Alpine Brain Imaging Meeting

Champéry, Switzerland, January 7-11, 2024

P R O G R A M

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

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Alpine Brain Imaging Meeting

Champéry 2024

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Locations:

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

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

GENERAL INFORMATION

Registration will take place at the *Hotel Suisse* (Rue du Village 55; see map) on Sunday, the 7th of January from 16:00 to 17:30. During the following days, participants can register in the conference room at the *Palladium* conference center (Route du Centre Sportif, 1), only during meeting hours, from 15:00 to 20:00. Additional information can also be obtained at the *Hotel Suisse* outside these hours.

The **opening keynote lecture** (Sunday at 17:30) will be held at the *Hotel Suisse* (Rue du Village 55) and will be followed by an informal **welcome reception** with wine & snacks. All other **talks** and **poster sessions** during the week will take place at the *Palladium* conference center (see program). Posters should be exposed throughout the conference from Monday to Wednesday to allow sufficient viewing time for all participants. **Three poster sessions** will be held on Monday 8th, Tuesday 9th and Wednesday 10th of January in the afternoon (see program and poster map). Speakers are invited to check their presentation in the conference room no later than at 15:00 on the day of their lecture.

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

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

A **farewell dinner** is planned on Thursday night at the restaurant *Le Gueullhi* (Route de la Fin, 11). The dinner will be free for all registered participants, excluding drinks. Please refer to the staff at the registration desk before Tuesday January 9th for any changes regarding your participation to the

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

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

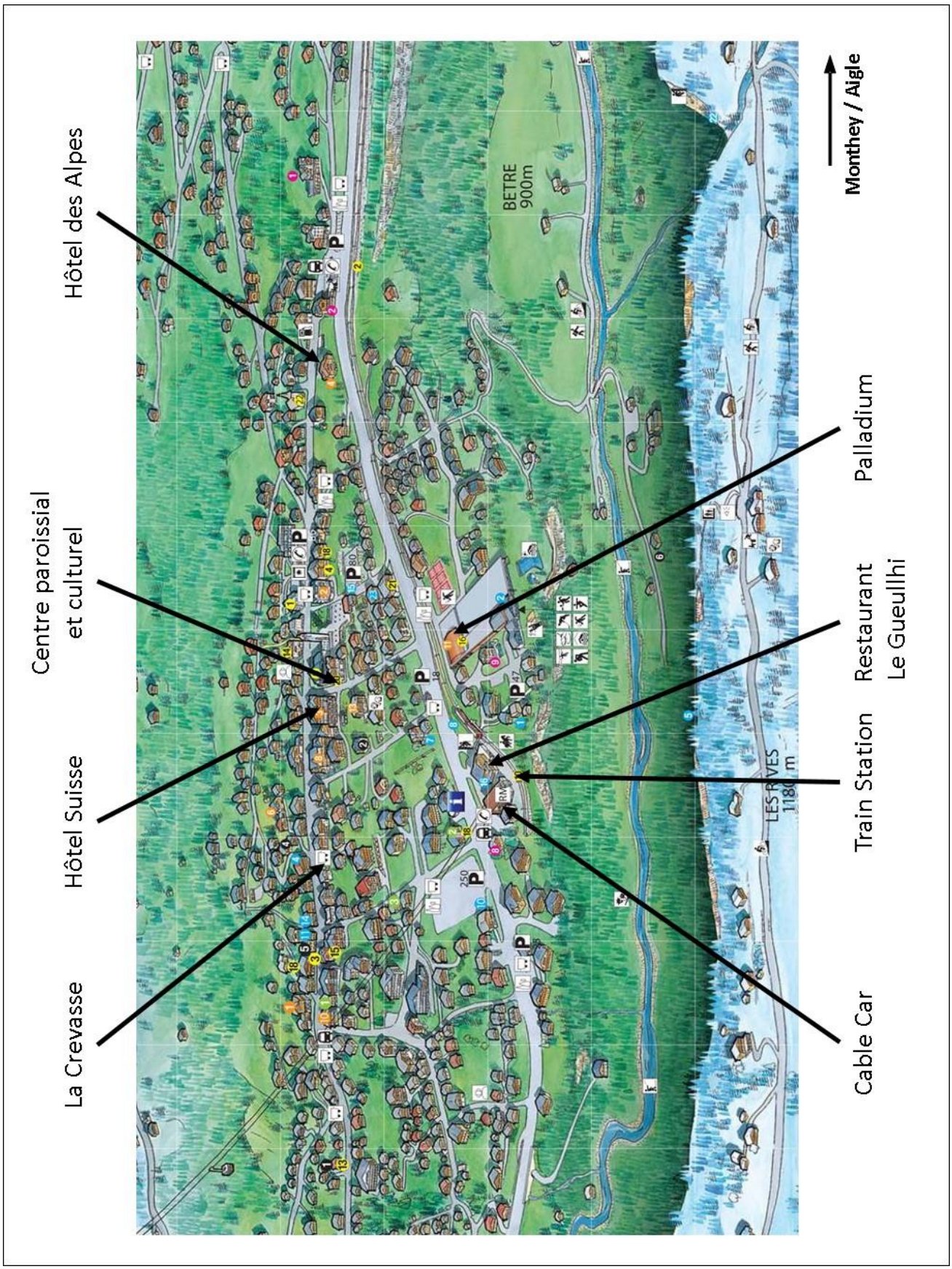
A **swimming pool** and **skating arena** can also be found at the *Palladium*.

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

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

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

MAP


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

Alpine Brain Imaging Meeting

2024

PROGRAM

SUNDAY, January 7th

OPENING LECTURE

16:00-17 :30 **Registration** (Hotel Suisse)

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

Nancy KANWISHER | Massachusetts Institute of Technology (MIT), Boston, MA, USA

- *How Deep Learning Can Inform the Functional Organization of the Human Brain*

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

MONDAY, January 8th

Evolution and Neurobiology of Language

15:00 Welcome Coffee & posters

15:30 **Adrien MEGUERDITCHIAN** | Université Aix-Marseille, Marseille, France

- *The Gestural Origin of Language: What Baboons' Gestures & Brain Specialization have told us*

16:15 **Maël MAUCHAND** | McGill University, Montreal, Canada

- *How the voice elicits empathy: the case of complaints*

16:35 **Leonardo CERAVOLO** | University of Geneva, Switzerland

- *Directed lateral-to-medial temporal lobe connectivity underlies improved voice perception in noise*

16:55 **Coffee Break**

17:25 **Nina KAZANINA** | University of Geneva, Switzerland

- *Neurobiological substrate for language: What's on the agenda?*

18:10 **Paul SAUSENG**| University of Zurich, Switzerland

- *One to rule them all: Oscillatory brain activity as unified control mechanism for working memory and social cognition*

18:30 **Amelie HAUGG** | University of Zurich, Switzerland

- *Brain response dynamics during novel script reading as compared to familiar script reading*

18:50 **Poster Blitz Presentations**

19:00 - 20:15 **Poster Session: Emotion & Motivation; Language & Music; Perception;**

- with apero *sponsored by*

TUESDAY, January 9th

Brain Connectivity

15:00 Welcome Coffee & posters

15:30 **Catie CHANG** | Vanderbilt University, USA

- *Tracking time-resolved brain and physiological states in the individual*

16:15 **François Stockart** | Univ. Grenoble Alpes, Univ. Savoie Mont Blanc, CNRS, Grenoble, France

- *Cortical evidence accumulation for perceptual experience occurs irrespective of reports*

16:35 **Lars Muckli** | University of Glasgow, UK

- *The cortical microcircuitry of contextual processing in mice, monkeys, and humans*

16:55 **Coffee Break**

17:25 **Satu PALVA**| University of Helsinki, Finland

- *Regulation of brain oscillation and synchronization dynamics*

18:10 **Sandrine De Ribaupierre** | Western University, London, Canada

- *Exploring Functional Pathways and Corpus Callosotomy Microstructure in Infantile Hydrocephalus*

18:30 **Nawal KINANY** | University of Geneva & EPFL, Switzerland

- *In vivo parcellation of the human spinal cord functional architecture*

18:50 **Poster Blitz Presentations**

19:00 - 20:15 **Poster Session: Methods; with apero.**

WEDNESDAY, January 10th

Hedonia, Anhedonia

15:00 Welcome Coffee & posters

15:30 **Diego PIZZAGALLI** | Harvard University, USA

- *Translational and Cross-Species Approaches to Anhedonia: Implications for Treatment Development and Stratification*

16:15 **Luigi SACCARO** | University of Geneva, Switzerland

- *Hippocampal dynamic connectivity in emotion dysregulation disorders patients and offspring: a transdiagnostic vulnerability marker?*

16:35 **David ROMASCANO** | EPFL & University of Geneva, Switzerland

- *Relationship between limbic tract integrity, substance addiction and neuropsychiatric fluctuations in Parkinson's disease*

16:55 **Coffee Break**

17:25 **Morten KRINGELBACH** | University of Oxford, UK

- *Meaning making: Discovering the underlying hierarchical brain orchestration using music and whole-brain modelling*

18:10 **Enya M. WEIDNER** | Bielefeld University, Germany

- *Differential contributions of left and right temporal lobe resections to emotional face perception: Evidence from event-related potentials and stimulus-induced gamma-band activity*

18:30 **Charline PEYLO** | University of Zurich, Switzerland

- *Oscillatory signatures of memory matching in visual perception*

18:50 **Poster Blitz Presentations**

19:00-20:15 **Poster Session: Clinical Neuroscience; Learning & Memory; with apero**

sponsored by Champéry

THURSDAY, January 11th

Clinical Multimodal Neuroimaging

15:00 Welcome Coffee & posters

15:30 **Gael CHETELAT** | Inserm, French institute for biomedical research, Caen, France

- *What does neuroimaging tell us about depression and meditation in aging populations?*

16:15 **Dorothea FLORIS** | University of Zurich & Donders Institute for Brain, Cognition, and Behavior, Radboud University Nijmegen

- *The individual-level, multimodal neural signature of face processing in autism within the fusiform gyrus*

16:35 **Joana SA DE ALMEIDA** | University of Geneva, Switzerland

- *Microstructural cortical maturation underlies longitudinal BOLD signal variability of emerging resting-state networks in preterm infants*

16:55 **Coffee Break**

17:25 **David CARMICHAEL** | King's College, London, UK

- *Structural and functional imaging of epilepsy at 7T*

18:10 **Emanuela DE FALCO** | EPFL, Lausanne, Switzerland

- *Subcortical and cortical neural signatures of hallucinations in Parkinson's disease*

18:30 **Fazilet Zeynep YILDIRIM-KELES** | University of Fribourg, Switzerland

- *Cross-validating the neurofunctional electrophysiological markers of early face categorization*

18:50 **Povilas TARAILIS** | University of Geneva, Switzerland

- *The sources of EEG microstates*

19:10 **Poster Blitz Presentations** | Travel Grant Awards *sponsored by*

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- **Enya Weidner** | Bielefeld University, Germany

  Differential contributions of left and right temporal lobe resections to emotional face perception: Evidence from event-related potentials and stimulus-induced gamma band activity

- **Akanksha Gupta** | Aix-Marseille Univ, Inserm, INS, Marseille, France

  Decoding Spatiotemporal Processing of Speech and Melody in the Brain

- **Ilenia Salsano** | Boys Town National Research Hospital, Boys Town, USA

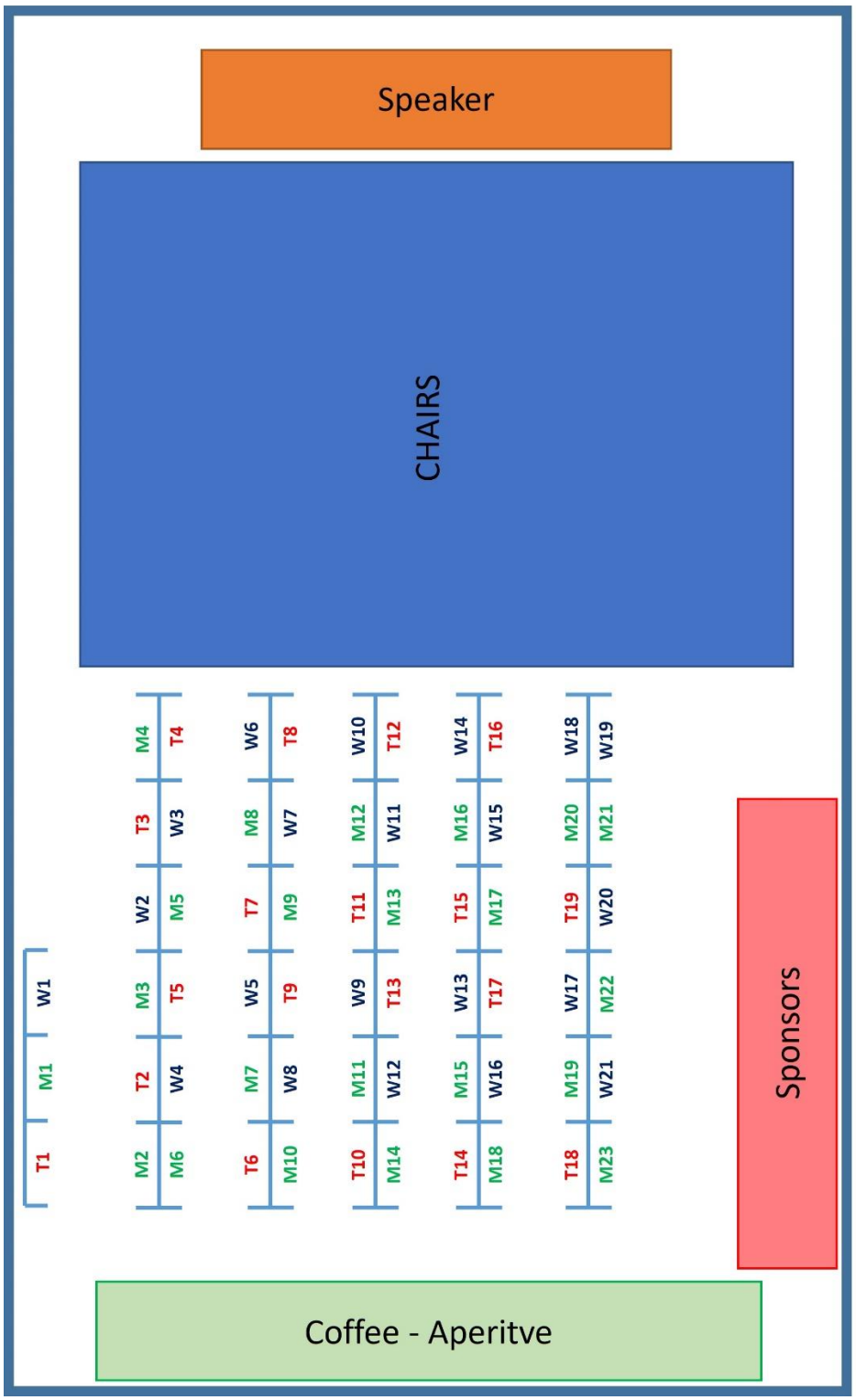
  Neural correlates of semantically driven visual search in naturalistic scenes in older adults.

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

with prize ceremony *sponsored by* Springer

- *Restaurant "Le Gueullhi"*

POSTER MAP


Speaker
CHAIRS
Sponsors
Coffee - Aperitve
T1 M1 W1
M2 M6 T2 W4 M3 T5 W5 T9 W2 M5 T7 M9 W3 T3 M8 W7 T4 M4 W6 T8
T6 M10 M7 W8 W9 T13 W10 T12 M11 W12 T11 M13 W11 T10 M12 W13 T17 W14 T16 M15 W16 T15 M17 W15 T14 M16 W17 M22 W18 W19 T18 M19 W21 T19 W20 M20 M21 M23
W1-W17 Clinical Neuroscience
W18-W21 Learning & Memory
T1-T19 Methods
M1-M7 Emotion & Motivation
M8-M17 Language & Music
M18-M23 Perception

ABSTRACTS OF ORAL PRESENTATIONS

The themes of the days are:

Sunday: OPENING LECTURE

Monday: EVOLUTION AND NEUROBIOLOGY OF LANGUAGE

Tuesday: BRAIN CONNECTIVITY

Wednesday: HEDONIA, ANHEDONIA

Thursday: CLINICAL MULTIMODAL NEUROIMAGING

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

Sunday

Opening Lecture

O1 ☆

How Deep Learning Can Inform the Functional Organization of the Human Brain

Nancy Kanwisher[1, 2]

[1]Department of Brain and Cognitive Sciences, Massachusetts Institute of Technology, Cambridge, USA, [2]McGovern Institute for Brain Research, Massachusetts Institute of Technology, Cambridge, USA

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The last 25 years of research in cognitive neuroscience have given us a glorious new picture of the human mind and brain, revealing a set of cortical regions with highly distinctive functions, from face recognition to music perception to thinking about what another person is thinking. Each of these regions is present in approximately the same location in virtually every normal person. I think this counts as real progress, by revealing an initial rough sketch of the human mind. But at the same time, our new map of the mind is still quite rudimentary and leaves the most fundamental unanswered. What are the actual computations that go on in each of the functionally distinct cortical regions we have identified? How might this organization, and these particular regions, arise over development and/or evolution? And why is this modular organization a good way to design a brain in the first place? I used to think these questions were out of reach, at least in my lifetime. But I now think that the recent advances in AI have given us tools that enable us to make important progress in answering these questions. In this talk I will sketch some of the initial steps we have taken in my lab to start to address these questions using artificial neural networks.

