data showed that the initial evoked response for each stimulus was indistinguishable when viewed in either orientation, but diverged at ~200 ms according to perceived category. We evaluated how visual similarity as well as perceptual similarity across the stimuli influenced the MEG signal by using deep neural networks (DNNs) and participant-specific similarity embeddings extracted from verbal stimulus descriptions, respectively. We found that correlations between the MEG data and DNN-based models peaked at ~100 ms, while correlations with perceived stimulus similarity peaked much later at ~300 ms. Overall, these results show that even when visual features are well controlled, the perceived category of an image (e.g. person or object) emerges relatively quickly in the human brain.

Brain, Mental Health and Lifestyle

O20 ☆

Fit Body, Sharp Mind: How Childhood Physical Activity Can Boost Brain and Cognition

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There is a growing public health burden of physical inactivity among individuals of industrialized nations. Children have become increasingly inactive, leading to concomitant increases in the prevalence of being overweight and unfit. Poor physical activity behaviors during childhood track throughout life and have implications for the prevalence of several chronic diseases during adulthood. Particularly troubling is the absence of public health concern for the effect of physical inactivity on brain and mental health, including cognition. It is curious that this has not emerged as a larger societal issue, given its relationship to increased body mass and other mental health disorders (e.g., depression, anxiety) that have captured public attention. My research program has investigated the relation of physical activity to cognitive and brain health. My techniques of investigation involve multimodal neuroimaging (EEG/ERPs, MRI/fMRI), behavioral assessments, and scholastic outcomes in an effort to translate basic laboratory findings into everyday life. Central to this translational approach is the identification of etiological substrates of brain networks that are susceptible to health behaviors. As such, the overarching goal of my research program is to determine factors that improve cognition, maximize brain health, and promote the effective functioning of individuals across the lifespan.

Brain, Mental Health and Lifestyle

O21 ☆

Influences of genes and environment on changes in brain health and mental health

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The human brain changes across the life span and impacts our mental health, during development and ageing. From gestation to emerging adulthood prominent neurodevelopmental changes occur in brain structure and functioning. These changes represent adaptation to new situations under the influence of genetic and environmental factors and are associated with mental health. We have recently found genes for brain changes during development and aging in longitudinal MRI data from 15,640 individuals, with the most robustly identified genes associated with metabolic processes. We demonstrate global genetic overlap with depression, schizophrenia, cognitive functioning, insomnia, height, body mass index and smoking. We find that physical exercise also impacts brain health and mental health. The unique opportunities and challenges to study individual lifespan trajectories to advance our understanding of neurodevelopment and mental health disorders, with the aim to optimize brain health and mental health, will be discussed.

POSTER ABSTRACTS

Ordered according to the days Monday (M), Tuesday (T), and Wednesday (W), and according to the following categories:

Clinical Neuroscience (M01-M13, T01-T12, W01-W11)

Emotion & Motivation (M14-M19, T13-T17, W12-W16)

Language & Music (M20-M23, T18-T20, W17-W21)

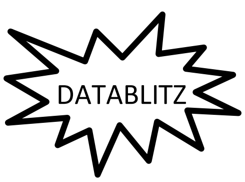
Learning & Memory (M24-M28, T21-T26, W23-W26)

Methods (M29-M39, T27-T38, W27-W36)

Perception (M40-M45, T39-T48, W37-W43)

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

Indicates that this abstract has received a travel grant award

M01

Music exposure modulates gamma-band brain activity in preterm newborns

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Although music-based interventions in the neonatal intensive care unit (NICU), have been proposed as a way to counteract the elevated noise levels and unpredictable and meaningless acoustic stimuli, the oscillatory electroencephalographic (EEG) signatures associated with musical perception in this context remain poorly understood.
Eight preterm infants, who were exposed to a music intervention during their NICU stay (Long-Term Exposure Group), received the same 8-minute music excerpt, with 8-minute resting-state recordings before and after the stimulus. Five preterm infants, not priorly exposed to music, underwent the same protocol but with no music excerpt during the resting-state acquisitions (No-Exposure Group). A third group of ten preterm infants not priorly exposed to music (Short-Term Exposure Group) received an 8-minute music excerpt, with 5-minute resting-state recordings before and after. Spectral power modifications across several frequency bands were examined using general-linear mixed-effects models and confirmed with a Monte-Carlo simulation.
During music presentation, both the Long-Term Exposure-Group and the Short-Term-Exposure Group exhibited a right-frontal–temporal increase in broadband-gamma activity relative to the pre-music resting-state baseline, an effect absent in the No-Exposure Group. The right-frontal broadband-gamma increase persisted into the post-music resting-state in the Short-Term-Exposure Group, whereas the Long-Term Exposure Group group showed a post-music gamma-power decrease. Additionally, during the pre-music-resting-state period, the Long-Term-Exposure Group demonstrated a modest right-frontal broadband-gamma increase relative to the No-Exposure Group .
Altogether, these findings suggest that right-frontal-temporal gamma activity might be a promising biomarker of the neurophysiological effects of music intervention in preterm neonates.

M02

Differential Prior Weighting in Perceptual Decision-Making: Behavioural Trends and Planned fMRI follow-up Study in Hallucination-Prone Individuals

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A hierarchical model within the predictive processing framework proposes hallucinatory experiences arise from weakened perceptual priors at lower processing levels in the brain and stronger cognitive priors at higher levels. Our large online study (N=350) in healthy individuals revealed a trend toward weakened perceptual prior weighting, increased sensitivity to detect signal in noise, and a more liberal criterion associated with hallucination proneness, but no stronger cognitive prior weighting. To map these behavioural findings to neural mechanisms, an ongoing fMRI study tests 25 healthy participants performing the same two perceptual decision-making tasks. Perceptual prior weighting will be quantified via choice history biases in a noisy-image discrimination task, while cognitive prior weighting will be assessed as performance increase in detecting degraded images from before to after learning their non-degraded counterparts. The following multi voxel pattern analyses will be performed: a support vector machine classifier trained on full contrast stimuli will be used to estimate the effect of perceptual priors on neural representations of noisy stimuli (reflecting choice history biases). The effect of cognitive priors will be quantified using representational similarity analyses that depict changes in neural patterns before and after learning. We hypothesize that neural correlates of prior weighting will mirror the behavioural findings, thus bridging cognitive models with underlying brain computations. This approach aims to elucidate the neural basis of perceptual and cognitive priors relevant to hallucinatory experiences.

M03

Neural plasticity in post-stroke aphasia: Evidence from inter- and intra-hemispheric connectivity

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Aphasia typically occurs following stroke to the left hemisphere (LH). One of the key questions in language rehabilitation after stroke is the extent to which language recovery relies on the restoration of dysfunctional “normal” language processing in the LH, or on ‘compensation’ processes involving functional reorganization of the network, associated with recruiting of brain areas and cognitive processes that are not typically involved in the task. I will review four fMRI studies in which we examined this question using measures of functional connectivity within and between hemispheres, in patients with post stroke aphasia.

Study #1 tested inter-hemispheric connectivity during sentence comprehension in a single time-point; Study #2 tested changes in Resting state connectivity before and after melody-based therapy; Study #3 measured changes in right hemisphere connectivity during phonological and semantic tasks following phonology-based treatment; and Study #4 measured changes in connectivity following morphology-based treatment.

Altogether our results show evidence for both ‘normalization’ and ‘compensation’ processes in language recovery. These are shown in both hemispheres, and depend on the tasks patients perform in therapy and during scanning. Our results do not support the hypothesis of transcallosal suppression between hemispheres in language processing, neither in patients nor in healthy participants. Connectivity between hemispheres may be particularly evident in tasks that require integration between complementary processes in the two hemispheres, such as semantic processing, or processing of melody. Excitatory interhemispheric connectivity may also be positively associated with language recovery in such tasks.

M04

Structure-Function Coupling in the Very Preterm Newborn Brain and the Effects of Early Music Exposure

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The Structure Decoupling Index (SDI) enables quantitative assessment of how functional activity links to underlying structural connectivity. How structure-function coupling develops in neonates before term-equivalent age (TEA) remains unclear, and the preterm period offers a window into its development. 62 very preterm (VPT) and 19 full-term (FT) infants were recruited from the University Hospital of Geneva. VPT infants were scanned at 33- and 40-weeks gestational age (wGA) and FT infants shortly after birth. VPT infants were randomized to music-exposure or control groups after the first scan in an intervention study. 3T MRI acquisitions consisted of 7-minutes RS-fMRI and diffusion imaging (b=200, 1000, 2000s/mm²). Bandpass-filtered regional BOLD timecourses (0.01–0.1Hz) were extracted using the UNC-Cedars Infant Atlas. Structural connectomes were generated from 20-million streamlines and weighted by mean kurtosis (MK). Non-parametric tests assessed longitudinal (Mann-Whitney U) and cross-sectional at TEA (Kruskal-Wallis) log-transformed SDI differences (FDR-corrected). In VPT infants, MK-derived SDI changes from 33 to 40wGA showed decreasing SDI (increasing structure-function coupling) in primary sensorimotor, sensory, and visual areas; and increasing SDI (indicating decoupling), in auditory, and higher-order executive, default mode, and language networks. This suggests maturation toward adult-like patterns, with coupling in primary sensory areas and decoupling in higher-order regions. At TEA, VPT infants exhibited delayed maturation of SDI in precentral regions, with less coupling. However, early environmental music exposure seems to promote a more mature coupling pattern in VPT infants in salience, limbic and language regions, with music intervention potentially enhancing decoupling in motor-planning, limbic, executive, and language networks.

DATABLITZ

M05

Brain Rhythms in Aging: What EEG Power Spectra Reveals about Cognitive Decline

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Amnesic mild cognitive impairment (aMCI) affects 10% of adults aged 65 and older, yet its mechanisms remain unclear1. Preclinical Alzheimer's disease (AD) is associated with decreased slow-wave and increased fast-wave power2-4. This study aimed to elucidate compensatory mechanisms distinguishing preclinical AD from normal aging. High-density electroencephalography (EEG) recordings were obtained during 5 minutes of eyes-closed resting-state from 149 participants (N = 58 Older adults; N = 58 Younger adults; N = 33 aMCI adults). EEG data were preprocessed in Cartool5, and power spectra (1–70 Hz) were computed using the Welch method. Threshold free clustering enhancement (TFCE) permutation tests were applied to normalized spectra across 204 retained channels for all pairwise group comparisons. Older adults were further stratified into 37 high- and 21 low-performing individuals based on Montreal Cognitive Assessment (MoCA), memory index scores (MIS), and hippocampal volume. Linear regressions tested whether cognitive scores, age, or sex predicted power spectra in TFCE-significant clusters. Finally, 1/f slopes were estimated. Older adults showed reduced delta/ theta and increased beta power compared to younger adults, particularly over midline, sensorimotor, and temporal sites, reflecting typical aging2-4. Both older adults and aMCI individuals exhibited increased parietal–occipital gamma power, suggesting compensatory age-related activity6. In aMCI, lower MIS predicted elevated gamma power, driven mainly by males, consistent with increased cortical activation in memory decline7. Flatter 1/f slopes with aging and poorer cognition may reflect excitation–inhibition imbalance and neural desynchronization8-9. Overall, cognitive decline appears to involve compensatory fast-wave activity and increased desynchronization beyond aging.

M06

Emotional regulation in Functional Neurological Disorder: Insights from structural connectivity and functional activity

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Functional Neurological Disorder (FND) is characterized by motor and sensory deficits occurring in the absence of identifiable structural lesions. Prior neuroimaging studies indicate alterations in emotional processing and in specific brain networks, such as the default mode network (DMN), salience network, and limbic circuits, as well as reduced white-matter integrity in pathways such as the corona radiata, uncinate fasciculus, anterior thalamic radiations, and cingulum bundle. However, results remain heterogeneous across studies.

This study aims to investigate emotion-related changes in resting-state brain activity and structural connectivity in FND, and to examine their relationships with subjective emotional processing, internalizing symptoms, and trauma exposure. Fifty FND patients and fifty healthy controls, aged 18–80, will complete a psychological assessment including measures of anxiety, depression, childhood trauma, PTSD symptoms, stressful life events, and emotion regulation strategies.

Neuroimaging data will be acquired using a multimodal MRI protocol integrating a functional task designed to probe post-emotional recovery dynamics and emotional inertia following exposure to negative stimuli, together with multishell diffusion imaging enabling tractography and voxelwise whole-brain analyses.

Preliminary results in healthy controls confirm the robustness of the protocol and its sensitivity to activity in key regions of the DMN (medial prefrontal and posterior cingulate cortices), salience network (anterior cingulate, insula), and emotion-regulation areas (lateral orbitofrontal cortex, supramarginal gyrus). Ongoing data acquisition will support the characterization of brain–behavior relationships, and forthcoming comparisons with FND participants are expected to reveal functional and structural abnormalities within these networks, contributing to a clearer understanding of the neural mechanisms underlying FND.

<u>M07</u>

Attentional Performance and Resting-State Networks in School-Age Children Born Very Preterm

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Very preterm (VPT) children born before 32-weeks gestational age often exhibit attentional difficulties and deficits in executive functions (EF). Resting-state functional connectivity MRI reveals underlying brain network differences in individuals with attention impairments, particularly in networks associated with attentional control and EF, such as the Default Mode Network and Cognitive Control Network. Literature suggests VPT children show differences in these resting-state networks when compared to full-term (FT) children, however, a comprehensive examination of relationships between various attentional and EF components and resting-state networks in school-age VPT children is limited. 60 children aged 6-11 years (35 VPT, 25 FT) underwent resting-state fMRI and completed the Kinder Test for Attentional Performance (KiTAP) to measure four aspects of attention and EF: alertness, flexibility, divided attention, and inhibition. We used Independent Component Analysis to identify brain networks and examine correlations between KiTAP scores and component loadings. Group differences and relationships between attention, EF performance, and brain networks were assessed. Preliminary analyses suggest that VPT and FT children showed similar attention, EF performances, and brain network patterns when controlled for age and gender. Cross-test correlations between the KiTAP subtests show that flexibility shows relatively weaker associations with other subtests. Additionally, specific component loadings correlated with flexibility performance, but not other attention measures, confirming that cognitive flexibility is a higher order EF, requiring cognitive control and task-set switching beyond basic mechanisms of attention. These preliminary findings suggest that by school age, VPT children may have similar attention abilities and brain organization as FT children.

M08

Brain dynamics of Persistent Perceptual Postural Dizziness at rest reveal alterations in multisensory and motor hubs

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Background: Persistent Perceptual Postural Dizziness (PPPD) is characterized by chronic dizziness and vertigo, impacting everyday life, thought to stem from a disruption in higher-order integration of visual and vestibular signals. Currently, no resolutive treatment is available and the relationship between brain networks and postural alterations is unclear. Objectives: to characterize dynamic brain activity in PPPD patients and its relationships to objective postural measures, stress markers, and clinical self-reports. Methods: A multi-modal, case-control study of 18 PPPD patients and 20 age- and gender-matched healthy controls (HC) was conducted. Participants underwent a resting state fMRI recording, postural assessments, and saliva sampling. The fMRI dataset was preprocessed using a standard pipeline and analysed using a co-activation patterns (CAPs) approach. Results: PPPD patients have distinct brain-wide CAPs temporal characteristics compared to controls, seeded from the right temporo-parietal junction, and the insula, similarly to other FNDs. Additionally, PPPD patients show altered CAPs dynamics seeded from the caudate nucleus and the hippocampus. Instead, no differences are found in CAPs seeded from the vestibular cortex OP2. The relationship between brain CAPs and features of posture, stress, and clinical self-reports are being explored (ongoing). Conclusion: This study reveals a dynamic brain signature of altered high-level motor control and multisensory processing, and supports the absence of alterations in vestibular hubs, offering new perspectives on the relationship between dynamic state alterations and postural readouts.

M09

Neuropsychological Profiles in Cerebellar Stroke and Associated Structural Connectivity Correlates

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Background: The cerebellum is increasingly recognized for its contributions to higher-order cognitive and affective processes through distributed cortico-subcortico-cerebellar loops. Although behavioral alterations following cerebellar stroke have been reported, the specific neuropsychological profile and its underlying structural connectivity correlates remain insufficiently studied. This study examines group differences between cerebellar stroke patients and healthy controls using an extensive neuropsychological battery, and outlines forthcoming DTI analyses.

Methods: Adults with isolated cerebellar stroke were compared to healthy controls. Participants completed a comprehensive neuropsychological assessment covering episodic memory, short-term and working memory, executive functions, attention, language and visuospatial abilities. Permutational ANCOVAs were conducted for each test, with group as the main factor and age, sex, and education as covariates. FDR correction was applied across comparisons. As a next step, DTI metrics, including fractional anisotropy, mean diffusivity, axial and radial diffusivity, and tract-based connectivity strength, will be extracted from key cerebellar output pathways and correlated with cognitive performance.

Results: Permutation analyses revealed significant group differences in several domains. The cerebellar group showed markedly reduced visuospatial working memory ($p = .0016$), increased intrusion/double responses during verbal episodic recall and reduced semantic processing efficiency. Additional effects emerged in verbal fluency, Stroop errors, and phasic alertness, though these did not survive FDR correction. We hypothesize that reduced fractional anisotropy and increased mean diffusivity in cerebellar pathways will relate to the observed deficits.

Conclusion: Cerebellar stroke is associated with a specific neuropsychological profile characterized by deficits in monitoring, semantic processing, and working memory, which are expected to relate to distinct underlying structural connectivity alterations.

M10

Functional Connectivity and Antiseizure Medication Modulation in Focal Epilepsy Revealed by fMRI

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Rationale: Antiseizure medication (ASM) are the first-line treatment for epilepsy and act through diverse mechanisms targeting neuronal excitability and synaptic transmission. However, their effects on large-scale functional brain networks remain poorly understood. These effects are also frequently questioned in imaging studies of patients with epilepsy.
OThese effectsshis retrospective study aimed to quantify functional connectivity alterations in focal epilepsy and assess the influence of ASMs on large-scale resting-state networks.
Methods: Resting-state fMRI data from 71 patients with focal epilepsy and 37 healthy controls were used to compute whole-brain functional connectivity matrices. Group differences and medication effects were assessed using Network Based Statistics (Zalesky et al., 2010). ASMs were grouped according to their primary mechanisms of action to evaluate network-specific effects.
Results: Preliminary analyses showed that patients with focal epilepsy presented significantly higher functional connectivity within a widespread bilateral network compared to controls ($p<0.01$). Patients treated with ASMs targeting voltage-gated sodium channels showed significantly reduced connectivity within functional networks ($p < 0.05$).
Conclusion: These preliminary results suggest that ASM may partially reverse functional brain network connectivity abnomalities in patients with focal epilepsy.

M11

Functional Connectivity Reorganization and Math Gains in Children with IH using Calcularis

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Children with Infantile Hydrocephalus (IH) often exhibit persistent visuospatial and mathematical difficulties despite successful shunting, yet the functional plasticity of the developing brain in this population remains poorly understood. This study examined whether a structured cognitive intervention can elicit measurable changes in behavior and resting-state functional connectivity. Participants included children with IH ($n = 11$) and age-matched controls ($n = 19$; 7–12 years). All completed a 3-month Calcularis training program, with pre–post assessments including WISC Arithmetic, WIAT Numerical Operations, and Math Fluency, alongside resting-state fMRI using an eyes-open “Sheep Show” protocol analyzed with the CONN toolbox.

Both groups showed significant improvements across arithmetic and fluency measures ($p < .001$). Numerical Operations gains were evident in both groups, but children with IH exhibited significantly larger improvements ($p = .001$), suggesting enhanced responsiveness to targeted training. Functional connectivity analyses revealed training-related reorganization in the IH group, including increased intra-visual connectivity between bilateral pericalcarine cortices and fusiform gyrus ($d = 0.6–0.7$) and strengthened visual–parietal coupling involving intraparietal and superior parietal regions ($d = 0.6–0.7$). Conversely, IH participants demonstrated reduced frontal–temporal connectivity, particularly between the right frontal pole, pars triangularis, and middle temporal cortex ($d = –0.6$ to $–0.65$).

Together, these findings suggest that cognitive training can drive functional reorganization in IH, promoting a shift from effortful, top-down control toward more efficient, perceptually anchored processing. Strengthening of visual–parietal pathways coupled with reduced frontal over-recruitment reflects emergent specialization of the neural systems supporting mathematical cognition in this population.

M12

A multi-technology approach to uncover the behavioral and neural mechanisms of object-based deficits

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Visuospatial neglect is a disabling post-stroke cognitive disorder in which patients fail to attend to the contralesional side of -space (egocentric) or -individual objects (allocentric). While egocentric neglect is well documented, object-based deficits remain understudied and clinically underestimated, despite their critical impact on daily functioning. This project investigates the behavioral and neural mechanisms underlying object-based deficits in subacute to chronic phases post-stroke to better understand its underlying brain processes, and to enhance the sensitivity and ecological validity of diagnostic tools.

To address this issue, we developed an innovative cognitive battery embedded within a motivating narrative context. It assesses multiple behavioral components and includes realistic virtual-reality and touch-based tasks, combined with quantitative measures such as eye- and body- movement tracking. Multimodal MRI further allows us to characterize the structural and functional disconnections caused by patients' lesions.

Preliminary data from 20 stroke patients indicate that 20% show signs of allocentric deficits. Although these patients show mild impairment on traditional paper-and-pencil tests, they consistently demonstrate deficits across our experimental tasks. This suggests that our paradigm is sensitive enough to detect object-based deficits, even subtle ones, and may help distinguish different subtypes of these deficits. Patients also reported high engagement, supporting the ecological validity of our approach.

Overall, these findings show that object-based deficits can persist and highlight the need for sensitive, ecologically grounded assessment tools. Fine-grained quantitative metrics offer a promising avenue for identifying nuanced deficits, predicting recovery trajectories, and guiding personalized rehabilitation strategies. Ongoing work aims to refine behavioral profiles and map the neural mechanisms underlying these complex disorders.

<u>M13</u>

Selective association of EEG microstates with clinical symptoms and mutation status in monogenic Alzheimer disease

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EEG microstates are transient and short-lasting periods of stable scalp potential fields associated with large-scale brain networks, which are affected by early synaptic loss in Alzheimer's disease (AD). We investigated EEG microstates in presymptomatic (PMC) and symptomatic mutation carriers (SMC) compared to healthy non-carrier (NC) controls in families with autosomal dominant AD (ADAD). 99 EEG recordings from 7 SMC, 17 PMC, and 24 NC were selected from a Swedish ADAD cohort. Seven classes (A to G) of microstate topographical maps were fitted to their resting-state EEG. Next, microstate parameters of coverage (fraction of total recording time), duration (average time in milliseconds), and occurrence (frequency per second) of different topographical maps were assessed in repeated-measures analyses to compare differences between NC, PMC, and SMC. Selective decreases in coverage of class B (SMC vs NC, $p = 0.023$) and class C (SMC vs PMC and NC, $p = 0.017$ and $p = 0.004$) were observed in symptomatic individuals. In contrast, mutation carriers had a decrease in coverage of class D (SMC and PMC vs NC, $p = 0.015$ and $p = 0.001$) and an increase in coverage of class E compared to controls (SMC and PMC vs NC, both $p = 0.001$). Thus, global brain network dynamics as described by EEG microstate classes were selectively affected in this cohort of monogenic AD, associated with either clinical symptoms (class B and C) or mutation status (class D and E). The latter suggests early mutation-related changes that are detectable already in the presymptomatic stages.

M14

Defensive Motor Dynamics of Infectious Threats: Integrating Postural Freezing and Corticospinal Excitability

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Peripersonal space (PPS) functions as a multisensory interface between the body and the environment, coordinating defensive behaviors. Freezing, characterized by reduced body sway, is one such response, thought to limit risk during threat evaluation while preserving the capacity for rapid action. Recent findings indicate that infectious cues trigger preparatory immune responses even before bodily contact, suggesting a link between pathogen detection, defensive behavior, and immune system. Here, we investigate how infectious threats shape both postural freezing and motor readiness.

In a virtual-reality study, participants stood on a force plate while infectious or neutral avatars approached them. Postural data revealed a distance-dependent freezing effect, with significantly reduced body sway when infectious avatars are close. Individuals with high-disgust sensitivity, a core component of the behavioral immune system, froze less overall but showed stronger discrimination between infectious and neutral avatars at close distances, compared to participants with low-disgust sensitivity. This suggests that disgust sensitivity sharpens selective freezing, tuning defensive physiology toward pathogen-specific cues.

Building on these behavioral results, a second study examines whether infectious threats evoke not only global immobility but also preparatory motor tuning. Using single-pulse transcranial magnetic stimulation, corticospinal excitability will be measured in distal (FDI) and proximal (AD) muscles across multiple approach distances. We predict a muscle-specific balance of inhibition and preparation, modulated by disgust sensitivity, mirroring the force-plate findings.

Together, these studies aim to determine whether freezing towards infectious threats reflects pure motor inhibition or a strategically controlled state combining bodily stillness with selective action readiness during infectious-threat processing.

