Alpine Brain Imaging Meeting

Champéry, Switzerland, January 6-10, 2019

P R O G R A M

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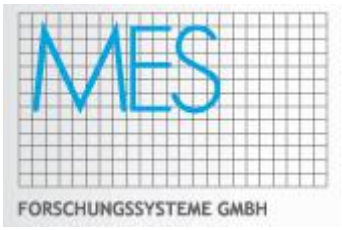

ABIM cover from Djalel Eddine Meskaldji, photo taken at ABIM 2016.

Alpine Brain Imaging Meeting

Champéry 2019

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Locations:

The opening keynote lecture on Sunday will be held at the *Centre Paroissial et Culturel*. The welcome reception and registration 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) on Sunday, the 6th of January from 18:30 to 20:30, and will be accompanied by an informal **welcome reception** with nibbles and wine. 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 15:15 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 *Centre Paroissial et Culturel* (Route des Dents Blanches, 28), just next to *Hotel Suisse* (see map). 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 Thursday to allow sufficient viewing time for all participants. Two poster sessions will be held on Tuesday 8th (odd numbers) and Wednesday 9th of January (even numbers) in the afternoon. 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* meeting 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.

Several **social events** are organized during the week and will represent the best occasion to meet among conference participants. A **blind test music quiz** will take place on Monday evening at 21.30 at the bar of the *Hotel Suisse*. A **karaoke night** is planned at the bar *La Crevasse* (Rue du Villlage, 71) on Wednesday evening. Details and updates will be given during the conference.

A **farewell dinner** is planned on Thursday night at the restaurant *Le Gueullhi* (Route de la Fin, 11, next to cable car station). You will have the opportunity to taste the famous *fondue*, a traditional local dish made of

melted cheese. As alternative dishes, potato rösti and rice with vegetables will also also available. The dinner will be free for all registered participants, excluding beverages. Please refer to the staff at the registration desk before Tuesday January 8 for any changes regarding the dinner, with respect to the preferences you expressed during the online registration. A **prize ceremony** will be held with best poster and best presentation awards. A **disco party** will follow at the bar *La Crevasse* (Rue du Villlage, 71). Don't miss it!

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 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.

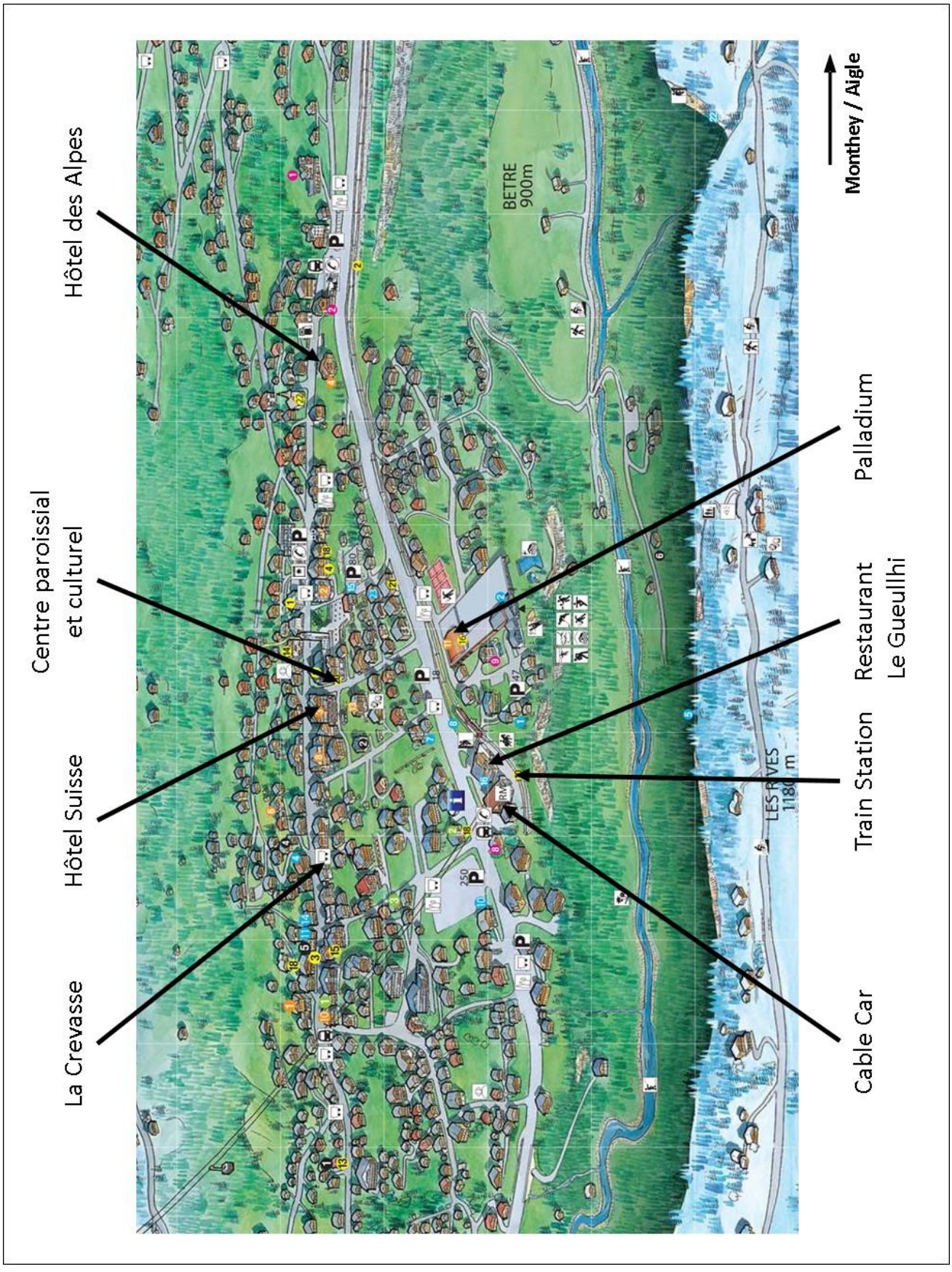
A **swimming pool** and **skating arena** can also be found in the *Palladium*. A **curling** initiation session can be organized for ABIM participants. Details will be given during the registration.