Monday

Evolution and Neurobiology of Language

O2 ☆

The Gestural Origin of Language: What Baboons' Gestures & Brain Specialization have told us

Adrien Meguerditchian[1]

[1]CNRS/Université Aix-Marseille, Marseille, France

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Language is an unique communicative system involving hemispheric lateralization of the brain. This lateralization is visible at the structural level, even at birth, in key cortical language areas, such as the perisylvian Planum Temporale, its main connecting fiber track with Broca's area - the arcuate fasciculus and the STS. To discuss the question of language origins, I will highlight the works on the communicative gestures in our primate cousins and their brain correlates. Indeed, nonhuman primates communicate mostly communicate not only with a rich vocal repertoire but also with manual and body gestures. In the last 20 years, we investigated this gestural system in the baboons Papio anubis, an Old World monkey species, as well as its lateralization and cortical correlates across development, using both ethological, psychology and longitudinal noninvasive in vivo brain imaging approach (MRI). In the present talk, I will summarize our main findings showing similar key intentional, referential "domain general" properties of language as well as some similar underlying structural hemispheric specialization including Broca, the Planum Temporale and the STS. I will also present our recent MRI longitudinal work documenting their brain ontogeny from birth and how they pave the way for the further emergence of gesture lateralization across development. It is thus not excluded that gestural signaling may have played a critical role in the phylogenetic roots of language brain organization and dated back, not to the Hominidae evolution, but rather to their much older Catarrhine common ancestor 25-40 million years ago.

Evolution and Neurobiology of Language

O3

How the voice elicits empathy: the case of complaints

Maël Mauchand[1, 2, 3], Jorge Armony[1, 2], Marc Pell[1, 2]

[1]McGill University, Montreal, Canada, [2]Centre for Research on Brain Language and Music (CRBLM), Montreal, Canada, [3]Swiss Center for Affective Sciences (CISA), Geneva, Switzerland

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Empathy is a phenomenon that we experience daily, across a multitude of social interactions, prompting us to share and understand others' feelings. In particular, complaints are emotive speech acts during which speakers aim to elicit empathy by vocally conveying signals of suffering and distress. The present fMRI study investigated how the prosody of complaints is processed by listeners and how these processes may relate to empathy. Twenty-four French participants listened to short utterances describing a painful event that were either produced in a neutral-sounding or complaining voice. Moreover, to assess the potential influence of culture, utterances were produced by both ingroup (French) and outgroup (French-Canadian) speakers, whose identities are marked by distinct accents, resulting in a within-subject two (emotional prosody)-by-two (regional accent) design. Analysis of BOLD signal revealed that complaining prosody increased activity in emotion- and voice-sensitive regions along the bilateral superior temporal cortices, auditory cortices, orbitofrontal cortices, and amygdala. Activity in the Salience network (anterior cingulate and anterior insula) and Theory-of-Mind areas (temporo-parietal junction, medial pre-frontal cortex, precuneus), traditionally associated with affective and cognitive aspects of empathy, respectively, was also modulated by complaining prosody and specifically correlated with how hurt speakers were perceived. Culturally, utterances produced by ingroup speakers elicited increased sensorimotor responses while outgroup speech modulated default mode and temporal activity, suggesting accent-based differences in empathic perspective. These results bring the neuroscience of empathy into everyday-life communication and extend the role of key empathy networks and emotional voice areas to new social and cultural contexts.

Evolution and Neurobiology of Language

O4

Directed lateral-to-medial temporal lobe connectivity underlies improved voice perception in noise

Leonardo Ceravolo[1, 2], Elisa Scariati[3], Sascha Frühholz[4, 5, 6, 7], Dimitri Van De Ville[8, 9], Didier Grandjean[1, 2]

[1]Neuroscience of Emotion and Affective Dynamics lab, University of Geneva, Geneva, Switzerland, [2]Swiss Center for Affective Sciences, University of Geneva, Geneva, Switzerland, [3]Developmental psychiatry unit, Psychiatry department, Geneva University Hospital, Geneva, Switzerland, [4]Neuroscience Center Zurich, University of Zürich and ETH Zürich, Zürich, Switzerland, [5]Cognitive and Affective Neuroscience Unit, University of Zürich, Zürich, Switzerland, [6]Center for the Interdisciplinary Study of Language Evolution (ISLE), University of Zürich, Zürich, Switzerland, [7]Department of Psychology, University of Oslo, Oslo, Norway, [8]Department of Radiology and Medical Informatics, University of Geneva, Geneva, Switzerland, [9]Center for Biomedical Imaging, Swiss Institute of Technology, Lausanne, Switzerland

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Social interactions between humans usually take place in situations in which noise is more than often present, sometimes even overwhelming. In a series of three studies—two fMRI studies and one behavioral study, we address the understudied research field of voice processing and perception in noise. We put a special emphasis on behavioral and underlying neural mechanisms allowing for improved voice perception in varying levels of background noise, illustrating everyday life events and general communication. Combining behavior with whole-brain, directed/undirected functional and effective connectivity, multi-voxel pattern analysis and dynamic causal modeling, our data converge toward a three-step model of voice processing in noise, unfolding as follows : a) auditory perception—in the lateral temporal cortex (TC); b) Noise reduction—in the medial temporal lobe and through anti-coupling with the lateral TC; c) Voice processing and decision processes—in the lateral TC and inferior frontal cortex and through their bilateral coupling. Serial and parallel occurrence of these steps is of course plausible. Taken together, our data support a neural framework for improved voice processing in noisy situations based on brain networks located in the lateral and medial TC and lateral, inferior frontal cortex and their connectivity.

Evolution and Neurobiology of Language

O5 ☆

Neurobiological substrate for language: What's on the agenda?

Nina Kazanina[1]

[1]Faculty of Medicine, University of Geneva, CH

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Language serves as a powerful conduit for conveying meaning. A linguistic input, typically in the form of a sentence, is parsed syntactically to establish the relationships among its constituent elements and is interpreted to derive its meaning. This presentation will discuss an amodal format for representing meaning that is shared by language and thought and relies on symbolic representation and computation. While this format is frequently dismissed as lacking neurobiological plausibility, I will make a case for the necessity and attainability of a symbolic representation of meaning, drawing support from animal neurobiology, including spatial navigation, action, and numerical cognition.

Evolution and Neurobiology of Language

O6

One to rule them all: Oscillatory brain activity as unified control mechanism for working memory and social cognition

Paul Sauseng[1], Elisabeth V.C. Friedrich-Higgs[1, 2]

[1]Neuropsychology and Cognitive Neuroscience, Department of Psychology, University of Zurich, [2]Department of Psychology, LMU Munich

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It has long been thought that coordination of briefly maintained information (working memory) and higher social cognition (mentalizing) rely on mutually exclusive brain mechanisms. However, here we show that slow rhythmical EEG activity in the dorsomedial prefrontal cortex controls distributed networks associated with working memory as well as mentalizing during cognitively demanding visual and social tasks. Depending on the effort necessary for cognitive operations, the phase of slow frontal oscillations is used to precisely tune communication with posterior brain areas (as measured by source reconstructed EEG phase-amplitude coupling). For participants having low autistic personality traits, this mechanism is identical across tasks – no matter whether visual or social information is processed. This underpins a unified function of the afore mentioned oscillatory brain mechanism in working memory and mentalizing. Participants with high autistic personality traits – thus, with difficulty in social cognition – however, have an inability to efficiently tune brain communication depending on cognitive effort in visual information processing. Even more striking, in higher social cognition they fail to implement coordination of distributed brain networks by slow frontal oscillations completely. While these findings suggest a unified function of brain oscillations in cognitive coordination they also explain why individuals with high autistic personality traits can have difficulties with demanding cognitive processing across domains.

Evolution and Neurobiology of Language

O7

Brain response dynamics during novel script reading as compared to familiar script reading

Amelie Haugg[1, 2], Nada Frei[1, 2], Alexander Zeller[1], Chayenne Garcia[1], Vinzenz Kasper Schmid[1], Anna-Marie Conrad[1], Sara Steinegger[1], Martina Röthlisberger[1, 2], Silvia Brem[1, 2, 3]

[1]Child and Adolescent Psychiatry, University of Zurich, Zurich, Switzerland, [2]NCCR Evolving Language, Switzerland, [3]Zurich Neuroscience Center, Zurich, Switzerland

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Reading involves an extensive, specialized reading network in the brain. In this study, we investigated the response dynamics of this reading network during reading in a recently learned artificial script (AS) compared to reading in the native and highly familiar Latin script (LS) and how these processes are influenced by attention and working memory. 61 typical-reading adults completed tests on working memory, attention, and reading fluency and trained 12 associations of AS letters and German speech sounds. After training, participants performed an fMRI lexical decision task with words and pseudowords written in either AS or LS. Finally, an AS reading fluency task was performed. Data analyses included block design analyses and time series extractions. Compared to LS reading fluency, AS reading fluency showed stronger correlations with attention ($r(60)=0.56$, $p<0.001$; difference: $z(60)=1.90$, $p=0.03$) and working memory ($r(60)=0.38$, $p=0.003$; difference: $z(60)=1.63$, $p=0.05$). During the lexical decision task, we observed more activation in the multiple demand (MD) network and the visual word form area (VWFA) for AS compared to LS. VWFA activation was associated with working memory (lexical VWFA: $r(60)=0.28$, $p=0.03$; perceptual VWFA: $r(60)=0.24$, $p=0.07$). Time courses showed differences in sustained activation, activation intensity, and temporal shifts between LS and AS and revealed different response dynamics in key regions of the reading network, emphasizing the importance of considering temporal dynamics when investigating lexical processing.

Tuesday

Brain Connectivity

O8 ☆

Tracking time-resolved brain and physiological states in the individual

Catie Chang[1]

[1]Vanderbilt University

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Internal states of the brain and body are continuously fluctuating, giving rise to behavioral and cognitive variability. Recent work has demonstrated the potential for extracting information about natural state changes from fMRI data, over time scales from seconds to minutes. In this talk, we will discuss our recent work on linking time-resolved fMRI signal patterns with physiological state changes, as reflected in behavioral, autonomic, and electrophysiological variations. We will also discuss the potential for dynamic fMRI states to provide clinical biomarkers.

Brain Connectivity

O9

Cortical evidence accumulation for perceptual experience occurs irrespective of reports.

François Stockart[1], Ramla Msheik[1], Lenka Jurkovicova[2], Dorian Goueytes[1, 3], Martin Rouy[1], Radek Mareček[2, 3], Dominique Hoffmann[4, 5], Liad Mudrik[6, 7], Robert Roman[2], Milan Brázdil[2, 3], Lorella Minotti[4, 5], Philippe Kahane[4, 5], Michael Pereira[1, 5], Nathan Faivre[1]

[1]Univ. Grenoble Alpes, Univ. Savoie Mont Blanc, CNRS, LPNC, 38000 Grenoble, France, [2]1st Department of Neurology, St. Anne Univ. Hospital and Faculty of Medicine, Masaryk University, Brno, Czech Republic, [3]Behavioral and Social Neuroscience Research Group, CEITEC MU, Brno, Czech Republic, [4]Neurology Department, CHU, Grenoble, France, [5]Univ. Grenoble Alpes, Inserm, GIN, 38000 Grenoble, France, [6]School of Psychological Sciences, Tel Aviv University, Tel Aviv, Israel, [7]Sagol School of Neuroscience, Tel Aviv University, Tel Aviv, Israel

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Perceptual experience is a multi-faceted, dynamical process, tackled empirically through measures of stimulus detectability and confidence ratings. We asked if stimulus detection and confidence can be explained by evidence accumulation, a form of sequential sampling of sensory evidence performed by the brain. We recorded stereotactic electroencephalography in 28 participants with epilepsy while they performed three face detection experiments, and analyzed high gamma activity from 3214 channels. Participants first performed an immediate-detection experiment, providing reaction times that were used to identify functional markers of evidence accumulation. We found that individual channels and a multivariate perceptual decision signal in the ventral visual and inferior frontal cortices displayed these markers. To assess conscious perception without motor or decisional confounds, participants performed two further experiments where they either provided a delayed report or viewed stimuli passively. The perceptual decision signal that was found to reflect evidence accumulation in the ventral visual cortex further differentiated between seen/unseen stimuli for delayed detection, and between high/low intensity stimuli during passive viewing. Using the same signal, we decoded confidence, a proxy of perceptual monitoring. Finally, a computational model of evidence accumulation successfully reproduced both behavioral and neural data. Overall, these results indicate that the same neural code in the ventral visual cortex was sensitive to (1) evidence accumulation, (2) conscious access irrespective of reports and (3) confidence judgments. We discuss the results in light of a proposal that a unified mechanism based on evidence accumulation can explain perceptual experience, encompassing both perceptual consciousness and perceptual monitoring.

Brain Connectivity

O10

The cortical microcircuitry of contextual processing in mice, monkeys, and humans

Lars Muckli[1], Christiaan Levelt[2], A. Tyler Morgan[3], Paolo Papale[2], Pieter R. Roelfsema[2], Koen Seignette[2], Matthew W Self[2], Michele Svanera[1], Lucy S Petro[1]

[1]Centre for Cognitive Neuroimaging, School of Psychology and Neuroscience, College of Medical, Veterinary and Life Sciences, University of Glasgow, [2]Netherlands Institute for Neuroscience, Molecular Visual Plasticity Group, Royal Netherlands Academy of Arts and Sciences, Meibergdreef 47, 1105 BA Amsterdam, the Netherlands, [3]Section on Functional Imaging Methods, National Institute of Mental Health, Bethesda, MD 20817, USA

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The architecture of the cerebral cortex supports the integration of sensory inputs with current demands, expectations and prior knowledge, in distinct processing streams flowing in bottom up and top down directions, embedded in laminar microcircuits (e.g. Larkum, 2013). We present across-species studies using a visual occlusion paradigm designed to isolate the influence of top-down information. This approach masks a portion of an image (the "occluded" region). This region of the visual field in the primary visual cortex of humans, monkeys and mice does not receive bottom-up receptive field stimulation, and neuronal recordings therefore measure functional and structural principles of top-down processing.

The dynamics of this contextual feedback information, studied using electrophysiology in monkeys, shows that V1 neurons in the occluded region process scene-specific contextual information less than 20 ms later than neurons whose receptive fields are presented with the scene stimulus. These contextual representations were correlated between humans and monkeys (Papale at al., 2023).

In mice, distinct populations of L2/3 neurons code for either sensory or feedback information, and contextual responses to occluded scenes are stronger in trained animals, suggesting that these responses can be explained in a predictive processing framework (Seignette et al., 2023).

We showed evidence in humans that top-down signals include predictive world models. The occlusion paradigm can also be implemented in a multispecies approach, with surprisingly consistent results in human and nonhuman primates and mice, opening the door for studying the involvement of finer-grained (cellular) neural mechanisms in feedback processing (Muckli et al., 2023).

Brain Connectivity

O11 ☆

Regulation of brain oscillation and synchronization dynamics

Satu Palva[1, 2, 3]

[1]Neuroscience Center, HiLIFE, University of Helsinki, Finland, [2]Division of Psychology, University of Oulu, Finland, [3]Centre for Cognitive Neuroimaging (CCNi), School of Psychology and Neuroscience, University of Glasgow, UK

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Neuronal oscillations and their interareal synchronization are fundamental for behaviour and cognition. Yet, the levels of synchronization show large inter-individual and anatomical variability that leads to variability in performance. The neuronal basis of this variability has, however, remained poorly understood. In my talk, I will show how variability in oscillation dynamics could be explained in the critical brain hypothesis framework (Fusca et al., 2023). Further, I will discuss how this framework could be used to predict aberrant oscillation and synchronization dynamics in brain diseases.

Brain Connectivity

O12

Exploring Functional Pathways and Corpus Callosotomy Microstructure in Infantile Hydrocephalus

Derya Adil[1], Emma Duerden[1, 2], Roy Eagleson[1, 3], Sandrine de Ribaupierre[1, 4]

[1]Western Institute for Neuroscience, Western University, [2]Applied Psychology, Faculty of Education, Western University, [3]Electrical and Computer Engineering, Faculty of Engineering, Western University, [4]Department of Clinical Neurological Sciences, Schulich School of Medicine and Dentistry, Western University

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Infantile hydrocephalus is characterized by an atypical accumulation of cerebrospinal fluid (CSF) in the brain, leading to progressive enlargement of the ventricular system and necessitating surgical intervention within the first 2 years of life.

The direction of ventricular dilatation subjects the periventricular white matter and the posterior cortex to sustained compression and cortical thinning.

We investigated structural alterations in the corpus callosum (CC) in children with infantile hydrocephalus, while concurrently exploring functional connectivity changes. Eighteen patients diagnosed with infantile hydrocephalus (mean age = 9 years) and 18 age- and sex-matched healthy children participated.

Our examination incorporated macro- and microstructural assessments, including CC volume and diffusion tensor imaging metrics. Significant differences in CC volume, fractional anisotropy, mean diffusivity, axial diffusivity, and radial diffusivity were observed between groups. Microstructural disparities, particularly in the posterior CC subdivisions (splenium and isthmus), were pronounced, revealing the mechanisms affecting CC integrity necessary for interhemispheric communication.

Furthermore, a functional connectivity analysis highlighted decreased connectivity in visuomotor pathways, involving the inferior frontal occipital fasciculus, superior longitudinal fasciculus, and frontal aslant tract. The right and left fusiform gyrus and precuneus showed notable impact, emphasizing the broader neural network disruptions induced by infantile hydrocephalus.

This combined structural and functional approach enhances our understanding of the neurodevelopmental processes in infantile hydrocephalus, emphasizing the necessity of evaluating both CC health and functional connectivity for a comprehensive grasp of its impact on interhemispheric communication.