M15

Attentional focus and emotion modulate voice recognition deficits in cerebellar stroke patients

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The cerebellum, long regarded as a motor structure, is increasingly recognized for its role in higher-order cognitive and socio-emotional functions. Its contribution to vocal emotion decoding, however, remains insufficiently understood. Direct evidence for its role in modulating prosody recognition under explicit versus implicit attentional demands is lacking. This study investigated how cerebellar stroke—controlled for time since stroke in months—alters vocal emotion processing depending on attentional focus. Fifteen patients with chronic cerebellar stroke and fifteen matched controls performed two tasks on vocal stimuli expressing anger, happiness, or neutrality. Behavioral performance was analyzed using mixed-effects logistic regression and drift diffusion modeling (DDM; 'angle' type). Patients showed lower accuracy than controls, with deficits particularly pronounced in the explicit task. Performance also varied by emotion. Contrary to our predictions, DDM parameters did not differ between groups, but instead task effects dominated. At the neural level, patients recruited extended networks during explicit processing, including orbitofrontal cortex, amygdala, anterior insula, and cerebellar lobule IX, alongside cerebello-cortical tracts. Implicit processing was associated with more restricted activations, particularly in frontal opercular and cerebellar regions (lobule IX). Model-based analyses further revealed that successful categorization in patients compared to controls relied more heavily on the left inferior frontal gyrus, inferior parietal lobule, and pre-supplementary motor area, but only when ignoring time since stroke—that totally neutralized these effects when controlled for. Our findings demonstrate that the cerebellum does not primarily shape decision dynamics but optimizes sensory representations of prosodic cues for downstream evaluation.

TRAVEL GRANT

M16

An auditory 'low road' for threat in humans sensitive to rapid temporal modulations: multimodal insights from EEG, fMRI, DWI, and peripheral measures

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Rapid threat processing is crucial for survival. In vision, neural models of emotion propose the existence of direct pathways from visual thalamus to the amygdala, which may rely on magnocellular inputs and enable fast processing of threat signals. In audition, evidence from non-human animals suggests the existence of similar fast magnocellular pathways, but their presence in humans remains unclear. Building on animal evidence that high-amplitude-modulated (highAM) sounds preferentially engage magnocellular auditory processing, we combined physiological and neuroimaging measures to identify a magnocellular pathway for auditory fear in humans. Specifically, we tested whether highAM fear sounds elicit rapid affective responses, and whether highAM emotional processing aligns with auditory thalamo-amygdala anatomical connectivity. During fear conditioning, we recorded electroencephalography and pupillometry (Study I) as well as functional and diffusion-weighted imaging (Study II) from healthy participants as they detected voices. Only stimuli presented at highAM, as opposed to lowAM, elicited early fear-related responses (before 100 ms post-stimulus; study I). Analyses of functional and diffusion-weighted imaging data (Study II) revealed that selective amygdala responses to highAM (and not lowAM) emotional voices were functionally associated with individual fiber density of a direct medial geniculate body – basolateral amygdala pathway. Together, these findings provide convergent functional and anatomical evidence supporting a magnocellular subcortical pathway for auditory threat processing in humans, potentially mirroring the visual subcortical pathways extensively investigated in human emotion research. These results also bridge animal and human work on evolutionarily conserved subcortical systems for affective processing.

Emotion & Motivation

M17

Emotion processing and vmPFC microstructure in school-age children born very preterm

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Preterm birth presents a significant risk for neurodevelopmental challenges persisting into childhood and adulthood, including cognitive deficits, socioemotional difficulties, and an increased likelihood of neuropsychiatric disorders. This study investigates emotional processing differences between very preterm (VPT, born < 32 weeks gestational age) and full-term (FT) children, focusing on emotional regulation and prosody, hypothesizing VPT children would show greater difficulties reflected in altered brain microstructure in emotion-related regions. 35 VPT and 25 FT children aged 6-11 years were recruited from previous newborn cohorts at the University Hospital of Geneva. Emotional Prosody Recognition (EPR) was assessed using a validated test. Emotional regulation was measured using parent-reported Emotion Regulation Checklist (ERC) and child-reported Emotion Regulation Questionnaire (ERQ). Diffusion MRI was acquired for each participant ($b = 200, 1000, 2700\ s/mm^2$) at the 3T platform at Campus Biotech. Regional gray matter diffusion metrics were compared between groups. Behavioral results indicated that VPT children performed similarly to FT controls on the prosody task and showed comparable emotional regulation subscores. However, preterm-born children showed reduced gray matter microstructural complexity in vmPFC (lower intra-neurite volume fraction and axial kurtosis, and higher radial diffusivity), suggesting delayed cortical maturation. These effects did not remain significant after FDR-correction, suggesting the need for a larger sample size and further investigation. Although no behavioral differences were observed, given vmPFC's central role in evaluating emotional signals and supporting regulatory processes, these alterations may reflect early neural vulnerabilities influencing the development of both emotion recognition and emotion regulation despite preserved behavioral performance.

M18

When the Eyes Disappear: Neural Dynamics of Emotion Recognition under Eye Occlusion

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Facial emotion recognition relies on the rapid integration of visual cues, with the eyes playing a central role in early perceptual decoding and later evaluative processes (Adolphs, 2002). Building on prior findings that different forms of eye occlusion elicit distinct shifts in appraisal and attentional allocation, this study examines how these effects unfold in the temporal dynamics of EEG responses. Participants viewed emotional faces (fear, joy, neutral) with open eyes, closed eyes, or sunglasses. This manipulation allowed us to assess how reduced access to ocular information modulates early perceptual components (N170, EPN), later evaluative activity (LPP), and the organisation of EEG microstates associated with emotional processing.

Despite existing work on the role of the eyes, no study has directly contrasted different forms of eye occlusion across both behavioural appraisal and the full cascade of EEG responses within a single paradigm. Based on prior literature and behavioural and eye-tracking data, we hypothesise that sunglasses, but not closed eyes, will reduce LPP amplitudes, reflecting differences in emotional appraisal. We also expect condition-specific changes in microstate duration and sequencing, indicating alterations in the functional architecture of socio-emotional processing.

Addressing this gap will clarify which aspects of eye information are essential for distinct stages of emotion processing and determine whether reduced eye visibility primarily affects perceptual computations, evaluative processes, or the broader organisation of brain states, directly relevant for understanding real-world social communication, with applications ranging from clinical assessment to the design of artificial agents that rely on facial cues.

M19

Healing Sleep to Improve Cognitive and Emotional Functioning in Adolescents

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Sleep is a vital physiological process that plays a fundamental role in cognitive and emotional functioning. However, many adolescents experience poor sleep quality, although they need more sleep than adults. The aim of this project is to improve adolescents' sleep and measure its impact on cognition and emotional regulation.

We designed a 4-week intervention consisting of group workshops on sleep, inspired by cognitive-behavioural therapy for insomnia (CBT-I). Adolescents monitored their sleep at home using both a sleep diary and an actigraph. Before and after the intervention, their cognitive and emotional functioning were assessed using questionnaires and behavioural tasks. These tasks included a paired-associates memory task, the Sustained Attention to Response Task (SART), a go/no-go paradigm assessing vigilance, and a virtual reality (VR) emotional regulation task inspired by the Montreal Imaging Stress Task (MIST). Here, adolescents performed arithmetic calculations in front of a virtual classroom and received positive or negative feedback based on their performance. Skin conductance and heart rate were recorded to quantify physiological arousal during stress induction.

Participants were assigned either to an intervention group or to a waitlist control group. A total of 119 adolescents aged 15-25 years took part in the workshops. We observed that, following the intervention, participants showed higher memory scores and made fewer errors in the vigilance task. In the VR task, they demonstrated faster reaction times, better calculation performance, and reduced stress responses.

These findings provide further evidence for the key role of sleep in supporting cognitive and emotional functioning, particularly during adolescence.

M20

Speech Processing in the Polyglot Brain

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Polyglots offer a unique window into the effects of extensive language experience. Prior neuroimaging work on speech perception in polyglots has focused on cortical lexico-semantic and morpho-syntactic regions and has relied on categorical group comparisons. We aimed at extending these findings by: a) treating multilingualism continuously, and b) conducting whole-brain analyses to test for effects of multilingualism beyond core language areas, as predicted by the “bilingual advantage” theory.

We collected fMRI data in 41 polyglots (speaking 5+ languages) and 80 controls during story listening (first language). We contrasted neural responses to intact speech, degraded speech, and intact vs degraded speech using both group comparisons and treating multilingualism continuously.

Group comparisons were not significant, with the exception of greater cerebellar activation for controls during degraded speech. The continuous analysis revealed that higher multilingualism was associated with: (1) stronger activation in bilateral IFG and left middle temporal cortex for degraded speech (2) stronger activation in right cerebellar regions, bilateral precuneus, and lingual gyrus for intact speech; and (3) stronger activation in right superior temporal, hippocampal/parahippocampal cortices for intact vs degraded speech. In contrast, lower multilingualism was associated with higher hippocampal/parahippocampal and ACC activation for degraded speech.

A continuous characterisation of multilingualism is more sensitive than a categorical one to graded effects of multilingualism. We find that highly multilingual individuals may recruit linguistic regions more strongly to extract structure from unintelligible speech, and that there are positive associations between multilingualism and neural responses beyond the core language network during intelligible speech processing.

M21

Preterm Infants Show Selective EEG Responses to Infant-Directed Speech and Maternal voice

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Preterm infants in the NICUs experience an atypical auditory environment, where caregiver separation and high background noise limit exposure to natural maternal voice and speech. This reduced input may hinder early auditory and socio-emotional development. Infant-directed speech (IDS) contains exaggerated prosody and heightened affect which supports infant attention and early speech processing. However, little is known about how preterm infant brain processes IDS versus adult-directed speech (ADS), or how responses differ between maternal versus unfamiliar voices.
We recorded 64-channel EEG from eight preterm newborns (4 male) at 40 wGA during presentation of naturalistic IDS and ADS with word ‘bébé’ spoken by each newborn’s mother and by an unfamiliar mother of a preterm newborn. ERPs and time–frequency (TF) responses were evaluated using non-parametric cluster permutation tests.
ERP results showed an adult-like MMN (150–300ms) for both speech and voice conditions. IDS MMN peaked slightly later than ADS, whereas maternal voice peaked earlier than stranger’s. These effects localized to central–parietal sites for speech and frontal–temporal–parietal regions for voice. Early MMN indicates automatic detection of ADS and maternal voice, alongside mechanisms supporting novelty detection (IDS) and early attentional–memory processes. Further, IDS–ADS TF contrasts revealed beta desynchronization and gamma (>30Hz) synchronization, reflecting greater engagement of attentional and higher-order networks. Mother–Stranger TF contrasts indicated widespread cortical synchronization for maternal voice, especially within low-frequency bands.
These findings suggest that preterm infants respond to familiar, enriched speech, underscoring the importance of providing maternal and IDS exposure in the NICU.

M22

Functional Brain Mapping Clustering reveals meaningful ERSP Motifs

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In epilepsy surgery, functional brain mapping (FBM) plays a key role in individualizing cortical resections and limiting potential negative consequences on daily functions. Despite the growing use of stereo-EEG, functional language mapping with stereo-EEG electrodes is not yet standardized. Here, we systematically assess cortical responses to simple language tasks in patients undergoing stereo-EEG monitoring at two epilepsy centers (Geneva, n = 9; Bern, n = 7), with the aim of grouping ERSP representations into a small number of spectro-temporal motif types (e.g. high-gamma increase) that are stable across patients, sensitive to functional task condition, interpretable, and consistent with known language brain-regions.

Tasks included picture naming, auditory naming, and sentence completion. Standard preprocessing was performed. For each modality, baseline-normalized event-related spectral perturbations (ERSPs, in dB) were calculated, time-locked to stimulus onset, and warped to account for stimulus duration and response alignment. Electrodes without apparent task-related activity were excluded using dB-level thresholding, retaining responsive sites. Two clustering pipelines were used: one with vectorized ERSP values for K-means, GMM, and HDBSCAN; the other with a custom spectro-temporal “island” metric (STIM) encoding time–frequency features to serve as a distance measure for UMAP embeddings in 10D space, followed by K-means and GMM clustering (K=6–36). Clustering quality was assessed with silhouette scores and compared between full-ERSP and STIM-based UMAP, with manual brain-region validation.

UMAP clustering with STIM achieved better separation (silhouette ≈ 0.55) versus raw ERSP. Motif distribution varied with task and location, supporting condition sensitivity and alignment with related brain-regions.

DATABLITZ

M23

Meaning without Borders: Do Brains and LLMs Think Alike Across Languages?

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Large language models (LLMs) have become powerful tools for predicting how language is represented in the brain, yet it remains unclear whether they mirror the mechanisms supporting multilingual comprehension. Prior work reports hierarchical correspondences between model layers and neural responses, but findings remain inconsistent and predominantly monolingual. Here, we investigate how contextual word embeddings from Transformer models map onto the brain during naturalistic story listening in English, Mandarin, and French. Using layer-wise analyses, we test whether the representational hierarchy of the models aligns with cortical and subcortical language processing across languages, and to what degree these embeddings are language-specific. Across languages, contextual embeddings yielded robust and shared predictive patterns in both cortical and subcortical regions, indicating a cross-lingual convergence between LLM representations and neural responses. In addition, the models capture Mandarin-specific right-hemisphere activation, reflecting known language-dependent features. On the other hand, layer-wise intrinsic dimensionality and proxy-surprisal, used as two interpretability metrics of the model’s processing dynamics, did not reveal comparable representational progressions between LLMs and the brain. Together, these findings suggest that while LLM embeddings reliably predict language-responsive regions across languages, their internal computational trajectories diverge from those of the brain. This highlights the need for richer interpretability metrics to evaluate mechanistic similarity beyond surface-level predictive alignment.

M24

Pharmacological Modulation of Sleep with Sodium Oxybate impacts Emotional Memory Consolidation

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Sleep supports memory consolidation, with non-rapid eye movement (NREM) sleep proposed to favor systems consolidation and rapid eye movement (REM) sleep implicated in integrating affective relevance. We tested whether pharmacologically modifying sleep architecture with sodium-oxybate (SXB) alters emotional episodic memory.
In a double-blind, randomized, placebo-controlled, cross-over study, 19 healthy young men completed two overnight sessions (SXB, placebo). During evening fMRI, participants rated the valence of emotional and neutral images (encoding), then received SXB or placebo and slept under polysomnography. The following afternoon, they returned for fMRI recognition testing and a second valence-rating task.
SXB modified sleep by increasing NREM expression (N2+N3, delta power), reducing REM sleep (percentage, REM-theta) without affecting sleep quality. Behaviorally, we observed a ceiling effect with no differences in memory performance between placebo and SXB. However, in physiological and neural indices, the typical emotional advantage was attenuated. Specifically, pupillometry showed reduced emotional–neutral differentiation after SXB. Region-of-interest fMRI analyses revealed that, under placebo, bilateral amygdala, hippocampus, locus coeruleus, and orbitofrontal cortex displayed increased activity for emotional than neutral conditions. These differences disappeared under SXB. Correlation analyses suggested that the loss of emotional selectivity under SXB was linked to the reduced REM sleep, while the typical association between NREM sleep and hippocampal responses to neutral material was no longer evident.
These results suggest that SXB disturbs 1) the privileged affective processing consistent with the disruption of REM sleep and 2) memory consolidation despite NREM sleep enhancement. Modifying the NREM-REM sleep balance during the night alters emotional memory consolidation.

M25

Dynamics underlying auditory working memory

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We aim to understand the dynamics underlying auditory working memory for maintaining 'simple' tones. We recorded MEG in 17 subjects while they maintained one of the two presented tones (or ignore both in the control condition). After 12s, subjects compared the pitch of a test tone with the maintained tone.

Analysis of evoked responses showed persistent activity throughout maintenance compared to the pre-stimulus silent baseline but only at the start of maintenance when compared to the control condition. Analysis of induced responses showed suppressed alpha in the left auditory cortex, enhanced theta in medial prefrontal cortex, and enhanced beta in cerebellum.

In a second experiment, 19 new subjects were presented with a tone and a Gabor patch and a retro-cue indicating which to maintain for 12s. Analysis of the induced responses in auditory condition yielded similar results to first experiment.

Connectivity analysis showed that the theta activity in medial prefrontal was phase-locked to left hippocampus and left auditory cortex. The beta activity in cerebellum’s phase-locking to left IFG was correlated to subject’s task accuracy.

Using MVPA, a LDA classifier was trained to decode the contents of AWM using beta band PLV with right cerebellum as its features. A channel searchlight analysis showed that decoder performance at right Anterior Cingulate Gyrus (56.17% acc.) was above chance.

Our data clearly shows a network of brain areas involving pre-frontal and hippocampus, IFG and cerebellum for maintaining sounds in the auditory cortex, consistent with previous fMRI and ECoG experiments.

M26

Working-Memory Control in Childhood: An Effective-Connectivity Study

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Working memory (WM), the ability to maintain, manipulate and update information for a short period, matures rapidly in early and middle childhood. Most neuroimaging studies follow the localizationist framework, emphasizing ‘where’ WM activates, rather than ‘how’ regions interact. We addressed this gap by applying Dynamic Causal Modeling (DCM) to an fMRI visuospatial n-back task in 120 typically developing children aged 5 to 8 years. Effective connectivity was estimated among eight regions spanning the frontoparietal network (FPN: bilateral middle frontal gyrus and superior parietal lobe) and default-mode nodes (DMN: bilateral precuneus and anterior cingulate cortex) based on mean activation maps and prior literature. Performance and reaction time improved linearly with age. Children showed robust frontoparietal coupling with expected self-inhibition across nodes. Accuracy was associated with stronger left frontoparietal coupling and tighter down-regulation of DMN nodes. Age was related to stronger parietal interactions, reduced frontal drive, and enhanced left posterior feedforward influences. Task modulations tracked these trends: under low WM load, better performance was associated with stronger suppression of DMN-related pathways. As the load increased, coupling shifted toward a right-lateralized attention configuration.
Overall, the data point to an emerging specialization of WM control in early school years, characterized by coordinated FPN–DMN interplay, increasing automatization (less frontal control, greater posterior drive), and hemispheric differentiation—with left-lateralized routes aligning with language-supported strategies linked to higher accuracy at low load, and right-lateralized routes supporting visuospatial attention when demands are higher.
These findings offer a preliminary window into how developing network interactions may inform broader approaches to supporting early working-memory function.

M27

Gray matter maturation, associated functional connectivity, and executive function development in early school-age children

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Gray matter decreases from early childhood to adolescence following a topological organization: specific brain regions are affected. Such a mechanism is interpreted as a maturational process (pruning) ultimately leading to better performance. For instance, cortical reductions in fronto-parietal areas may be associated with better executive performance in youth. Besides, brain functional reports indicate that fronto-parietal and cingulo-opercular circuits may become more efficient over development, in association with improvements in executive function. To date, no studies have explored the relationship between gray matter decrease, changes in associated functional connectivity, and executive function development.
To address this gap, we leveraged the baseline data from the “Art and Development” study, a randomized controlled trial evaluating the benefits of arts interventions. These data include 126 children aged 5-9 years who completed T1-weighted, resting-state functional magnetic resonance imaging and a comprehensive battery of executive function tasks. We will combine voxel-based morphometry with seed-based functional connectivity to evaluate age-related gray matter maturation and its functional connectivity correlates. A linear mixed model will be used to assess age effects on executive function components (working memory, inhibition, and flexibility performance). Relationships between gray matter, functional connectivity, and behaviour will be further explored with independent pairwise correlations and network-based analyses.
We expect significant decreases in gray matter in the precuneus, prefrontal cortex, and striatum, associated with increased functional connectivity within the default mode, fronto-parietal, and cingulo-opercular networks with age. Structural and neural features may explain a substantial part of age variance in executive function behaviour.

M28

Large-scale brain network dynamics sustain inter-individual differences in visuomotor adaptation

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The ability to adapt motor behaviour to changing environmental demands requires precise spatio-temporal coordination of sensorimotor systems and higher-order areas. Here, we propose to apply the innovation-driven co-activation patterns (iCAPs) framework to continuous visuomotor adaptation to identify the dynamic cortical interplay sustaining inter-individual differences in learning abilities.

29 young healthy right-handed adults practiced a reaching task with a rotated visual feedback. iCAPs retrieved four networks located in the visual (iCAP1-Vis), left somatomotor (iCAP2-SM), right fronto-temporal (iCAP3-Temp) and frontal (iCAP4-Front) cortices underlied motor adaptation. Multivariate analysis revealed an association between faster improvement in movement time, trajectory length and movement smoothness, and slower improvement in initial directional error with higher presence and stability of the sensorimotor and temporal network, increased coupling of the temporal network with the sensorimotor and frontal networks, and increased anti-coupling of the temporal and visual networks.

These results reveal distinct cortical signatures sustaining aspects of learning related to successive movement phases. The right temporal cortex, associated with higher-order somatosensory processing and visuospatial learning, arises as a central component in visuomotor adaptation, mediating visuomotor integration with higher-order functions.

M29

Machine Learning based EEG Neurofeedback

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EEG neurofeedback traditionally relies on predefined frequency-band modulations (e.g., alpha increase for relaxation), which often fail to generalize across individuals due to inter-subject variability in spectral patterns. To address this limitation, we implemented a personalized machine-learning pipeline designed to discriminate against cognitive states using only a short per-subject calibration phase. EEG data were recorded from 10 dry electrodes at 250 Hz using the OpenBCI Galea headset. Band-power features (Delta, Theta, Alpha, Beta, Gamma) were estimated at 2 Hz from sliding windows, then normalized per electrode to remove amplitude variability and emphasize relative spectral contributions. During calibration, the participants alternated between 30 seconds of relaxation and 30 seconds of focused attention. A logistic regression classifier, optimized using Stochastic Dual Coordinate Ascent (SDCA), was trained on the resulting 50-dimensional feature vectors. Training required less than one second on a standard CPU and produced an interpretable model consisting of linear weights.

Model performance was evaluated offline using a 75/25 validation split. For the 3 participants tested so far, the classifier achieved high accuracy (> 90%), and provided a stable, continuous probability of the Focus state suitable for real-time neurofeedback. The low latency feature extraction and the fast linear prediction enable real-time deployment within interactive applications such as video games or virtual reality simulations.

This work demonstrates the feasibility of an individualized EEG state classification system using lightweight machine learning. Ongoing work includes evaluation across multiple participants over repeated sessions, exploration of temporal models to further enhance neurofeedback stability, and multi-class cognitive states classification.

M30

MiCoBID: Multi-institution Computable Biomedical Imaging Data Platform

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Biomedical imaging data in Switzerland remains fragmented across institutions, limiting reuse, interoperability, and large-scale collaborative research. To address these challenges, the MiCo-BID project aims to establish a multi-institution, computable biomedical imaging data platform connecting CHUV, HUG, UNIL, UNIGE, and EPFL. The initiative focuses on developing secure, standardized, and FAIR data infrastructures to enable controlled, project-based, and voluntary data transfer within a federated environment. MiCo-BID defines a cross-institution data governance framework integrating data producers, consumers, and governing bodies, and provides shared tools including a unified data catalogue, depersonalization and defacing workflows, annotation environments, and computational pipelines. The project contributes to and extends the open-source Shanoir platform, supporting its integration into a national imaging research ecosystem. Since its kick-off in early 2025, MiCo-BID has coordinated partners, established infrastructure requirements, and progressed on clinical retrospective data pipelines, including DICOMweb de-identification via Karnak and harmonized CHUV–HUG de-identification profiles. A pilot Shanoir instance deployed at UNIGE includes SWITCH edu-ID authentication, cybersecurity auditing, and onboarding of two bilateral Geneva–Lausanne projects (HeartMagic for cardiac MRI and ORBIT for brain MRI). MiCo-BID is working with the Swiss Personalized Health Network (SPHN) to define a national imaging concept for interoperability. Ongoing development includes full de-identification workflows, annotation pipelines, on-premise S3 storage, extended governance design, deployment of a second instance at CHUV, and pilot data exchanges between CHUV and HUG. Overall, MiCo-BID lays the foundation for a replicable, interoperable infrastructure that strengthens multi-institution AI research, enhances reproducibility, and promotes open, harmonized biomedical imaging practices across Switzerland.

M31

Multi-scale investigation of the neuronal basis of epileptic seizures in human

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The unpredictable nature of seizures represents one of the most significant challenges for individuals with epilepsy and their caregivers. While dependable seizure detection and prediction could facilitate on-demand treatment and substantially improve patients' quality of life, achieving this remains a complex challenge. The MicroEPI project, conducted in partnership with the University of Geneva and HUG, provides us with an unprecedented opportunity to record brain activity at the individual neuronal level. Here we present a platform that we are developing to manage the extensive data collected (comprising 48 microwire contacts sampled at 30 kHz alongside stereo-EEG recordings), automate preprocessing and synchronization and support HUG's operational needs. The platform aims to incorporate a web-app for unsupervised co-registration of pre-op/post-op MRI/CT scans and integration with Voxeloc, a GUI designed to help locate intracranial-EEG contact locations. The goal is to provide spike-sorting pipelines designed to automatically identify individual neuronal activity and synchronize LFP with microwire data. Microwire data undergoes a preprocessing pipeline that includes 50Hz comb notch and high-pass filtering, as well as removal of corrupted epochs. Following preprocessing, the cleaned data is processed through various spike-sorting algorithms (such as Kilosort, Spiking Circus, and Tridesclous), optimized using spike-interface. A suite of Application Programming Interfaces (APIs) will also be implemented to make the processed data accessible to external applications. We anticipate generating novel, patient-specific biomarkers for detecting epileptic activity at the microscopic scale, thereby enhancing on-demand therapeutic interventions such as deep-brain stimulation.