A **snowshoe walk** with a guide will be organized on Wednesday morning (half day) and will be free for 20 ABIM participants, on a first come first served basis. Details and registration for this activity will be available during the conference registration on Sunday evening.

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 topics.

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

MAP


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

PROGRAM OVERVIEW

SUNDAY, January 6

CONFERENCE OPENING

17:30 **Opening Keynote Lecture** (Centre Paroissial et Culturel)

Pascal FRIES | *Ernst Strüngmann Institute, Frankfurt, Germany*

- *Rhythms for cognition*

18:30-20:30 **Welcome Reception & Registration** (Hotel Suisse)

MONDAY, January 7

NEURAL OSCILLATIONS

15:30 **Lucia MELLONI** | *Max Planck Institute, Frankfurt, Germany*

- *Neural mechanism for natural and artificial sequences*

16:20 **Martin SEEBER** | *University of Geneva, Switzerland*

- *Subcortical electrophysiological activity is detectable with high-density EEG source imaging*

16:40 **Francesco DE PASQUALE** | *University of Teramo, Italy*

- *Temporal modes of synchronization in the dynamic core network at rest*

17:00 **Coffee Break**

17:30 **Simon HANSLMAYR** | *University of Birmingham, UK*

- *How a desynchronized cortex and a synchronized hippocampus cooperatively form and retrieve memories*

18:20 **Petr JANATA** | *University of California, Davis, USA*

- *The music playing in your head helps consolidate memory for incidentally associated events*

18:40 **Benjamin MORILLON** | *Aix Marseille University & INSERM, France*

- *Groove! Distinctive implication of auditory, motor and parietal areas in auditory temporal predictions*

19:00 **Luc H. ARNAL** | *University of Geneva, Switzerland*

- *The sound of salience: how roughness enhances aversion through neural synchronization*

TUESDAY, January 8

RESTING-STATE NETWORKS

15:30 **Lucina UDDIN** | *University of Miami, USA*

- *The salience network and cognitive and neural flexibility*

16:20 **Meytal WILF** | *Lausanne University and University Hospital (CHUV), Switzerland*

- *Prism adaptation enhances decoupling between default mode network and attention for action network: evidence from fMRI connectivity during resting state and naturalistic stimuli*

16:40 **Markus WERKLE-BERGNER** | *Max Planck Institute for Human Development, Berlin, Germany*

- *Noradrenergic responsiveness preserves attention across the adult lifespan*

17:00 **Coffee Break**

17:30 **Nathan SPRENG** | *McGill University, Montreal, Canada*

- *Explorations into the default network of the human brain*

18:20-20:00 **Poster Session (odd numbers)**

with drinks and snacks

WEDNESDAY, January 9

FUNCTIONAL MRI IN ANIMAL MODELS

15:30 **Wim VANDUFFEL** | *University of Leuven, Belgium*

- *Optogenetic interrogation of the attention network in primates*

16:20 **Coralie DEBRACQUE** | *University of Geneva, Switzerland*

- *Human brain responses to affective primate vocalizations: Acoustic properties and phylogenetic perspectives*