Brain Connectivity

O13

In vivo parcellation of the human spinal cord functional architecture

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The spinal cord acts as a central hub in the central nervous system, transmitting and processing signals between the brain and the periphery through topographically organized pools of neurons. Although these functional levels are pivotal units of the sensorimotor hierarchy, accurately mapping them in vivo in humans has been a long-standing challenge. Here, we propose to address this by leveraging resting-state spinal cord functional magnetic resonance imaging (fMRI), neuroanatomy, and functional connectivity approaches, to achieve a non-invasive, data-driven, and principled functional parcellation of the cervical spinal cord. Specifically, we used two resting-state datasets of healthy individuals collected in two different sites. For each of them, we extracted spinal networks using two data-driven methods: independent component analysis (ICA) (Varoquaux et al. 2010) and innovation-driven coactivation pattern analysis (iCAP) (Karahanoğlu et al. 2015). Our results demonstrate robust (i.e., across methods) and replicable (i.e., across datasets) patterns, effectively capturing the spinal functional levels. Additionally, we present pioneering evidence of spinal resting-state networks organized in functional levels in individual participants, unveiling personalized maps of the spinal functional organization. These findings underscore the potential of data-driven approaches to reliably outline a functional parcellation of the spinal cord architecture. The implications are far-reaching, from spinal cord fMRI processing to personalized investigations of healthy and impaired spinal cord function.

Wednesday

Hedonia, Anhedonia

O14 ☆

Translational and Cross-Species Approaches to Anhedonia: Implications for Treatment Development and Stratification

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Anhedonia, defined as the loss of pleasure or lack of reactivity to pleasurable stimuli, represents a critical treatment challenge across neuropsychiatric disorders. Among individuals with major depressive disorder (MDD), anhedonia has been found to predict poor disease course, worse response to psychological, pharmacological, and neurostimulation treatments, as well as increased suicide risk. In spite of these pressing needs, few studies to date have employed parallel approaches to study anhedonia across species, which is expected to accelerate translation toward better treatment strategies. Further, although preclinical data have emphasized stress-mediated disturbances of mesocorticolimbic dopaminergic functions in the pathophysiology of anhedonia, the mechanisms and substrates underlying these processes are largely unknown in humans. Findings from recent studies in Dr. Pizzagalli's laboratory combining behavioral, functional neuroimaging, and molecular imaging to study the neurobiology of anhedonia across species will be reviewed. Collectively, these findings indicate that depression and anhedonia are characterized by dysfunction in brain reward pathways. The potential implications of these findings for treatment development and stratification will be discussed.

Hedonia, Anhedonia

O15

Hippocampal dynamic connectivity in emotion dysregulation disorders patients and offspring: a transdiagnostic vulnerability marker?

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Emotion dysregulation disorders(EDD) are a transdiagnostic group of prevalent mental health disorders marked by disrupted emotional control. While early interventions for EDD have demonstrated efficacy, vulnerability markers in high-risk individuals are missing. Employing co-activation patterns(CAPs) analysis on resting-state fMRI we investigate the dynamic functional connectivity(dFC) of the hippocampus-a central component of emotion regulation networks-in 75 EDD patients (including bipolar, BD, borderline personality disorder, and ADHD patients), 58 offspring(OFF) of EDD patients, and 70 healthy controls(HC). In a subgroup of 26 BD patients, 18 BDoff, and 53 HC, we implemented a cutting-edge micro-CAPs analysis of the dFC of hippocampal parcels, revealing that dFC between the hippocampal body and a somatomotor-micro-CAP was lower both in BD patients(p-valueFDR:0.00015) and in BDoff(p-valueFDR:0.020) than in HC. Inversely, dFC between the hippocampal head and a limbic-micro-CAP was higher in BD patients than in HC(p-valueFDR:0.005). Furthermore, correlations between a frontoparietal-micro-CAP and both depression and emotion dysregulation symptoms were significantly higher in BD than HC. Traditional CAPs analysis did not highlight transdiagnostic differences in hippocampal dFC between EDD patients, OFF, and HC. Overall, we observed alterations of large-scale functional brain networks associated with disrupted somatomotor and emotion processing in BD. Interestingly, BDoff presented an intermediate phenotype between BD and HC, suggesting that dFC of hippocampal subregions might represent a marker of vulnerability to BD. Given the lack of initial evidence supporting the transdiagnostic relevance of these alterations through traditional CAPs analysis, further research utilizing micro-CAP analysis on the entire transdiagnostic sample is warranted.

Hedonia, Anhedonia

O16

Relationship between limbic tract integrity, substance addiction and neuropsychiatric fluctuations in Parkinson's disease

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The mesolimbic tract connects the ventral tegmental area to the nucleus accumbens and plays a major role in addictions. Neuropsychiatric fluctuations in Parkinson's disease (PD) have been suggested as a risk factor for behavioral addiction. We studied the relationship between the integrity of this tract and clinical scores related to impulsivity, addiction, severity of neuropsychiatric fluctuations, in PD and Heroin Dependence (HD) patients. Integrity metrics were derived from Diffusion Tensor Imaging: Fractional Anisotropy (FA), Axial and Radial diffusivity (AD and RD), and the Apparent Diffusion Coefficient (ADC). 17 PD patients (mean age=63+/-9 years), 15 HD subjects (45+/-7 years) and 26 age-matched healthy controls (HC) (56+/-13 years) were recruited. The neuropsychiatric fluctuation severity, the degree of impulsivity and dependence were estimated through the NFS, UPPS and ASBPD questionnaires respectively. Group effects on DTI metrics were tested using an ANCOVA model with age, sex, and motion during scan as covariates. Partial correlation between DTI metrics and clinical scores were tested, using age as covariate. All diffusion metrics were significantly different between PD and HD in the right hemisphere. There were significant partial correlations between right DTI metrics and NFS; between the bilateral DTI metrics and UPPS; but not between DTI and ASBPD. This result suggests that neuropsychiatric fluctuations may promote the onset of behavioral addictions in PD through a greater denervation within the mesolimbic pathway. The lateralization of the disturbance on the right side could be explained by the fact that PD predominated on the left side in our cohort.

Hedonia, Anhedonia

O17 ☆

Meaning making: Discovering the underlying hierarchical brain orchestration using music and whole-brain modelling

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For Aristotle, the goal of human life was to live well, to flourish, and to ultimately have a good life. He conceptualised this as "eudaimonia", a concept distinct from "hedonia" or pleasure, coming from 'hedus', the Greek word for the sweet taste of honey. Over the last decade, we have been making significant progress in understanding how the brain orchestrates hedonia but human flourishing has proven notoriously difficult to study - especially given how hard it is to reliably bring about flourishing. Some have likened this process to catching a rare butterfly in a large jungle. Still progress has started to be made and we are pursuing the hypothesis that human flourishing is orchestrated by a necessary and sufficient but unstable constellation of brain regions and networks at the top of the brain hierarchy. Here I will focus on neuroimaging studies of the 'sweet anticipation' of music showing not only how music leads to pleasure, but also to meaning making and thriving. Over longer timescales these experiences can give rise to both flourishing and suffering, providing meaning and purpose to life. I will discuss the evidence from whole-brain modelling of neuroimaging data including jazz improvisation for orchestrating eudaimonia, and propose future strategies for exploring the deep remaining questions.

Hedonia, Anhedonia

TRAVEL GRANT

O18

Differential contributions of left and right temporal lobe resections to emotional face perception: Evidence from event-related potentials and stimulus-induced gamma-band activity

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Although it is widely believed that medial temporal lobe (mTL) structures, predominantly the amygdala, drive visual processing biases for emotional faces in scalp EEG signals, systematic research on the temporal dynamics of mTL contributions to emotional face processing are still sparse. By comparing a sample of 36 epilepsy patients with left- or right-hemispheric temporal lobe resections (lTLR/rTLR) to a matched healthy control group (HC), this study aimed to uncover possible influences of such resections on event-related potentials and gamma-band activity (GBA) that typically differentiate emotional from neutral faces in healthy participants. ERP data demonstrated reduced early attentional selection of fearful over neutral faces in rTLR patients compared to HC, as indicated by reduced P1 difference amplitudes (fearful – neutral). Likewise, emotion differentiation in occipital GBA was ipsi-resectionally reduced in rTLR compared to HC from about 30-360 ms and 550-700 ms. By contrast, lTLR patients presented with stronger emotion differentiation than HC in the N1. These results suggest an involvement of the right mTL, perhaps particularly the amygdala, in rapid attentional selection of emotionally relevant faces but also in sustained gamma-band synchronization. Also, present data imply a role of the left mTL in attentional disengagement from emotion that diminished in lTLR patients.

Hedonia, Anhedonia

O19

Oscillatory signatures of memory matching in visual perception

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Top-down predictions of future events based on prior experience can help allocating limited attentional resources more efficiently and are thought to be implemented as mental templates stored in memory. When such mental templates meet matching visual bottom-up information, increased theta-gamma phase-phase coupling and evoked gamma activity can be observed in early visual brain areas, providing evidence for theta-gamma phase coupling and evoked gamma activity as oscillatory signatures of memory matching in visual perception. How these two signatures evolve during the formation of new mental templates and how they relate to the fidelity of such, however, remains an important yet currently unanswered question. To bridge this gap, we recorded electroencephalography (EEG) while participants learned to classify target shapes as matching or mismatching with preceding cue sequences based on single-trial feedback. Afterwards, participants performed an unannounced free-recall drawing task, in which they were asked to reproduce targets from their memory as means of template fidelity. In line with previous reports and our hypothesis of stronger template-to-input matching with increasingly concrete mental target templates, we observed increased matching-related theta-gamma phase coupling and gamma phase locking in early visual areas around 100–200 ms post-stimulus over time. The strength of these increments was correlated with the fidelity of mental target templates used during the matching process. Our results suggest that theta-gamma phase-phase coupling and evoked gamma activity might serve as fidelity-dependent and complementary signatures of memory matching in visual perception with a potential specialization for mental templates stored in working and long-term memory, respectively.

Thursday

Clinical Multimodal Imaging

O20 ☆

What does neuroimaging tell us about depression and meditation in aging populations?

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The links between psycho-affective factors like depression, stress, anxiety, and Alzheimer's disease (AD) in aging individuals are still insufficiently explored, particularly in relation to the brain mechanisms that underlie these connections. Depression, for example, stands out as a prominent modifiable risk factor for AD in people over 60 years old, and conversely, it often manifests as an early symptom of the disease. Investigating the connections between these psycho-affective factors and neuroimaging biomarkers across the spectrum from normal aging (including the preclinical AD stage) to dementia, while also considering potential sex differences, could help elucidate their evolving interactions.

Given the growing recognition of the significance of these psycho-affective risk factors in aging populations, there is a burgeoning focus on efforts to reduce their presence, intensity, or impact. Among these efforts, meditation training emerges as a promising non-pharmaceutical strategy for preserving or enhancing mental well-being in aging individuals. The Medit-Ageing project (publicly known as the Silver Santé Study) is the largest endeavor of its kind, conducting two extensive clinical trials: one involving patients with subjective cognitive decline (the SCD-Well study) and another targeting cognitively unimpaired individuals aged 65 and above (the Age-Well study). The initial findings from these trials will also be presented and discussed within the broader context of non-pharmaceutical interventions and lifestyle-based preventive approaches.

Consciousness and Decision Making

O21

The individual-level, multimodal neural signature of face processing in autism within the fusiform gyrus

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Face processing is among the most reported social difficulties of autistic individuals. While its neural underpinnings have been explored unimodally, there is still little knowledge about how different neuroimaging markers are simultaneously implicated and associated with social functioning in autism. Extracting shared information across different modalities is essential for better understanding underlying mechanisms of autism. We leveraged the EU-AIMS Longitudinal European Autism Project dataset to study the cross-modal signature of face processing within the fusiform gyrus (FFG) across structural MRI, resting-state fMRI (rs-fMRI), task-fMRI and EEG. After employing normative modelling on each imaging modality, unimodal individual-level deviations were merged using linked independent component (IC) analysis. We next tested whether a) ICs significantly differed between autistic and non-autistic individuals (NAI) and b) were significantly associated with social features in autism using canonical correlation analysis. In total, 50 independent components were derived, among which one IC showed a significant difference between autistic and NAI (t=3.5, pFDR=0.03). This IC that was mostly driven by bilateral rs-fMRI, bilateral structure, right task-fMRI, and left EEG. Finally, there was a significant canonical correlation between multimodal ICs and a set of social features (r=0.65, pFDR=0.008). Results suggest that the FFG is a central region differentially implicated in autistic and non-autistic individuals across a range of imaging modalities and these can simultaneously inform mechanisms associated with core social functioning in autism. Elucidating a more holistic picture of neural associations of core cognitive and clinical features in autism, will pave the way for the development of more personalised support.

Consciousness and Decision Making

O22

Microstructural cortical maturation underlies longitudinal BOLD signal variability of emerging resting-state networks in preterm infants

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BOLD signal variability (BOLD-SD), calculated as the standard-deviation (SD) of BOLD signal, has emerged as a recent measure for assessing brain function, but little is known regarding its biological significance.
We aim to demonstrate that cortical BOLD-SD modifications are accompanied by structural intracortical maturational changes, as well as to elucidate which brain networks are undergoing the most important maturational changes during early development.
We recruited 54 very preterm infants that have undergone a longitudinal brain MRI acquisition at 33 and 40 weeks' gestational age (GA). Using a resting-state fMRI (RS-fMRI) newborn atlas comprising 10 brain networks, constructed from our population using an ICA (independent component analysis) approach, we assessed the longitudinal modifications per brain network of cortical BOLD-SD and NODDI (neurite orientation dispersion and density imaging) indices: such as NDI (neurite-density-index) and ODI (orientation-dispersion-index).
A significant longitudinal cortical BOLD-SD increase was observed in primary sensory networks (sensorimotor, visual, auditory) as well as in the posterior Default-Mode-Network (pDMN: precuneus and posterior cingulate gyrus) and was accompanied by a significant decrease of NDI and/or increase of ODI, reflecting a concomitant structural intracortical maturation. Of notice, the magnitude of the BOLD-SD increase in these brain networks was parallel to the NDI decrease.
In conclusion, during early brain development, the BOLD signal variability increase in RS-networks was associated to underlying structural intracortical maturational changes and thus it can be considered as a marker of cortical maturation.

Consciousness and Decision Making

O23 ☆

Structural and functional imaging of epilepsy at 7T

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7T MRI has been available for a while but is now at an important point in its development where high-quality whole-brain imaging is accessible beyond research centers with large physics teams. I will show examples of protocols for standard weighted imaging and how these have been used to image children with focal epilepsy. This demonstrates both that 7T MRI is sensitive to lesions seen at 3T and a significant proportion of children with MRI negative 3T scans. It may not be possible to image everyone at 7T but perhaps we can use 7T data to enhance 3T imaging. In the next part of the talk, I will then go onto describe work with quantitative R1 (1/T1 maps) and artificial intelligence to enhance quantitative maps obtained at 3T that also show potential to reveal abnormalities in children with focal epilepsy that were not previously visible. In the last part, I will briefly discuss initial pilot work to obtain high resolution fMRI, and potentially combine it with EEG, aiming to better understand laminar abnormalities.

Consciousness and Decision Making

O24

Subcortical and cortical neural signatures of hallucinations in Parkinson's disease

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Parkinson's disease (PD) is a progressive and irreversible neurodegenerative disease characterized by a wide range of motor symptoms. Growing evidence indicates that PD is also affecting non-motor circuits, resulting in numerous non-motor symptoms. Hallucinations are among the most prevalent non-motor symptoms, affecting about 50% of PD patients and are associated with an increased risk of rapid progression of the disease (including rapid cognitive decline, dementia, psychosis). Despite their high clinical relevance, the brain mechanisms, especially the subcortical ones, underlying hallucinations in PD are currently poorly understood. Here, thanks to latest DBS-recording technology, we characterize for the first time the subcortical and cortical electrophysiological signature of a specific minor hallucination, namely the presence hallucination (PH), in PD patients. One of the challenges in studying hallucinations is their unpredictable and subjective nature. To overcome this issue, we employed a recent robotic technology, based on sensory-motor stimulation, to induce on-demand PH in PD patients. During the robotic procedure, we simultaneously recorded the brain activity from Subthalamic Nuclei (STN) and from cortical regions. Subcortical activity was recorded through chronically implanted DBS devices (Medtronic Percept) that allow acquisition of the local field potential in the target region, while cortical activity was acquired using scalp EEG. We found that the activation of the STN in the alpha band (between 8 and 12 Hz) was higher during robot-induced hallucinations than in the control condition. However, the difference in cortical evoked responses between PH-inducing and control condition was dampened for PD patients already suffering from hallucinations in their daily lives, indicating a possible mechanism underlying symptomatic hallucinations.

Consciousness and Decision Making

O25

Cross-validating the neurofunctional electrophysiological markers of early face categorization

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The N170 event-related potential (ERP) is the most widely investigated neurofunctional marker of early face categorization, with more than a thousand studies over nearly 30 years. In the past ten years, there has been a surge in research using the fast periodic visual stimulation (FPVS) methodology to delve into face categorization. FPVS studies have consistently reported robust bilateral face categorization responses over the occipitotemporal cortex with a right hemispheric dominance, closely mirroring the N170 topography. Yet, the precise neurofunctional correspondence between these two electrophysiological markers remains elusive. To address this issue, we recorded the electrophysiological signals of human observers who viewed natural images of objects and faces using both ERP and FPVS paradigms. We measured early and late ERP visual components, including the P1, N170 and P2 in response to face stimuli, while also extracting the matching ERP components from the FPVS time domain. Our results revealed little to no relationship between any single ERP component and the FPVS frequency response. Only the ERP peak-to-peak differences between N170 and P2 components significantly explained the FPVS frequency response. Our data show that the FPVS frequency response is not singularly contingent on any isolated ERP component, such as the N170, but rather reflects a later complex neural integration. These findings raise crucial methodological and theoretical considerations on the relationship between FPVS and ERP responses, urging caution when interpreting the neurofunctional role of both electrophysiological signals. Both markers relate to distinct neural computations and dynamics of how the human brain processes faces.