M32

Early life swimming as a preventive intervention for cerebral palsy motor dysfunction in a rodent model of cerebral palsy

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Introduction: Cerebral Palsy (CP) involves motor and cognitive impairments caused by early brain insults. Sensorimotor stimulation during early development can reduce brain damage and motor dysfunction. Because the corticospinal tract (CST) organizes within the first two years of life, this period offers a window for interventions that may promote CST reorganization and support sensorimotor recovery. We tested whether early-life swimming (SW) could prevent CP-like deficits in a rodent model.

Methods: Pregnant Wistar rats received LPS (200 mg/kg IP on E18–E19). At P0, pups underwent 20 minutes of anoxia (37°C). From P2–P21, hindlimb movements were restricted for 16 h/day. From P7–P21, animals performed self-initiated repetitive swimming movements in 32°C water, starting at 5 minutes and increasing by 10 minutes/day to reach 30 minutes. Locomotor function, 3D gait kinematics, H-reflex EMG, and resting-state brain functional connectivity (cerebral blood volume changes as an indirect readout of neuronal activity) were assessed at P28.

Results: Gross motor function improved in the CPSW group, with gait deficits mainly preserved in females. CP induced soleus and gastrocnemius sarcopenia, with no SW-related rescue. However, EMG revealed improved frequency-dependent depression deficits after SW. SW reversed CP-induced brain hyperconnectivity, and hindlimb stimulation revealed cortico-thalamic connectivity disruptions in CP that were also reversed by SW.

Conclusions: Early-life swimming prevented locomotor deficits, improved gait kinematics, and reduced CP-induced brain hyperconnectivity. These findings highlight the importance of early diagnosis and early sensorimotor interventions to optimize therapeutic outcomes for individuals with CP.

M33

Bicommunities Disentangle Directed Functional Pathways from BOLD fMRI and Structural Connectivity

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Understanding how brain activity can be explained from the underlying white matter structure remains a central challenge in network neuroscience. Efforts that aim at predicting future functional states (e.g., next fMRI frames) while integrating anatomical constraints typically consider static transition matrices that cannot model time-dependent changes and thus underperform in predicting the activity itself.
Here, we make use and apply a recent approach for community detection in directed graphs, the bicommunity framework, to an undirected population-average structural connectome. While the underlying structure has no direction, the highlighted bicommunities can be directed and will, in that case, have a conjugate bicommunity in the other direction. With that, we evaluate how each transition between fMRI BOLD frames aligns with the bicommunity structure, thus estimating directed pathways of brain communication. Essentially, the approach finds the linear combination of bicommunities that best predicts frame to frame transition. Finally, the model was tested and validated using task and rest fMRI from a subset of participants from the Human Connectome Project.
The average alignment between fMRI transitions and the bicommunity structure shows higher prediction accuracy than with conventional connectome. Furthermore, the highlighted transient patterns are consistent within task conditions, revealing specific patterns of directed brain communication.
We show the potential of bicommunities to identify patterns of recurrent transition in BOLD fMRI. Provided with an undirected graph structure, our approach infers directionality from the activity itself, thus opening up new avenues for the investigation of causal brain communication.

Methods

M34

Late and Early Fusion Graph Neural Network Architectures for Integrative Modeling of Multimodal Brain Connectivity Graphs

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Predicting brain age is critical for understanding neurodevelopment, yet effectively integrating structural and functional data remains challenging. Although anatomical structure constrains functional dynamics, implying intrinsic correlation, their integration captures complementary variance that enhances predictive accuracy beyond unimodal capabilities. We evaluated early versus late fusion strategies in graph neural networks using connectomes derived from diffusion weighted imaging and functional magnetic resonance imaging data. Analyzing 747 subjects from the Philadelphia Neurodevelopmental Cohort across five model backbones, we found that late fusion architectures significantly outperform single-modality and early fusion approaches. Specifically, the graph convolutional network implementing late fusion yielded the most robust performance. Crucially, we observed that distinct modalities require specific architectural designs: structural connectivity favored deep, narrow networks to capture hierarchy, whereas functional connectivity required shallow, high-dimensional configurations. This work establishes late fusion as the superior strategy for integrating heterogeneous brain graphs, underscoring the need for modality-specific optimization to exploit the synergistic potential of multimodal connectomes.

M35

Source-reconstructed EEG graph signal processing: pitfalls and potential workarounds

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Graph signal processing (GSP) is a framework used to study brain structure-function coupling by examining how functional signals vary on the structural connectome (SC). While traditionally applied to fMRI, GSP has recently gained interest with EEG due to its higher temporal resolution. Source activities are reconstructed through electrical source imaging (ESI) and singular value decomposition (SVD) is a common way of summarising them into parcellated time-series. Graph Fourier transform is then applied, leveraging the SC graph Laplacian's eigenvectors. This study investigates two biases in GSP-EEG analyses: the SVD sign ambiguity and the ESI-leakage. First, we proposed and validated on simulations a method to resolve the SVD sign ambiguity and applied it to interictal epileptiform discharges. The cut-off frequencies (i.e., splitting the graph power spectra into two equal parts) computed with and without sign correction were compared. Secondly, simulations were employed to study the effect of leakage on the graph Fourier decomposition: cut-off frequencies from reconstructed time-series were compared to the ground truth, across inverse solutions (exact Low Resolution Electrical Tomography, eLORETA, vs Linear Constraint Minimal Variance, LCMV), conditions (baseline vs spike), and connectomes (structural vs Euclidean distance-based, EC). Findings demonstrate that uncorrected SVD sign ambiguity increases high-frequency content, a bias mitigated by controlling the signs. Conversely, ESI-leakage inflates low-frequency content, especially during high-SNR events. This effect varies across spike localisation, is stronger for eLORETA than LCMV and with the EC compared to SC. These results suggest caution in GSP-EEG analyses and result interpretation, and help guiding pipeline choice.

Methods

M36

GEDAI: realtime EEG denoising based on leadfield filtering in python

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Current electroencephalogram (EEG) denoising methods struggle to remove the complex physiological and environmental artifacts typical of real-world settings, which hinders the isolation of true neural activity and limits the technology's translational potential. We present the Generalized Eigenvalue De-Artifacting Instrument (GEDAI), a novel algorithm for denoising highly contaminated EEG. GEDAI employs leadfield filtering to selectively remove noise and artifacts that diverge from a theoretically defined EEG forward model. This approach offers unique advantages over existing solutions, including: (1) denoising highly corrupted recordings without requiring "clean" reference data; (2) single-step correction of artifactual epochs and bad channels; and (3) unsupervised detection of brain and noise components based on the Signal and Noise Subspace Alignment Index (SENSAI).

In ground-truth simulations with synthetic and empirical EEG contaminated by realistic artifacts (EOG, EMG, and environmental noise), GEDAI consistently outperformed leading denoising techniques based on principal component analysis (ASR) and independent component analysis (ICLabel, MARA). It achieved large effect sizes in challenging scenarios involving simultaneous artifact mixtures, low signal-to-noise ratio (−9 dB), and high temporal contamination (up to 100%). Thanks to its real-time-capable implementation, the Python version of GEDAI may support future applications in real-time brain–computer interfaces (BCIs) and in mobile, out-of-lab dry-electrode EEG recordings.

Methods

M37

PhRUiTS : Phantom Raw-data as an Unconventional Training Set

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We leverage supervised deep learning (DL) to estimate and correct rigid-body motion that corrupts brain Turbo-Spin echo (TSE) MRI scans. Supervised DL for MRI typically requires large training datasets of anatomically specific patient scans, whose availability is tied to clinical workflow. Sharing and publication of such datasets are tightly constrained by ethical and privacy regulations, especially for pathological cases.
We investigated whether a DL model trained exclusively on a phantom dataset (two standard MRI phantoms, fruits, vegetables, and a raw chicken) with simulated rigid-body motion can learn k-space motion physics that transfer to in vivo human brain imaging. To this end, we propose PhRUiTS (PHantom Raw data as an Unconventional Training Set), a pipeline for producing such phantom-based-datasets then feeding it to a DL model for motion-estimation in k-space. Multi-coil 2D TSE phantom scans were acquired on a 3T system and used to synthesize motion-corrupted k-space from simulated rigid-body motion trajectories. Building on our previous work SISMIK (Search-In-Segmented-Motion-Input-in-K-space), we adapt a DL model to TSE acquisitions, estimating slice-wise motion parameters, then reconstructing the images with a NUFFT-based algorithm.
PhRUiTS was evaluated in vivo from brain scans of healthy volunteers performing a choreography-controlled (ChoCo) motion protocol with prescribed head movements. PhRUiTS showed stable training–validation dynamics, and subsequent reconstructed images exhibited qualitatively reduced ghosting and blurring. Results indicate contrast robustness and partial object-independence of the learned k-space motion model.
Because training uses only non-brain phantom k-space data, no patient scans are needed, removing patient-privacy constraints on training and simplifying acquisition.

Methods

M38

Temporal evolution of Neural Codes: The Added Value of a Geometric Approach to Linear Coefficients

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Multivariate decoding analyses have become a cornerstone method in cognitive neuroscience. When applied to time-resolved brain imaging signals, they provide insights into the temporal dynamics of information processing in the brain. In particular, the temporal generalization (TG) method—where a decoder trained at one time point is tested on others—is commonly used to assess the stability of neural representations over time. However, TG performance can be ambiguous: distinct representational dynamics—such as sparse versus distributed activity, or scaling of activity versus recruitment of new units—can yield similar TG matrices. Moreover, even when generalization is strong, underlying neural representations may still be evolving in ways that TG alone fails to reveal. This ambiguity of performance profiles can mask meaningful changes in the geometry of neural representations. In this study, we use controlled simulations to demonstrate how different dynamic processes can produce indistinguishable TG profiles. To resolve these ambiguities, we propose a complementary approach based on the geometry of the learned linear coefficients. Specifically, we quantify the Rotation Angle θ between decision subspaces (with cosine similarity) and the Feature Density \mathbf{\alpha} (capturing whether feature contributions are distributed or sparse). Together, these measures complement TG analyses, revealing how neural representations evolve in space and time. Beyond time-resolved decoding, our approach applies broadly to any linear model, offering a geometric perspective on representational dynamics.

M39

Connectivity-Informed EEG Source Reconstruction via Weighted Connectome Harmonics

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EEG source imaging reconstructs cortical activity to enhance spatial resolution, but most methods assume source independence, thereby neglecting the brain's complex network structure. Connectome Spectrum Electromagnetic Tomography (CSET) addresses this limitation by using structural connectivity (derived from tractography) to guide reconstruction.

While CSET exploits sparsity in connectome harmonics (a compact basis for large-scale dynamics), we observe that dominant activity patterns consistently reside in low-frequency harmonics, which are also most robust to connectome errors. This suggests that sparsity alone is insufficient.

To guide reconstruction toward these stable harmonics, we introduce weighted CSET (wCSET), which incorporates the gap-spectrum—a measure of frequency separation between consecutive harmonics that requires no data beyond standard CSET. Harmonics are weighted using a smoothness prior that emphasizes robust modes: primarily low-frequency modes, but also higher-frequency harmonics supported by large spectral gaps.

We evaluate wCSET in silico by simulating a spike propagating along the structural connectome and computing spatial correlations between reconstructed and true activity. While all methods perform similarly at spike onset (when sources act independently), wCSET achieves the highest correlations during propagation (mean 0.63 vs. 0.47 for CSET and 0.23 for sLORETA).

These results show that wCSET matches traditional methods for isolated source localization and significantly outperforms them when connectivity-driven interactions dominate, enabling the study of large-scale, dynamic network activity. Although in-vivo validation remains necessary, wCSET demonstrates the potential to move source imaging beyond independent sources toward fully connectivity-informed reconstructions.

M40

Cross-species fMRI signature of Locus Coeruleus-driven brain state transitions

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The locus coeruleus (LC) orchestrates arousal, attention, and global brain state transitions through noradrenergic signaling. Computational models suggest that LC-driven modulation facilitates shifts between segregated and integrated configurations, steering the brain between functional states. Despite this key role, the macroscopic fMRI signature of LC activation remains undefined. Using optogenetic fMRI in mice, we discovered a canonical LC-driven BOLD signature showing spatiotemporal patterns of activation. We confirmed this signature under spontaneous LC fluctuations during urethane anesthesia and physiological sleep-wake transitions in rodents, with expression increasing at arousal onset and diminishing during sleep.

To achieve cross-species translation, we mapped mouse LC-signature regions to human homologs and applied spatial regression to human polysomnographic sleep fMRI data. We observed parallel modulation of the LC signature, with increased expression during NREM-to-Wake transitions and decreased expression in the reverse, demonstrating a conserved neuromodulatory dynamic linking noradrenergic activity to global brain state changes across species.

In summary, our work provides a robust translational neuroimaging signature of noradrenergic LC activation, integrating mouse optogenetics with human brain-state regulation and advancing translational neuroscience and clinical applications. This cross-species signature enables bottom-up interpretation of resting-state fMRI variability and individualized brain-state mapping, providing a translational framework for precision brain medicine. The conserved LC-driven wave of brain activity reveals fundamental principles of internal brain-state transitions, supporting future research on neuromodulatory circuit dysfunction in neuropsychiatric and neurodegenerative diseases.

M41

How Photo Editing Shapes Self-Recognition: Neural and Behavioral Correlates in Natural Versus Edited Images

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In an increasingly digitalized world, where people are constantly exposed on social media (SM), self-images are continuously shared, viewed, and edited. Online self-presentation can shape how we see ourselves, creating a gap between our digital and real identities. This project investigates how this gap is reflected in the neural representation of one's own face. A survey was developed and administered to 1,220 individuals to investigate their SM use, selfie behavior, and psychological factors. Appearance anxiety and social approval emerged as key factors leading to facial editing.

Based on these results, a behavioral task was developed with young adults to assess how much of their idealized "digital self" is included in their face representation. Each participant had a natural photograph taken, which was then modified according to predefined criteria reflecting SM beauty standards. The edited and actual face images were used as the two extremes of a face-morphing procedure. Participants were presented with morphed stimuli containing different levels of edited/actual images and asked to judge whether each image represented them, while responses, morphing percentage, and reaction times were recorded. Twenty participants have been tested so far, and the final sample size will be 40.

Next steps involve examining how natural and idealized self-representations are mapped in the brain using an EEG paradigm, allowing us to study whether edited self-images are processed similarly to others' faces or whether they elicit neural responses typically associated with self-recognition. These findings will help in understanding the complex relationship between the ideal, digital, and real self.

M42

Mapping Physiological Signatures of Awareness of Motor Action

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Great progress has been made investigating conscious perceptual awareness by contrasting sensory stimuli with versus without awareness while measuring the accompanying physiology. Much less work has been done to identify the neural signals underlying conscious awareness of motor action, in part due to a lack of paradigms where aware versus unaware motor actions can be directly compared. We developed a task based on a slider puzzle car parking game where very similar moves are performed repeatedly, and we intermittently quizzed participants on awareness of their last move. High density scalp electroencephalography combined with eye metrics revealed several physiological signatures of aware versus unaware moves. These included increased magnitude of motor-volitional signals, such as the pre-movement positivity and frontal midline theta activity, with aware versus unaware moves. We also saw increased perceptual signals, such as the N140, P300, alpha/beta and event-related desynchronization, as well as increased post-move blink rates, with aware moves. Finally, we found that longer-term arousal and attention effects may contribute, based on a progressive decrease in pupil size associated with an increased rate of unaware moves over the course of testing sessions. In summary, contrastive analysis revealed that aware actions have greater volitional and perceptual neural signatures, and are associated with higher arousal/attention states. These findings have practical significance for understanding our ethical responsibility for what we do, and for improving neurological disorders where awareness of action is lost.

M43

Movie features are hierarchically encoded in the dynamics of functional connectivity

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The perception of the external environment relies on a cascade of neural computations in the visual cortex, where stimulus features are represented hierarchically. These features can be extracted through Convolutional neural networks (CNN) from naturalistic stimuli. Neuroimaging studies showed that these are processed along the dorsal and ventral visual streams and linked a gradient of increasing complexity to sequential activations and reorganization of cortical interactions. Spectrally, in the alpha and beta bands, Magnetoencephalography revealed that natural viewing induced a reduction in the amplitude of functional connectivity and a maintenance of topography. However, the impact of specific stimulus features on functional connectivity remains unclear. To address this gap, we acquired MEG data on 12 subjects (5 female) during movie watching and used CNNs to track the dynamics of movie features. Then, we compared the temporal dynamics of CNN layers with changes in functional connectivity in the alpha and beta bands. Our findings show that feature encoding in functional connectivity relates to a complex temporal, spectral, and topological organization. In both bands, increasing stimulus complexity involves a higher number of connections and longer temporal delays between stimulus and the connectivity dynamics. Moreover, as complexity increased, we observed a shift in the involvement of connector hubs from low-level nodes to high-level ones in the visual network. Finally, a spectral dissociation emerged: the alpha band primarily encoded mid-level features, while the beta band encoded higher-level ones.

DATABLITZ

M44

A biophysical mechanism for the temporal dynamics of conscious experience

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Visual decision-making studies have uncovered neural mechanisms underlying the transformation from noisy sensory evidence to detection decisions. Yet it remains unclear at what stage of this transformation conscious experience emerges. Traditional contrastive approaches comparing brain activity for seen versus unseen stimuli yield candidate neural correlates of consciousness. Still, they confound true correlates with prerequisites (e.g., attention) or consequences (e.g., decision-making). To move beyond this limitation, I propose a mechanistic framework linking the temporal dynamics of neural populations to the unfolding of conscious experience, estimated using a duration-reproduction task. Combining subjective reports of detection and duration allows us to separate better the neural bases of conscious experience from decisional processes. Using a biophysical model of excitatory and inhibitory rate-based neurons with synapses that support AMPA, NMDA, and GABA receptors, I will show how biological parameters (e.g., the AMPA/NMDA ratio or top-down feedback) shape subjective reports and simulated cortical activity through temporal integration (or evidence accumulation). To support this framework, I will present new intracranial electrophysiological recordings in humans, revealing convergent dynamics between simulated activity and that observed in late visual areas. This integrative approach clarifies where and when conscious experience arises from sensory processing and how perturbations of cortical dynamics can be associated with perceptual dysfunctions such as hallucinations. I will illustrate this with simulations of ketamine intake and preliminary results from a large online experiment probing false-alarm phenomenology. Ultimately, the model provides a computational sandbox for testable hypotheses that can be related to prominent theories of consciousness.

DATABLITZ

M45

What to expect when you're not attending: Elucidating the role of predictive visual processing in facilitating sustained vigilance

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Humans are often required to remain vigilant during monotonous tasks, yet are also profoundly limited in the duration over which we can effectively sustain our visual attention. This "vigilance decrement" is responsible for a range of catastrophic failures in the real world, including vehicle and aircraft accidents, and medical screening errors. It is therefore imperative to understand how visual perception changes during lapses in sustained attention. Notably, research shows that perceptual processing relies upon prediction, and predictable structure is a characteristic feature of real-world vigilance tasks. However, it remains unknown how predictive processing changes with the vigilance decrement. This project aimed to differentiate between two competing hypotheses. H1-Visual processing deficits during sustained attentional lapses may extend to predictive mechanisms. H2-Alternatively, visual processing may rely more heavily on prediction to compensate for these deficits. We recorded magnetoencephalography (MEG), eye-tracking, and T1-weighted magnetic resonance imaging (MRI) from N=25 healthy human volunteers who completed a novel 1.5-hour vigilance task. In this task, participants monitored a frequency-tagged cloud of predictably moving dots, and used a joystick to report the motion direction of rare "target" events. The results replicated established neural and behavioural markers of the vigilance decrement and predictive coding effects. Further, signatures of predictive processing were strongest when neural markers of sustained attention were weakest. These results support the conclusion that predictive processing compensates for lapses in sustained attention. Thus, when humans become distracted, we perceive the world as we expect it to be, rather than as it is.

T01

Modalities and Metrics of Consciousness: A Bayesian Meta-Analysis of Single-Subject ERP Occurrence

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Diagnosis of disorders of consciousness (DoC) could benefit from neurophysiological measures such as event-related potentials (ERPs). Among these, the N200, mismatch negativity (MNN), P300, and N400 have been repeatedly examined as potential diagnostic markers. Because clinical decisions rely on accurate diagnoses, assessing these ERPs' sensitivity and specificity at the individual level is crucial. Here, we present the first meta-analysis quantifying single-subject ERP effects across auditory and tactile modalities in healthy controls (HC) and patients with DoC.

From 8305 eligible records, 42 studies met inclusion criteria. A Bayesian random-effects model was applied to estimate the likelihood of observing individual ERP effects. In the tactile modality, sufficient data were available only for the P300. The N200 could not always be reliably modelled due to limited data. For the remaining auditory ERPs, the estimated mean probabilities were markedly higher in HC than DoC: MMN (HC 86% vs. DoC 64%), P300 (HC 89% vs. DoC 47%) and N400 (HC 61% vs. DoC 21%). In the tactile P300, corresponding estimates were 64% and 44%. All estimated values had large credible intervals. Furthermore, strong indications of publication bias were present across ERPs and modalities in both groups, limiting the reliability of reported effects. Considerable heterogeneity also emerged, alongside sensitivity to experimental and statistical choices.
Despite these limitations, all modelled ERPs significantly differentiated between HC and DoC groups. These findings underscore the promise but also the current instability of single-subject ERP markers for consciousness assessment.

T02

Aberrant Functional Gradients as a Transdiagnostic Feature Underlying Psychotic Symptoms

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Aims. Schizophrenia (SZ) and bipolar disorder (BPD) share transdiagnostic disruptions in large-scale functional brain networks. This study explores how alterations in cortical functional gradients relate to psychosis phenotypes across diagnostic boundaries, leveraging a cohort comprising SZ, BPD, and healthy controls (HC).
Methods. Resting-state fMRI and clinical data from the UCLA Consortium for Neuropsychiatric Phenomics dataset were preprocessed using the FSL software with functional connectivity matrices generated via the 400-parcel Schaefer atlas. Cortical gradients were extracted through diffusion map embedding and aligned to HC for categorical group comparisons. Concurrently, partial least squares (PLS) analysis delineated dimensional associations between these gradients and symptom severity within the patient cohort, capturing transdiagnostic brain-behavior signatures.
Results. Our analysis identified three principal gradients representing distinct functional axes: visual–somatomotor (Gradient 1), primary sensory–higher-order associative (Gradient 2), and multidemand–exteroceptive (Gradient 3). Group differences emerged with a contraction along Gradient 2, indicating reduced cortical differentiation from primary sensory to associative regions in patients. Additionally, there was an increase of Gradient 3 values within the somatomotor network, reflecting altered somatosensory integration. Dimensional PLS analyses underscored significant disruptions in Gradient 1 correlating with symptom severity, distinguishing SZ from BPD by divergent connectivity patterns in visual and somatomotor cortices.
Conclusion. Psychosis entails a disruption of hierarchical cortical organization and aberrant somatomotor integration. Symptom severity maps onto these gradient perturbations, differentiating SZ and BPD along a neural continuum that transcends conventional diagnostic categories. These findings illuminate a refined neurobiological framework for understanding psychotic disorders through both categorical and dimensional lenses.

T03

Sex-differential functional temporal dynamics of the fusiform gyrus in autism

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Autism is primarily characterized by social-communicative difficulties, and atypical face processing has been the focus of many neuroimaging studies. The fusiform gyrus (FFG), a core region of the face processing network, shows different activation and connectivity in autistic individuals. However, most prior work has focused on static functional properties across the whole FFG, leaving it unclear how its activity and that of its functional subdivisions dynamically reconfigures with the rest of the brain in autistic males and females. Here, we included 286 autistic individuals (208 males) and 228 non-autistic individuals (NAI; 146 males), aged 6–30years. Using a recent extension of a dynamic functional connectivity (dFC) approach (μCAPs) and the FFG as seed region, we derived six μCAPs co-activating with major networks (ventral/dorsal attention, visual central/peripheral, and two default mode network [DMN] subdivisions), each mapping to distinct FFG-subregions. Using connectivity gradient analysis, we validated that derived FFG-subregions align along a posterior-to-anterior axis reflecting a transition from lower-to-higher-level visual processing. A significant sex-by-diagnosis interaction emerged for the DMN-C μCAP, driven by more occurrences in NAI females than males, with no sex difference in autism ($p=0.004$, pFDR=0.025). Follow-up temporal dynamics of this DMN-C μCAP also showed sex-by-diagnosis interactions: non-autistic females had longer dwell time ($p=0.014$) and more frequent transitions from baseline ($p=0.004$, pFDR=0.028), effects absent in autism. 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 when examining brain dynamics in autism.