16:40 **Natalie EBNER** | *University of Florida, USA*

- *Neuroplasticity and cognitive benefits associated with chronic intranasal oxytocin administration in aging*

17:00 **Coffee Break**

17:30 **Suliann BEN HAMED** | *Institute of Cognitive Sciences, Lyon, France*

- *The spatial and temporal dynamics of attention: insights from direct access to the attentional spotlight*

18:20-20:00 **Poster Session (even numbers)**

with drinks and snacks

THURSDAY, January 10

MODELLING AND ENCODING

15:30 **Marcel VAN GERVEN** | *Donders Institute, Nijmegen, Netherlands*

- *AI-Driven Neuroscience*

16:20 **Raphaël LIÉGEOIS** | *University of Geneva & EPFL, Switzerland, National University of Singapore, Singapore*

- *Dynamic modes of resting-state and task fMRI time series*

16:40 **Saige RUTHERFORD** | *University of Michigan, USA*

- *Fundamental Differences: A Basis Set for Characterizing Inter-Individual Variation in fMRI Data*

17:00 **Coffee Break**

17:30 **Bijan PESARAN** | *New York University, USA*

- *State dependent neural interactions supporting decision and action.*

18:20 **Margherita CARBONI** | *University of Geneva & University Hospital of Geneva, Switzerland*

- *HD-EEG source connectivity in focal epilepsy can predict post-operative seizure outcome in the presence and absence of scalp interictal epileptic discharges*

18:40 **Johanna KISSLER** | *Bielefeld University, Germany*

- *Effects of right medial temporal lobe resections on the visual processing of emotional stimuli*

19:00 **Philipp KOCH** | *EPFL, Lausanne & Clinique Romande de Réadaptation, Sion, Switzerland*

- *Connectome and dysconnectome analyses to determine degree and patterns of motor recovery after stroke*

20:30 **Farewell party with prize ceremony**

- *Swiss Fondue at the restaurant Le Gueullhi*
- *Disco party at the bar La Crevasse*

ABSTRACTS OF ORAL PRESENTATIONS

The themes of the days are:

Sunday: **OPENING LECTURE**

Monday: **NEURAL OSCILLATIONS**

Tuesday: **RESTING-STATE NETWORKS**

Wednesday: **FUNCTIONAL MRI IN ANIMAL MODELS**

Thursday: **MODELLING AND ENCODING**

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

Sunday
Opening Lecture

T1 ☆

Rhythms for Cognition

Pascal Fries[1]

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Natural viewing induces gamma-band oscillations in early visual cortex. If the gamma rhythm in a lower visual area entrains a gamma rhythm in a higher visual area, this might establish an effective communication protocol: The lower area sends a representation of the visual stimulus rhythmically, and the higher area is most excitable precisely when this representation arrives. At other times, the higher area is inhibited, which excludes competing stimuli. I refer to this as the Communication-through-Coherence (CTC) hypothesis. Indeed, when two visual stimuli induce two local gamma rhythms in V1, only the one induced by the attended stimulus entrains V4, and the gamma synchronization between V1 and V4 occurs at the phase relation that is optimal for stimulus transmission. I will then investigate how these changes in gamma synchronization between visual areas are controlled by top-down influences. Posterior parietal cortex influences visual areas primarily via beta-band synchronization. Generally, beta-band influences are stronger in the top-down direction, while gamma-band influences are stronger in the bottom-up direction. This holds across macaques and human subjects, and in both species, it allows building a hierarchy of visual areas based on the directed influences. Finally, attentional selection occurs at a theta rhythm. When two objects are monitored simultaneously, attentional benefits alternate at 4 Hz, consistent with an 8 Hz sampling rhythm, sampling them in alternation. This theta rhythm can be seen in V1 and V4. The attended stimulus is monitored more continuously, whereas the unattended stimulus is sampled intermittently.

Monday
Neural oscillations

T2 ☆

Neural mechanism for natural and artificial sequences

Lucia Melloni[1]

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Temporal contingencies and sequences are abundant in the environment. Sequences are critical for language, memory, motor control and spatial navigation. In language, for instance, sequences of phonemes form words, and sequences of words form sentences. In the memory domain, episodic memories are composed of sequences of events. How does the brain parse, track, and process sequences that unfold over time? In my talk, I will discuss our recent efforts to understand how sequences are processed online, how they are used to make predictions, and how they contribute to memory formation. I will put special emphasis on the role that role brain rhythms might play in these processes. Specifically, I will discuss studies demonstrating that rhythmic cortical activity entrains concurrently at multiple levels from smaller to larger (linguistic and non-linguistic) units, even in the absence of any sensory cues for the boundaries between events. Similar processes occur in the visual domain. Multiple areas in the brain track those sequences at different levels, from encoding predictions, to ordinal position and serial order. Together, these studies show that cortical entrainment reliably tracks temporal sequences whether visual or auditory, offering endless possibilities to objectively assess for instance language processing in children, difficult-to-test-populations (e.g., minimally conscious patients), as well as language precursors in animal preparations to allow for cross-species comparisons.