Consciousness and Decision Making

O26

The sources of EEG microstates

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A growing body of clinical and cognitive neuroscience studies have adapted the broadband EEG microstate approach to evaluate large scale spontaneous brain electrical activity. Thereby, the recorded electrical signal is defined by non-overlapping distinct topographies, where usually 4-7 topographical maps explain ~80% of the data. Based on physical laws, distinct topographies are generated by distinct neuronal sources, thus being potentially related to different functional and physiological processes. Yet, the exact sources of these microstates are not conclusive. Here, we extracted 5 data-driven microstates and estimated their sources in two independent large datasets of 257-channel resting state EEG recordings (159 and 118 subjects respectively). All time points labelled with a given microstate were concatenated, source-localized using LORETA and then averaged within and between subjects . A standardization across time was applied for each of the 7000 solution point in a grey matter-constrained MNI head model. We found highly replicable microstate topographies and source distributions in the two datasets. The main sources of microstate A were located in left inferior temporal, frontal and occipital areas, the sources of microstate B were similar but right lateralized. For microstate C the main sources were found in the temporal lobe bilaterally, in the hippocampi and in parietal areas. Microstate D was localized in inferior and middle temporal areas bilaterally. The main sources of microstate E were in sensorimotor areas. The underlying sources of each microstate in both datasets are in line with previously reported functional attributes of the microstates.

POSTER ABSTRACTS

Ordered according to these categories:

Emotion & Motivation (M1-M7)

Language & Music (M8-M17)

Perception (M18-M23)

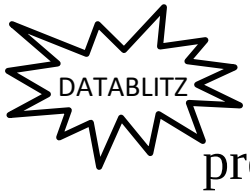
Methods (T1-T19)

Clinical Neuroscience (W1-W17)

Learning & Memory (W18-W21)

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

Emotion & Motivation

M1

Reorganization of brain functional gradients during film watching

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The use of film in functional magnetic resonance imaging (fMRI) has recently gained great interest to study brain function, but also as a replacement for the resting-state condition with better participant compliance. However, analysis of naturalistic stimuli is complex and has benefited from advanced methods such as decoding of individual differences based on functional connectivity (FC). In this work we build upon the functional gradients methodology, which provides an elegant way to represent the macrostructure of brain organization. We specifically investigate the relationship between gradients and emotion processes during film watching. Our results show the impact of social and affective events on brain reorganization by considering subject variability and prediction of individual differences. We collected rest and film fMRI recordings of healthy participants and further used continuous annotations of emotion experience from independent samples to derive a "ground truth" of emotional experience. A main method novelty being emotion-informed gradients is introduced, that is to select timeframes according to levels of valence/arousal/dominance when generating gradients. We investigate the intersubject variability and also predict individual differences using our emotion-informed gradients. Our findings show that the gradient space derived from film fMRI is more stable across subjects, consistent with FC in film. While the literature showed film to be superior to rest in personality prediction , our results do not support this for gradients. Our work is also the first to show emotion-informed gradients to predict individual differences. We demonstrate that processes such as emotion experience reflect idiosyncrasy.

Emotion & Motivation

M2

Social influence effects on food choices generalize based on conceptual similarity

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Social norms influence what and how much we eat, with important consequences for health. An unaddressed question is how social influence may generalize across different food choices. Generalization is defined as the transfer of previously acquired information to new stimuli and can be based on both perceptual and conceptual similarity. We hypothesized that social influence on food choices can generalize based on how much people consider healthiness and tastiness, which are two of the main attributes driving food choices. We conducted three studies (total N = 468), in which healthy participants rated how much they would like to eat different food items and were then presented with the ratings of several other people ('social ratings'). Unbeknownst to our participants, they were randomly assigned to social ratings that either reflected a mainly health-driven valuation of food items or to social ratings that reflected a taste-driven valuation of food items. The results across all three studies showed that participants' food ratings were more influenced by healthiness in the group in which healthy items were more popular than in the group in which healthy items were less popular. No such group differences were found for tastiness. In sum, our findings show that social influence effects on food choices generalize based on inferred health preferences of others. Futures studies could characterize the brain mechanism underlying these effects and test generalization in domains other than food.

Emotion & Motivation

M3

Left anteromedial temporal lobe resection leaves ERP emotion enhancements during picture viewing intact

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The medial temporal lobes and in particular the amygdalae have been theoretically linked to emotional processing of visual stimuli. It is often assumed that the amygdala upregulates responses of the visual cortex, contributing to larger event-related potentials (ERPs) for emotionally arousing compared to neutral pictures. In a previous study with epilepsy patients who had undergone right anteromedial temporal lobe resections, we found a lack of P1 modulation by negative pictures and ipsi-resectional reductions in the N1 and Early Posterior Negativity (EPN) responses whereas in the late positive potential (LPP) emotional modulation did not differ from controls. Here, we complement this evidence with data from 18 patients with left anteromedial temporal lobe resections. Following left resections, we find fully intact early emotion modulation (P1, N1) as well as larger than normal EPN and LPP potentials in response to negative pictures. Together, these data suggest that whereas the right anteromedial temporal lobe, theoretically most likely the amygdala, critically contributes to rapid emotion-related ERP responses which disappear following resection, the left anteromedial temporal lobe may exert a regulatory role in emotion processing, its resection potentially disinhibiting right hemispheric responses. These results help specify the contributions of left and right temporal lobes to different stages of ERP responses to emotional stimuli.

DATABLITZ

M4

Time-resolved functional connectivity of emotion processing and regulation in preterm and full-term adolescents during movie-watching

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Preterm birth is a leading cause for neurodevelopmental delays and has been associated with a large range of disorders including emotional abilities. These difficulties often persist throughout childhood and teenage years, and lead to impaired social relationships. Here, we leveraged psychophysiological interaction of co-activation patterns (PPI-CAPs) to assess the dynamics of brain activity underlying emotion processing and regulation in preterm- and full-term-born teenagers. The participants watched short movie clips with high emotional valence, interspersed with intervals during which they were asked to focus on their breathing. Using a seed in the anterior cingulate cortex, we found six CAPs, five of which displayed a significant interaction between task and subject group, and involved the visual, frontoparietal, limbic, salience and dorsal attention networks. Using a naturalistic paradigm and a dynamic approach to assess brain activity we reveal cortical correlates sustaining differences in emotion processing in preterm teenagers when compared to full-term-born counterparts.

Emotion & Motivation

M5

Behavioral and neurobiological impact of emotions on spatial navigation

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Spatial navigation is a key component of cognitive processing that enables autonomy in daily life. Spatial navigation can be influenced by many internal and external factors, such as the complexity of the environment. On the other hand, emotions, particularly those related to threat (e.g., anger), have been shown to capture attention, which then facilitates coding, storage, and subsequent retrieval of the emotional information. In a previous study, we sought to test the behavioral impact of angry voices on spatial navigation capacities within contexts (mazes) of varying degrees of difficulty. We found that these voices improved navigation skills in the easiest mazes but impaired them in the most complex maze. In this new study, we attempted to replicate these results and investigated brain activations as well. Our preliminary results confirmed our previous findings and revealed particularly bilateral temporal and left hippocampal activations.

Emotion & Motivation

M6

Emotion components and brain networks: a video game paradigm testing expectation and uncertainty

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The nature and generation of emotions and emotion episodes remain subjects of ongoing debate in the literature, but prevailing theories seem to suggest their multicomponent nature. This project aims to link multiple components of emotions to functional brain systems by developing and validating a novel procedure to actively elicit emotions in a naturalistic and dynamic manner. Drawing inspiration from appraisal models of emotion causation, we designed a first-person perspective, interactive videogame task to be experienced in virtual reality, which will be used to assess emotion components and brain networks. In the current iteration, we are manipulating uncertainty and expectation appraisals, influencing in-game gains and losses.

Upon validation, the task will be integrated with fMRI to explore the effects of manipulating expectation and uncertainty appraisals on respiration, heart rate, skin conductance, and brain responses. The primary goal is to observe their impact on emotion causation, brain networks, and determine whether patterns of multicomponent responses can predict discrete emotions. We predict that different manipulations will be reflected in different elicited emotions, functional brain patterns and physiology patterns. This research aims to contribute valuable insights into the intricate interplay between emotions, their elicitation processes, and underlying neural mechanisms.

Emotion & Motivation

M7

Exploring Emotion Components with Naturalistic Appraisal Manipulation via Video Games

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In this study, we investigated the neural underpinnings of emotions within the framework of the component process model, which emphasizes the role of appraisal in eliciting emotions. We conducted a systematic exploration of emotional responses in the context of a video game.

A stealth game was developed for this purpose, engaging 55 participants in an fMRI experiment. The game involved collecting points while navigating enemies, with goal obstructiveness manipulated by adjusting enemy numbers. Behavioral measures, such as the sum of inverse distance to enemies and player's projected distance, were extracted. Participants also completed personality assessments, including the Beck Depression Inventory (BDI).

Partial Least Square Correlation analyses revealed a significant latent component explaining approximately 50% of the covariance, with BDI scores contributing significantly. The results of the GLM with behavioural measures as parametric modulators indicated increased activity in brain regions linked to avoidance and heightened attention accompanied the sum of inverse distance to enemies, while the player's projected distance activated regions associated with the reward system.

The Psychophysiological Interaction analysis demonstrated higher connectivity between the prefrontal cortex to the somatomotor cortex, while the orbitofrontal cortex, linked to emotional stimuli, coactivated with attention networks in the case of distance to the enemies. When examining player's projected distance, we observed an increased connectivity between the precuneus, associated with self-referential processing, and the visual and dorsal attention networks.

This study enhances our understanding of emotional processing by revealing the intricate interconnectivity of neural networks in response to appraisal manipulation during video game engagement.

M8

Brain activation for language and its relationship to cognitive and linguistic measures: a multimodal exploration

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Language use and learning require complex skills, ranging from auditory perception to higher-order syntactic planning. The neural bases of these abilities have been mostly investigated separately so far. Here, we employ data-driven multimodal and multivariate analysis methods to characterize language learning profiles in a large dataset in which a broad array of behavioural and brain imaging data was collected, with the aim of identifying the key dimensions underlying language learning, their subcomponents and their relationship with language-related brain activation. Participants (N=136) differed widely in their multilingual experience, and a subgroup (N=25) had a previous dyslexia diagnosis. Behavioural measures assessed general cognition, domain-specific measures and language-specific tests, and fMRI data assessed language processing using a language localiser in their first language. Partial Least Squares Correlation was used to uncover common dimensions underlying the two types of data (i.e. behavioural data, consisting of the most relevant scores on the tasks and questionnaires, and fMRI data). The analysis revealed two significant components. The first was correlated with higher scores on measures of higher-level cognition and language, and with greater activation in predominantly bilateral cortical areas involved in such processing. The second component was negatively correlated with lower—level phonological and motor skills at the behavioural level with greater activation more left lateralised regions associated with lower-level phonetic and acoustic processing.

The present work reveals different, complementary explanatory dimensions underlying both the behavioural and brain imaging data, with the key dimensions reflecting aspects of lower-level (acoustic-phonetic) versus of higher-level (linguistic and cognitive) processing.

M9

Longitudinal Music vs Singing Perception in Preterm Infants using Dynamic fMRI Analysis

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Despite similarities, instrumental music and singing voice differ due to the vocal component of the melody and each presents distinct neural-processing pathways in adults. However, the developmental origins of these neural-processing specificities remain unclear. Literature has shown that newborns already distinguish speech from music, thus the preterm population allows us to further explore the ontogenesis of instrumental and vocal music distinction. This study explores differences and similarities of instrumental music vs singing neural processing during early brain development.

A dynamic psychophysiological interaction of co-activation patterns approach (PPI-CAPs) was applied to longitudinal fMRI data in preterm infants at 33- and 40-weeks gestational age (GA) while listening to a melody either played by a flute or sung by a female voice. This approach selects moments when a seed region (auditory cortex) is highly active and clusters frames based on co-activation patterns (CAPs). Each CAP is tested whether it varies according to seed activity, task, or interaction (PPI-effect). To assign relevance to identified CAPs, we overlayed an ICA-derived functional networks atlas, previously published by our team.

Our results showed that the preterm brain responds to singing, eliciting stronger activation of salience and language-related networks, while music elicited activity in limbic networks. The default-mode network and right temporal gyrus showed co-activation/deactivation for both stimuli longitudinally. The visual network was also involved for both stimuli but only at term-equivalent age.

In conclusion, preterm infants already present specialized processing for instrumental music and singing stimuli since 33-weeks GA, with multisensory processing developing over the following weeks.

Language & Music

M10

Neural resources underlying prosody-syntax interactions

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There is a lack of naturalistic fMRI studies that have examined the interaction between different levels of language processing, such as higher-level syntactic operations versus lower-level features such as speech prosody. Even less research has been done to extend such approaches to different languages that differ in their typological features. Thus, the aim of our study is twofold: (1) to understand the neural resources that overlap and interact across syntax and prosody, and (2) to compare these networks across Mandarin and English.

We analysed an fMRI dataset from 24 English and 24 Mandarin speakers listening to excerpts from "The Little Prince". We used an encoding paradigm to model (1) prosodic features, including f0, envelope and prosodic boundaries, which we extracted via spectro-temporal analysis of the stimuli, and (2) syntactic features, that include constituency and dependency relationships within the stimuli and that were extracted via statistical and linguistic modelling within each language.

We show that while the processing of prosodic boundary information engages a network involving bilateral auditory temporal regions that largely overlap in Mandarin and English, the f0 and envelope information in Mandarin is preferentially encoded in regions known to be involved in the processing of semantics and syntax. Conversely, while brain activation correlates with constituency boundaries in both languages, syntactic dependency closures appear to be encoded primarily for English speakers. These cross-language differences are discussed in the light of typological differences between English and Mandarin, both at the sublexical and supralexical levels.

Language & Music

M11

Measuring audiovisual integration abilities and their brain correlates in children at school-age

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Audiovisual integration is a multisensory process central for understanding human speech. The McGurk illusion is a common paradigm to assess this ability in the laboratory. It consists in an illusion elicited by the incongruency between visual and auditory stimuli. In school-aged children, little is known about the presence and the neural basis of the McGurk illusion, knowing that multisensory integration is still developing during this period. Using behavioral assessment and functional MRI in 6 healthy subjects aged between 6 and 10 years old, we aimed at identifying whether we could elicit the McGurk illusion and determine its brain correlates. We designed a paradigm in which we presented incongruent, congruent and unisensory syllables in different levels of auditory noise. By recording the responses to the open-choice behavioral task, we showed that every subject experienced the illusion (mean(sd) = 78.9%(23.1), range = 43.3 – 96.7) and that noise increased the McGurk susceptibility. Furthermore, a comparison of the accuracy of audiovisual with audio-only perception perception showed a significantly better performance in the audiovisual condition ($t = 4.44$, $p < 0.01$, mean difference(sd) = 16.7%(9.2)). A regression analysis of the McGurk susceptibility with the BOLD activation during the McGurk trials showed that subjects less prone to the illusion had more activity in the left fusiform gyrus suggesting that this area is important in the accurate processing of the lip's movements. These results confirm that children at school-age exhibit audiovisual integration capacities in noisy environments and that the fusiform has a role in this process.

DATABLITZ

M12

Functional language mapping with stereo-EEG

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In epilepsy surgery, functional language mapping (FLM) plays a key role in individualizing cortical resections and limiting their potential negative consequences on language functions. Despite the growing popularity of stereo-EEG, FLM with stereo-EEG electrodes is not a standardized procedure. Here, we systematically assessed cortical responses to simple language tasks in patients undergoing stereo-EEG monitoring.

Three basic tasks were used to examine language-related cortical activity: picture naming, auditory naming and sentence completion. Thus far, 7 patients participated in the study at Geneva University Hospitals' Epilepsy Monitoring Unit. For each presentation modality, baseline-normalized, event related spectral perturbation (ERSP) and event-related potentials (ERPs) were computed. These measures were time-locked to the delivery of the stimulus and time-warped to account for varying stimulus durations and realign response events.

The ERP and ERSP preliminary analysis revealed significant functional response on 7.5% of channels per patient, i.e., 62, 38, 40 channels on average respectively for visual naming, auditory naming, and sentence completion. We detected 4 typical response patterns with respect to baseline suggesting the involvement of multi-level processing: stimulus/response evoked ERPs combined with ultra high frequency (150-300 Hz) power decrease, broadband frequency (2 - 300 Hz) power increase with decay towards the end of the stimulus presentation, high frequency (50-150 Hz) power increase combined with low frequency (<20 Hz) power decrease during stimulus presentation, and anticipatory pre and post HF power increase..

Our functional mapping protocol allows us to assess language function by analyzing cortical responses to visual and auditory inputs.