TRAVEL GRANT

T04

Structural and Functional Connectivity Correlates of Clinical Response to Electroconvulsive Therapy in Major Depressive Disorder

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Electroconvulsive therapy (ECT), the most effective treatment for severe major depressive disorder (MDD), induces widespread neuroplasticity. Yet, the precise structural and functional pathways underlying symptom improvement remain unclear. This study examined how ECT alters white matter and functional connectivity (FC), as well as how these changes relate to symptom reduction.
Patients with MDD underwent diffusion tensor imaging (DTI; n = 23, mean age = 40.5 ± 13.2 years), resting-state fMRI (rsfMRI; n = 20, mean age = 38.3 ± 11.4 years), and clinical assessments before and after ECT. We analyzed the cingulum, which mediates fronto-limbic communication and emotion regulation, and the corpus callosum, which supports interhemispheric integration. Previous research indicates that both areas are implicated in depression and response to ECT.
Exploratory Pearson correlation analyses showed that greater decreases in cingulum mean diffusivity (MD) were associated with larger reductions in Hamilton Depression Rating Scale (HAMD) scores, suggesting that microstructural reorganization accompanies symptom reduction. Among responders, defined as over 50% HAMD improvement (n = 13), increased callosal fractional anisotropy (FA) indicated enhanced interhemispheric integrity post-treatment. Examining rsfMRI revealed that inter-network FC changes between sensory, cerebellar, salience, and memory networks correlated with improvements across clinical scales. Particularly high associations were seen with the Concise Health Risk Tracking Scale (CHRT), implying that reductions in suicidality coincide with adaptive changes within these circuits.
These findings identify important structural and functional correlates of ECT response. Ultimately, microstructural remodeling and restored functional connectivity appear to underlie the processes supporting clinical recovery in depression.

T05

The association of gray matter structure with early life adversities in social anxiety disorder

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The association of early life adversities (ELA) and the development of social anxiety disorder (SAD) or other psychiatric disorders is a well-documented fact. Thus, ELA represent a risk factor for the occurrence of SAD. Additionally, it was demonstrated that ELA also moderate the fMRI correlates of SAD during confrontation with social threat and at rest. It is unclarified, though, if brain structure also reflects this moderation by ELA. In the present voxel-base morphometry (VBM) study (N=103), we observed an interaction of SAD and ELA in the left amygdala. While healthy controls with high ELA and individuals with SAD and low ELA exhibited increased gray matter density (GMD), GMD was comparable to low ELA controls in high ELA individuals with SAD. These results show that ELA moderate the neural correlates of SAD at the structural level analogously to the functional level. While this might help to understand inconsistencies among studies on the structural correlates of SAD and stresses the need to consider ELA as potential confounder in this area of research, it also represents a starting point for further research into the nature of the observed interaction.

T06

Dynamic brain network states during fMRI neurofeedback in chronic tinnitus: Insights from a multi-seed CAP analysis

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Chronic tinnitus manifests as a phantom auditory percept, often accompanied with distress. Currently, neural dynamics underlying treatment response remain unclear. Using a longitudinal data set from a fMRI neurofeedback (NF) trial targeting bilateral auditory downregulation in 21 patients with tinnitus (NCT05737888), we investigated transient co-activation patterns (CAPs) as potential markers of neural modulation and clinical change across the NF training. Group CAPs (gCAPs) were generated from five seeds (right planum temporale, bilateral parietal operculum 3, and bilateral auditory cortices) across NF and transfer runs. We also implemented a scalable python-based CAP pipeline with temporal thresholding, k-means clustering, and gCAPs generation able to process large input data. Across ROIs, gCAPs reproduced combinations of canonical attention, salience, and sensorimotor Yeo7 networks, showing longer, more stable states, and reduced transitions during NF, particularly in auditory and opercular regions. Preliminary clinical correlations indicate that baseline gCAP metrics from PTr and OP3r were associated with tinnitus handicap (THI), anxiety (STAI-Y1), and depression (BDI). In contrast, several auditory-seed gCAP metrics at early post-assessment correlated with STAI-Y2 and sleep quality (PSQI) after the intervention. Average gCAP duration and resilience best tracked symptom changes across different k, while entries were consistently baseline-predictive for BDI, THI, and WHODAS, across multiple ROIs. These results demonstrate the feasibility of multi-ROI CAP analysis in task-based NF and support the relevance of dynamic network measures for characterizing therapeutic engagement. Further analyses will test predictive relationships between baseline CAP profiles and long-term clinical improvement, advancing the identification of network-level biomarkers in NF for tinnitus.

T07

Interictal Neuronal Signatures in Epilepsy: Exploring Single-Unit Activity and the HFA–MUA Relationship

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Epilepsy affects over 50 million people worldwide, yet the neuronal mechanisms underlying seizure generation remain in large part a mystery. Although modern neurophysiological techniques permit single-unit recordings in humans, the unpredictable nature of seizures makes capturing them consistently challenging. Interictal epileptiform discharges (IEDs), which occur more frequently, may offer a window into neuronal activity patterns related to seizure initiation.

In this study, we analyzed interictal periods containing marked IEDs to develop single-unit activity profiles to later be compared to neuronal dynamics observed at seizure onset. We further evaluated whether high-frequency activity (HFA) can serve as a surrogate measure of multi-unit activity (MUA) across different brain states, given that microelectrode recordings remain relatively uncommon. Data were obtained from patients undergoing continuous intracranial EEG monitoring combined with either Utah Arrays or hybrid stereo-electrodes containing tetrodes, and spike sorting was performed to extract single-unit activity.

Preliminary observations suggest distinct patterns of firing rate change in single units from baseline activity, as well as a significantly positive correlation between HFA and MUA, confirming HFA reliably reflects spiking activity across states. These findings, together with ongoing comparisons to seizure-onset activity, may help identify reproducible neuronal signatures that contribute to the development of reliable biomarkers for seizure detection.

Clinical Neuroscience

T08

Claustrum Microstructure and Laterality in Preterm and Full-Term Infants: Insights from Neonatal MRI

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Claustrum is a densely connected grey-matter structure implicated in salience-guided attention and cognitive control, yet its neonatal development remains poorly characterised. This study investigates hemispheric asymmetries, preterm–full-term (PT–FT) differences at term-equivalent age, and longitudinal maturation in preterm infants.

An average claustrum mask derived from manually delineated neonatal labels was applied to left and right hemispheres in 17 FT infants scanned at term-equivalent age and in 47/30 PT infants scanned at 33 and 40 weeks postmenstrual age; 17 PT infants contributed longitudinal data. Microstructural indices included FA, MD, RD, AD, MK, RK, AK, and intra- and extra-axonal measures. Linear mixed-effects models tested hemispheric asymmetry, PT–FT differences at 40 weeks, and longitudinal change in PT infants.

At 40 weeks, both FT and PT infants showed a significant leftward claustrum volume asymmetry, while PT infants at 33 weeks showed no hemispheric difference. Microstructural asymmetry was limited to small effects in isolated metrics and did not form a consistent pattern. After FDR correction, no significant PT–FT differences in claustrum volume or microstructural measures were detected at term-equivalent age. Longitudinally, PT infants showed clear maturation between 33 and 40 weeks, including increased volume, higher FA, and decreased diffusivity.

By term-equivalent age, infants show a reliable leftward claustrum volume asymmetry. Although PT–FT differences were not detected at this age, PT infants displayed marked volumetric and microstructural maturation across the 33–40 week interval. These findings provide initial reference data for early claustrum development in both preterm and full-term infants at term age.

T09

Brain dysconnectivity and cognitive impairment in early psychosis

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Cognitive deficits are a core feature of psychosis and are a key factor in poor prognosis. Although white matter microstructural abnormalities have been consistently linked to cognitive impairment in chronic schizophrenia, far less is known about how these relationships manifest in the early stages of illness. Generalized fractional anisotropy (gFA) derived from diffusion spectrum imaging (DSI) provides a measure of white matter microstructural integrity. Alterations in gFA in early psychosis patients have been reported and may underlie early cognitive deficits. In the present study, 98 early psychosis patients from the Treatment and Early Intervention in Psychosis Program in Lausanne, Switzerland, and 112 healthy controls underwent DSI and neuropsychological assessment. We analyzed gFA using voxel-based and tract-based network approaches to characterize white matter microscturcture changes from both spatial and connectivity perspectives and examined their associations with cognitive performance. Among cognitive domains, processing speed measured with the digit symbol coding emerged as the most impaired in EPP. Voxel-based analysis showed significantly lower gFA in patients compared to controls. Processing speed was associated with widespread gFA reductions in the full sample, however this association was not significant in the patient-only group. Network-based analyses showed reduced gFA within rich-club connections in patients; the correlation between tract-averaged gFA in these edges and processing speed showed a non-significant trend. Analyses considering subgroups and potential covariates, including cannabis use, are underway. These findings suggest that alterations in white matter microstructure may contribute to early cognitive deficits in psychosis, although to a lesser extent than in chronic schizophrenia.

T10

Hierarchical large-scale brain organization changes in early psychosis: evidence from the HCP-EP cohort

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Schizophrenia is marked by disruptions in large-scale functional connectivity, which can be quantified using functional gradient analysis of resting-state fMRI. Prior work on gradients in schizophrenia has predominantly focused on neocortical networks, overlooking cortico–subcortical loops that are crucial for its pathophysiology. Here, we analyzed resting-state fMRI data from 25 healthy controls and 52 patients with non-affective schizophrenia from the HCP-EP cohort. Results revealed two parallel gradients. In parallel with the canonical principal cortical gradient spanning from sensorimotor cortex to the default mode network, we observed a principal subcortical gradient extending from the putamen to the rest of the anterior hippocampus. Group comparisons of gradient values showed significantly decreased values in default mode and visual regions, as well as in the hippocampus, pallium, and caudate; and increased values in the postcentral gyrus and the orbitofrontal cortex. In addition, we defined between-network dispersion as the difference between the mean gradient values of two networks. Relative to controls, individuals with non-affective schizophrenia showed significantly increased dispersion between visual and default mode networks ($z=3.314$, $p=0.002$) and decreased dispersion between somatomotor and default mode networks ($z=-6.231$, $p<0.001$). Cortex–subcortex dispersion inflated in patients with non-affective schizophrenia ($z=4.166$, $p<0.001$), particularly in the hippocampus ($z=2.057$, $p<0.040$). Together, these findings suggest that schizophrenia involves a coordinated reconfiguration of parallel cortical and subcortical functional hierarchies, with selective vulnerability of hippocampal- and default mode–centered circuits.

T11

A Random Forest Classifier Reveals a Multimodal, Transdiagnostic Signature of Emotion Dysregulation Vulnerability Across Patients, Offspring, and Controls

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Emotion dysregulation (ED) is a core transdiagnostic feature of several psychiatric disorders, including borderline personality disorder, bipolar disorder, and attention-deficit/hyperactivity disorder. These ED disorders (EDD) exhibit overlapping clinical presentations and shared heritability. This study used a transdiagnostic framework to identify early and multimodal markers of vulnerability, particularly in high-risk populations such as the offspring of EDD patients (EDDoff). A total of 237 participants (97 EDD patients, 67 EDD-off, 73 healthy controls) completed a multimodal assessment that included clinical evaluations, diffusion and functional MRI, and immune and neurotrophic serum biomarkers. Dimensionality reduction was performed using principal component analysis (PCA), and random forest (RF) models were trained for group classification and symptoms prediction. PCA on the full multimodal dataset yielded eight components, two of which significantly differed between groups. One component reflected high ED and altered hippocampal dynamic functional connectivity (dFC), for which EDDoff showed an intermediate phenotype. Another component was driven by systemic inflammation and was increased in EDD patients only. Modality-specific PCA identified significant inter-modality correlations, including reduced white matter integrity with increasing immune dysregulation, and positive correlations between hippocampal dFC and both ED symptoms and inflammation ($p=<.01$ for all correlations). An RF classifier accurately distinguished controls from EDD/EDDoff individuals (85.7% accuracy), based on a 70/30 train/test split validated with out-of-bag estimates. Multimodal non-clinical features reliably predicted ED symptoms ($p<.01$). We identified a specific, clinically relevant, transdiagnostic and multimodal signature of vulnerability to ED, spanning clinical, neural, and immune systems. This multimodal profile may inform future early intervention strategies targeting at-risk populations.

T12

Circadian preference relates to structural variation of the central circadian regulator in bipolar disorder

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Disruptions in the circadian system represent a key pathogenic pathway in bipolar disorder (BD). The suprachiasmatic nucleus (SCN), the brain's master circadian pacemaker, exhibits volumetric variations that may reflect integrity of circadian regulation. Prior studies report inconsistent SCN volumetry in BD compared to other mood disorders, rarely examining potential modifiers including chronotype. We hypothesized that SCN structure specifically associates with BD, rather than with affective disorders generally, and that chronotype moderates this distinction. We analyzed T1-weighted neuroimaging data from the UK Biobank in individuals with BD (N=120), age-/sex-matched major depressive disorder (N=205), psychotic disorder (N=95), and healthy controls (N=200). The anterior-inferior hypothalamic segment containing the SCN was segmented using a fully automated FreeSurfer pipeline, and its volume was calculated. ANOVA tested diagnosis × chronotype ("Morning"/"Evening"/"Other") interactions on volume, accounting for total intracranial volume, age, sex, and handedness. Specificity was evaluated in four additional hypothalamic segments (anterior-superior, tubular-inferior, tubular-superior, posterior). Post-hoc multiple-comparisons-corrected estimated marginal means testing explored interactions. Chronotype interacted with diagnosis of the anterior-inferior hypothalamic segment volume in BD, but not in the other groups ($F(6)=2.853$, $p=.0095$). Within BD, evening-types had larger volumes than morning-types ($t(591)=3.225$, $p=.0038$). No other significant contrasts for no other groups/segments emerged. In evening-chronotype BD, the SCN-containing hypothalamic segment is enlarged compared to morning-types, a pattern absent in other diagnoses. This specificity implicates circadian mechanisms prominently to this BD presentation. Though clinical implications remain unclear, these findings motivate chronotype assessment to tailor circadian-targeted interventions.

T13

Emotion components and fMRI: a video game paradigm testing anticipation and outcome of loss and reward

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Neuroscience approaches to the study of emotions have flourished since the advent of neuroimaging techniques, with focus shifting from a one-to-one mapping in the brain, or emotion-specific areas, to networks and systems of emotion behavior. Appraisal theories of emotion support this shift to multi-componential approaches, and argue that emotions are not given by intrinsic features of stimuli or events, but by the interaction between emotion components. According to this framework, changes in motivational, expressive, physiological and subjective components are driven by the cognitive component, i.e. appraisal of stimuli.

Drawing inspiration from appraisal models of emotion causation, we use fMRI and an interactive, first-person perspective video game task manipulating expectation, uncertainty and goal congruence appraisals to link in-game events with brain activity and subjective feelings ratings in healthy participants.

We show that manipulating expectation and uncertainty appraisals significantly influences self-reported emotion ratings, indicating that emotional preferences are condition-dependent. Preliminary imaging results will be presented.

<u>T14</u>

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

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Curiosity is a fundamental driver of human behaviour, motivated by the desire of reducing ignorance and uncertainty. Researchers have distinguished two types of curiosity: instrumental curiosity (IC), which involves exploring the environment to learn its rules, and non-instrumental curiosity (NIC), which refers to the spontaneous seeking of epistemic knowledge in the absence of clear utility. However, cognitive neuroscience research on curiosity is still scarce. We developed a novel cognitive task that jointly models reward, IC and NIC, allowing us to study for the first time the neural networks supporting these behaviours, within the same subjects. We combined computational modelling and high-resolution 7T to investigate the neurocomputational mechanisms of curiosity in a sample of 50 healthy participants. We found that both reward, IC and NIC are supported by a shared brain network, characterised by an anterior-to-posterior reward-relevance gradient in the anterior cingulate cortex. Then, we developed a novel two-branch Hierarchical Gaussian Filter to disentangle reward and information prediction errors (PEs) and investigate their neural underpinnings. Reward PEs were encoded in a striatal-ventral prefrontal network, whereas information PEs were encoded by a large higher-order frontal-parietal network, implicated in integrating current outcomes and the represented structure of the task. Altogether, our findings provide evidence that learning to exploit and learning to explore are two separate functions supported by distinct brain networks.

T15

Emotion without motion: comparing brain activity between vocalized and subvocalized emotional words

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Can we express our emotions in our head? Our ability to subvocalize, i.e., to “imagine” ourselves speaking, suggests the existence of embodied representations of speech, including its emotional aspects. In the sparse neuroscientific literature on vocal emotion production, emotions, the relationship between emotional representation and emotional expression is not always clear. The present study aimed to investigate this relationship by assessing common networks between vocalized and subvocalized emotions. Twenty-five participants were asked to produce pseudo-words under these two productions conditions (vocalized: pronouncing the word out loud with the appropriate prosody; subvocalized: simply imagining the production of the word and prosody) across three emotional conditions (Happy, Angry, Neutral). Conjunction analyses of brain activity revealed common activation for vocalized and subvocalized emotions (Happy and Angry), including motor, pre-motor, and sensory areas, anterior cingulate, and right insula. In the Neutral condition, however, vocalized and subvocalized only showed common activity in the left premotor cortex. Post-hoc functional connectivity analyses further confirmed the involvement of motor, emotional, and mentalizing networks in subvocalized emotions. These results highlight our ability to represent emotional expression even without speaking, in line with a theoretical view of the embodiment of emotional prosody.

<u>T16</u>

Pharmacological Modification of REM Sleep: Impact on Risk-Taking

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Rapid eye movement (REM) sleep has long been associated with emotional regulation, reward processing, and decision-making. However, its role in shaping risk-taking behavior remains poorly understood. In this study, we combined pharmacological manipulation of REM sleep with functional neuroimaging to examine how modulating REM affects risk-related choices and their neural underpinnings. Nineteen healthy participants completed a within-subject design with two sessions: administration of reboxetine, a selective norepinephrine reuptake inhibitor known to reduce REM sleep, and a placebo. Each session was followed by a night of sleep, after which participants performed the Balloon Analogue Risk Task (BART) while undergoing functional magnetic resonance imaging (fMRI). During this task, participants inflate virtual balloons to earn rewards, with the risk that the balloon may burst and forfeit the earnings. Behaviorally, participants in the reboxetine condition exhibited reduced risk-taking compared to the placebo condition, suggesting that REM suppression biases decision-making toward more cautious strategies. At the brain level, this effect was accompanied by increased activation in regions involved in emotional evaluation, including the insula and medial cingulate cortex. Together, these findings provide converging evidence that REM sleep contributes to the calibration of risk-taking behavior, potentially through the regulation of emotion-related brain networks. This work highlights a mechanistic link between sleep physiology, affective processing, and decision-making.

T17

Mapping odor-elicited feelings in the human brain: fMRI evidence from 101 participants and 50 everyday odors

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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. This study explored the neural correlates of specific emotion categories typically reported during odor perception. We investigated how the brain represents multidimensional olfactory feelings, as defined by 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 each GEOS dimension is associated with distinct and discriminable neural patterns, thereby enabling a finer characterization of the brain networks involved in odor-elicited feelings beyond hedonic processing only. Data collection is now complete, with 101 healthy adults who were exposed to 50 everyday odors spanning a range of olfactory properties while their brain activity was recorded using functional Magnetic Resonance Imaging (fMRI). During scanning, participants rated each odor along the GEOS dimensions, providing trial-level measures of elicited feelings. First, as a sanity check, we assessed whether we replicated classical olfactory activations, using a standard univariate pipeline. Then for each dimension, we computed univariate parametric general linear model, to test which voxels exhibited BOLD responses that scaled proportionally with participants' trial-level subjective ratings, capturing both positive and negative correlations. This approach enabled the localization of brain regions sensitive to the intensity of specific odor-elicited feelings beyond simple hedonic valence. Finally, we explored whether neural responses to each emotional dimension were segregated or overlapping across brain regions.

DATABLITZ

T18

A music-reward localizer: using fMRI to identify neural responses to musical pleasure

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Pleasurable music engages the brain's reward network, offering a unique window into the neural basis of abstract reward and its therapeutic potential. Yet the field lacks a validated fMRI localizer that can reliably identify music reward-related regions within individual participants, a gap which limits the development of objective biomarkers for music-based interventions. We developed and tested an fMRI localizer designed to isolate neural activity associated with musical pleasure. Twenty participants underwent fMRI while listening to self-selected pleasurable vs. emotionally neutral researcher-selected elevator musical excerpts. Behavioral ratings of pleasure and physiological measures (electrodermal activity and heart rate) were collected concurrently. Significant activation was observed bilaterally in the ventral striatum and the midbrain (substantia nigra/ventral tegmental area), as well as the superior and inferior temporal gyri and insula, for pleasurable compared with neutral music, surviving small-volume FWE ($p < 0.05$). In the reverse contrast (elevator > reward music), we observed increased activity in the ventromedial prefrontal cortex, a core hub of the default mode network, which suggests the presence of mind-wandering during neutral music. This localizer identifies neural activity within key regions of the reward and dopaminergic network implicated in musical pleasure, providing a foundation for developing biomarkers of music- and reward-related brain function relevant to both basic research and music-based clinical interventions.

T19

Hierarchical neural adaptation supports flexible speech perception across rates

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Human listeners can understand speech presented faster than natural conversational rates, revealing powerful adaptation to atypical temporal structures (Dupoux & Green, 1997). Although behavioural responses show this flexibility, the underlying neural mechanisms of adaptation remain unclear. A central question addressed here is whether, when presented with speech at different rates, the brain uses an adaptive (rate-specific) or a fixed (rate-invariant) processing mechanism to encode the speech envelope. To adjudicate, we analysed local neural activity from 15 participants (MEG) and 11 patients (sEEG) listening to speech (podcasts, isolated sentences) presented at Slow, Normal, and Fast speech rates (2.5–9 syll/s). We implemented a structured training–testing procedure in which three separate neural encoding models were independently trained on one of these three speech rate conditions (Slow, Normal, Fast), and subsequently tested in all three conditions. By systematically comparing model performance (reconstruction accuracy) for same or different speech-rate conditions (within-condition vs cross-condition generalisation), we can determine whether neural encoding of the speech envelope is sensitive to temporal structure of each speech rate or whether neural encoding uses fixed, rate-invariant encoding mechanisms observed previously.

We find hierarchical adaptation: early auditory regions show rate-invariant neural encoding, whereas higher-order areas more distant from auditory cortex show rate-adaptive neural encoding. This adaptation is indexed by reduced cross-rate generalisation, systematic shifts in the latency of peak encoding weights, and greater cross-rate dissimilarity of model weights in temporal, parietal and frontal regions. These findings show the hierarchical cortical dynamics underlying speech rate adaptation in human listeners.

TRAVEL GRANT

T20

Single word conceptual specificity, not phrasal composition, drives anterior temporal lobe during semantic processing: evidence from combined EEG/MEG

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A foundational challenge in semantic cognition, language and their impairments, such as Semantic Dementia (SD), is reconciling the neural basis of semantic memory (retrieving single word meaning) and semantic composition (constructing meaning from word sequences). Both literatures consistently implicate the anterior temporal lobe (ATL), the region most impacted in SD. Inspired by neurocomputational models proposing a unified semantic "hub", we investigated whether deriving meaning from single words (e.g., owl) and adjective-noun phrases (e.g., nocturnal bird) relies on common neurocomputational principles, focusing on the role of conceptual specificity. We recorded concurrent MEG and EEG data from 36 participants using a novel parametric design that manipulated conceptual specificity across three levels: low (bird), mid (nocturnal bird), and high (owl). Source analyses revealed a non-linear, step-like response in bilateral ATLs (400-520 ms post noun onset) and bilateral inferior frontal cortices (IFC) (430-630 ms). Specifically, activity was significantly elevated for high-specificity single words compared to both low-specificity words and mid-specificity phrases. Thus, while the ATL provides a unified hub function, our data suggests that the highest resource cost for the ATL hub is the fine-grained resolution and individuation of a highly specific concept from competing representations, not the compositional construction of a concept of "intermediate" specificity. Intriguingly, SD patients show deterioration of specific concepts earliest in the progression of the disease. Our findings provide a new perspective on explaining the clinical pathology of SD: the highest computational cost is placed on the system by the concepts lost earliest in the disease.

T21

Anchoring Emotional Memory in Time and Space

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Episodic memory allows individuals to retrieve past experiences along with their spatial, temporal, and emotional characteristics. The hippocampus plays a key role in binding these elements by generating multidimensional cognitive maps that integrate where and when events occur. A functional gradient along the hippocampus' axis may support this process, with its posterior portion encoding events that are closer in time and space, and anterior portion representing events that are farther away in time and space. However, it remains unclear whether spatial and temporal distances rely on overlapping neural mechanisms, and whether/how emotional relevance interacts with spatio-temporal maps of memory events.

In this study, participants navigated an immersive virtual reality environment across three weekly encoding sessions, incidentally encountering goal-relevant (emotional) and goal-irrelevant events. Behaviorally, participants remembered goal-relevant events with greater spatial and temporal precision than goal-irrelevant ones, indicating that emotional relevance enhanced the spatio-temporal resolution of memory representations.