TRAVEL GRANT

M13

Decoding Spatiotemporal Processing of Speech and Melody in the Brain

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The human brain processes speech and melody differently, with the left hemisphere predominantly processing temporal features and the right hemisphere processing spectral features. However, the neural dynamics behind this differential encoding of acoustic features for speech and music processing are not fully understood. To investigate this, we recorded intracranial EEG data from fourteen epileptic patients with implants in auditory cortical areas. We used a stimulus set of a cappella songs, each with three versions: temporally degraded, spectrally degraded, and the original. Participants first performed a binary choice task and then engaged in passive listening while watching a silent documentary. Employing decoding and time-frequency analysis, we trained a classifier to distinguish between sentences and melodies and examined the encoding of temporal and spectral modulations. Behavioral results revealed reduced sentence recognition in temporally degraded conditions and reduced melody recognition in spectrally degraded conditions. Decoding accuracies exhibited a similar pattern, with speech processing primarily relying on temporal modulations and melody processing relying on spectral modulations. These decoding patterns were consistent across time and channels, indicating a spatiotemporal code in the auditory system. Furthermore, additional analysis on a single patient revealed variability in decoding across various frequency bands, indicating their distinct roles in processing temporal and spectral features for speech and melody.

Language & Music

M14

Neural mechanisms of operating an intracranial brain-computer interface for imagined speech decoding

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Brain-computer interfaces (BCIs) can provide new means of communication for patients who have lost the ability to speak. Recent years have seen great advances in the field of speech-BCI for decoding attempted speech in patients with anarthria. However, this approach is precluded in patients affected by language disorders like aphasia, in which the damage affects speech production in regions located upstream of motor speech representations. For these disorders, a BCI would require decoding representation of speech units produced through imagined speech. Only a handful of studies have attempted imagined speech decoding in real-time, thus the knowledge on the neural mechanisms of operating such BCIs remains scarce.

To fill this gap, we developed a BCI based on intracranial electroencephalography to decode in real-time the imagery of two syllables chosen for their contrasted phonetic features.

Results from six patients affected by pharmacoresistant epilepsy showed marked inter-individual variability in the most discriminant decoding features, but similar offline classification accuracy. Furthermore, we investigated neural plasticity in one patient who participated in a three-day training. While the spatial distribution of the decoding features was stable across days, the contribution of the beta and low gamma bands increased with training. Real-time BCI-control was rather limited and variable across participants, likely due to differences in the electrodes' implantation site. These results shed light on the neural correlates of operating a covert speech-BCI and can guide the choice of the implantation site and decoding approach in future invasive interfaces.

Language & Music

M15

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

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Social synchrony and newborns' socio-emotional development depend on anticipation and prediction mechanisms. These abilities are thought to be already at work at an early stage of development and are strongly related to neural entrainment induced by rhythmical patterns (e.g., in language). During interactions in the early stage of development, adults communicate with infant-directed speech, which is slower than adult-directed speech, mainly at delta frequency. In preterm infants, early anticipatory problems can lead to subsequent communication and social impairments. This study, therefore, aims to investigate the neural mechanisms of short-term anticipatory and prediction processes in moderate to late preterm and term infants at 6 months of (corrected) age. Infants will undergo EEG recordings during the presentation of auditory delta or theta rhythmic patterns from a parent or a stranger in an omission paradigm. Rhythmic and vocal entrainment is also performed with infants. We predict a differential effect of the rhythm in each auditory condition and an impact of prematurity, with reduced anticipatory abilities in preterm infants. This research will allow us to disentangle the role of rhythmical and vocal entrainment on infants' anticipatory responses. Some results of a pilot study will be presented. This study will improve our understanding of human voice processing prediction mechanisms and increase our knowledge of short-term prediction brain pathways at an early stage of development in at-risk newborns to develop initial interventions for sustaining early abilities in interpersonal communication.

Language & Music

M16

Perceptual chunking in an isolating language

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We compare Vietnamese listeners' cortical response to segmentally identical compounds and phrases, to investigate the neurocognitive reality of the prosodic word level in Vietnamese.

The proposed linguistic redundancy of a prosodic word level for Vietnamese (Schiering et al., 2010) has implications for the Prosodic Hierarchy Hypothesis (Selkirk, 1980, 1986) and it prompts questions on the neurocognitive mechanisms underlying speech segmentation (Ding et al., 2017; Giraud & Poeppel, 2012). We ask how Vietnamese listeners chunk syllables on the sub-phrasal level and, influencing that chunking, we investigate what, if any, is the role of phonetic juncture marking on the speaker's side and what, if any, is the role of linguistic and contextual inference on the listener's side.

We re-recorded the stimuli of Nguyễn & Ingram (2007) consisting of disyllables (e.g. 'chân vịt') which in some contexts are produced to denote compounds (e.g. 'propeller') and in others phrases (e.g. 'duck feet') and we use them as stimuli in an EEG experiment with Vietnamese listeners. Phonetic juncture marking is implemented by recording the stimuli both naturally and with the specific intention to disambiguate and phonetic distinguishability is analyzed with a random forest analysis. Linguistic inference is implemented as usage-based statistics; contextual inference is implemented as the presence or absence of antecedent presentation of pictures denoting the speaker's intended meaning. We discuss these different levels of disambiguation as predictors of sub-phrasal segmentation / supra-syllabic chunking through the analysis of cortical responses using both Event-Related Potentials and Time-Frequency Analysis techniques.

Language & Music

M17

Brain Integration of Affective Prosodic and Semantic Information in Sarcasm Understanding

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Language may serve many purposes, among them, is the communication of emotions. These emotions can be conveyed in different ways in speech, either with prosody or in a lexico-semantic manner. These two types of emotional information are differently communicated, interactive, and activate some common brain regions in the brain, such as the superior temporal gyrus and the inferior frontal gyrus (Buchanan, 2000; Meyer, 2003). However, how these different cues are integrated at the behavioral and brain level is still little understood. To better understand this semantic and prosodic integration, researchers often used incongruity paradigm (Kotz et al., 2015, Lin et al., 2020). Indeed, when affective prosodic and semantic information is incongruent, like in the case of sarcasm or irony, the listener needs to integrate both information to decode the intended affective message. Few brain studies investigated sarcasm and irony processing at the brain level and showed that the inferior frontal gyrus (IFG) was involved in irony and sarcasm understanding (Matsui et al., 2016; Filik et al., 2019). Moreover, some authors suggest that understanding sarcasm relies on the ability to make inferences about others' mental states, that is the theory of mind (Zhu &Wang, 2020), and activates prefrontal areas, including the ventromedial prefrontal cortex (Tamir et al., 2016). Altogether, our fMRI study will attempt to shed light on brain mechanisms implied in irony and sarcasm understanding and investigate the functional connectivity between brain regions involved in voice processing, semantic and prosodic cues integration, and higher-order social cognition mechanisms. We present here pilot study results and preliminary fMRI results.

Perception

M18

Affective bias can be modulated by psychedelics in a predictive coding framework

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In a predictive coding perspective, the brain is seen as a system that makes predictions about the external environment regarding internal models. These models facilitate treatment of information and influence perception through top-down signals. Therefore, importance accorded to these models are at the origin of interpretational biases. These biases are observed in subjects having high scores on anxiety, depression and phobic social scale. Broadly speaking, these subjects are more sensitive to classify ambiguous stimuli in a negative way during facial expression identification task. This phenomenon can be explained by an aversion to positive bottom-up signals and a focus on negative top-down signals. Psychedelic substances are believed to be responsible for the weight modulation given to these models and would allow an internalization of less biased external stimuli. By short videos of dynamical facial expression from one emotion to another showed on computer, participants are asked to indicate by pressing the space bar, when they detect the target emotion. Through this task performed before and 4-6 days after a psychedelic experience, this study aims to explore the long-lasting modulation of internal model expression by psychedelics.

Perception

M19

Co-varying eye movements and power modulations of alpha oscillations during working memory: a pilot study

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It is commonly agreed that power modulations in alpha oscillatory activity serve as an inhibitory neural mechanism, selectively routing information within cerebral circuits. In visuo-spatial attention, alpha oscillations enhance the processing of relevant targets and suppress potential distractors. However, there are inconsistencies regarding alpha power modulations with increasing load in common working memory (WM) tasks. Particularly, high WM load is associated with either decreased or increased alpha power, depending on the type of WM task deployed (i.e., N-back vs. Sternberg WM tasks).

This pilot study (N = 10) utilized simultaneous EEG and eye tracking to examine the relationship between alpha power modulation and oculomotor action in the context of an N-back task and two variations of Sternberg tasks. The study aimed to explore whether different gaze patterns during these tasks offer explanatory value in addressing the variations in alpha power with WM load.

Preliminary results confirmed a decrease in posterior alpha power with increasing WM load in the N-back task. However, for the Sternberg tasks, this relationship was not clearly evident. The three tasks exhibited distinct gaze variability depending on the WM load condition. Statistical power permits conclusions regarding the presence or absence of a clear relationship between alpha power and gaze variability. However, these exploratory results highlight a novel research avenue linking alpha oscillations, eye movements, and working memory, providing valuable insights for future research and implications for understanding the neural mechanisms underlying the brain’s control of eye movements.

Perception

M20

Insights from Neuroergonomics: An fMRI Meta-Analysis on Manual Execution vs. Supervision in Car Driving.

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Neuroergonomics, an interdisciplinary field combining the strengths of neuroscience and ergonomics, investigates the neural underpinnings of human cognition and behaviour in real-world settings will first be introduced. Then, with the neuroergonomics field, the study aimed to conduct a comprehensive meta-analysis using functional Magnetic Resonance Imaging (fMRI) studies to delineate brain regions involved in manual driving and those implicated in supervising the same driving activity. By systematically reviewing available literature, 11 distinct studies encompassing 17 contrasts were analysed to compare brain activations during active (manual) driving and passive (supervised) driving tasks. The results demonstrated consistent engagement of specific brain regions during active driving, predominantly the left precentral gyrus (BA3 and BA4) and the left postcentral gyrus (BA4 and BA3/40). In contrast, passive driving exhibited greater recruitment of brain regions such as the left middle frontal gyrus (BA6), right anterior and left posterior cerebellar lobes, right sub-lobar thalamus, right anterior prefrontal cortex (BA10), right inferior occipital gyrus (BA17/18/19), right inferior temporal gyrus (BA37), and the left cuneus (BA17). These findings align with Goodale and Milner's dorsal-ventral stream model, suggesting a differential activation pattern in the brain's streams during active and passive driving. These results bear theoretical significance by illustrating how the output of the visual scanning in a singular task may activate distinct cognitive pathways. From a pragmatic standpoint, contrary to the prevailing view in the Human Factors community, our findings challenge the ease of transitioning from passive to active driving, given that these two driving modes engage different neural networks.

Perception

M21

Learning to regulate subliminal perception in the healthy human brain: a rt-fMRI based Neurofeedback Study

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Research in healthy people indicate that briefly presented face stimuli in masking paradigms can evoke subliminal activation in specific visual areas, while they are not consciously perceived by the subject (Brooks et al., 2012). In the current project, real-time fMRI neurofeedback (NFB) was used to train 20 healthy volunteers, over the course of 3 sessions, to enhance such subliminal activation in the fusiform face area (FFA). A matched control group (n=19) underwent the same training protocol but received a feedback signal based on right inferior parietal sulcus (IPS) activity. While being presented with masked subliminal fearful faces, 11 participants from the FFA-group successfully learned to self- regulate their right FFA evoked neural response (FFA-learners). Similarly, in the IPS group, 9 participants gained voluntary control over their IPS activity (IPS-learners). Further, successful FFA training resulted in subsequent enhancement of subliminal face processing, as measured by a subliminal priming task. These neural enhancements were in turn associated with improved behavioral detection of subliminal faces in a rapid visual masking paradigm after compared to before training. IPS learners showed no such effects. The specificity of these effects in the FFA-trained group strongly suggests that NFB-training led to functional changes in perceptual processing of subliminal face information within FFA, rather than being driven by enhanced top-down attentional modulation from IPS. This underscores the potential of NFB in enhancing non-conscious brain processes and provides opportunities for future therapeutic interventions.

Perception

M22

Impact of the pulvinar in visual attentional processes

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Over the past few decades, research has identified a key role of the pulvinar nucleus in visual selective attention. An emerging hypothesis suggests that the pulvinar is involved in coordinating the synchronization of cortical areas within the dorsal attention network through the low-frequency bands (theta: [4-8Hz] ; alpha: [8-12Hz]). However, our understanding of the specific contribution of the pulvinar to this process predominantly stems from non-human primate models, and a notable gap in knowledge remains concerning the human cognition. To address this issue, we adopted a causal approach to investigate the relationship between the pulvinar and brain oscillations. Leveraging EEG in stroke patients, we recorded brain activity during both resting-state (RS) and visual search task (VST) to assess the patients' cognitive performance together with associated neural changes. Our study included four distinct groups of participants for comparison: young healthy, elderly healthy, patients with a subcortical lesion outside the pulvinar, and patients specifically presenting a lesion extending to the pulvinar region. We conducted sensor-to-sensor connectivity analysis on the RS EEG data, and we analyzed reaction times alongside with the lateralized attention event-related potential 'N2pc' during VST. During RS, we observed a distinct EEG pattern characterized by low-frequency non-directed connectivity within the patient group, notably exhibiting a decrease in right fronto-parietal connections when compared to the control groups. During VST, we identified a delayed N2pc component in pulvinar patients associated with a dysregulation of alpha. These findings add new support to the pulvinar's integral role in shaping selective attention and intrinsic connectivity.

Perception

TRAVEL GRANT

M23

Neural correlates of semantically driven visual search in naturalistic scenes in older adults.

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Context plays a pivotal role in the cognitive processing of natural scenes, with previous research emphasizing the influence of semantic salience in determining attentional priorities, regardless of immediate perceptual features. While extensive work has delved into the neural correlates of context perception in healthy young adults, to our knowledge, none have ventured into examining this phenomenon in healthy aging, where declines in attention occur. In this study, we employed functional MRI to identify the neural regions associated with semantically driven attentional bias during a visual search task involving context-relevant objects within complex naturalistic scenes. Forty-one older adults (mean age = 63 years) viewed words representing a target object followed by an indoor scene image and were instructed to press a button when the target object was located within the scene. Half of the target objects were contextually congruent with the scene, while the other half were incongruent. Behavioral findings revealed slower response times for congruent compared to incongruent objects, suggesting that additional attentional resources are required when searching for objects that do not emerge from the scene (i.e., contextually-incongruent objects). Consistently, increased activation within the fronto-parietal attention network and occipital brain regions was observed when searching for congruent vs. incongruent objects. This underscores an attentional effort to localize objects that seamlessly blend within the scene context, contrasting with the prioritization that emerges when objects are contextually-incongruent. These initial insights in healthy aging will be further investigated through a comparative analysis with young adults.

Methods

T1

MRI Adventure: Prepare children in VR before an MRI scan

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30% of pediatric MRI scans are unusable due to incomplete scans or excessive motion. That's why 50% of pediatric MRI exams are currently sedated, but sedation is risky and scans duration can last 2.5 times longer than usual. To tackle this issue, some protocols implemented a training for children before an MRI scan using a mock scanner. The idea is to teach children to control their fears and to not move their heads during MRI scans using a psychologically safer environment. While using mock scanners appears to be a good solution, there are also some drawbacks: the available space required near the MRI scanner, and the undesired emotional states that can be induced in the context of many research projects.
On another hand, scientific literature already demonstrated Virtual Reality (VR) can be used to reduce anxiety and to threat many phobias. Based on these results, we decide to build MRI Adventure, a VR application allowing children to immerse themselves inside the 3D reproduction of an MRI scanner. The main objectives of the VR application are to teach children the safety rules in an MRI environment, to allow children to get familiar with an MRI scanner to control their fears (feelings of anxiety and/or claustrophobia), and finally to teach children to not move their heads during scans to ensure proper image acquisition. We conducted a preliminary study to validate the effect of the VR training before an MRI scan. Results showed 6-12 years old children successfully learned MRI security rules and to avoid head motions during scans.

Methods

DATABLITZ

T2

Structural range of functional interactions via a graph signal diffusion framework reveals a meaningful cortical gradient

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Human brain anatomy corresponds to a topologically and microstructurally complex network. Brain regions that express coherent activity recruit multiple axonal fiber pathways to establish local and distant inter-areal communication; such mediation can for instance be revealed by representing gray matter activity as a function confined by white-matter structure. There exist conventional distance measures between pairs of cortical areas: Euclidean distance, cortical geodesic distance, or tractography-based shortest path distance. Based on these measures, inter-areal communication is then typically divided in short- and long-range interactions. Furthermore, activation maps can be expressed on a structural connectome using persistence control energy principles. Here we propose an alternative framework that fully accounts for high-resolution information. We construct subject-specific brain graphs defined at the resolution of voxels from diffusion MRI data, covering both gray and white matter. We then study the relationship between subject-specific, seed-based, resting-state functional connectivity maps and the white-matter structure using a signal diffusion framework defined on the graphs. Using this framework, we derive a measure of the structural range of functional interactions associated to different regions across the cortex. Results reveal a meaningful cortical gradient that differentiates unimodal and transmodal cortical areas, across spatial scales. Transmodal cortices exhibit functional interactions that entail a greater structural range than that of unimodal cortices across subjects. The range maps also exhibit intricate idiosyncrasies. Our proposed framework to interpret brain activity as a function on high-resolution brain graphs provides a fertile ground for multiple future avenues of research on the human brain in health and disease.