Neuroimaging results revealed distinct representational mechanisms across the hippocampal formation, with goal relevance amplifying these neural distinctions. These results suggest that goal relevance strengthens the neural encoding of both spatial and temporal dimensions of episodic memory.

DATABLITZ

T22

Sensory-motor rhythms and prospective action planning: Neural signatures of motor anticipation and their behavioural relevance

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Sensory-motor rhythms (SMR, 13-17Hz) over the motor cortex have been linked to motor processing and memory-guided action anticipation. Decreases in SMR have been associated with selection and prospective planning of an upcoming action. Traditionally, findings of memory-guided action planning in healthy adults are based on correlational evidence from EEG. Therefore, it remains unclear whether the desynchronized SMR detected in EEG are causally related to behaviour in memory-guided action planning.

I will first present data on how internal motor representations are reinstated after task-relevant visuomotor distraction. These results of SMR desynchronisation indicate that working memory representations of planned actions are rapidly reselected, highlighting the dynamic and proactive nature of action preparation. Building on this, I will present our project aiming to causally link SMR activity in the primary motor cortex (M1) during memory-guided action planning with behavioural performance. Using an online repetitive transcranial magnetic stimulation protocol, we applied 13-Hz stimulation to M1 during initial action-selection to supposedly disrupt SMR-related processes. Contrary to our hypothesis, the stimulation did not produce changes in behavioural performance. This null result suggests either that 13-Hz SMR activity in M1 is not essential for the selection of actions maintained in working memory, or that the applied stimulation parameters were insufficient to modulate the relevant neural processes.

Overall, our findings do not provide evidence for a causal link between SMR activity and action planning. This challenges theories on SMR desynchronization in prospective action planning and underscores the need to identify precise cortical generators and mechanisms underlying SMR-related signals.

T23

Abstract integration of sensory information during flexible perceptual decisions in humans

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Human perceptual decisions show a remarkable adaptability to context, but are typically studied in conditions that require limited flexibility. Here, by studying decisions based on combinations of visual features across multiple objects, we show that human decision flexibility is supported not only by the selection of sensory features, but also by their combination and abstraction during integration. Neuromagnetic activity patterns reflect a hierarchy of object representations that grow increasingly abstract and gated as a function of decision relevance. A single neural trajectory – shared across all contexts – supports the projection of successive objects on the decision axis prior to their integration. Artificial neural networks trained to perform accurate decisions under human-like noise levels converge on similar computations. Together, these results provide a neurocomputational account of the high flexibility of human perceptual decisions.

DATABLITZ

T24

Higher-order and distributed synergistic functional interactions encode information gain in goal-directed learning

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Goal-directed learning arises from distributed neural circuits including the prefrontal, posterior parietal and temporal cortices. However, the role of cortico-cortical functional interactions remains unclear.
To address this question, we integrated information dynamics analysis with magnetoencephalography to investigate the encoding of learning signals through neural interactions.
Our findings revealed that information gain (the reduction in uncertainty about the causal relationship between actions and outcomes) is represented over the visual, parietal, lateral prefrontal and ventromedial/orbital prefrontal cortices. Cortico-cortical interactions encoded information gain synergistically at the level of pairwise and higher-order relations, such as triplets and quadruplets.
Higher-order synergistic interactions were characterized by long-range relationships centered in the ventromedial and orbitofrontal cortices, which served as key receivers in the broadcast of information gain across cortical circuits.
Overall, our results provide evidence that information gain is encoded through synergistic and higher-order functional interactions and is broadcast to prefrontal reward circuits.

T25

EEG-based neurofeedback for visuospatial attention: protocol, feasibility, and preliminary findings

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Visuospatial attention deficits, particularly hemispatial neglect, represent a critical target for functional recovery after stroke. Neurofeedback (NFB) offers a compelling perspective as an intervention, enabling individuals to progressively modulate their own brain activity with potential for generalized cognitive rehabilitation. Yet implementing NFB, and even more so combining it with fMRI, raises substantial experimental and technical challenges, particularly concerning real-time artifact correction to ensure signal fidelity. This project aims to characterize the behavioral benefits of alpha-based NFB training and to identify the neural correlates of successful regulation, with the long-term goal of refining future NFB protocols for clinical rehabilitation.

Our experimental design consists of four EEG neurofeedback sessions (≈20 min each), in which participants learn to modulate occipito-parietal alpha activity to shift visuospatial attention. Pre–post assessments include a Posner task and visual search paradigms to quantify attentional performance. The fourth training session is performed concurrently with fMRI acquisition, allowing us to examine whole-brain activation patterns associated with effective regulation. This simultaneous EEG–fMRI setup requires advanced signal preprocessing and artifact suppression during NFB regulation, constituting an essential methodological step for reliable neurophysiological interpretation.

Preliminary results from the first participants support the feasibility of the protocol. We observe voluntary modulation of alpha oscillations during training, successful validation of EEG correction pipelines inside the MRI environment, and early behavioral indications of attentional enhancement in some task components. These initial findings justify further neurobehavioral and neuroimaging analyses, paving the way toward optimized NFB-based rehabilitation strategies for hemispatial neglect.

T26

Probing the dynamics of episodic memory format

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Sequential semantic memories, such as the order of meaningful events, actions, or concepts, are fundamental to learning and recalling structured knowledge. Yet the neural mechanisms by which such sequences are encoded, linked across modalities, and later reactivated remain poorly understood. In this study, participants learned short sequences of words and images that conveyed the same meanings but differed in sensory form, while their neural activity was recorded with magnetoencephalography (MEG). We asked (i) how the brain encodes sequences of stimuli across modalities, (ii) whether semantic representations can be decoded across word–image pairs, and (iii) how these representations are reactivated, both when triggered by external cues and spontaneously during resting periods. Using cross-modal decoding, we identified common representations between words and images with matched meaning. We then examined both externally triggered and spontaneous reactivations of these representations, with a focus on how they reflect the sequential structure of the learned material. In particular, we asked whether reactivation of one item increasingly tends to elicit reactivation of its neighboring sequence elements, and whether this co-reactivation strengthens and unfolds in sequence as learning progresses. These preliminary results provide initial insights into how semantic knowledge is encoded, linked, and replayed during sequence learning.

Methods

T27

Hemodynamic Network Activity of Response Inhibition

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Response inhibition plays a vital role in everyday behaviour: e.g., by preventing us from eating freshly baked cookies. There is a large body of research indicating that transient response inhibition is related to (right) inferior frontal cortex ((r)IFC) and pre-supplementary motor area (pre-SMA) activity. In contrast, research on the neural basis of sustained response inhibition is sparse, connecting inhibitory processing to motor cortex (M1) deactivation. Hereby, it is not clear if (r)IFC and pre-SMA activity also relate to sustained motor inhibition. To address this, we recruited 30 individuals and recorded their neural hemodynamics while performing a motor sequence task in a GO- and NO-GO-condition, and a control task where targets had to be identified in a sequence of four symbols, using functional near-infrared spectroscopy. We expected an increased activity in the rIFC and the pre-SMA; and a reduced activity in M1 in the NO-GO condition compared to the GO-condition and the control task. We found increased oxygenated hemoglobin concentrations in the rIFC in the NO-GO condition compared to the control task – and in the left IFC. Additionally, there was an increased M1 activity in the GO-compared to the NO-GO condition as a function of decreased deoxygenated hemoglobin concentrations contralateral to the executing hand. But M1 was also activated in the NO-GO condition. We did not find conditional differences in pre-SMA activity; but an unexpected increased activity in the left dorsolateral prefrontal cortex in the NO-GO-condition. These results indicated similar network activity in both transient and sustained response inhibition.

T28

Disruptions in Whole-Brain MRSI Metabolic Similarity Reveal Network Biomarkers in Psychosis Risk

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Standard MRI captures structure and blood-flow correlates but often misses early metabolic changes in psychiatric and neurological diseases. We augment connectomics with whole-brain 3D H-MR spectroscopic imaging (MRSI), quantifying tNAA, tCr, Glx, Cho, and Ins to build an individual metabolic connectome that links brain parcels by similarity of their five-metabolite profiles. At-risk participants (Lausanne cohort, n=21, 16-33 y) and 13 matched controls underwent 20-min 3T H-FID-MRSI (5 mm isotropic), reconstructed with compressed-sensing. An independent healthy cohort (Geneva; N=51, 13-15 y) assessed reproducibility. Brains were parcellated into 210 gray-matter regions. For each subject, median metabolite levels per parcel were z-scored, pairwise Spearman correlations yielded a Metabolic Similarity Matrix (MetSiM), and principal components defined a dominant metabolic similarity mode (MS-mode). Two principal paths summarized MS-mode organization obtained via optimizing the tradeoff between local metabolic similarity and global metabolic diversity. Group differences used permutation testing and effect sizes; regional deviations were linked back to metabolite levels. MetSiMs were stable within subjects and consistent across cohorts. The leading MS-mode formed a caudo-rostral gradient spanning cortex, subcortex, brainstem, and cerebellum. Metabolic similarity aligned weakly with tractography ($r=0.10$, $p<0.001$) but more strongly with cytoarchitecture ($r=0.26$, $p<0.001$) and gene co-expression ($r=0.34$, $p<0.001$), implicating cellular and molecular organization. At-risk participants showed reduced MS-mode monotonicity along metabolism-constrained principal paths; focal effects traced to tNAA, Cho and Glx in metabolic hub-rich regions. Whole-brain metabolic connectomics is feasible in vivo, complements structural measures, and yields principal-path biomarkers of psychosis risk grounded in raw metabolites.

T29

Assessing Signal Consistency After Upgrading from Siemens 3T Prisma to CIMA.X

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Hardware and software upgrades in MRI systems can alter image quality, stability, and signal characteristics, potentially affecting longitudinal analyses and the integration of pre- and post-upgrade datasets. After the recent transition of the Siemens 3T MRI system at the University Hospital of Geneva from the Prisma to the CIMA.X platform (clinical and research use), this project characterizes signal and sequence-dependent differences between scanners due to hardware and software changes, to assess whether longitudinal studies can be reliably continued across the upgrade and whether previously acquired data remain usable.

We conducted a within-subject comparison in 16 healthy participants, each scanned twice on both scanners with identical protocols including resting-state fMRI and T1-weighted imaging. MRIQC was used to extract Derivative of root mean square VARiance over voxelS (DVARS) and temporal signal-to- noise ratio (tSNR). fMRIPrep was used to quantify geometric distortion of EPI scans across sessions and scanners. For T1-weighted data we compared contrast-to-noise ratio (CNR) and structural SNR for various brain regions. Repeated-measures ANOVA was applied.

Preliminary analyses showed no significant main effect of scanner on tSNR or DVARS, with a non- significant trend toward higher tSNR on CIMA.X, and no significant session effects. Structural SNR and CNR showed no meaningful scanner-related differences.

Our findings support a favorable impact of the Prisma-to-CIMA.X transition, indicating that quality metrics are not substantially affected and that continuity of longitudinal studies and integration of data across scanner generations are preserved. The only notable difference is a slight SNR increase on CIMA.X, likely reflecting hardware improvements.

Methods

T30

The Dry truth: When Dry Electrodes Get Thirsty and Signal Quality Suffers

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With the rapid advancement of clinical neuroscience and Brain-Computer Interfaces (BCIs), there is an increasing demand for convenient, patient-friendly EEG acquisition methods suitable for diverse environments, including home-based settings. Traditional gel-based EEG systems, while reliable, are often cumbersome and time-consuming, whereas dry electrode systems tend to suffer from elevated noise levels.

In this study, we investigate whether wetting the hair with water can enhance EEG signal quality in dry electrode systems by improving scalp electrode conductivity.

To this end, we recruited 22 healthy participants and compared their resting-state (RS) EEG activity across three experimental conditions (dry, wet, and gel) within a single-session design. Specifically, we analyzed electrode impedance, spectral power (SP), and functional connectivity (FC). Our results show that wetting the hair significantly reduces electrode impedance and improves both SP and FC measures relative to dry electrode application. While gel remains the gold standard, our findings indicate that water-wetted hair represents an intermediate condition between dry and gel, more closely resembling gel performance than dry.

Although this method does not fully match the signal quality of traditional gel-based systems, it represents a promising compromise, enhancing EEG data quality under suboptimal conditions. This approach offers a practical and non-invasive means to improve EEG signal integrity, ultimately increasing the reliability and usability of EEG-based applications in real-world, user-friendly contexts.

T31

Fine-Grained Functional Parcellation of the Neonatal Thalamus Using Resting-State fMRI

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Resting-state fMRI has enabled the study of intrinsic brain connectivity without any specific task and has been particularly valuable for exploring neonatal brain development. The thalamus in particular plays a central role in integrating sensory information and supporting higher-order functions, yet its functional differentiation during the neonatal period remains poorly understood. While adult thalamic nuclei are well characterized, how and when these functional subdivisions emerge in newborns remains unclear.
In this study, we investigated thalamic functional parcellation in neonates aged 37–44 weeks post-conception using a large dataset of 588 subjects from the developing Human Connectome Project. Voxel-wise thalamic functional connectivity profiles were computed with respect to 40 cortical and subcortical regions. Instead of classical winner-takes-all labeling, we applied k-means clustering with bootstrapping to identify stable clusters with functional uncertainty maps, reflecting the confidence of the cluster assigned to each voxel. We identified four thalamic functional clusters that showed broad, overlapping connectivity to sensory, associative, and frontal regions, suggesting immature specialization. However, key subdivisions began to emerge, including a pulvinar-related cluster, as well as medial and ventrolateral clusters associated with salience and motor functions, respectively. A dorsal higher-order cluster showed increasing connectivity and relative volume, particularly after 41 weeks.
Developmental analyses revealed increasing bilateral symmetry, reduced uncertainty, and a transient connectivity peak around 41 weeks, consistent with rapid network maturation. These findings provide new insight into early thalamic functional organization and establish a reference framework for studying atypical development.

T32

A Unified Framework for Brain–Heart Coordination: Slow Oscillations, Spindles, and Cardiac Timing

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Sleep depends on the coordination of cortical, thalamic, and autonomic systems, yet the principles governing this tri-modal communication remain poorly understood. Slow oscillations (SOs), sleep spindles, and cardiac rhythms each exhibit state-dependent dynamics, but whether they form an integrated coupling mechanism has not been systematically examined. Here, we propose and empirically evaluate a unified framework for brain–heart coordination during NREM sleep, combining oscillatory, aperiodic, and cardiovascular measures.

Thirty healthy adults underwent overnight high-density EEG (128 channels) and ECG recordings. We quantified SOs, spindles, spectral slope, Lempel–Ziv complexity (LZC), and heart rate. To capture tri-modal coordination, we developed Joint Phase–Amplitude Coupling (JPAC) indexing the similarity between the SO-phase–modulated spindle-amplitude profile and the SO-phase–modulated R-peak probability profile. Cluster-based permutation tests and sensor-level regressions identified spatially specific coupling effects. JPAC exhibited a robust fronto-central cluster (cluster-corrected $p < 0.05$), aligning with canonical SO–spindle generators. Across participants, stronger JPAC in this cluster was associated with lower heart rate (slope = −0.023; $R^2 = 0.37$; $p = 0.000381$). Spectral slope showed a significant negative centro-parietal cluster ($p < 0.05$), such that steeper slopes correlated with stronger JPAC. LZC showed an analogous negative centro-parietal cluster ($p < 0.05$), with higher complexity associated with reduced JPAC.

Together, these findings reveal that SOs, spindles, and cardiac timing form a unified, state-dependent coupling system whose strength is maximized during synchronized, low-arousal NREM states. This framework provides an integrated account of how aperiodic neural dynamics, thalamocortical oscillations, and autonomic physiology jointly organize during sleep.

Methods

T33

EEGpal: a new graphical user interface for performing automatic and semi-automatic EEG processing and analysis

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The growing complexity of EEG analysis pipelines often limits reproducibility and accessibility, particularly for researchers without advanced programming skills. EEGpal is a new open-source MATLAB toolbox designed to facilitate transparent, standardized, and user-friendly analysis of EEG data from preprocessing to statistical inference. Built on top of established frameworks such as Cartool and eeglab, EEGpal provides an intuitive graphical interface that enables both novice and expert users to implement robust analysis pipelines without need of coding. It enables the creation of batches for the automatic or semi-automatic processing of multiple participants.
The toolbox supports a full range of EEG processing steps, including filtering, artefacts detection or correction tools, ICA, interpolation and epoching. It also includes time–frequency analysis, automatic peaks detection, and statistics on tracks. Importantly, EEGpal emphasizes reproducibility by automatically generating traceable reports that document all parameters and analysis steps.
To validate EEGpal, we benchmarked its performance against standard Cartool and eeglab pipelines using face recognition evoked potentials. Results show equivalent accuracy.
By bridging the gap between accessibility and methodological rigor, EEGpal aims to promote open and reproducible science in cognitive electrophysiology. The toolbox is freely available on GitHub (https://github.com/DePrettoM/EEGpal). It includes detailed PDF manuals and tutorial videos on YouTube to guide researchers in its use.

T34

Assessing the reliability of hippocampal single-voxel proton magnetic resonance spectroscopy through intra-class effect decomposition

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The hippocampus plays a central role in learning, memory, and stress regulation but is particularly vulnerable to biological and environmental influences that compromise its structural and metabolic integrity. Proton magnetic resonance spectroscopy (^{1}HMRS) enables in vivo quantification of hippocampal neurochemistry, yet the absolute and relative reliability of these measures has rarely been systematically evaluated. We assessed both forms of reliability in hippocampal metabolite estimates acquired with single-voxel ^{1}H MRS at 3 T. Nineteen healthy adults (8 male; mean age = 40.9 ± 16.9 years) underwent four measurements across two consecutive days, with one session including an extended acquisition (256 vs. 128 transients). Absolute reliability was quantified using coefficients of variation (CVs), and relative reliability was estimated with the Intra-Class Effect Decomposition (ICED) framework, which partitions variance into true-score, day-specific, session-specific, and residual components. Despite low CVs (≈ 4–7%) indicating high absolute precision, ICED analyses revealed only moderate relative reliability for glutamate, glutamate+glutamine (Glx), myo-inositol, total choline, and total creatine (ICCs = 0.39–0.70) and lower reliability for glutathione, taurine, NAA, and tNAA, largely due to residual error. Increasing the number of transients improved spectral precision, reflected in higher signal-to-noise ratio (SNR) and lower Cramér–Rao lower bounds (CRLBs), but did not enhance rank-order stability. These results show that hippocampal metabolite quantification at 3 T achieves high absolute but limited relative reliability, underscoring the need for continued methodological refinement to enhance its suitability for longitudinal and individual-differences research.

T35

Towards convolutional neural networks for BOLD fMRI time series deconvolution

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Recent developments in blood-oxygen-level–dependent (BOLD) functional magnetic resonance imaging (fMRI) are enabling the capture of brain dynamics at increasing spatiotemporal resolutions. Innovation-driven co-activation patterns (iCAPs) have emerged as a powerful framework for capturing transient fluctuations underlying neural activity. By deconvolving BOLD signals, extracting transients, and subsequently clustering them into components, iCAPs can reveal fast network dynamics that are otherwise obscured in the original signal. However, current iCAPs implementations rely on computationally iterative deconvolution algorithms sensitive to acquisition parameters.

To address these challenges, we propose a 5-layer convolutional neural network (CNN) with approximately 600.000 parameters that approximates the deconvolution step with local spatiotemporal operations. The network relies on 2D restricted spatial kernels and 1D temporal kernels that account for the duration of the hemodynamic response function (HRF), ensuring consistency with physiological constraints.

To overcome the absence of a ground-truth representation of the underlying deconvolved signal, we train the model using task data from 300 subjects of the Human Connectome Project (HCP) and generate targets informed by the experimental design leveraging general linear model (GLM) regression coefficients.

The results demonstrate that our model can accurately estimate deconvolved signals for unseen tasks and thus opens the avenue for resting-state analysis. Moreover, when the GLM provides weaker estimates of the neuronal activity, model predictions align more closely with the observed data, suggesting that the CNN may capture the underlying hemodynamic patterns more faithfully.

Together, these results constitute a promising step toward a fast, efficient, and model-agnostic framework for modelling transient-driven brain dynamics.

T36

Functional Connectivity Signatures of Human REM and NREM Sleep

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fMRI-derived functional connectivity (FC) provides important signatures of consciousness alterations and sleep. However, the ability of FC to decode specific sleep stages remains insufficiently explored, and rapid eye movement (REM) sleep has rarely been recorded with MRI. Here, we leverage a unique EEG-fMRI dataset including both NREM and REM sleep to (1) identify key brain networks characterizing different sleep stages; and (2) classify these stages from FC measures. Eighteen narcoleptic patients and eighteen healthy controls were included; REM sleep was recorded only in narcoleptic participants, who more easily reach this stage. Sleep stages were scored in 30-s EEG epochs. FC was computed as pairwise Pearson correlations between regional fMRI time series in matching 30-s windows, after standard preprocessing and atlasing (Glasser parcellation). Our results highlight distinct patterns of somatomotor and dorsal attention network involvement differentiating wakefulness from deep sleep, while REM shows FC configurations more similar to wake. Sleep-stage classification using a support vector machine with 5-fold cross-validation yielded good performance for wake (F1 = .63) and deep sleep stages N2/N3 (F1 = .62), but poor performance for N1 (F1 = .04) and REM (F1 = .07). REM classification improved when restricting analyses to subjects with REM recordings (F1 = .36). Misclassification of N1 as wake or N2 aligns with its transitional nature between these stages. Beyond limited sample size for REM, its low classification accuracy—primarily due to confusion with wake—suggests high inter-individual variability in REM-related brain dynamics, potentially reflecting the well-known cognitive and emotional complexity of dream experiences during this stage.

DATABLITZ

T37

Beyond Pairwise Interactions: Charting Higher-Order Models of Brain Function

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Traditional models of brain connectivity have primarily focused on pairwise interactions, overlooking the rich dynamics that emerge from simultaneous interactions among multiple brain regions. Although a plethora of higher-order interaction (HOI) metrics have been proposed, a systematic evaluation of their comparative properties and utility is missing.
Here, we present the first large-scale analysis of information-theoretic and topological HOI metrics, applied to both resting-state and task fMRI data from 100 unrelated subjects of the Human Connectome Project. We identify a clear taxonomy of HOI metrics — redundant, synergistic, and topological—, with the latter acting as bridges along the redundancy–synergy continuum. Despite methodological differences, all HOI metrics align with the brain's overarching unimodal-to-transmodal functional hierarchy. However, certain metrics show specific associations with the neurotransmitter receptor architecture. HOI metrics outperform traditional pairwise models in brain fingerprinting and perform comparably in task decoding, underscoring their value for characterizing individual functional profiles.
Finally, multivariate analysis reveals that, among all HOI metrics, topological descriptors are key to linking brain function with behavioral variability, positioning them as valuable tools for linking neural architecture and cognitive function. Overall, our findings establish HOIs as a powerful framework for capturing the brain's multidimensional dynamics, providing a conceptual map to guide their application across cognitive and clinical neuroscience.

T38

REMSIT (Reproducible Eye-tracking Toolkit for Multi-sensory Integration Research)

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Multi-sensory integration (MSI) allows the brain to fuse sensory information across modalities, enhancing perception and action through faster, more reliable responses. Classical simple reaction time (SRT) paradigms show that multi-sensory responses can exceed predictions from independent sensory channels—the race model—indicating co-activation. Yet, SRT tasks capture only a narrow aspect of behavior, overlooking continuous sensorimotor processes such as eye movements that reflect the temporal dynamics of MSI. The oculomotor system, with multi-sensory convergence in the superior colliculus, provides sensitive indices of attention, arousal, and detection through saccadic and pupillary measures. Despite advances in eye tracking, standardized workflows for MSI-focused analyses remain limited. We introduce REMSIT (Reproducible Eye-tracking Toolkit for MSI Research), an open, user-friendly framework written in Python that unifies recording, preprocessing, and analysis of ocular data within MSI paradigms. REMSIT employs standardized synchronization via Lab Streaming Layer (LSL), precise audiovisual stimulus presentation, and structured eye-tracking data segmentation, offering pipelines for key MSI metrics such as saccadic latency, time-to-first-fixation, pupil size variability, and blink rate. By linking ocular measures to race-model predictions, REMSIT extends classical SRT approaches toward more naturalistic and continuous markers of sensorimotor integration, promoting transparency and reproducibility across studies.

T39

Subcortical Contributions to Visuospatial Attention: Pulvino-cortical Functional Connectivity and Spatial Bias

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Visuospatial attention research has been for decades mainly cortico-centric. Yet, emerging evidence indicates that subcortical structures also play essential roles, such as the pulvinar which is the largest thalamic nucleus and highly connected to the cortex.

In some attention tasks, healthy subjects tend to exhibit a systematic spatial bias toward one hemispace, most often the left side (right pseudoneglect). The neural basis of this bias remains unresolved. Understanding whether resting-state pulvino-cortical interactions predict the strength of this spatial bias may provide novel insights into the subcortical contributions to visuospatial attention.