Methods

T3

Assessing E-field Simulations Outcomes with Defaced MRI Scans for Open Science

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Introduction: Transparency and reproducibility are vital in modern scientific practice, but privacy concerns often limit the public sharing of raw data. Anonymizing MRI scans through tools like the Python package pydeface can make facial features unrecognizable, ensuring data privacy. However, it is essential to investigate if using defaced or full-faced scans affects electric-fields (e-field) when simulated.
Methods: We conducted e-field simulations (n=17) using SimNIBS 4.0, applying transcranial magnetic stimulation (TMS) at 80% of the resting-motor threshold over the left DLPFC. Simulations were performed using T1-weighted and T1-T2-weighted scans, with both defaced and full-faced versions.
Results: We found no significant differences between defaced and full-faced scans for e-field percentiles (99.9%, 99.0%, 95.0%), except for the 99.9% e-field percentile, where T1-weighted scans had higher e-fields than T1-T2 weighted scans.
Discussion: In summary, for e-field simulations with SimNIBS 4.0, defaced scans yield comparable results to full-faced scans. SimNIBS 4.0 replaces missing facial data with template data, contributing to the minimal differences observed. However, different scan types may lead to variations in the highest e-field percentile. To promote the open science concept and enable the sharing of scans and head-mesh files with the interested public, it is recommended that future simulation studies consider utilizing defaced images.
Key words: electric-field, NIBS, SimNIBS, open science, pydeface, data sharing

Methods

T4

SISMIK: Search In Segmented Input in K-space

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In the field of MRI imaging, addressing motion artifacts remains a significant challenge. Traditional methods largely depend on image-based techniques, but there's a growing interest in exploring k-space (the measurement space in MRI). Motion events are well localized in k-space, whereas they are distributed throughout image space. This study introduces a novel, reference-less motion correction pipeline that operates directly in k-space. By leveraging deep learning, the pipeline estimates motion parameters and integrates these with model-based image reconstruction. To train the deep learning model, named SISMIK, large training sets were created using physics-based simulations of 2D brain MRI scans. Empirically labeled in vivo datasets were also acquired and demonstrate that SISMIK is able to achieve good generalization performance. Results demonstrate that SISMIK excels in motion parameter estimation, effectively handling successive motion events. The approach leverages local information in k-space to estimate motion parameters in a relative manner and hence does not require any motion-free reference at inference. Following estimation of the motion trajectory by the deep learning model, a model-based approach leveraging the Fourier shift and rotation theorems is able to significantly reduce motion artifacts in the reconstructed images. Moreover, the model-based reconstruction aspect of SISMIK allows avoiding the introduction of hallucination artifacts, a common issue in deep learning, which is a major problem in the medical field. Overall, this innovative approach marks a significant advancement in motion correction for MRI, potentially enhancing the quality and reliability of diagnostic imaging.

Methods

T5

Enhancing Alzheimer's Disease Detection: Transfer Learning for Optimal Adaptation of Normative Neuroimaging Models to Independent Clinical Populations

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Alzheimer's Disease (AD) is a neurodegenerative disorder impacting memory and cognition, with associated hippocampal atrophy. Disentangling healthy-aging related shrinkage and AD-related pathological atrophy is crucial for early disease detection and understanding. Building on this, recent advances in neuroimaging methods, such as normative modelling, offer promising avenues. These methods establish normative trajectories using large-scale datasets, allowing the assessment of deviations in clinical populations. Despite their growing use and benefits, the application of normative models to independent clinical populations presents methodological challenges, such as limited sample sizes per site and variations in MRI scanner parameters specific to each site.

Our study addresses these challenges by using transfer learning to align pretrained models with new data. Normative models were established for the left and right hippocampal volumes in the UK Biobank (N=42,747) and were transferred to the AIBL dataset (N=462, 12% AD), using sub-samplings of healthy controls (HC) as transfer learning adaptation sets. We explored how sample size and scanner impacted model adaptation in HC and examined the influence of sample size on accurately representing AD neuroanatomical deviations in the AIBL dataset, assessed through a classifier's performance in differentiating HC from AD individuals.

The results showed that transfer learning for adapting UK-based normative models to the AIBL HC is optimal with 20 samples used in the adaptation set. This number of samples in the adaption set also ensured to reach the performance asymptote of the AD-classification.. Our work provides essential guidelines for effectively adapting normative neuroimaging models to independent clinical populations.

Methods

T6

Voxel-Wise Magnetic Resonance Imaging Analysis with StructuralEquationModels.jl

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Analyzing magnetic resonance imaging (MRI) data voxel-wise entails fitting a statistical model to each voxel, leading to the estimation of a considerable number of models, often in the hundreds of thousands. This high computational demand restricts the complexity of the statistical models employed. To alleviate this burden, we introduce highly efficient software for structural equation modeling (SEM). SEM encompasses a set of multivariate statistical models widely used in psychological research. In two illustrative examples, we show that our software is efficient enough to allow voxel-wise MRI analyses using SEM. We also show how SEM can be used to answer more intricate research questions in MRI analysis.

Methods

T7

HMM learning: initialization through the spectrum

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Mixture models form an important tool in machine learning and statistics to analyze and estimate characteristics of data arising from different subpopulations. They are also of interest when investigating latent processes, often modeled as hidden Markov models (HMM).
Learning the parameters of such models is typically conducted through expectation minimization (EM), which is the de-factor standard due to its effectiveness. EM requires a proper initialization can help reach more favourable regimes, usually done through k-means clustering, an efficient.

We revisit a spectral learning scheme which estimates moments from the data to extract key parameters of the HMM process and investigate its properties in high dimension compared to k-means. Our contribution lies in stabilizing the diagonalization of the tensor and the inclusion of a shrinkage step on the estimates, driving key quantities towards a global optimum and thus making the method independent of its initially random parameters.

Methods

T8

Comparison of gradient-echo EPI sequences for whole-brain fMRI at 7T using a parallel transmit head coil

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Ultra-high field MRI with radio-frequency parallel transmission improves signal-to-noise ratio (SNR) leading to superior temporal SNR and image quality. However, determining the optimal combination of spatial and temporal resolution for whole-brain functional MRI (fMRI) at 7T remains a challenge. This study aims at comparing blood oxygen level dependent images from three protocols with different temporal and spatial resolutions, by assessing SNR, task-based activation, and resting-state networks.

Ten healthy volunteers were recruited for the study in a 7T scanner equipped with an 8-channel transmit and 32-channel receive head-coil. Structural and three simultaneous multi-slice gradient-echo echo-planar-imaging (EPI) protocols, namely Lower_Res, Mid_Res and Higher_Res were acquired during resting-state and task-based paradigms. Submillimetric fMRI was feasible and image quality was not compromised although wrap-around artefacts were present. The three protocols demonstrated high spatial and temporal SNR in various brain regions. However, the Mid_Res protocol gave superior SNR than the others. Analysis of task-based activations consistently demonstrated robust results across all protocols, with larger voxel sizes correlating with higher statistical significance and activation volume. Furthermore, resting-state networks were reproducible across the different protocols.

Parallel transmission at 7T provided good signal homogeneity in fMRI images in cortical and deep brain structures, fostering comprehensive whole-brain resting-state and task-based fMRI analyses at a submillimetric scale. Future work will allow to address artifacts and minimize signal loss, allowing for more advanced functional connectivity analyses and exploration of temporal dynamics of the functional signal.

Methods

T9

Sparse Topographic Time-Frequency Decomposition of the EEG: Theoretical Concepts and Implementation

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Time-domain microstate analysis has become an increasingly popular and successful strategy for the effective and informative decomposition of resting state EEG into functional components. Nevertheless, it has clear shortcomings, i.e. when it comes to modeling data at polarity reversals, or when the “no temporal overlap” prior collides with contradicting observations or analysis strategies, as when applying spectral analysis or averaging ERPs. I will present a theoretical extension of the microstate model that overcomes these shortcomings by relaxing the a priori constraint from “no overlap in time” to “no joint overlap in time, frequency, and phase”. Fitting EEG into such an extended microstate model results in a filter learning problem that can be solved with optimization tools. It yields a decomposition of the EEG into a sparse set of transient spatially distributed common phase oscillations that represent networks of commonly activated brain regions.
I will also present a MATLAB/EEGLAB-based implementation of this approach, together with the first systematic results obtained from this toolbox in multichannel sleep EEG. At least for this data, our results indicate that, as previously claimed, the power distribution of topographic microstate classes is rather independent of the spectral power distribution, suggesting that the EEG’s spectral and topographic power distributions result from the superposition of functionally separate homeostatic processes.

Methods

T10

Longitudinal Functional Connectome Fingerprinting of Stroke Patients

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The extraction of “fingerprints” from human brain connectivity data has become a sought after goal in neuroscience. A lot of work has been done concerning healthy individuals, with promising results, but little is known about how the aforementioned ‘’fingerprints’’ change after the onset of neuropathologies. In particular, while neurodegenerative disorders such as Alzheimer and Parkinson have previously been investigated with this technique, it has never been applied to the case of stroke events, which is the focus of this study.
In this study, the goal is two-folded. One one hand we aim to prove that fingerprinting can be applied in a scenario characterized by phases of high plasticity and brain reconfiguration, such as the one after a stroke event. On the other hand, we aim to show how this technique is able to extract features from the functional connectivity data, able to capture the undergoing functional reconfiguration and ultimately explain the individual behavioral recovery.
To this extent we will leverage a new longitudinal dataset, unique in its nature, that follows a population of stroke patients for a year after the stroke onset, with fMRI acquisitions and behavioral measurements.
In terms of results, we can successfully fingerprint the stroke population, identifying a group-level trajectory of functional reconfiguration, as well as explain the behavioral recovery with the individual functional reconfiguration pattern specific to the VIS, VA, FP and DMN networks, opening possible new ways for individualized precision medicine.

Methods

T11

Combined electroencephalograhy-electrocorticography analysis of microstates in quiescence and music

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Electroencephalography (EEG) microstates have been shown to mediate local activity patterns during rest. To expand our knowledge of microstate mediated activation during auditory stimuli, we re-analyzed EEG microstate dynamics and electrocorticography (ECoG) temporo-spectral evolution in 2 patients while listening to Beethoven's 5th symphony. Methods: We analyzed data during rest and music from two participants with simultaneous noninvasive scalp EEG and invasive ECoG recordings. Microstate template maps were fitted to the scalp EEG data. To estimate the interaction effect of microstates x quiescence/music, we fitted covariance maps using the interaction timeline (microstates x quiescence/music) and ECoG local filed potentials filtered in different frequency bands (theta, alpha, beta, and high gamma). Results: We found a significant interaction covariation effect of microstates x music/quiescence and ECoG spectral amplitudes in all four frequency bands ($p = .001$, permutation test). Specifically, we found a large difference in microstates B, E, F, and G in the alpha and theta frequency bands between the two conditions. Discussion: To our knowledge, this is the first study to investigate intracranial electrophysiological activity during scalp EEG-based microstates during rest and music. Our results are consistent with the literature demonstrating the critical importance of the superior temporal lobe in music perception. We found that during serval microstates (specifically E, F and G) the interaction between different anatomical regions seems to be associated with changes in theta and alpha frequency bands. Conclusions: We demonstrate the feasibility of the scalp EEG microstate - ECoG method in comparing different states.

Methods

T12

EEG markers to task-irrelevant stimuli under higher and lower levels of flow

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We used EEG to characterize the neural bases of the state of flow, as defined by Csikszentmihalyi & Larson (2014) - a state of full immersion and optimal performance in the ongoing activity. We induced a higher versus a lower flow state in each participant through two individually tailored video game play sessions. Importantly, the induced lower flow state guaranteed that participants stayed on task, trying their best as in the higher flow state, avoiding confounds from off-task behaviors such as boredom or frustration.

As in Castellar et al (2019), we incorporated an auditory oddball paradigm, requiring participants to respond to infrequent "target" auditory oddball stimuli while playing their assigned game sessions, either in a higher or a lower flow state. We predicted that the target oddball sounds in the higher flow state would elicit slower RTs and reduced P300 amplitudes as compared to the lower flow state, in accordance with the hypothesis that stimulus events irrelevant to the video game task would receive fewer processing resources in the higher flow state.

Here we present our behavioral and EEG results during game play. We first demonstrate that ERP markers of the auditory oddball, in particular the N1, N2 and P3 components, can be recovered. We then discuss how artifact correction has been optimized, with respect to numerous eye movements. Finally, we present our ERP findings on the Fz and Pz electrodes and whether the ERP components may be affected by different flow states.

Methods

T13

Enhancing Neural Replay Detection through Unified Methodological Advancements and Statistical Evaluation

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Humans and animals demonstrate a remarkable ability to learn from limited data, a capability believed to be enabled by a cognitive process known as 'neural replay.'
Central to studying this phenomenon is the method known as temporally delayed linear modelling (TDLM). While TDLM has been successfully applied in various studies, it has not yet been rigorously examined as a statistical method in its own right. This has led to fragmented implementations across research groups, each refining the method independently. Such variations complicate result comparison and hinder developing a standardized, robust TDLM approach. Enhancing TDLM's accessibility and utility in neural replay research involves two main challenges:
First, TDLM must become more user-friendly for wider research community adoption. Secondly, and crucially, there is a need for a comprehensive and rigorous evaluation of TDLM's inherent statistical decisions.
This demands a unified implementation that is not only cohesive but also several orders of magnitudes faster than current ones. The enhanced computational speed is not merely a convenience but a necessity for conducting extensive simulation studies, which are indispensable for a robust statistical evaluation of TDLM. With this improved infrastructure, we can enhance TDLM components, like replacing the L_1 regularized decoder with an L_0 regularized decoder to refine state space representation. These improvements aim to make TDLM more accurate, reproducible, and insightful for neural replay studies.

Methods

T14

A multimodal approach to decomposing age effects in inhibitory control

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Aging is accompanied by alterations in the brain's structure and function, which can influence the response inhibition, known as inhibitory control. This study explores how these changes appear during the antisaccade task, a well-established method for measuring inhibitory control, requiring participants to look away from a visual cue. Typically, older adults show slower reaction times and make more errors, indicating a decline in inhibitory control. However, the specific cortical changes leading to this decline are not fully understood. In our study, we used high-density EEG and eye-tracking to record and compare brain activity patterns associated with inhibitory control tasks in both older (n = 100, mean age 68.7) and younger (n = 100 age 23.6) groups. We employed a standardized antisaccade protocol, allowing a comprehensive examination of the neurophysiological differences potentially underlying age-related changes in response inhibition. Using a linear mixed-effects model, we analyzed the interaction between trial type and age at each epoch's time point, accounting for individual participant variability. The older adults demonstrated higher error rates, longer reaction times, significantly more inhibition failures, and late prosaccades as compared with young adults.

At the neurophysiological level, a significant interaction between age and condition was observed. Aging was related to a decreased amplitude of presaccadic event-related potentials (~200 ms before saccade onset) over centro-parietal electrodes during the antisaccade condition. Simultaneously, older subjects showed a larger amplitude of occipital electrodes compared to young subjects. Taken together, the results highlight the importance of simultaneous eye tracking and EEG to decompose aging effects in inhibitory control.

Methods

T15

Towards a functional fingerprint of the human spinal cord

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Different studies have shown that the human brain has a unique "fingerprint" that can be identified through the pattern of functional connectivity between brain regions and used to successfully recognize individuals. Here, we propose to build on these analyses to investigate, for the first time, the identifiability of functional connectomes (FC) beyond the brain. In particular, we examined whether a fingerprint can be revealed from functional connectomes of the cervical spinal cord, another key part of the central nervous system (CNS). We used 2 independent datasets: i) a rest dataset (Kinany et al. 2020, n=19, 360 volumes, TR=2.5s, resolution=1x1x3mm) and ii) a rest dataset with 2 separate sessions (n=18, 288 volumes, TR=2.08, resolution=1x1x5mm). Parcelled time series were generated from 14 axial subdivisions of both grey and white matter along 4 rostrocaudal subdivisions (spinal levels C5-C8 for i) and C3-C6 for ii), resulting in 56 ROIs. We calculated the "identifiability matrix" A, representing the correlation matrix among the subjects' FCs. Subsequently we determined the quality of identifiability by computing its score following the method proposed by Amico et al. 2018. Additionally, we assessed the accuracy in identifying each subject. The scores were 15.11% and 15.27% with corresponding accuracies of 100% and 78%, respectively, for the two datasets.

These findings are the first evidence of a functional fingerprint in the human spinal cord, incentivizing to consider a more comprehensive view of the CNS. Eventually, this work might contribute to identifying individualised biomarkers of neuronal connectivity for clinical applications.

Methods

T16

Higher-order connectomics of human brain function reveals local topological signatures of task decoding, individual identification, and behavior

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Traditional models of human brain activity often represent it as a network of pairwise interactions between brain regions. Going beyond this limitation, recent approaches have been proposed to infer higher-order interactions from temporal brain signals involving three or more regions. However, to this day it remains unclear whether methods based on inferred higher-order interactions outperform traditional pairwise (i.e. node and edge-based) methods in the analysis of fMRI data.

To address this question, we conducted a comprehensive analysis using fMRI time series of 100 unrelated subjects from the Human Connectome Project. We show here that local higher-order indicators, extracted from instantaneous topological descriptions of the data, outperform traditional node and edge-based methods in task decoding as well as providing improved functional brain fingerprinting based on local topological structures, and a more robust association between brain activity and behavior.

Overall, our approach sheds new light on the higher-order organization of fMRI time series, improving the characterization of dynamic group dependencies in rest and tasks fMRI, and revealing a vast space of unexplored structures within human functional brain data, which may remain hidden when using traditional pairwise approaches.

Methods

T17

Exploring Spinal Motor Circuitry Through Integrated Transcranial Magnetic Stimulation and Spinal Cord fMRI

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The spinal cord, a crucial center in the central nervous system, facilitates sensorimotor activity for diverse human functions. Despite its significance, the exploration of its functional intricacies, especially independent motor mechanism characterization, is an evolving research area. To tackle this, our ongoing investigation integrates transcranial magnetic stimulation (TMS) and fMRI for a comprehensive delineation of spinal circuitry's motor aspect. In our investigation, we acquired spinal fMRI data from ten subjects under two sessions using a concurrent TMS-fMRI acquisition protocol. The TMS pulse was applied with three varying intensities of pre-estimated subject-specific resting motor threshold (rMT), i.e. sub-threshold (0.8% rMT), threshold, (rMT), and supra-threshold (1.2% rMT). Additionally, EMG electrodes were placed over the targeted muscle groups on the left hand to record motor evoked potential (MEP) responses to the applied TMS. Data were preprocessed using a established pipeline. Utilizing a GLM approach, spinal activation maps were derived via an event-based design, with non-modulated (NM) and modulated (M, orthogonal to NM) variables, constructed from MEP responses to diverse TMS intensities. We observed that the effect of applied TMS (NM) in both sessions primarily elicits activity in descending white matter tracts that transmits motor information from the cortex. Conversely, TMS intensity modulation (M) induced stimulation-side dominated bilateral activity in the ventral gray matter horns, which house motor neurons. This study validates our proposed multimodal setup for simultaneous stimulation and imaging of corticospinal circuits, particularly the spinal motor circuitry. It further highlights the role of spinal motor neurons in response to varied TMS intensity.

Methods

T18

DATABLITZ

Functional ultrasound localisation microscopy in rodents: monitoring of brain-wide connectivity at microscopic scale

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Functional ultrasound (fUS) has successfully pushed the boundaries of neuroimaging in rodents, allowing for brain-wide imaging of the hemodynamic flow down to 100-um resolution. Functional ultrasound localisation microscopy (fULM) was recently introduced to overcome this limit, and achieved micrometer resolution by localising intravenously injected micro-bubbles. However, the underlying data acquisition process is inherently sparse as its based on detection of individual micro-bubbles at very high frame rates, and rasterising high-resolution images comes with the cost of substantial increase of the final data size. In this work, our task is to develop algorithms for analysing brain activity and connectivity using fULM data. Two types of data representations acquired from rodent experiments are considered. First, we consider rasterised images displaying local density, and velocity of the micro-bubbles during whisker stimulation of a mouse. This representation allows for application of standard image processing techniques. Through SVD analysis, we observe augmentation in blood volume due to stimulation occurring across broader time interval compared to the raise in the blood velocity. Second, instead of rasterising high-resolution images, we directly register the micro-bubble detections on the atlas regions at each time frame. This procedure limits the degrees of freedom of the data to the total number of the atlas regions, while preserving high-resolution nature of the data, which substantially reduces the data size and allows for efficient downstream analysis. As an example, we compute functional connectome of a mouse at rest.

Methods

T19

Optimising magnetisation preparation of the 7T Fluid-Attenuated Inversion Recovery contrast: simulations and experimental validation

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At 7T, magnetisation preparation should be adjusted to obtain an adequate fluid-attenuated inversion recovery (FLAIR) contrast, which is widely used in clinical routine to detect lesions; e.g. in multiple sclerosis. However, such optimisation of the pulse sequence and comparison between preparation types are missing. This work aimed to set a simulation framework to investigate the timing of the magnetisation preparation at 7T. T2- and double inversion recovery (DIR) preparations were compared. Simulations of the FLAIR sequence were performed to investigate various preparation durations, optimise the nulling time of the cerebrospinal fluid signal and predict the signal and image contrast. The image contrasts obtained under simulation were experimentally validated on healthy volunteers using a 7T MAGNETOM Terra.X scanner (Siemens Healthcare). The results showed that signal intensity and contrast between tissues were sensitive to the duration of the preparation. The T2-preparation offered a quantitatively higher signal-to-noise ratio and a qualitatively-assessed contrast closer to the FLAIR images at 3T than the DIR preparation. However, FLAIR images with this type of preparation suffered from - presumably magnetic susceptibility – artefacts, which were not present on the FLAIR images with DIR preparation. Future work will include removing those artefacts and testing the sequences on patients with lesions in order to validate the contrast between normal-appearing/damaged tissues predicted by the simulations. In conclusion, we demonstrated that an adequate FLAIR contrast at 7T can be obtained by optimising magnetisation preparation. The simulations could be further used to optimise the readout in terms of timings and flip angles.

Clinical Neuroscience

W1

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

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Motor and non-motor symptoms related to Parkinson's disease (PD) are initially well controlled by levodopa therapy. However, as the disease worsened, these symptoms fluctuate which has a severe impact on patient's quality-of-life. The pathophysiology of non-motor fluctuations is still poorly understood. In terms of EEG resting-state power, levodopa administration is linked to an increase in theta, alpha and beta power compared to the levodopa withdrawal state (i.e. OFF state). To date, the temporal and EEG oscillatory dynamics of the transition from the OFF state to the levodopa effect phase (i.e. ON state) has not been investigated in terms of motor and non-motor symptoms.

We report preliminary results from 4 PD patients, who underwent high-density-EEG recordings during the OFF-state and ON state (6 minutes) and the 60 minutes following levodopa oral administration. Motor, neuropsychiatric and cognitive symptoms were assessed every 10 minutes. Five minutes eyes-closed resting state EEG sessions were performed in between each clinical assessments until the full ON state. Time-frequency analysis was performed on the resting-state EEG periods using as baseline the average OFF resting-state power.

Motor and non-motor transition profiles presented striking differences with differential onsets between motor and non-motor ON state. Time frequency analysis showed a progressive increase in theta and beta band absolute power and a decrease in alpha band power compared to the OFF state.

Altogether, these preliminary results suggest an asynchronous motor and non-motor clinical improvement from the OFF to ON dopaminergic state which correlates with EEG oscillation changes in different cortical areas.

Clinical Neuroscience

W2

EEG source reconstruction validation with simultaneous intracranial EEG in patients with epilepsy

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EEG is essential for assessing brain activity in epilepsy patients and identifying seizure-prone regions. To evaluate the added value of high density EEG connectivity analysis in predicting the eligibility for epilepsy surgery in pharmacoresistant cases, we first aim to validate EEG source reconstructed signals by comparing them with the gold standard of simultaneous intracranial EEG (iEEG) recordings. We obtained simultaneous high density EEG and iEEG data from 34 patients. We applied bandpass and band-stop filters to both modalities and EEG artifacts were removed with independent component analysis. First, we investigated which iEEG re-reference approach better mitigates the common reference bias. To do so, we examined the four re-referencing methods: gray matter channel common average (GMCA), white matter common average (WMCA), bipolar montage (BM), and no re-referencing. Subsequently, we employed the eLORETA inverse solution followed by a simplified forward model to estimate potentials onto iEEG electrode positions as virtual iEEG electrodes. Finally, we calculated the correlation between iEEG and virtual iEEG signals. Preliminary findings indicate that the correlation between iEEG and virtual iEEG varied primarily across subjects and less across re-referencing method (median=0.08, [Q1, Q3]=[0, 0.15]). Notably, even though BM measures local fields, the correlation between iEEG and virtual iEEG is not worse with BM compared to other re-referencing methods. Moreover, BM is not affected by the common average and is less sensitive to distant sources, therefore BM is selected for further analysis. Future investigations should explore correlations across different brain rhythms and electrode depths and explore other inverse solutions.

Clinical Neuroscience

W3

Dynamic segregation and integration during interictal epileptic discharges revealed by connectome spectrum analyses

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Brain networks in epilepsy exhibit complex interactions between segregation and integration. This study delves into the dynamic interplay during interictal epileptic discharge (IEDs) in temporal lobe epilepsy (TLE) patients, utilizing graph signal processing on high-density EEG recordings. EEG data from 20 TLE patients were marked and aligned at the center of 1-second epochs containing IEDs. Activity of 118 brain regions was estimated using an individual head model and a distributed inverse solution. Employing a template structural connectome (SC), source signals were decomposed as the sum of SC graph Laplacian eigenvectors, termed 'network harmonics.' For each subject, the energy spectrum of the transformed signal was divided into low-frequency harmonics (LF, reflecting network integration) and high-frequency ones (HF, reflecting segregation). The first were used to reconstruct the part of the ROI traces mostly coupled to the underlying structure (Xc), while the latter the decoupled one (Xd). Xc and Xd norms were calculated over all brain regions and the dynamics of their energy distribution along the IED were compared with a cluster-based permutation test across patients. Findings revealed two significant clusters at the IED onset and its first peak. Between start and midrise, HF harmonics content was significantly greater than LF ($p<.05$), indicating increased segregation. Around the IED peak, coupled signal energy predominated ($p<.05$), suggesting increased integration. Results imply a temporal succession of segregation and integration regimes during IED. Initial segregation surge may reflect spatially confined IED onset, while later integration increase suggests effective information transfer through propagation in the epileptic network.

DATABLITZ

W4

Eigenvector centrality connectivity patterns indicate age and APOE4 carrier status.

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Age and Apolipoprotein E4 (APOE4) are the greatest risk factors for Alzheimer's disease (AD) but the fundamental process remains unclear. Functional brain change in AD, as revealed by functional magnetic resonance imaging, is characterized by disruption of neuronal brain networks.

Here, we explored functional connectivity (FC) changes associated with aging and carrying APOE4 allele, to link individual brain network properties with AD risk. We included in the study 128 individuals from the Alzheimer's Disease Neuroimaging Initiative database (ADNI). This sample includes 54 APOE4 carriers and 74 non-carriers), as well as their clinical status counting 76 non-symptomatic (39 Cognitive Normal, 37 Subjective Memory Complaint) and 52 symptomatic individuals (39 Mild Cognitive Impairment, 13 AD).

We investigated the relationship between eigenvector centrality, aging and the presence of APOE4. We are exploring the impact of aging on brain functional connectivity and the potential mediation of this effect by the presence of the genetic risk factor for AD.

We use partial least square analysis to study the association between eigenvector centrality with age and APOE4 status.

We found a significant relationship between centrality, aging, the presence of APOE4 and disease progression in brain regions in parietal and frontal lobes ($p\text{-val}<0.001$). Decreased centrality in the dorsal somatomotor and visuospatial attention networks is associated with aging, cognitive impairment, and the presence of the genetic risk factor APOE4.

Our findings suggest that FC alterations are associated with aging but also with the presence of APOE4 and especially in individuals presenting cognitive impairment.

Clinical Neuroscience

W5

The individual-level, multimodal neural signature of face processing in autism within the fusiform gyrus

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Face processing is among the most reported social difficulties of autistic individuals. While its neural underpinnings have been explored unimodally, there is still little knowledge about how different neuroimaging markers are simultaneously implicated and associated with social functioning in autism. Extracting shared information across different modalities is essential for better understanding underlying mechanisms of autism. We leveraged the EU-AIMS Longitudinal European Autism Project dataset to study the cross-modal signature of face processing within the fusiform gyrus (FFG) across structural MRI, resting-state fMRI (rs-fMRI), task-fMRI and EEG. After employing normative modelling on each imaging modality, unimodal individual-level deviations were merged using linked independent component (IC) analysis. We next tested whether a) ICs significantly differed between autistic and non-autistic individuals (NAI) and b) were significantly associated with social features in autism using canonical correlation analysis. In total, 50 independent components were derived, among which one IC showed a significant difference between autistic and NAI ($t=3.5$, $pFDR=0.03$). This IC that was mostly driven by bilateral rs-fMRI, bilateral structure, right task-fMRI, and left EEG. Finally, there was a significant canonical correlation between multimodal ICs and a set of social features ($r=0.65$, $pFDR=0.008$). Results suggest that the FFG is a central region differentially implicated in autistic and non-autistic individuals across a range of imaging modalities and these can simultaneously inform mechanisms associated with core social functioning in autism. Elucidating a more holistic picture of neural associations of core cognitive and clinical features in autism, will pave the way for the development of more personalised support.

Clinical Neuroscience

W6

Learning to control the visual cortex and enhancing visual attention via fMRI-based Neurofeedback

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Attention is a crucial cognitive function allowing us to select pertinent sensory information while ignoring irrelevant stimuli in the environment. This capacity emerges from top-down mechanisms involving bilateral fronto-parietal networks that interact with early visual areas. Following frontal or parietal brain lesions and therefore disruption in this system, peculiar conditions may emerge, such as unilateral spatial neglect (USN): a syndrome denoted by impaired awareness of stimuli presented in the visual field contralateral to the lesion site, in absence of pure sensorial or motor losses. One functional explanation of this condition might rely on abnormal biases in top-down regulation of sensory pathways from higher-level attentional networks towards early visual areas. Neuromodulation and up-regulation of such preserved sensory areas have proved to account for partial restoration of this balance and improvement in clinical symptoms. In particular, functional MRI (fMRI) based real-time neurofeedback (NFB) represents a promising and effective neuromodulation tool. However, specific mechanisms underlying successful modulation of visual areas via fMRI NFB are still unclear. For this reason, we couple the spatial precision of fMRI with the temporal resolution of EEG in EEG-MRI multimodal imaging fashion during NFB training to unravel structural and functional correlates of such learning process in the brain. Results from this study will further help develop an informed EEG-NFB based protocol to apply in clinical context for USN rehabilitation.

Clinical Neuroscience

W7

Predicting risk of relapse by combining brain connectivity and microstates in patients with new onset epilepsy

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After a diagnosis of epilepsy, 20-30% of patients will relapse. To date, markers able to predict future success in drug response are still lacking. Here, we investigated electroencephalography (EEG) connectivity and microstates between patients who became seizure-free ("responders") and patients who experienced seizures despite medication ("non-responders"). We retrospectively recruited 62 new onset epilepsy patients (with at least 2 years of follow-up) for whom an EEG was performed following their first epileptic seizure but before treatment was introduced. We computed connectivity analyses (weighted phase-lag-index) on all brain regions for delta, theta, alpha, beta, and gamma frequencies, along with microstates analysis, i.e. a spatiotemporal approach to investigate large-scale networks. By performing mixed-models analysis, we tested EEG connectivity across frequency bands and microstates, between responders and non-responders. After treatment, 51 patients remained seizure-free (mean age: 52.2; SD: 18.4) while 11 relapsed (17.7%; mean age: 53.1; SD: 20.2). We observed interactions between groups and frequency bands ($p < 0.001$), global explained variance ($p = 0.036$), and number of occurrences ($p = 0.007$) of microstate maps. In the group of non-responders, we observed a decrease in delta connectivity ($p = 0.022$) and an increase in alpha connectivity ($p = 0.022$), a higher global explained variance for microstate C ($p = 0.021$), and a decreased number of occurrences for microstate A ($p = 0.031$). EEG connectivity and microstates after a first epileptic seizure might have the potential to identify future partial drug treatment response, but larger studies are required to corroborate such findings.

Clinical Neuroscience

W8

Using MRI-Personalized vs. Standardized Multi-Electrode tACS for precise targetting of the angular gyrus in MCI patients

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Transcranial alternating current stimulation (tACS) is commonly delivered using 2 electrodes, limiting control of the target regions. In our double-blind, sham-controlled clinical trial with Mild Cognitive Impairment (MCI) patients, we used a 6-electrode tACS montage over the left angular gyrus, which is one of the hub regions reflecting dementia-related memory deficits. The stimulation pattern was defined using the simNIBS algorithm, which allows for precise mapping of individual brain anatomy. tACS-induced electrical fields in the brain can be strongly affected by anatomical changes, which may be particularly important in MCI patients with expected cortical atrophy and other structural differences. In this study, we compared personalized (individual MRI-based) simulations to simulations with a fixed average setting (computed on the MNI head model) in MCI patients and questioned whether the distribution and strength of the induced electrical field would differ. Structural MRI scans were acquired from 23 MCI patients (9 females; M age=70.9 years, SD=±6.78). MRIs were analyzed using simNIBS to define the electrical current at each electrode to optimally reach the target region with the normal component of the electrical field at 0.3 V/m. Standardized and personalized tACS simulations significantly differed in the strength of the electric field over the angular gyrus. Furthermore, the standardized simulation pattern had a more widespread range of stimulated brain areas compared to the personalized one. This study demonstrates that individualized modeling of electric fields is necessary to control anatomical differences and ensure proper target region dosing, while minimizing stimulation spread to other areas.

Clinical Neuroscience

W9

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

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The correlation of early life adversities (ELA) and the occurrence of social anxiety disorder (SAD) and other psychiatric disorders is a well-known fact in psychiatry. While ELA represent a risk factor for the development of SAD, recently it was shown that a history of ELA also moderates the cerebral correlates of SAD during confrontation with social threat. It remains unclarified, however, if this moderating effect is also reflected in at the structural level. Here, we present a diffusion tensor imaging (DTI) study (N=99) where we combined literature-based ROIs with fiber tracking creating tailored ROIs for the study sample in addition to tract based spatial statistics (TBSS). An interaction of SAD and ELA was observed in the left thalamus in fibers connected to the left inferior longitudinal fasciculus (ILF) and with borderline significance in the white matter between the right ILF and the right thalamus extending into the thalamus. While high ELA controls and low ELA individuals with SAD exhibited increased fractional anisotropy (FA), FA in high ELA individuals with SAD was decreased. This study demonstrates that ELA act as moderator of the neural correlates of SAD not only at the functional but with an analogous pattern also at the structural level. This might explain inconsistencies between previous studies and emphasizes that ELA should thus be considered and included as potential confounder in this area of research and potentially also with regard to other psychiatric disorders.