Fifteen healthy participants performed a Landmark bisection task to quantify their individual spatial bias. Based on task performance, participants were classified into high-bias and low-bias groups using a median split. Resting-state fMRI data were then preprocessed and analyzed with the CONN functional connectivity toolbox using an atlas-based approach. Left and right pulvinar were examined separately in relation to cortical networks defined by the Yeo 2011 atlas.

The left pulvinar shows no significant connectivity in either group. The right pulvinar shows a differentiated connectivity profile depending on the magnitude of the bias: negatively connected to the Ventral Attention Network (VAN) in subjects with the strongest bias, but positively connected with Somasensory, Dorsal Attention (DAN) and Limbic networks in those with weaker bias. These preliminary results suggest that individual spatial attention asymmetries are reflected in differential right pulvinar connectivity patterns, supporting subcortical contributions to visuospatial attention with right-hemisphere dominance. These findings require confirmation from a larger cohort.

T40

Controlling the visual cortex via fMRI-based neurofeedback: Multimodal mechanisms, correlates, success predictors, and clinical implications

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Stroke is one of the leading causes of death in the world. For the survivors, the impact can be devastating, severely affecting physical mobility and/or visuospatial attention. In the latter case, a puzzling syndrome called neglect often occurs. Patients affected by neglect are unable to perceive anything occurring in the visual field contralateral to the brain lesion, despite having intact vision. For example, following a right vascular accident in frontal and/or parietal brain regions, they will stop perceiving and interacting with stimuli on their left side of the world.

Neuromodulation of the intact visual cortex appears to be a promising pathway for rehabilitation from this syndrome. This is the case of neurofeedback: a non-invasive neuromodulation technique which aims to teach users to control their own brain activity using different neuroimaging techniques and therefore train them to regulate specific brain states according to an ongoing sensorial feedback. In the presented study, we trained participants using fMRI to control the functional balance between the right and left visual cortex. During one week, they learnt how to regulate their brain activity by mind-controlling a couple of wheels, making them spin clock- or counter-clockwise on a screen, with a subsequent increase of visual attention performance. At the same time, we show how this learning process affect oscillatory correlates of visuo-spatial attention and which multimodal factors might predict training success.

These findings can allow us to develop novel personalised EEG neurofeedback protocols using EEG to be applied in hospital or at-home therapies for stroke survivors.

T41

Leveraging event-related potentials to task-irrelevant sounds to track the impact of perceptual load and action-like video game expertise on attention

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The present study records event-related potentials (ERPs) to a passive auditory oddball stream while participants either play a demanding video game or perform a simple counting task at fixation, allowing us to contrast ERPs to task-irrelevant auditory sounds under a condition of high versus a low perceptual load. In accordance with the load theory of attention (Lavie et al., 1995), larger N1 ERPs amplitudes were expected under low than high load. Of further interest, participants had variable levels of expertise in action video game play. As previous work documents heightened attentional resources in action video game players, we could also test the proposal of larger N1 amplitude responses to task-irrelevant sounds with higher levels of action video game expertise. Concerning the effect of load, larger N1 amplitudes were observed at low load as compared to high load for predictable distractors (one standard and one deviant pure tones), as predicted by the load theory of attention, but not for unpredictable distractors (novel stimuli). This suggests that the effect of load on attentional deployment is not fully automatic, but rather depends on the a-priori knowledge of the physical characteristics of the distracting information. Concerning the effect of expertise, in contrast with higher resources in action video game players (and thus higher processing at higher load), we found smaller N1 amplitudes as action video game expertise increased. This result suggests greater suppression of task-irrelevant distractors (predictable or novel) as video game expertise increased, in line with a rather early sensory gating.

Perception

T42

Attentional Orienting in a 360-Degree Virtual Environment using a Posner Paradigm

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Orienting attention in space is crucial for efficient perception and adaptive responses to sensory information from the environment. Cognitive and neural underpinning of spatial attention have been studied in various tasks, including the Posner paradigm which implies shifting and focusing attention across locations. However, most studies investigated attention in the frontal space, but few considered full space in 360-degree environments. Here, we exploit opportunities offered by immersive Virtual Reality to study the deployment of attention in front and rear space. We adapted the Posner paradigm in virtual reality in order to investigate attentional orientation within a more ecological context and assess whether performance in 3D is comparable to findings in the classic Posner paradigm conducted on 2D screens. Participants (n=21) had to search for and discriminate between 2 targets, presented on pillars displayed around them, as quickly and accurately as possible. Targets were preceded by a spatial cue whose validity was manipulated using auditory signals (Valid or Invalid), and presented with varying distractors to compare the impact of serial search in both front and rear space. We found that performance in front and rear were comparable to the classical Posner paradigm, with participants being faster in the valid than invalid cue condition. Distractors significantly delayed target detection, in line with previous research on serial search. These results suggest that orienting attention in front and rear spatial fields is achievable in a 360-degree virtual environment and engage similar mechanisms of sensory competition, supporting an overlap or continuity in space representation.

T43

Sensorimotor experience of architecture shapes the multisensory representation of space

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Recent studies have shown that a virtual promenade can modulate the dorsal premotor cortex and that parietal motor rhythms encode transitions in architectural forms (Presti et al., 2023).
Based on these findings, we hypothesize that architecture (indoor vs outdoor) and sensorimotor experience (static vs dynamic) may impact parieto-frontal networks, affecting the multisensory representations of space.
We employed an audio-tactile interaction task (Canzoneri, 2012), in which participants responded to tactile stimuli delivered while a sound was perceived at six distances from the body (from D1: 5 cm to D6: 300 cm). Reaction times (RTs) were analyzed to test for benefits or costs.
Results indicate that architecture influenced RTs, with faster responses indoors. Static experience led to faster responses near the body (up to D3:125 cm), conversely, during dynamic exploration, we observed a gain at the far distance (D6), indicating that the space about to be reached becomes more salient.
To extend these findings, we replaced the tactile stimulation with single-pulse TMS over M1 while sounds were presented at two distances (D1: 90 cm; D2: 250 cm). Motor evoked potentials (MEPs) were recorded from the first dorsal interosseous muscle and are expected to reflect behavioral facilitation: greater MEPs for D1 during static experience, particularly indoors, and greater MEPs for D2 during dynamic exploration.
Overall, fronto-parietal networks appear sensitive to both sensorimotor experience and the physical characteristics of the surrounding architecture. Multisensory resources are finely distributed across space, mapping not only near but also far locations to support adaptive and complex interactions.

Perception

T44

Linking Visual Gamma Oscillations to Oculomotor Variability Across Stimulus Contrasts

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Neural oscillations are shaped by the cognitive demands imposed on the brain. Among these rhythms, visual gamma oscillations (30–90 Hz) occupy a central position in theories of perceptual and associative processing. Gamma activity recorded over occipital cortex has been linked to feature binding and perceptual integration, as well as displaying excitation in response to stimulus properties. Yet, despite extensive work on how stimulus properties such as contrast and spatial frequency shape gamma power and peak frequency, the mechanistic origin of this variability remains unresolved. One possibility which is rarely examined in human EEG, is that gamma modulation may partly reflect systematic changes in oculomotor behaviour. For example, microsaccades are known to influence early visual responses and have been associated with gamma-band activity in non-human primates. However, evidence in large-scale human datasets is sparse.
To address these limitations we will use dynamic, concentric gabor gratings presented at four contrast levels (25, 50, 75, and 100%) while recording EEG and eye-tracking simultaneously in a large sample of 50 participants. This design provides data on changes in microsaccade rate and eye velocity, alongside gamma frequency and power responses to stimulus contrast.
Preliminary pilot data (N=10) show that increasing stimulus contrast is associated with reduced microsaccade rate, and a trend of increasing gamma power and gamma peak frequency. These pilot findings support the working hypothesis that gamma-band variability partly reflects contrast-dependent oculomotor adjustments. A full study with a well-powered sample will be conducted to test this relationship at scale.

T45

Gaze is directed towards faces of out-group members without visual awareness

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Rapid reactions towards members of an out-group may provide an evolutionary advantage. Typically, individuals categorize out-group faces faster and make quicker saccades towards out-group than in-group faces. However, it is unclear whether "invisible" out-group members' faces still attract observers' gaze differentially. We tracked West Caucasian (N = 22) and East Asian (N = 21) observers' gaze while presenting West Caucasian and East Asian faces suppressed from visual awareness using continuous flash suppression. After stimulus presentation, observers indicated the position of the face (one of the visual field's four quadrants) and its group (West Caucasian or East Asian), and rated the visibility of the face image. When subjective face visibility was zero and task performance was at chance—confirming successful suppression of the face image from awareness—both groups directed their gaze toward their out-group but not in-group faces. This interaction shows that it is the relationship between the observer and the category of the faces that genuinely drives this effect and rules out low-level visual features as the cause. Our data reveal that "invisible" out-group faces direct eye movements, suggesting that group-specific facial features are not only processed outside of visual awareness but also actively guide oculomotor behaviour.

T46

Brain-body coupling follows arousal level during sleep

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Sleep spindles and slow waves are cerebral oscillations that can be recorded with, electroencephalography and are hallmarks of consolidated sleep. They have been implicated in numerous sleep-related processes, ranging from sensory disconnection to memory consolidation. Recent studies have shown a tight coupling between the generation of these oscillations and physiological rhythms (i.e., cardiac and respiratory cycles). However, these oscillations can also be elicited in response to external sensory stimulation, such as loud noises. It remains unclear under which conditions the generation of sleep oscillations is driven primarily by interoceptive signals (i.e., signals originating from the body) versus exteroceptive inputs (i.e., stimuli from the external environment). Over the past decade, research has revealed that sleep often exhibits a regular, approximately 1-minute alternation between periods of fragile sleep, characterized by high sensitivity to noise, and periods of stable sleep, characterized by reduced sensory responsiveness and memory consolidation. We hypothesized that these regular alternations, referred to as infra-slow oscillations and tightly related to the activity of the autonomic system, also rhythmically modulate brain-body coupling and influence the generation of sleep spindles and slow waves by physiological cycles. Using polysomnographic recordings combined with nasal airflow and electrocardiographic measures, we first confirmed and extended previous findings on brain-body coupling during sleep. We then demonstrated that brain-body coupling diminishes during periods of fragile sleep suggesting that brain-body coupling is intrinsically linked with sleep stability and sensory isolation.

T47

Investigating longitudinal associations between striatal dopamine D2 receptor losses and perceptual speed subcomponents in aging

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Perceptual speed has an earlier onset of decline than other age-sensitive cognitive abilities. We recently showed that older adults with exacerbated dopamine D2-like receptor (DRD2) losses between ages 65–75 years showed faster decline in perceptual speed (correct responses per minute). Here, we apply drift-diffusion modeling (DDM) to increase our knowledge of whether specific subcomponents of perceptual speed are affected by DRD2, which could be any single one or a combination of DDM parameters: higher decision thresholds (cautiousness), slower evidence accumulation (drift rate), or slower sensory and motor latency (non-decision time). We employed data from the Cognition, Brain, and Aging (COBRA) study, in which healthy older adults (ages 64–68 years at baseline; n = 181) were followed for 10 years across three measurement waves (n = 129 at wave 2 and n = 93 at wave 3). At each wave, DRD2 availability was assessed with PET and [11C]-raclopride, and perceptual speed was assessed via letter, number, and figure comparison tasks. DDM parameters were estimated with a longitudinal Bayesian model that constrained non-decision time with finger-tapping data. Based on previous findings on the role of the striatum in DDM parameters, DRD2 decline can be expected to increase response times due to higher decision boundaries, however, effects on drift rate and non-decision time are also conceivable. The findings will reveal whether any perceptual speed subprocesses are particularly sensitive to variation in DRD2 decline and will be discussed in relation to dopaminergic modulation of cortico-striato-thalamo-cortical loops.

T48

Temporal hierarchy in Auditory object discrimination in Full-term and Preterm born children

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Auditory object processing exhibits a temporal hierarchy with broad categorical distinctions (living vs man-made sounds) emerging at earlier post-stimulus latencies and finer semantic discriminations arising later in time. Prior work has shown that children born preterm display long-lasting alterations in sensory and semantic sound processing. Here, we examined whether such alterations extend beyond broad auditory categories to the level of semantic subcategories within living and man-made sounds. Eighteen preterm children (born <33 weeks GA) and nine full-term children, all aged ten years, completed an auditory oddball task comprising human and animal vocalizations, as well as context-related and context-free action sounds. High-density EEG was recorded and measures of response strength (global field power) and topography (microstate segmentation, single-subject fitting) were calculated. Full-term children showed robust discrimination of semantic subcategories across both living (human vs animal vocalizations) and man-made domains (context-related vs context-free sounds), reflected in early and late topographic differences and response-strength modulations. Their patterns closely resembled those reported in adults, suggesting substantial maturation of domain-specific auditory object processing by age ten. In contrast, preterm children exhibited attenuated or absent differentiation of both vocalization subtypes and action-related sound categories. Across several temporal windows, the findings indicated altered recruitment of functional brain networks in the preterm group. These findings demonstrate that prematurity affects not only broad semantic distinctions but also fine-grained auditory object representations, revealing persistent alterations in the temporal dynamics and topographic organization of auditory semantic processing at ten years of age.

Clinical Neuroscience

W01

Exploring the relationship between functional inter-hemispheric connectivity, psychopathological factors and genetic variations in a large neurodevelopmental cohort

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Background: Interhemispheric functional connectivity (ihFC) reflects coordinated activity between brain hemispheres and is essential for cognitive and socio-emotional functions. Altered ihFC has been linked to cognitive and psychopathological difficulties in various DSM-5 neurodevelopmental disorders. This study examines the relationship between ihFC, psychopathologies, and genetic variation using a multidimensional, data-driven approach.
Methods: Multi-modal data were drawn from the Philadelphia Neurodevelopmental Cohort (PNC; Satterthwaite et al., 2026, N=877, ages 8–21), a large-scale neurodevelopmental dataset including resting-state fMRI and clinical assessments.
Resting-state fMRI data (TR = 3000 ms, TE = 32 ms, voxel size = 3×3×3 mm, 6 min acquisition) were preprocessed using fMRIPrep (Esteban et al., 2019). Functional connectivity (FC) matrices were computed using homotopic Markov Random Field 400 atlas and connectivity was estimated with Pearson’s correlation.
Graph Neural Network (GNN), ARMA layers, is used to model behavioral factor scores from ihFC features. An ablation analysis was performed to determine which inter- or intra-hemispheric components of the FC matrix, at both the graph and functional network levels, had the greatest impact.
Genetics data were preprocessed with PLINK2.0 and bcftools and a candidate gene association study was performed.
Results: Interhemispheric default mode network connectivity contributes to predict psychosis and obsession, whereas intrahemispheric limbic and dorsal attention network connectivity is linked with depression. This suggests different contributions of intra- and interhemispheric networks to psychopathologies.
Conclusion: This study highlights how interhemispheric integration is contributing to psychopathologies. It also supports the importance of transdiagnostic models in predicting multiple psychopathological factors.

W02

Mapping corpus callosum architecture: developmental, genetic, and cognitive correlates in youth

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Background: The corpus callosum (CC), the brain's largest white-matter commissure, enables interhemispheric communication. As a key projection structure, CC alterations can affect both callosal fibres and the cortical regions they connect to, influencing cognitive functioning. This study aims to investigate structural CC characteristics as potential biomarkers of cognitive development.
Methods: This study used diffusion-weighted imaging, cognitive and genetic data from 1342 participants (ages 8–21) of the Philadelphia Neurodevelopmental Cohort. Single-shell diffusion-weighted images were preprocessed (QSIprep), diffusion-tensor modelling generated whole-brain maps of fractional anisotropy (FA), fibre orientation distributions peaks were estimated (QSIrecon). Using tractography-based segmentation (TractSeg), 7 CC streamlines were reconstructed. FA was computed along 100 equidistant segments for each of the CC streamlines. Cognitive functions were assessed via the Penn computerized neurocognitive battery, and four cognitive factors were derived using factor analysis. Genes implicated in callosal axonal guidance were selected for the current candidate gene association study: NRP1, DCC, ROBO1 and IQCJ-SCHIP1. A functional data analyses framework was used allowing to assess global and local associations between spatial variation in diffusion properties along CC tracts with age, cognition and selected genes.
Results: Functional data analyses revealed spatially varying associations between along callosal tract FA and age with important spatial variation. All cognitive factors were associated with along-tract CC metrics. Along CC-tract spatial variation was also associated with NRP1, ROBO1 and IQCJ-SCHIP1 genes.
Conclusion: Spatial variation in CC diffusion metrics was associated with age and cognitive outcomes. The observed spatial heterogeneity was also associated with NRP1, ROBO1, and IQCJ-SCHIP1 genes involved in callosal axonal guidance.

W03

Stress, Reward, and Resilience: A Neurobiological Model of Depression Vulnerability

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A recurring factor in the etiology of depression is exposure to varying degrees of childhood stress, which contributes to emotional blunting and, ultimately, anhedonia. Resilience has emerged as a key predictor of remission in depression (Hillmann et al., 2016), however the neural processes through which early stress shapes resilience remains poorly understood. We propose an fMRI study examining how childhood stress influences brain state in adulthood, how these neural patterns modulate resilience in the face of stress. Our objective is to recruit 120 participants, including 80 individuals who experienced childhood stress and 40 control participants. All participants will undergo fMRI while completing a stress-induction task (Baez-Lugo et al., 2023; Gaviria et al., 2021). The task involves viewing neutral and stressful movie, followed by a resting-state period that will allow us to assess participants' resilience capacity. We will also collect EEG, behavioral, salivary (cortisol / alpha amylase), and macrobiotic data. We hypothesize, first, that individuals exposed to childhood stress will show a higher activation of amygdala in comparison to controls, consistent with prior findings (Reinelt et al., 2019). Second, we will explore the associations between resilience and the neural networks implicated in stress processing. We expect to observe group differences particularly within the amygdala and striatum (Baik, 2020). This project will provide a better understanding of the underlying mechanisms of depression, which are still poorly understood, through the identification of biomarkers, thereby improving existing clinical practices by integrating neurobiological indicators into prevention and treatment strategies.

W04

Impact of Prematurity on Auditory Processing: An fMRI study

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Very preterm children, born before 32 weeks of gestation, are at elevated risk for neurodevelopmental impairments, including deficits in auditory processing. During their first weeks or months of life, they typically remain in the NICU, where they are deprived of the biological maternal sounds normally experienced in utero and exposed instead to high and unpredictable background noise. This combination of deprivation and excessive noise can negatively affect auditory development, and children born preterm show higher rates of hearing impairments and altered auditory processing.

In a longitudinal study of 46 children (24 very preterm; mean age = 9.287, SD= 1.212 and 22 full-term children; mean age = 9.294, SD= 1.351), we investigated how prematurity influ-ences auditory processing and associated neural responses. Using a functional MRI, Hearing Voice in Noise Task, we assessed behavioral performance and neural activation during voice-in-noise processing. Behaviorally, only the noise-level factor showed significant effects: both groups found the task more difficult as noise increased, ($F38, 4226.1 = 2.24$, $p < 0.001$), but no group differences were observed, and reaction times did not differ significantly. In contrast, whole-brain voxel-wise analyses revealed significantly greater activation in the left supra-marginal gyrus and left angular gyrus in very preterm participants compared to full-term peers, indicating a distinct neural response to perceptual difficulty in these regions. These findings suggest that children born very preterm may recruit additional neural resources to achieve similar behavioral performance, providing new insight into how early prematurity shapes audi-tory processing across development.

W05

The neural dynamics of coherence: modeling drift and shift in narrative processing

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Objective: Formal thought disorder, a core phenotype in the psychosis spectrum, reflects a breakdown of coherence. To clarify the processes that sustain coherence, in this study we modeled the neural dynamics of drift and shift during narrative processing. Methods: We acquired an intensive 7T fMRI dataset in which a healthy male adult listened to thirteen German crime stories for six hours, providing the resolution needed for voxelwise modeling of coherence. The same stories were processed by a large language model (LLM) to generate two continuous time series from the unfolding narrative, one reflecting gradual semantic drift and the other marking rapid shifts. These features were aligned with the audio stream and used to predict BOLD activity in a regularized voxelwise encoding framework evaluated on held-out stories. Results: Shift aligned with rapid activity changes in bilateral peri-Sylvian auditory-language regions. Drift showed a complementary profile, with highest prediction accuracies in default-mode and parietal hubs including angular gyrus, precuneus, and posterior cingulate. In these regions, BOLD responses were best captured by an LLM-derived accumulation signal that integrates semantic context over time while gradually forgetting earlier content, indicating sensitivity to the slow contextual build-up that coherence depends on. Conclusion: The neural dynamics of coherence resolved into two large-scale processes, rapid event shifts in peri-Sylvian language regions and slow contextual drift in default-mode and parietal hubs. Modeling these processes from narrative input revealed how the brain segments and integrates meaning over time, establishing a mechanistic footing for understanding coherence breakdown in formal thought disorder.

W06

Attentional modulation during emotional voice processing: a fMRI study on cerebellar stroke patients

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Traditionally considered a motor structure, the cerebellum is now recognised as a contributor to cognitive processes. Emotional prosody, the nonverbal component of speech, is essential for social communication, allowing us to infer others' feelings and intentions. In social interactions, it can be processed explicitly, when attention is directed toward emotional tone, or implicitly, when emotional information is extracted despite attention being focused on another feature. Yet, the cerebellum's role in modulating prosodic processing under different attentional demands remains poorly understood. This study investigated how explicit versus implicit attention shapes vocal emotion processing in individuals with chronic cerebellar stroke.

Twenty cerebellar stroke patients and their matched healthy controls underwent BOLD fMRI while performing two tasks on vocal stimuli expressing anger, happiness, or neutrality. In the explicit condition, participants identified the expressed emotion, whereas in the implicit condition they categorised speaker gender, ignoring emotional tone. Whole-brain activation patterns were analysed using multivoxel pattern analysis.

Results showed that cerebellar stroke patients modulate both cortical and subcortical responses during prosodic processing. In the implicit task, they exhibited greater recruitment of the superior temporal gyrus and cerebellar lobules I–VIII, suggesting increased reliance on auditory and compensatory cerebellar mechanisms. Under explicit demands, patients engaged regions associated with attention and higher-order cognition, including the precuneus, cuneus, anterior STG, sensorimotor regions, and inferior frontal gyrus subdivisions, reflecting heightened effort and strategic resource allocation.

These findings suggest that the cerebellum contributes to dynamic attentional control during emotional voice processing and highlight the need to consider subtle socio-affective impairments in cerebellar patients.

W07

Theta/Beta Ratio in Attention Deficit Hyperactivity Disorder: A Multiverse Analysis

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Attention Deficit Hyperactivity Disorder (ADHD) affects 5-7% of children worldwide. Current diagnostics rely on subjective assessments, highlighting the need for objective neurobiological markers. The theta/beta ratio (TBR) recorded with electroencephalography has been proposed as a potential ADHD biomarker, with affected children showing increased theta and decreased beta activity compared to healthy controls. However, recent findings have raised concerns about TBR's diagnostic validity, suggesting it may only be reliable under specific methodological conditions. To address these inconsistencies, we employed multiverse analysis to systematically investigate how researcher degrees of freedom affect TBR estimates across the full spectrum of reasonable methodological choices. Using two large, independent samples (Healthy Brain Network: N=1,499; validation sample: N=381), we varied TBR computation methods to evaluate the consistency of group differences across the analytical space. Our results demonstrate that TBR differences are highly contingent on analytical choices. Critically, we observed virtually no main effects of diagnosis, indicating no reliable differences between healthy controls, ADHD-inattentive, and ADHD-combined subtypes. However, significant interactions emerged, particularly with age and IAF, specifically when TBR was computed from 1/f-uncorrected power and from the aperiodic signal itself. These findings suggest that previously reported TBR differences in ADHD may be confounded by variations in the 1/f slope rather than reflecting genuine differences in oscillatory power. Importantly, these interaction patterns replicated across both independent datasets and held for categorical and dimensional ADHD definitions. Taken together, these findings indicate that TBR does not provide a reliable standalone biomarker for ADHD.

W08

Alterations in Critical Neural Dynamics in Early Psychosis

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The brain criticality hypothesis suggests that neural systems operate near a critical point, reflected in scale-free activity patterns. Criticality-based frameworks are increasingly used to study altered consciousness and disorders like schizophrenia. Using a phenomenological renormalization group (PRG) approach, we analyzed rs-fMRI data from the HCP-Early Psychosis dataset, including 44 patients and 24 healthy controls. PRG provides low-dimensional descriptions of high-dimensional systems, revealing a non-Gaussian fixed probability distribution for the activity and robust scaling behaviour across iterations. We complement this approach with Detrended Fluctuation Analysis (DFA) to reveal the presence of long-range temporal correlations in the network activity. We obtain statistically significant scaling exponents using both methods, providing a principled way to characterize functional differences in the brain between healthy and clinical populations.

<u>W09</u>

Electrophysiology of voluntary action in Functional Neurological Disorder

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Functional Neurological Disorder (FND) is characterized by neurological symptoms arising from altered brain network functioning, with disruptions in the sense of agency i.e. the subjective experience of controlling one's own actions, proposed as a core mechanism. The Libet clock experiment is a classical task used to assess agency and is known for revealing the readiness potential, a slow cortical drift preceding voluntary action. This study examined the electrophysiology of voluntary action in patients with FND compared to healthy controls (HC). Twenty-seven FND patients and twenty-eight HC completed a modified Libet clock task while respiration was monitored with a breathing belt and brain activity was recorded using EEG. Voluntary button presses were recorded while participants focused either on the timing of their action (Movement condition) or on the moment of their initial intention to act (Wanting condition). In HC, button presses were significantly coupled to the expiration phase in the Movement condition but not in the Wanting condition, whereas FND patients showed this respiratory–motor coupling in both conditions. EEG analyses revealed a significant interaction between group and condition in readiness-related activity. Overall, FND patients exhibited stronger coupling between voluntary actions and the breathing cycle, along with altered readiness-potential dynamics, even when task instructions differed. These findings suggest reduced flexibility in adapting action–breathing coordination strategies and provide further evidence for agency-related disturbances in FND.

W10

Improving negative symptoms in psychotic disorders is associated with decreasing fMRI activity within the bilateral temporal voice area during social cue perception

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Patients with psychotic disorders may exhibit negative symptoms 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 and social skills. 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). In addition to clinical assessments, changes in fMRI activation during perception of nonverbal social cues (emotional facial and vocal expressions) were evaluated using SPM25 (www.fil.ion.ucl.ac.uk/spm, $p < 0.05$).
Statistical analysis revealed no significant differences between MOSAIC and SUPPORT in terms of improvement in negative symptoms, but showed a significant reduction in negative symptoms with medium to large effect sizes within each group. The fMRI activity during social cue perception showed no significant main effects of time, nor group-by-time interaction. However, individual improvement in negative symptom severity correlated with decreasing hemodynamic activity (T0 > T1) within the bilateral temporal voice area during social cue perception. These findings further corroborate the link between clinical improvement and neuroplastic changes in cerebral regions contributing to social cognition and emotional processing.

W11

Latent structures in multivariate EEG feature patterns

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Signal-processing methods are widely used to extract EEG biomarkers, but feature sets are often ad hoc, high-dimensional, and poorly interpretable, with many features assumed to reflect the same neural process showing low correlation. Here, we aimed to identify latent patterns in the EEG feature space that reliably predict age, beyond the heterogeneity of single features. We applied several feature-reduction approaches to resting-state EEG from two open-access datasets, ranging from central tendency and principal component analysis to channel covariance methods leveraging spatial information. Large feature sets, exhibiting weak correlations among individual features, improved prediction. Moreover, performance plateaued after a limited number of predictors, and spatially aware methods offered a favorable performance–interpretability trade-off. These results support the potential of multivariate feature patterns to more reliably predict individual variability, cognitive states, and disease-related differences.

DATABLITZ

W12

Mapping cognitive impulsivity: fNIRS during individualized delay discounting

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Cognitive impulsivity is characterized by the preference for smaller, more immediate rewards over larger, delayed rewards. Cognitive impulsivity is often measured in the laboratory using the Monetary Choice Questionnaire (MCQ) which presents hypothetical choices between smaller immediate rewards (SIR) and larger delayed rewards (LDR), such as “Would you prefer $5 today or $15 in 10 days?”. Responses are used to calculate a k-value, which reflects an individual’s “willingness to wait,” with higher k-values indicating greater cognitive impulsivity. Here, we used k-values from the MCQ to create personalized “easy” and “hard” delay discounting trials for each participant to be presented during prefrontal cortex brain imaging via functional near infrared spectroscopy (fNIRS). Trials included Control (same delay, different amounts), Easy (clearly preferable SIR or LDR), and Hard (SIR and LDR are expected to be similarly attractive for the participant). Preliminary results indicate that participants who were more willing to wait on hard trials (i.e., chose the LDR) showed greater activation in the left dorsolateral prefrontal cortex, $rs(45) = -.376$, $p = .011$, a region associated with cognitive control and delay discounting. These results suggest that willingness to wait (an index of cognitive impulsivity) may be associated with prefrontal cortex activity. This finding is part of a larger investigation into cognitive impulsivity among college-aged students with and without concussion and will be presented within the broader goal of improving our understanding of subtle cognitive symptoms associated with conditions that impact prefrontal cortex function such as brain injury.

W13

The temporal dynamics of reappraisal

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Reappraisal is an intentional attempt to change emotion through reconstrual or repurposing. Previous studies revealed that using reappraisal to decrease negative emotion will induce a reduction in late positive potential (LPP) amplitudes, a decrease in amygdala activity, increases in frontal theta oscillations and relative left frontal activity. However, most existing studies focused on manipulating regulation goals rather than manipulating reappraisal tactics themselves. In our study, we want to reveal the differences between more positive reappraisal (MPR, reinterpret the cause, outcome and consequence in a more positive way) and less negative reappraisal (LNR, reinterpret in a less negative way). Fifty-five university students with healthy mental states were recruited to perform an emotion regulation task, in which they need to watch or reappraise the emotion that are triggered by the pictures (40 neutral and 120 negative, from the Nencki Affective Picture System) according to the instructions. To balance the strategy order effect, 33 participants performed the LNR blocks after MPR blocks, and the remaining 22 participants in reverse. After each picture, they rated positive emotion, negative emotion and arousal level. At the same time, brain oscillations were measured using a 64-channel electroencephalography. Results indicated that both MPR and LNR successfully reduced arousal, negative emotion and increased positive emotion. In both order groups, the strategy which was implemented in the second order induced more decrease in arousal and negative emotion as well as heart rate variability. However, there is no significant regulation effect with regards to LPP at classical frontal and central-parietal electrodes.

W14

Making Sleep Care Accessible: A School-Integrated CBT Intervention for Adolescents

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During adolescence, physiological and psychosocial changes often lead to sleep disturbances, which in turn are associated with impairments in cognitive performance or emotional regulation. Despite this, many adolescents underestimate the importance of sleep and/or do not seek medical help for their sleep difficulties. Although cognitive behavioural therapy (CBT) has demonstrated efficacy for treating sleep disorders in adults, few studies have examined interventions specifically tailored to adolescents. We decided to implement these interventions in school settings, closer to adolescents' daily environments than traditional clinical contexts.

This study investigated how CBT components can be adapted for younger populations through group workshops scheduled during school lunchtime. We evaluated the effectiveness of this intervention by measuring sleep parameters using sleep diaries and actigraphy.

In a randomized longitudinal experimental design, 119 adolescents (aged 15–25 years) with self-reported sleep problems were randomly assigned either to an immediate intervention group (experimental group, N=75) or to a control group that waited one month before receiving the intervention (waitlist group, N=44). The intervention consisted of four weekly group workshops focusing on psychoeducation, behavioural strategies, and personalised sleep hygiene guidance. Outcomes were assessed using both subjective and objective measures across six recorded weeks.

Participants who received the intervention showed significant improvements in sleep efficiency, subjective sleep quality, and reductions in daytime sleepiness. These findings demonstrate the feasibility of delivering a CBT-based intervention for insomnia in an accessible, school-based format and highlight its potential to meaningfully improve sleep parameters in adolescents.

Emotion & Motivation

W15

Intracranial Evidence for Attention-Independent Verbal Emotion Processing in the Amygdala

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Reading is a relatively recent development in the evolution of the homo sapiens. Still, seemingly abstract words elicit emotional reactions. To date, the neural mechanisms underlying the processing of emotional language remain poorly understood. Some postulate that it depends at least partially on the amygdala, but data on this is inconclusive. In this study, we examined whether gamma-band activity (GBA, > 30 Hz) in the amygdala encodes emotional salience in words. Furthermore, we investigated whether these effects are modulated by selective attention allocated towards or away from emotion in words. Eleven patients with intracranial EEG implantations were viewing a series of positive, neutral, and negative nouns, while one valence was assigned as the target condition. Afterwards, they were tasked with a free word recall. We observed improved detection accuracy of emotional compared to neutral words. GBA analysis revealed a significant increase in low GBA (42.50 to 47.50 Hz) for both positive and negative words between 460 ms and 550 ms post-stimulus. Notably, selective attention to valence did not modulate amygdala GBA. These findings suggest that while emotional words are processed outside traditional reading networks, this likely occurs after initial semantic encoding. Overall, these findings offer new insights on the brain mechanisms that underlie the processing of emotional words.

Emotion & Motivation

W16

Investigating higher-order signatures of emotions in the human brain using film fMRI

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Emotions are complex, temporally evolving processes emerging from coordinated neural activity. However, traditional brain connectivity models typically rely on pairwise relations, potentially overlooking higher-order interactions (HOIs), the simultaneous coordination of three or more regions, through which emotional experiences may unfold. In this study, we test whether collective group activity patterns, as quantified by a recent dynamical HOI framework, provide a more accurate link between neural activity (via fMRI) and moment-to-moment emotional content during naturalistic film viewing.

We analyzed fMRI data from 30 participants watching 14 emotionally rich short films (Emo-FilM dataset), annotated with 50 time-resolved emotion regressors. We computed dynamic HOI measures (e.g., homological scaffolds) and evaluated their temporal correspondence with emotional time courses. We then used Partial Least Squares Correlation (PLSC) to identify multivariate patterns linking these HOI signatures to emotional profiles. Recurrence-based similarity analyses (i.e., time-time correlation analyses) reveal that higher-order scaffold dynamics show the strongest correspondence with emotion time courses, outperforming standard pairwise connectivity approaches. The PLSC analysis further identifies coupled brain–emotion components, delineating a distributed "core" of functional interactions that recur across films. These components captured different emotional dimensions, such as valence, arousal, and power. Critically, cross-validated prediction analyses demonstrated that HOI-based features more accurately reconstruct moment-to-moment emotional states than traditional connectivity measures.

These findings demonstrate that temporal HOI measures capture crucial aspects of brain–emotion coupling during complex, naturalistic experiences inaccessible to conventional analyses. The higher-order framework offers a more precise and powerful tool to characterize brain dynamics in naturalistic contexts.

W17

Influence of language experience on multilingual language processing as revealed by magnetoencephalography

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How and when multilingual experience shapes the grounding of semantic categories has not yet been elucidated. We examined whether the neural responses to semantic categories align across languages and whether later-learned languages show weaker sensorimotor grounding. With data collection ongoing, this unique dataset comprises Spanish–Basque–English trilinguals – balanced in proficiency across their early acquired languages (Spanish, Basque) but not their third and later-acquired language (English) – listening to single spoken words in each language during magnetoencephalography recording. Time-resolved representational similarity analysis (RSA) was used to assess cross-language alignment of neural representational dissimilarity matrices and their correspondence to a sensorimotor model derived from the Lancaster norms. Exploratory regression analyses were run to assess the effect of language experience on cross-language similarity and neural–sensorimotor alignment across time. For the currently available data (n=7), group-level RSAs showed no reliable cross-language similarity at any latency and no significant neural–sensorimotor correlations. However, there is evidence that age of acquisition (AoA) interacts with both the degree of neural overlap between languages and the strength alignment between the neural signal and the sensorimotor model. These preliminary results suggest that multilingual language processing is language-specific across linguistic levels. Although we did not observe robust sensorimotor grounding at the group level, AoA-related modulations hint that earlier acquisition may strengthen rapid access to grounded features. Ongoing work will test whether these patterns hold when jointly modeling more language experience variables in a larger cohort.

DATABLITZ

W18

The network consequences of incoherence: graded perturbations of narrative structure disorganize the language system

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Objective: Incoherent speech is a core feature of formal thought disorder in schizophrenia and reflects disturbed semantic integration, yet it remains difficult to measure objectively. Production tasks reveal disorganization but entangle semantic processes with motor and executive demands. Manipulating coherence during comprehension provides a cleaner way to target the integrative mechanism, and large language models allow this manipulation to be graded and controlled. We hypothesized that increasing incoherence would weaken frontotemporal coupling within the language network. Methods: Using 7T fMRI, we recorded the neural response of a healthy participant listening to genre-matched narratives. The coherence of these narratives was systematically degraded by sampling GPT-4 at increasing temperature values. A functional localizer was used to define language-specific clusters within the language network. Multiple runs per condition were acquired to obtain stable estimates. Functional coupling and graph theoretic measures were assessed across coherence levels. Results: Coherent narratives elicited strong frontotemporal coupling within the language network, consistent with effective semantic integration. Increasing incoherence induced a graded reduction in this coupling and a shift toward a more segregated network architecture. Correlations between inferior frontal and posterior temporal regions dropped from high to moderate values, and the language network showed lower efficiency and higher modularity as incoherence increased. These changes emerged consistently across repetitions. Conclusions: Increasing incoherence weakened frontotemporal coupling and pushed the language network toward a more segregated configuration. This shift mirrored the reduced integration described in formal thought disorder and showed that disrupting narrative structure alone was sufficient to reproduce this network pattern.

W19

Temporal predictive processes in 6-month term-born infants: a preliminary EEG study

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Social synchrony and socio-emotional development of newborns rely on predictive 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 stages of development, adults use infant-directed speech, which is slower than adult-directed speech, primarily in the delta frequency range. Therefore, this study aims to investigate the neural mechanisms of short-term prediction processes in 6-month-old term-born infants. Infants were EEG-recorded while presented with auditory delta or theta rhythmic patterns from a parent or stranger in an omission paradigm. We have predicted a differential effect of the rhythm in each auditory condition. 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 aims to enhance our understanding of the predictive mechanisms underlying human voice processing and our knowledge of short-term predictive brain pathways at an early stage of development.

DATABLITZ

W20

Side by side but also together: Overlapping and distinct neural sources for syntactic structure and lexical probability during spoken language comprehension

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The neural mechanisms that govern the combination of words to form phrases and sentences remain an important open problem in the neurobiology of language. Recent studies have shown that this process is concurrently informed by word probability and knowledge of syntactic structure: both sources of information aid the reconstruction of neural activity. Here, we investigate how this pattern originates by studying the relationship between various metrics of word probability and syntactic structure in intracranial recordings. We analyzed electrocorticography (ECoG) recordings with Temporal Response Functions (TRFs) and a cumulative model comparison approach to evaluate the neural encoding of syntactic and probabilistic features in high gamma power (HGP), delta-band, and theta-band activity. The syntactic features were obtained from constituent hierarchies ('predictive': top-down node counts; 'reactive': bottom-up node counts); and the lexical probability features were obtained from a transformer model (‘predictive’: entropy; ‘reactive’: surprisal). Our results showed that the neural sources of syntactic structure and lexical probability were both overlapping and distinct. Statistical and structural features modulated neural activity in 420 (HGP), 542 (delta band) and 376 (theta band) out of 1377 channels. Among these, 25-30% encoded both syntactic structure and lexical probability, and the remainder encoded only one. There was a similar divide between ‘predictive’ and ‘reactive’ measures of structure and probability. These findings existed across frequency bands. Our findings suggest that joint processing of syntactic structure and lexical probability is performed by several classes of neural populations: populations that represent one type of information, and populations that integrate them.

W21

Separable cognitive and neural mechanisms for word learning and perceptual learning of novel speech

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Perceptual learning and word learning are key adaptive processes in speech comprehension. However, little is known about how they interact when both are task-relevant. For instance, should the speech segment /lɛdər/ be interpreted as an accented form of ‘letter’ or a new word, ‘ledder’? In two online studies and one M/EEG (magneto-/electroencephalography) study, semantically constraining sentence contexts were used to guide participants either towards inferring a pseudoword’s meaning (i.e., word learning; “Every morning, Sophie drank a cup of… /pəbuːf/”) or correcting an accented familiar word’s surface form (i.e., perceptual learning; “The sailors found which way was north using a… /kʌmpəf/”). Study 1 (N=108) demonstrated that participants can engage both learning processes in one task, although the extent of learning depends on the relative number of unique trained items (type frequency) and item repetitions (token frequency). Study 2 (N=180) showed that suitable type and token frequencies result in robust perceptual and word learning persisting at least 12 hours, and that an individual’s success at one type of learning is uncorrelated with success at the other. In Study 3 (N=32), simultaneous M/EEG recordings were collected as participants listened to spoken items before, during, and after training. Analyses revealed lexicality-sensitive clusters of activity prior to training that changed depending on the type of learning to which an item was subjected. The present results provide evidence that perceptual learning and word learning can be induced with a single paradigm, yet they are distinct cognitive and neural processes.

<u>W22</u>

The Integration of Prosody and Semantics in Non-Literal Speech: A Voxel-wise Encoding Model Approach using LLMs

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Irony and sarcasm are complex forms of non-literal language that hinge on a misalignment between surface meaning and speaker intent, requiring listeners to integrate contextual, semantic, and prosodic cues. While prior neuroimaging studies have implicated a broad network—including the temporal cortex, the inferior frontal gyrus (IFG), the medial prefrontal cortex (mPFC), and the temporo-parietal junction (TPJ)—in the comprehension of ironic and sarcastic speech, the precise neural mechanisms underlying the integration of semantic and prosodic information remain unclear. In the present study, we addressed this gap by employing voxel-wise encoding models to systematically identify brain regions specifically involved in combining prosodic and semantic cues during non-literal language comprehension. Participants listened to naturalistic auditory dialogues in which both the discourse context and the target utterance's semantics and prosody were systematically manipulated. We derived custom text embeddings using transformer-based models to capture context-sensitive semantic representations of ironic statements, alongside extracted prosodic features characterizing affective intonation. Ridge regression models were fitted to predict BOLD responses at the voxel level using semantic, prosodic, and combined features and we systematically examined voxels that were best predicted by the combined modalities rather than one or the other. We found that voxels showing the strongest integration effects were mainly localized in the bilateral inferior frontal gyri, temporal speech regions, and the right TPJ.

W23

Using lateralizing verbal and visual learning material to study memory replay via spindle during sleep

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Memory consolidation is known to unfold during sleep. Oscillatory events such as sleep spindles and slow waves seem to support this process through the reactivation of memory representations. However, the role of spindle characteristics in replaying the newly learned material and in predicting post-sleep memory performance remain unclear. In this ongoing repeated-measures study, we use lateralized learning material to test the hypothesis that memory-specific topographies expressed during encoding reappear during sleep spindles and relate to subsequent retrieval.

To date, three participants have completed two experimental sessions each. In every session, participants underwent high-density EEG (64 channels) complemented by EOG and ECG for polysomnographic monitoring. Each session starts with a psychomotor vigilance task (PVT), followed by the encoding of either verbal (eight lists of six semantically related words) or visuospatial material (positions and sequence of 18 abstract figures within an arena). After a first retrieval test, participants took a 90-minute nap, followed by a PVT and a second, post-sleep retrieval test. Delayed recall was additionally assessed the following morning and again one week later via an online procedure.

Encoding-related neural patterns were quantified by contrasting the learning phase against the PVT, isolating topographies specific to memory processing. These were then compared to spindle topographies detected during the subsequent nap to estimate encoding-sleep representational overlap. Preliminary analyses examine whether this overlap occurs, if it is specific to the lateralized learnt material and if it predicts retrieval performance across the three post-learning time points.

W24

Disorganization impairs cognitive maps built from visual inputs

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Objective: Cognitive disorganization is a core disturbance across the psychosis spectrum, marked by difficulties in integrating perceptual information into coherent structure. How such disturbances affect the construction of internal cognitive maps that support conceptual organization, reasoning, and generalization remains unclear. A central question is whether these maps arise as readily from visual perceptual input as from language-based structure and how the resulting representations guide decisions. Methods: Participants with varying levels of schizotypy learned the grading of two variables by sequential fragmented exposure, presented either as image-based or language-based stimuli. They then learned the associations between the graded variables and food items. Participants then judged food-pair similarity and completed a reward-learning task in which unknown rewards depended on each item's location within the unshown 2D map based on the learned graded variables. Results: Among individuals with greater cognitive disorganization, 2D distances were less predictive of similarity-judgment ratings but only in the image-based condition. Computational modeling showed that internal spatial representations guided value-based decisions. Consistent with behavioral findings, higher cognitive disorganization selectively weakened spatial generalization in the image-based condition. Conclusion: Individuals with greater cognitive disorganization showed a reduced capacity to build and use cognitive maps from visual input, while performance remained intact when the structure was provided linguistically. This pattern suggests that a central vulnerability in the psychosis spectrum lies in turning raw perceptual signals into stable internal structure, whereas the ability to work with already organized, conceptually framed information remains largely preserved.

W25

Individual differences in affective learning

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Problematic reward-seeking behavior, wherein individuals persist in the pursuit of reward despite the absence of positive consequences, occurs in a variety of common mental health difficulties such as substance use disorder. Research suggests that certain computational phenotypes are associated with transdiagnostic dimensions underlying problematic reward-seeking. There is uncertainty, however, regarding how stable these computational phenotypes are across time and contexts. This study consisted of five experiments assessing individuals' associative learning profiles across a range of contexts, reinforcers, and modalities, over a behavioral session (N = 214) and a functional magnetic resonance imaging (fMRI) session (N = 80). A wide range of mental health difficulties was assessed through questionnaires. Computational modeling using model-free and model-based models indicated that participants varied in their tendency to rely on state (SPE) and reward prediction errors (RPE) during the Pavlovian learning task conducted in the fMRI. RPEs were identified in the striatum while SPEs were identified in the intraparietal sulcus. Analyses of a behavioral instrumental devaluation task showed variability in sensitivity to devaluation across participants, while eye-tracking analyses showed individual differences in the propensity for sign-tracking and goal-tracking in both a Pavlovian reversal and a Pavlovian extinction task. Network analyses revealed complex interactions between the transdiagnostic mental health dimensions extracted from questionnaires using exploratory factor analysis. These findings provide insight into the ways individual differences in associative learning relate to transdiagnostic mental health factors and to each other across different tasks.

W26

Trasnforming maps into decisions: dynamic allocentric-to-egocentric coding in retrosplenial and parahippocampal cortex

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Navigating familiar environments from novel viewpoints requires transforming stable allocentric maps into transient egocentric motor plans. To elucidate the neural dynamics underlying this process, we employed a virtual navigation paradigm that isolates allocentric-to-egocentric transformation from imagined to actual navigation. Participants learned routes within a three-intersection environment and subsequently repeated or retraced these routes from varying starting locations. Starting at intermediate intersections required allocentric-to-egocentric transformations, whereas starting at the initial or final points relied primarily on egocentric representations. Behaviorally, increased transformation demands elicited a cognitive cost, reflected in longer reaction times.

Univariate fMRI revealed that during imagined navigation, the allocentric reference frame engaged the ventral visual stream (including the parahippocampal area, PHA) and the intraparietal sulcus, in contrast to the dorsal sensorimotor network recruited during purely egocentric navigation. Representational similarity analysis localized transformation-specific codes to the retrosplenial cortex (RSC), PHA, and superior parietal cortex (SPC) during actual navigation. Critically, time-resolved multivoxel pattern analysis demonstrated that, unlike the hippocampus, the RSC–PHA–SPC network shows sustained cross-temporal decoding from imagination to actual navigation. This robust maintenance bridges internal simulation with decision-making, identifying the RSC–PHA–SPC network as a dynamic interface that translates static spatial knowledge into goal-directed action.

W27

Gotta train'em all: presenting BBL's gamified training program for MRI operators

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Becoming an MRI operator is often more of a necessity than a dream to fulfill. This training requires time and a lot of effort, while researchers already have enough challenges to overcome in their careers. That's why this training program doesn't generate much enthusiasm and may even discourage some from venturing into it. But not with us. Because we've created the most exciting operator training program in the universe. It's a gamified training program that immerses the apprentice operator in the role of a character in an epic adventure. Each piece of knowledge to be learned, each skill to be mastered, becomes a milestone to be reached, a goal to be achieved and rewarded. Since the implementation of this system, more than 22 operators have been trained and have contributed to 23 projects representing a total of more than 3,300 hours of acquisition. Motivated to go ever further, the trainee responded enthusiastically to the challenge that awaited them, evolved and keep evolving, like a Pokémon, during this training program, which was once mundane but has now become stimulating and exciting. Apprentices report a sense of constructive rivalry, which creates healthy competition that pushes them all to excel. The challenge is daunting, but the reward is worth it. Who will be the best MRI operator apprentice? Will they ever discover all the secrets of the training program? Come and find out at the Brain and Behaviour Laboratory!

Methods

W28

MRI Adventure: A virtual reality serious game to reduce head motion in pediatric MRI

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Magnetic resonance imaging (MRI) can be stressful for children and often leads to excessive head motion and degraded image quality. Virtual reality (VR) serious games are a promising tool to prepare children for MRI, yet most studies focus on anxiety rather than objective motion. We developed MRI Adventure, an immersive VR serious game that recreates the scanner environment with child-friendly characters and eye- and head-tracking mini-games to teach safety rules, familiarize children with the procedure, and train them to keep their head still.

We retrospectively analyzed 262 MRI scans from children prepared with one of three protocols: (1) VR training + mock scanner + standard explanations (N=137), (2) mock scanner + explanations (N=70), or (3) explanations only (N=55). Head motion was quantified using mean and maximum framewise displacement (FD). Head motion decreased with age. Children in the VR group showed significantly lower mean and maximum FD than children in the other groups (both $p<0.01$). Notably, among the youngest children, those who received VR training still exhibited less in-scanner motion than their peers.