DATABLITZ

W10

Voxel-based morphometry, functional connectivity, and behavioral signatures of mild cognitive impairment

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Mild Cognitive Impairment (MCI) represents a cognitive state between normal aging and dementia. This loss of cognitive ability does not importantly impact daily life functioning. Cognitive impairments in memory, attention, spatial orientation, or executive functions, and increased fall risk occur. A minority of MCI patients may stay stable or recover to some extent, but most convert to dementia. Yet, regular cognitive training can boost or maintain cognitive and brain functions. This study is part of a randomized controlled trial comparing the influence of music/psychomotor interventions on brain and behavior in MCI patients. Here, we take advantage of trial baseline data to evaluate behavioral, grey matter volume, and resting-state functional connectivity differences between a group of 32 MCI patients and 17 gender- and age-matched controls at baseline (60-80 years). We report lower performance in patients global cognitive functioning, processing speed, switching, attention, and speech in noise perception. The analysis of GM volume revealed a widespread pattern of atrophy in patients. 3 clusters are significant after multiple comparison corrections (bilateral hippocampi and mid cerebellum, $p < 0.05$ FWE). In addition, significant decreased functional connectivity associated with 3 seeds was detected in patients (left angular gyrus, inferior temporal gyrus, and putamen, $p < 0.05$ FDR). These results enrich the anamnesis of MCI cognitive deficits and confirm the importance of the inferior temporal lobe in MCI pathology. Further evaluation of relationships between behavior, grey matter volume, and functional connectivity will be performed in the hope of refining MCI diagnosis and establishing new psychometric/neural biomarkers.

Clinical Neuroscience

W11

Event-Related Potential microstates in Mild Cognitive Impairment patients during memory recognition task

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Information processing during cognitive tasks can be studied using event-related potentials (ERPs). Previous studies reported longer P300 latency and decreased N200 amplitude in mild cognitive impairment (MCI) patients. However, none of these studies exploited the spatiotemporal information about brain states from the ERP data. In this study, we used a spatiotemporal ERP microstate analysis approach, which allowed us to identify spatial properties and precise timing of mental processes during a working memory task. 23 MCI patients (9 female; M age= 70.9), 60 healthy older (34 female; M age= 71.5), and 60 healthy younger (33 female; M age= 25.9) adults performed a recognition task in which 20 previously encoded neutral images were presented mixed with 20 new neutral images. Data was acquired using a 257-channel system to calculate ERP microstates elicited by new and repeated images. We identified one microstate that showed a significantly delayed onset in MCI patients (350 ms) and healthy older adults (326 ms) compared to healthy young adults (302 ms). This brain state corresponds to the P300 complex, which is associated with cognitive processes such as working memory and decision-making. Crucially, we identified an earlier microstate at around 260 ms that was present only in MCI patients and healthy older adults and led to delayed P300 response. This brain state corresponds to the N200 component, often associated with selective attention and cognitive control. The results indicate that MCI patients and healthy older adults engage more time in attention and cognitive control processes, leading to a decision-making delay.

Clinical Neuroscience

W12

Real-time functional MRI neurofeedback in Functional Neurological Disorder: A proof-of-concept study

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Functional Neurological Disorder (FND) is a neuropsychiatric condition defined by the experience of neurological symptoms without a clear organic cause. Symptoms may include motor dysfunction (such as tremor or limb weakness), sensory dysfunction (such as tingling, numbness or pain), or non-epileptic seizures. Regardless of the type of symptoms experienced, a common feature of FND is a perceived loss of control over one's actions, referred to as an impaired sense of agency. Recent neuroimaging studies have linked FND to abnormal brain function and connectivity, particularly in the right temporoparietal junction (rTPJ), a key brain area for the sense of agency. One technique for directly modulating the affected neuronal correlates is real-time functional MRI neurofeedback (fMRI NF). By learning different cognitive strategies, fMRI NF enables participants to gain volitional control over the activity or connectivity between specific brain regions. This proof-of-concept study aims to assess whether FND patients can learn to increase the activity of the rTPJ through fMRI NF. During fMRI NF, participants perform a behavioural agency task in the MRI designed to increase activity in the rTPJ, which is conveyed to the participants through visual feedback. Preliminary results suggest that the defined rTPJ mask captures the activation change within the region of interest and that most participants can upregulate rTPJ activity during the fMRI NF training phase. Ultimately, this study provides insights into novel methods to non-invasively modulate the sense of agency and may pave the way for new clinical treatments.

Clinical Neuroscience

W13

EEG microstates temporal dynamics in Alzheimer's disease and mild cognitive impairment: a meta-analysis

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While EEG microstates are increasingly used as a novel tool to investigate intrinsic whole-brain neuronal network activity, as well as potentially relevant markers of atypical neurocognitive functioning, only a few studies so far have reported microstate temporal features in dementia. The current work attempts to provide normative estimates of microstate temporal features in patients with Alzheimer's disease, patients with mild cognitive impairment, and healthy older individuals. We carried out a systematic search of the literature, followed by the meta-analysis of the average values of the microstate temporal parameters reported in studies that measured resting state EEG in older individuals during periods of eyes-closed resting state. Multi-level meta-analytic models were fitted to yield estimates of average microstate duration and occurrence in 8 studies, making up for a total of 1163 participants comprising 458 Alzheimer's disease patients, 418 patients diagnosed with mild cognitive impairment and 287 healthy older participants. Our results provide the expected range of microstate feature estimates across typically developing and clinical study samples, revealing significant differences in microstate duration and occurrence when comparing clinical groups to controls. Specifically, microstates A and B last longer, with microstate A occurring more frequently, while microstate D was shorter and less frequent in both clinical groups; microstate C occurs less in Alzheimer's disease patients. Finally, we inquired into the heterogeneity stemming from clinical, demographic, and methodological factors. Altogether, this study corroborates the view according to which microstates temporal dynamics are clinically relevant markers for the detection and further understanding of Alzheimer's disease.

W14

Effect of wake vs sleep seizure occurrence on brain network and memory in focal epilepsy

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Epilepsy, sleep and memory are intertwined: higher hypersynchrony of neuronal networks during non-rapid eye movement (NREM) sleep facilitates seizures, and memories are consolidated during NREM sleep. However, their relationship remains poorly understood. We studied EEG-based brain networks in 94 patients with focal epilepsy (54 temporal lobe epilepsy, TLE). Seizure occurrence was classified as "sleep-related", "wake-related" or "independent". The outcome (normal, impaired) of visual and verbal memory tests was collected alongside. We extracted epochs of interictal activity during wakefulness (W) and NREM sleep (N2) and performed source-reconstruction of these timecourses. We calculated phase-based connectivity and estimated the networks' integration (global efficiency, GE) and segregation (clustering coefficient, CC). We investigated the interactions between seizure occurrence (wake, sleep, circadian-unrelated) and the vigilance status (W, N2) on GE and CC with mixed models and used chi-squared tests to investigate the relationship of seizure occurrence with epilepsy type (TLE, other epilepsies) and the cognitive deficit. A main effect of the vigilance status shows that theta segregation is higher during wakefulness than N2 sleep ($p<.05$). Sigma segregation and integration are higher during N2 sleep ($p<.001$), but no interaction nor main effect of seizure occurrence was found. Chi-squared tests only showed that, as expected, TLE patients are more likely to have wake-related seizures ($p<.001$). These results suggest that seizure occurrence (the moment of the day mostly disrupted by ictal activity) does not differently affect the integration/segregation of sleep vs wake brain networks nor does it lead to a different outcome in term of visual and verbal memory.

Clinical Neuroscience

W15

High-density EEG source localisation of averaged interictal epileptic discharges validated by surgical outcome

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Electroencephalographic source localisation (ESL) of interictal epileptiform discharges is a valuable tool for presurgical evaluation of pharmacoresistant focal epilepsy. Various forward models, inverse solutions algorithms, and software packages have been published. However, clinical validation studies are based on heterogenous end points and study cohorts. To allow comparison of different interictal ESL methods within one standardised dataset, we provide deidentified clinical data of 45 well-characterised patients with pharmacoresistant focal epilepsy and a first resective surgery, validated by 12-month postsurgical outcome. Thirty patients had favourable outcome, including 28 with complete seizure freedom, indicating that the epileptogenic zone was correctly estimated. For each patient, pre-processed individual structural MRI, 257-channel EEG averages of homologous discharges, postsurgical structural neuroimaging, and detailed clinical and technical information are given. In patients with favourable outcome, source maxima of averaged discharges were <10mm remote from the resection in 67% and within a sublobe affected by the surgery in 83%. Future validation studies of new ESL approaches can be compared to this benchmark.

Clinical Neuroscience

W16

Increase of medio-frontal gray matter volume is associated to reduction of negative symptoms in patients with psychosis: VBM correlates of psychotherapy-related changes

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Besides psychotic symptoms (hallucinations, delusions), cognitive deficits and negative symptoms may occur in patients with psychotic disorders. Negative symptoms (blunted affect, alogia, anhedonia, avolition, social withdrawal) are the most important predictors of long-term impairment. This study evaluated an innovative cognitive behavioral therapy (MOSAIC) comprising individual sessions of cognitive behavioral therapy (CBT) and corresponding social skills group trainings. MOSAIC-therapy (30 sessions of individual CBT & 30 group trainings within 8 months) was compared with SUPPORT-therapy (supportive talks and enjoyable group activities in the same timeframe) in a randomized controlled trail. Sixty patients with psychotic disorders participated. Assessments for negative symptoms (PANSS-neg) were carried out before initiation (T0) and after completion of the interventions (T2). Furthermore, structural MRI data (3T) were assessed for therapy-related changes of gray matter volume using SPM12 (www.fil.ion.ucl.ac.uk/spm, CAT12-Toolbox, $p < 0.05$). Statistical analysis did not reveal significant differences between MOSAIC and SUPPORT regarding the reduction of negative symptoms ($p = 0.36$, Cohen's $d = 0.1$). However, pre-post comparisons showed symptom reduction within both groups with moderate to large effect sizes (MOSAIC: $p < 0.001$, $d = 0.82$, SUPPORT: $p = 0.005$, $d = 0.53$). Regarding VBM correlates, no interaction between time (T2 vs. T0) and group (MOSAIC vs. SUPPORT) was observed, whereas the extent of individual reduction of negative symptoms correlated with increased gray matter volume (T2 > T0) in the bilateral ventromedial prefrontal cortex (vmPFC) and the left temporal pole. These results indicate a link between clinical improvement and neuroplastic changes within regions underlying social motivational processing.

Clinical Neuroscience

W17

The Self-thoughts in Mild Cognitive Impairment: A high-density, resting-state EEG study

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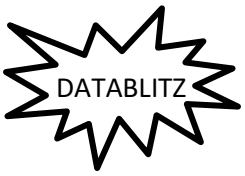
Alzheimer's disease (AD) is a progressive neurodegenerative disorder associated with cognitive memory loss, including an impairment of autobiographical memory. Capturing such self-relevant memory loss in the early stages of AD, i.e., during mild cognitive impairment (MCI), could be a valuable biomarker of disease progression. Resting state EEG microstates represent brief periods of global neuronal synchronization of large-scale networks that dynamically change over time. EEG microstates have the potential to be a useful clinical tool for early AD diagnosis. The study aimed to detect alterations in MCI patients compared to healthy controls during resting-state high-density EEG recordings using the EEG microstate approach and examine associations between the intrinsic dynamics of EEG microstates and self-reported thoughts. We recruited 23 MCI patients (9 female; M age= 70.9), 60 healthy older (34 female; M age=71.5) and 60 healthy younger (33 female; M age=25.9) participants. The resting-state activity was acquired for 5 minutes in eyes closed condition, using the 257-channel system to characterize microstate alterations in duration, occurrence, and time coverage. After the recording, a subgroup of participants completed the Amsterdam Resting-State Questionnaire (ARSQ), specifying their thoughts during the rest. MCI patients showed significant alterations in microstate C and lower "self" dimension scores of the ARSQ. Correlation analysis between the temporal parameters of the significant microstate C and the ARSQ showed a moderate correlation between microstate duration and the "self" dimension. These findings demonstrate the relevance of characterizing microstate dynamics in MCI patients and assessing spontaneous thought for understanding intrinsic brain activity.

Learning & Memory

W18



A grid-like code for value-based decision making

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Theoretical models propose that value-based decisions utilize a common neural currency for utility to compare choice options, where rewarding options such as foods, money, and social stimuli are encoded using a common neural value code in the brain (the "brain valuation system [BVS]"). This value coding reflects an individual's subjective valuation—how rewarding something is based on an individual's preference. However, how a given choice option is transformed to its subjective value remains poorly understood. One candidate for how this transformation could happen is via the brain's the grid coding system. To test this hypothesis, we designed a novel task where human participants are asked to make value-based risky choices between two shapes that span a 2D attribute space between reward probability and reward amount while undergoing fMRI scanning. First, we utilized well-established computational models to calculate the subjective value of each participant's choices according to the Cumulative Prospect Theory (CPT) model. We show that blood-oxygen-level-dependent (BOLD) activity is associated with individuals' subjective value difference between the two options in the BVS, replicating previous findings in our new task. Second, using well-established analyses, we also find a grid-like representation of individuals' decision vectors in a subjective value space that is distorted as predicted by CPT. Strength of activation in these two systems (BVS and grid-coding system) is correlated across participants, suggesting these neural codes operate in tandem to construct values. These findings suggest a previously unknown mechanism in the transformation of a reward's attributes into subjective value.

Learning & Memory

W19

Impact of Driving Expertise, Short-Term Experience, and Automation on Brain Morphometry

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This study investigates the influence of driving expertise, brief experiences, and varying degrees of automation on brain morphometry among drivers. The goal is to discern structural brain changes related to driving skills and automation use. Analysing MRI data, we examined the brain morphology of expert and novice drivers and identified distinct structural variations correlated with their skill levels.
Experts exhibited increased cortical thickness asymmetry relative to novice drivers in sensorimotor and visuospatial regions of the cerebellum, suggesting neural adaptations related to previously learned driving abilities.
Additionally, short-term driving experiences showed notable alterations in brain structure after just a few weeks. These changes primarily occurred in the cortical thickness of regions linked to motor control and sensorimotor integration for all drivers, and some were specifically present in novices, underlining the brain's adaptability to new driving environments.
Furthermore, the study explored how different forms of automation affected brain morphometry, revealing differential structural changes related to short-term experience as a function of expertise. A cerebellar structure implicated in attention and cognitive shifting was differentially affected by automation modes and drivers' expertise.
The findings highlight the brain's plasticity in response to driving expertise, short-term experiences, and automation usage, providing insights into how the brain adapts to driving conditions and technological advancements in automotive systems. Understanding these neural adaptations can aid in designing safer and more effective automated driving systems, optimising human-automation interactions, and advancing our comprehension of brain plasticity in real-world contexts.

Learning & Memory

DATABLITZ

W20

How emotion influences memory of complex events in space and time?

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Our daily lives unfold continuously, yet our memories are organised into distinct events, situated in a specific context of space and time, and chunked when this context changes (at event boundaries). Previous research showed that this process, termed event segmentation, enhances object-context binding but impairs temporal order memory. Physiologically, peaks in pupil dilation index event segmentation, similar to emotion-induced bursts of autonomic arousal. Emotional arousal also modulates object-context binding and temporal order memory. Yet, these two critical factors have not been systematically studied together. To address this gap, we ran a virtual reality (VR) study using a novel paradigm designed to study event segmentation and emotion effects on episodic memory and simultaneously recorded physiological measures. During encoding, participants entered a room with a specific colour of the walls (colour changes defining events), and were presented with objects paired with a neutral or aversive sound. During retrieval, we tested participants' memory of the object details, temporal order of object presentation, colour of the walls and spatial location of the object. We found complex effects of emotion and event segmentation on different aspects of episodic memory. While event segmentation (triggered by changes in the wall colour) impaired temporal order memory, neither event segmentation nor emotion affected memory for the wall colours. Conversely, we observed interaction of emotion and event segmentation on spatial location memory, in line with varying levels of arousal reflected by pupil changes. These findings increase our understanding of episodic memory organization in naturalistic settings, with perceptual changes and emotion fluctuations constantly interacting.

W21

The role of oscillatory brain activity in successful learning in health aging: Unraveling the impact of pre-stimulus activity on post-stimulus theta synchronization and alpha desynchronization

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The capacity to learn is a key determinant for the quality of life but is known to decline to varying degrees with age. However, despite mounting evidence of memory deficits in older age, the neural mechanisms contributing to successful or impeded learning remain unclear. Previous research has primarily focused on memory formation through remembered versus forgotten comparisons, lacking the ability to capture the incremental nature of learning. Moreover, previous EEG studies have primarily examined oscillatory brain activity during the encoding phase, such as event-related synchronization of theta (ERS) and desynchronisation (ERD) of alpha power, while neglecting the potential influence of pre-stimulus activity. To address these limitations, we employed a sequence learning paradigm, where participants learned a fixed sequence of visual locations through repeated observations. This paradigm enabled us to investigate theta ERS, alpha ERD, and how they are affected by pre-stimulus activity during the incremental learning process. Behavioral results revealed that young learned significantly faster than older subjects, in line with expected age-related cognitive decline. Successful learning was directly linked with decreases of theta ERS and increases of alpha ERD. Notably, these neurophysiological changes were less pronounced in older subjects, reflecting a slower rate of learning. Importantly, our mediation analysis showed that in both age groups, the influence of sequence repetition on theta ERS and alpha ERD was mediated by pre-stimulus activity. Our findings offer new insights into the age-related differences in memory formation and highlight the importance of pre-stimulus activity in explaining post-stimulus responses during learning.

PARTICIPANTS

Poster abstracts are preceded by a 'M', 'T' or 'W' depending on the presentation day (M=Monday, T=Tuesday, W=Wednesday).
Talk abstracts are preceded by a 'O'.
* Presenter abstracts

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WEIDNER	ENYA MARIE	O18*
WILDGRUBER	DIRK	W16*
WIRSICH	JONATHAN	W15
WITTMANN	ADRIEN	M17*
WYSS	KIM	W8 W11 W13 W17*
YILDIRIM-KELES	FAZILET ZEYNEP	O25*
ZERBI	VALERIO	