These results suggest that VR serious-game training is a feasible and more effective preparation method to reduce pediatric MRI head motion than standard approaches. To address the limitations of this retrospective trial (i.e., unbalanced group sizes and heterogeneous sequence protocols), we are launching a randomized controlled trial comparing MRI Adventure plus standard care to standard care alone, with primary outcomes of head motion and scan success, and secondary outcomes of child anxiety and acceptability.

W29

What is the maximum yield of EEG? A Simultaneous High-Density EEG And Intracranial EEG Study

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Introduction: High-density EEG (hdEEG) is central to human neuroscience, yet electrical source imaging (ESI) is limited by biases from forward and inverse modeling. To assess the intrinsic capabilities of hdEEG independent of these steps, we used simultaneously recorded intracerebral EEG (iEEG).
Methods: We analyzed spontaneous hdEEG-iEEG recordings from 33 patients across two centers (Geneva, HUG and Milan, Niguarda). As a baseline, the activity of the sources in the gray matter were reconstructed with eLORETA and projected onto iEEG electrode locations to generate “virtual” iEEG. We then computed an optimal linear operator (LSop) mapping hdEEG directly to iEEG via least-squares error minimization. Reconstruction accuracy was measured using correlations, peak localization error (PLE), and spatial deviation (SD). These measures were modelled with generalized linear mixed-effects analyses to compare eLORETA and LSop, and test the influence of electrode depth, iEEG montage, frequency band, hdEEG electrode count, and spike rate.
Results: Median broadband correlation was 0.07 for eLORETA and 0.40 for LSop, with LSop showing zero PLE. Performance decreased with electrode depth ($p<.001$) but was unaffected by spike rate. Delta and theta band activity were better reconstructed than broadband ($p<.001$, $p<.01$) and all bands outperformed beta band ($p<.001$). Accuracy declined with fewer hdEEG electrodes, and bipolar montage was the least well explained.
Conclusion: hdEEG can optimally recover about 40% of iEEG variance. Depth is a fundamental limitation, and low-frequency activity is more faithfully captured than broadband. These findings reveal latent information in hdEEG beyond what standard ESI recovers. Ongoing work includes replication with MEG-iEEG.

W30

Cognitive load modulates human brain excitation–inhibition balance revealed by fMRI dynamics

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Elucidating how the human brain maintains a dynamic balance between excitation and inhibition (E/I) during cognitive processing is fundamental to understanding neural computation and large-scale network organization. Magnetic Resonance Spectroscopy (MRS) remains the only noninvasive technique capable of quantifying glutamate and GABA+, direct neurochemical proxies of E/I balance. However, its limited spatial resolution and reliance on single large voxels constrain whole-brain inference and hinder scalable applications. This gap motivates the development of complementary biomarkers that can estimate E/I balance using widely accessible neuroimaging modalities.

The Hurst exponent (H), a fractal measure reflecting long-range temporal dependencies and scale-invariance in neural time series, has recently emerged as a promising functional proxy for E/I balance. Despite encouraging preliminary evidence, the sensitivity of H to experimental manipulations and its biological validity remain incompletely characterized, particularly in task-based functional MRI (fMRI) paradigms.

In this study, we analyzed four fMRI sessions (i.e. rest, 0-back, 1-back, and 2-back) collected under parametrically increasing working-memory load, alongside MRS data acquired from 36 healthy adults. H was estimated using established fractal analysis methods, including detrended fluctuation analysis and fractionally integrated noise modeling. We observed systematic decrease in H as cognitive demands intensified, along with significant negative associations between H and MRS-derived E/I ratios. These findings suggest that higher excitation relative to inhibition corresponds to decreased temporal persistence in neural activity.

Our results support the Hurst exponent as a scalable, noninvasive biomarker of in vivo E/I balance, enabling broader investigation of E/I dynamics in cognitive function, lifespan development, and neuropsychiatric conditions.

Methods

W31

BOLD signals periodically change during periodic breathing in infants

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Resting-state functional MRI (rs-fMRI) is a valuable tool for investigating brain function and functional connectivity (FC). In adults, a rhythmic respiration pattern is known to bias fMRI analyses by increasing global FC values. However, there is still limited literature in infants regarding the impact of periodic breathing (PB)—a common breathing pattern in infants characterized by repetitive short cycles of respiratory pauses and breathing (typically 10–20 seconds)—on rs-fMRI measurements. This study aimed to clarify the effect of PB on BOLD signal in preterm infants (PT), both at 33- (PT-33w) and 40-weeks (PT-40w) gestational age (GA), and full-term infants (FT). We assessed 7-minute rs-fMRI recordings acquired simultaneously with abdominal respiratory measurements (24 PT and 17 PT scanned at 32.6–34.4 weeks and 37.0–41.1 weeks GA, respectively, and 7 FT scanned at 39.0–41.4 weeks GA). Regional gray-matter BOLD-signal time courses were extracted using the UNC-Cedars Infant Atlas. Synchronized respiratory and BOLD time courses were visually inspected to identify apnea-linked BOLD transients. Nine PT-33w, 10 PT-40w, and 2 FT scans contained at least three continuous respiratory pauses and breathing cycles (PB). Notably, 12 out of these 21 scans including PB showed pronounced BOLD-signal decrease across the entire gray matter following each apneic period. Given that oxy- and deoxy-hemoglobin concentrations are expected to change during apnea (transient hypoxia), these BOLD fluctuations may not reflect underlying neuronal activity and may ultimately bias resulting FC profiles. We highlight the need to consider these PB-associated BOLD signal changes in rs-fMRI analyses in infants.

W32

Mesh-free 3D fULM processing pipeline for monitoring brain activity through changes of blood microcirculation

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Ultrasound localisation microscopy (ULM) is a recent advance that leverages ultrafast imaging and microbubble-based super-resolution to enable non-invasive imaging of deep brain vascular networks at a microscopic resolution of about 10 micrometers. However, extending ULM to 3D dramatically increases data volume and storage requirements, underscoring the need for more efficient, optimised image-processing methods.

Here, we introduce a fully mesh-free 3D fULM data-processing pipeline. Instead of rasterising large 3D matrices of observables, as is conventionally done for 2D data, we analyse the signal on the vascular tree in the continuous domain reconstructed directly from microbubble detections and flow orientations. This strategy enables us to study the dynamic behaviour of key observables—such as microbubble count, velocity, and vessel cross-section—with maximal accuracy, free from rasterisation artefacts, and with substantially reduced storage requirements.

We demonstrate our pipeline on a rat dataset with visual stimulation and obtain whole-brain neurovascular activation maps. While rasterising the data at a single time instance would lead to 1 billion spatial voxels, we obtain a vascular-tree skeleton represented only by 30 thousand reference points. In particular, we observe changes in vessel cross-sections at the origins of feeding arterioles, providing new insight into neurovascular coupling. These changes are too small to be detected with standard rasterised methods, underscoring the importance of our mesh-free pipeline.

W33

Structure-function coupling in microstructure-weighted connectomes

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Structure-function coupling varies across the brain (Fotiadis et al., Nature Reviews Neuroscience, 2024). This coupling has been predominantly explored using the number of streamlines (NOS) from tractography as a structural connectivity edge weight, in relation to BOLD fMRI functional connectivity. Here, we explored regional structure-function using microstructure-sensitive parameters from diffusion tensor imaging (DTI) or biophysical diffusion modelling (standard model imaging; SMI) as alternative weights of SC edges. In n = 66 subjects from the Human Connectome Project, we constructed structural connectomes at four parcellation scales (82, 128, 230, 460 regions), using white matter bundles from Alemán-Gómez et al., (Scientific Data, 2022). Structural connectomes were weighted by NOS, DTI parameters fractional anisotropy (FA) and radial diffusivity (RD), and SMI parameters axon signal fraction (f) and perpendicular extra-axonal diffusivity (Deperp), specific to axonal density and myelination, respectively. Functional connectivity (Pearson correlation) was measured from resting-state fMRI. Structure-function coupling was measured for each brain region as the Spearman correlation between group-average structural and functional edge weights connected to that region. Despite weak structure-function coupling at the whole-brain level, connectomes weighted by diffusion metrics had high regional structure-function coupling. Connectomes weighted by NOS and Deperp had strongest and most widespread coupling, with patterns reflecting previously reported gradients in structure-function coupling across the cortex (Vázquez-Rodríguez et al., PNAS, 2019). While structure-function coupling patterns in NOS-weighted connectomes exhibited a dependence on spatial scale, Deperp-weighted connectomes were robust to parcellation scale. Thus, microstructure-weighted connectomes could be better suited for structure-function coupling analyses across spatial scales.

W34

Brain functional alignment in the age of generative AI

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Anatomical and functional inter-individual variability poses a significant challenge to group analysis in neuroimaging studies. While anatomical templates help mitigate morphological differences by coregistering subjects in fMRI, they fail to account for functional variability, often leading to blurred activation patterns on the template due to group-level averaging. To address this problem, hyperalignment identifies fine-grained correspondences between functional brain maps of different subjects, with Procrustes analysis and optimal transport being among the most effective approaches. However, many hyperalignment based imaging studies rely on the selection of a single target subject as the reference to which all other subjects' data are aligned; the introduction of functional templates eliminates the need for this arbitrary selection, effectively encapsulating population similarities while preserving anatomical coherence.

In this talk, we first review the strongest brain alignment techniques and the resulting template estimation procedures. We discuss the validation of such templates through decoding experiments, both in standard classification settings and using recent generative decoding approaches, where functional alignment integrates well with deep phenotyping approaches. We present preliminary results on the impact of functional alignment on cross-species brain data analysis.

W35

Characterizing building blocks of reaction times with single-trial EEG modeling

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Breaking down the nature and speed of information processing operations occurring in the time interval between a stimulus and a response, i.e. the reaction time (RT), allows a better understanding of behavior. However, characterizing these cognitive processes is complicated by the particular statistical properties of reaction times and the restricted information coming from using behavior alone. Co-registration of physiological measurements, such as electroencephalograpy (EEG), and RT can provide information about the temporal unfolding of these cognitive processes. However, the low signal-to-noise ratio of these measures and the large between trial variation of the underlying neural generators make them challenging to use. In this presentation, we will introduce hidden multivariate pattern analysis. This method models the EEG signal during the reaction time as a sequence of an unknown number of events that recur over trials at different times. It estimates the expected time distributions and topographies of each event, thereby transforming noisy, single-trial neural data into a trial-by-trial probability distribution for each sequential event that leads to the response. We will demonstrate the application of this method to typical paradigms, such as oddball and visual search tasks, as well as to more complex behaviors, such as decision-making and cognitive control tasks. These examples demonstrate the method's ability to determine the timing of single-trial events related to RT and thereby leverage the effect of experimental conditions on their average time and topographies to elucidate their functional roles.

W36

Towards layer-dependent EEG-fMRI connectomics

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Both the Electroencephalogram (EEG) and functional Magnetic Resonance Imaging (fMRI) are non-invasive methods to capture human brain activity. Both modalities can map the functional connectivity structure at the whole-brain scale. 7T-fMRI enables measuring sub-mm layer-dependent activity. We previously showed that a moderate connectivity correlation can be reliably reproduced across different setups, including at 7T. We recently demonstrated that sub-mm fMRI with simultaneous EEG acquisition is feasible. Macrovascular venous signals contaminate 2D-EPI layer-dependent fMRI, but the impact on the EEG-fMRI correlation is unexplored.

Here we explored 13 eyes-open resting-state EEG-fMRI recordings using a 64 channel EEG (Brainproducts) in a 7T Terra MRI Scanner (Siemens). The study confirms our previous findings that EEG connectivity is moderately correlated to fMRI connectivity (r~0.3), with the largest correlation between beta-EEG and fMRI (r=0.35). We further show that connectivities of surface, intermediate, and deep layers are moderately correlated to all EEG bands. The surface layer connectivity was less correlated to EEG than the intermediate and deep layers (e.g beta-EEG vs. fMRI surface/intermediate/deep r=0.33/0.34/0.35).

We confirm that a 0.8-mm fMRI protocol can be used to derive reliable EEG-fMRI connectomes in line with our previous results. We further show that this approach extends to cortical layers and that the mixing of macrovascular signals, dominant close to the pial surface, might contribute to a lower EEG-fMRI correlation. Future work will investigate the impact of removing unwanted venous signals to better understand the interactions between EEG and layer fMRI.

Perception

DATABLITZ

W37

Seeing the invisible: Pareidolia as a window into the creative brain

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Creativity, a key process of human cognition, is notoriously difficult to study. Conventional tasks measuring individual creative production in the lab are often very stressful and associated with large inter-trial variability. Here, we asked whether the creative process might be captured by a simple perceptual task, in which ambiguous shapes are perceived as meaningful forms—for example, faces in clouds or a coffee stain seen as a snail. These spontaneous perceptions, called pareidolia, substantiate the generation of meaning from noise, which we propose is the shared, foundational component of any creative process. One hundred participants completed a pareidolia task in which they viewed noisy fractal images and described what they perceived in them. The number and originality of reported pareidolia were compared with two standard creativity metrics: a questionnaire probing everyday creative accomplishments and a divergent association task. Participants' brain activity was continuously recorded with high-density EEG to capture perceptual signatures emerging from noise and neural markers of creativity. Individual pareidolia performance significantly correlated with classical creativity measures and required only a few trials to obtain stable estimates of creativity. Moreover, trial-by-trial pareidolia responses were highly consistent. We next established that pareidolic content elicited electrophysiological responses similar to actual perception: (i) emotional pareidolia (e.g., a crying woman) were associated with increased heart rate, and (ii) human pareidolia elicited a larger face-sensitive N170 than animal pareidolia. Our findings demonstrate that pareidolia provides an engaging, rapid, and reliable measure of creativity, with objectifiable neural signatures.

W38

When the brain prepares to act: how response expectation shapes serial dependence and neural representations

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Human perceptual decisions are serially dependent and biased by recent experience. Prior studies have shown that the strength and direction of these biases—whether attractive or repulsive—can vary depending on whether an explicit response was made on the preceding trial. In particular, omitting a response tends to weaken attractive biases or shift them toward repulsion. One possibility is that no-response trials, especially when randomly intermixed with responses, induce an expectation to respond on the next trial. This expectation may reengage attention, enhance the precision of current stimulus representations, and increase their discriminability from past inputs—ultimately promoting repulsive biases.
We tested this hypothesis using a classic orientation reproduction task combined with EEG recordings. At the behavioral level, omitting a response on the previous trial increased repulsive serial dependence on the current trial. At the neural level, this was accompanied by enhanced EEG markers of attentional engagement, such as stronger global field power at latencies compatible with attention effects. Inverted encoding model analyses further revealed greater precision in the neural representation of the current stimulus orientation following no-response trials. Together, these findings suggest that serial dependence is not driven by static mechanisms but reflects dynamic fluctuations in task expectation and attentional state.

Perception

TRAVEL GRANT

W39

Preserved unimodal-transmodal functional hierarchy differentiation in patients with blindsight

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Damage to the visual cortex leads to clinical blindness. Yet some patients retain visual functions and respond to stimuli they do not consciously perceive; a condition known as blindsight. Recent neuroimaging indicates that variations in consciousness alter functional connectivity across the brain's hierarchy, from unimodal to transmodal areas. Here we explore whether changes in resting-state functional connectivity serves as biomarkers for distinguishing conscious and non-conscious visual processing using the largest cohort of blindsight patients to date.

Blindsight was assessed using a two-interval detection task in patients with visual cortex damage, grouped into blindsight-positive (B+, n=8) and blindsight-negative (B-, n=8). Resting-state functional MRI data were collected from all patients and age-matched healthy controls (n=17). Connectivity was analysed using mutual information, where lower values indicate greater diversity and lower coupling.

B+ patients retained a functional connectivity pattern differentiating unimodal and transmodal areas, unlike B- patients whose hierarchical organization was altered compared to controls. Proficiency in non-conscious stimulus detection correlated significantly with preserved connectivity along the sensory-to-association axis. Hierarchical disruption correlated with decreased mutual information within somatosensory and visual networks, maximally expressed in the posterior thalamus (compatible with pulvinar location).

Despite similar lesion sizes and locations, blindsight relates to preserved large-scale functional organization, positioning sensory-motor and transmodal regions at opposite ends of the hierarchy. Mutual information differences in the posterior thalamus correlate with blindsight and cortical functional segregation. This suggests adaptive brain plasticity enabling compensation for cortical damage and non-conscious visual processing.

W40

Do people who care more about smell process odors differently? Behavioral and neural evidence from 101 participants

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Olfaction plays a crucial role in everyday life, yet individuals differ considerably in the importance they attribute to odors and in their sensitivity to environmental sensory stimuli. While these traits are assumed to shape how people process olfactory stimuli, it remains unclear whether such subjective differences are reflected in objective psychophysical olfactory performance and neural responses to odors. Critically, most existing studies examine behavioral and neural markers separately, leaving unanswered how these interindividual differences relate across both behavioral and neural levels. The present study leverages a large multimodal dataset to explore how the subjective importance of olfaction and self-reported sensory sensitivity relate to psychophysical olfactory performance and odor-evoked brain responses. A total of 101 healthy adults (51 women – 50 men; Mage = 25.7 ± 6.6 years) completed the Sniffin' Sticks test (threshold, discrimination, identification) along with a battery of questionnaires including the Importance of Olfaction Questionnaire (IOQ) to assess how participants value olfaction in daily life and the Clobert Adult Sensitivity Scale (CASS) to assess sensory sensitivity. Participants then underwent a functional Magnetic Resonance Imaging (fMRI) session in which their brain activity was recorded while they smelled 50 different everyday odors. Integrating psychophysical, self-report, and neural measures within a single dataset offers a valuable opportunity to explore whether individuals who attribute a greater importance to olfaction, or who report heightened sensory sensitivity, exhibit enhanced olfactory performance or stronger odor-evoked brain activations. This comprehensive dataset also allows an exploratory investigation of potential sex differences.

W41

Low attentional states trigger perceptual filling-in

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Filling-in refers to the perceptual replacement of a figure by its background after a period of steady fixation. Here, we studied the effect of attention on the perceptual filling-in of a grey figure presented on a dynamic texture background. The spreading of the background texture into the region representing the figure may be mediated by long-range horizontal connections in early visual cortex and/or feedback from higher areas. Attention is thought to suppress horizontal connectivity in early visual cortex and thus may suppress filling-in. Here we present three separate studies to support this hypothesis.

Pupillometry revealed a pupil constriction before filling-in onset, a known marker of reduced arousal and attenuated attention. We also use EEG tracking of alpha-band power and lateralization to track spatial attention prior filling-in onset. Behavioral monitoring using a novel gradual Continuous Performance Task (gradCPT) showed increased reaction time variability preceding filling-in, signaling a low-attentional state.

So far, our results point to low attentional states predicting perceptual filling-in, in line with a facilitation of horizontal connectivity in the absence of directed attention, which may promote spreading of the background representation into the region occupied by the figure.

Perception

W42

Prediction Dynamically Modulates Gain and Tuning-Width of Frequency Tuning in Human Auditory Cortex

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Predictive processing frameworks propose that the brain attenuates predictable (expected) information to remain sensitive to novel items. This cancellation view has been criticised for overlooking the need for perception to remain veridical, not driven by novelty alone. To reconcile this balance, dual-opponent theory proposes that neural tuning properties may change - sharpen or dampen – as predictive estimates are updated (Press, Kok, & Yon, 2020). Prior work has tested this hypothesis primarily through multivariate decoding, where changes in sensitivity to expected or unexpected inputs are taken as indirect signatures of population tuning. Here, we outline a framework that enables a more direct assessment of how population tuning dynamically adjusts in response to ongoing predictions. Using dynamic pure-tone sequences with shifting sampling probabilities, we model how the predictive landscape evolves across frequency space (Skerritt-Davis & Elhilali, 2021) and link these fluctuations directly to population receptive field (pRF) structure in auditory cortices. Within this framework, we focus on two mechanistic possibilities: (i) gain modulation, in which unexpected events increase overall responsiveness across frequency channels, and (ii) tuning-width modulation, in which precision-weighted predictions sharpen responses around expected inputs. By fitting these models to layer-resolved 7T fMRI, we probe whether surprisal and precision-weighted predictions map onto gain changes, tuning-width modulation, or both. Our results indicate co-occurring gain modulation driven by momentary surprisal and modest sharpening around predicted frequency channels. Together, these findings illustrate how the auditory system balances responsiveness to unexpected, potentially informative inputs with increased selectivity for expected structure.

W43

Emotional and cross-modal guidance of eye movements in the absence of visual awareness

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We usually move our eyes towards parts of the visual scene we consciously perceive. However, some visual stimuli also attract eye movements in the absence of visual awareness. Here we show that unseen images guide the eyes when these images are emotionally charged or paired with a congruent sound or a congruent action. We rendered images invisible using continuous flash suppression and verified full suppression from awareness with objective and subjective measures. Eye tracking results revealed that the eyes are repelled by angry faces and attracted by fearful faces and by faces of a different race. Eyes are also attracted by neutral faces when paired with a congruent voice, by threat-related car images when paired with a congruent sound and by action-related body part images when paired with an action. Thus, when visual stimulus representations of unseen images are sufficiently strengthened, either by emotional charge or cross-modal congruence, they have the power to guide eye movements even in the entire absence of visual awareness.

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

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MOYNE	MAËVA	T25*
MUCKLI	LARS	
MÜLLER	MATTHIAS	
MULLIN	KATHERINE	
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NACCACHE	LIONEL	
NILSSON	MARTIN	T34*
NONNI	MARTINA	T13*
OLASAGASTI	ITSASO	M38
ORSENIGO	DAVIDE	T37 W39*
PALOMINOS	CLAUDIO	O15
PARKS	RICHARD	
PEREIRA	MICHAEL	M44*
PETRI	GIOVANNI	T24* T37 W16 W39
PETROVA	TEYA	T09*
PETRUSO	FLAVIA	T35* W16
PIGNAT	JEAN MICHEL	
PIRON	NICOLAS	M38 T26*
POOL	EVA	W25
PRETI	GIULIA	T21 T36 W16*
PROIX	TIMOTHÉE	
PYLKKANEN	LIINA	
QUOSSI	ANAIS	T17 W40*
RABE	FINN	W05 W18 W24
RAMBOSSON	ISABELLE	W19*
RAZAFINDRAHABA	ANNA	W41*
RENTON	ANGELA	M45*

RETSA	CHRYSA	T48*
RIGONI	ISOTTA	M35 W23*
ROEHRI	NICOLAS	M10 M35 M39 W29*
ROS	TOMAS	M36 T30
SACCARO	LUIGI FRANCESCO	O4 T03 T11*
SALAGNON	MATHILDE	T17* W40
SANDER	DAVID	T17 W25 W40
SANI	ILARIA	M12 W26
SANTORO	ANDREA	T37* W16
SAUSENG	PAUL	T22 T27
SAVIOLA	FRANCESCA	O4 W30*
SCHMIDT	LÉA	M34 W01 W02*
SCHOLLAERT	LOÏC	W03*
SCHWARTZ	SOPHIE	M19 M24 M38 T16 T26 T36 T46 W14 W23 W37
SCOTT	ZOË	
SHERIF ADLY RIZK ABDOU	SARAH	M07 W04
SHI	CHUNYAN	W13*
SHIRAKI	ANNA	M21 W31*
SHPEKTOR	ANNA	O10*
SIFFREDI	VANESSA	M34 W01 W02*
ŠKULTÉTY	VIKTOR	W32*
SLAATS	SOPHIE	W20*
SONG	JIE	W26*
SOULIÉ	PAOLA	M19 W14*
SPENCER	ARTHUR	M33 W33*
STASYTYTE	MONIKA	O6*
STERPENICH	VIRGINIE	M19 M24 T16 T36 W14 W23
STIENNON	EMMA	M15 W06*
STRZELCZYK	DAWID	T03 T44 W07*
TAHEDL	MARLENE	T12* W18
TEICHMANN	LINA	O19*
THIRION	BERTRAND	W34*
TOPAL KEMENT	IREM	W08*
TZOVARA	ATHINA	
VALLISA	SAMUELE	O15
VAN DE VILLE	DIMITRI	O9 M04 M33 M35 M45 T06 T11 T21 T35 T36 W16 W30 W32 W33
VAN HAREN	JORIE	W42*
VEBER	JULES	M22 T07
VETTER	PETRA	T45 W43*
VILLAR ORTEGA	EDUARDO ENRIQUE	T38*
VON DER WEID	LAURE	W09*
VUILLEUMIER	PATRIK	M06 T13 T14 T17 T25 T39 T40 T42 W13 W16 W26 W40

VULLIEMOZ	SERGE	W29 W36
WAN	BIN	O13* T02
WEINDEL	GABRIEL	W35*
WEISS-COWIE	SAMUEL	W21*
WILDGRUBER	DIRK	W10*
WIRSICH	JONATHAN	M10 M28 T25 W13 W36*
WITTMANN	ADRIEN	W22*
WOJCIECHOWSKI	JAKUB	
WU	XIAOYAN	W24*
WUENSCH	LAVINIA	W25*
WYART	VALENTIN	T23
YANG	NI	O15 M23*
ZAFFINA	LORENZO	W16*
ZAMORA	LEA	W11*
ZERBI	VALERIO	M40