T3

Subcortical electrophysiological activity is detectable with high-density EEG source imaging

Martin Seeber[1], Lucia Cantonas[1], Mauritius Hoevels[2], Thibaut Sesia[2], Veerle Visser-Vandewalle[2], Christoph M. Michel[1]

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Subcortical neuronal activity is highly relevant for mediating communication in large-scale brain networks. While electroencephalographic (EEG) recordings provide appropriate temporal resolution and coverage to study whole brain dynamics, the feasibility to detect subcortical signals is a matter of debate. In this work, we investigate if scalp EEG can detect and correctly localize signals recorded with intracranial electrodes placed at the level of the centromedian thalamus, and in the nucleus accumbens. Externalization of deep brain stimulation (DBS) electrodes, placed in these regions, provides the unique opportunity to record subcortical activity simultaneously with high-density (256 channel) scalp EEG. In three patients during rest with eyes closed, we found significant correlation between alpha envelopes derived from intracranial and EEG source reconstructed signals. Highest correlation was found for source signals in close proximity to the actual recording sites, given by the DBS electrode locations. Therefore, we present direct evidence that scalp EEG indeed can sense subcortical signals.

T4

Temporal modes of synchronization in the dynamic core network at rest

Francesco de Pasquale[1], Maurizio Corbetta, Wens Vincent, Stefania Della Penna

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Recent MEG studies showed that the integration of resting state networks relies on two fundamental properties of their connectivity: the structural topology and temporal dynamics. In this scenario, cortical hub regions seem to form a 'dynamic core' where the degree of interaction among these cores and the rest of the brain varies over time. To promote integration, functional and anatomical connections link different areas at different scales. From a functional point of view, alternating periods of strong and weak centrality of the dynamic core relate to periods of strong and weak global efficiency in the brain. This suggests that information processing in the brain is not stable but fluctuates in a pulsatile regime to ensure an efficient information transfer across distinct cognitive domains. In this talk, I will report on the temporal dynamics of a MEG dynamic core investigated in the alpha and beta bands. Regions forming the dynamic core seem to show a frequency specific temporal architecture where, in the beta band, a set of the identified hubs are synchronized over time giving rise to three clusters. These can be related to specific modes of integration among different parts of the Default Mode, Fronto-Parietal, Somato-Motor, Visual and Dorsal/Ventral Attention Networks. These three axes of synchronization of hubs and their temporal properties shed some light on the hypothesized pulsatile regime of integration in the brain at rest.

T5 ☆

How a desynchronized cortex and a synchronized hippocampus cooperatively form and retrieve memories

Simon Hanslmayr[1]

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Brain oscillations have been proposed to be one of the core mechanisms underlying episodic memory. But how do they operate in the service of memory? Reviewing the literature a conundrum emerges as some studies highlight the role of synchronized oscillatory activity, whereas others highlight the role of desynchronized activity. In this talk, I will describe a recently published computational model that resolves this conundrum and parsimoniously shows how these two opposing oscillatory behaviours may cooperate in the service of memory. Building on empirical evidence, I will argue that the synchronization and desynchronization reflect a division of labour between a hippocampal and a neocortical system, respectively. Specifically, whereas desynchronization is key for the neocortex to represent information, synchronization in the hippocampus is key to bind information. I will then derive specific predictions that arise from this model about how the interaction between a synchronized hippocampus and a desynchronized neocortex is supposed to look like. These predictions will be assessed in a number of empirical studies ranging from non-invasive EEG and MEG data, invasive and non-invasive brain stimulation studies, and studies using intracranial recordings in human epilepsy patients. Together, these data support the notion that a desynchronized neocortex together with a synchronized hippocampus implement memory encoding and retrieval operations in the human brain.

T6

The music playing in your head helps consolidate memory for incidentally associated events

Petr Janata[1], Benjamin Kubit[1]

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Why is music so effective at evoking memories from one's past? We linked two common musical phenomena: involuntary repetitive musical imagery (IRMI; commonly called "earworms") and music-evoked autobiographical remembering, in testing the hypothesis that such imagery aids in the consolidation of memory for events with which music becomes associated. In each of three experiments with different participant samples, participants first heard novel music loops while performing tasks that differed in their sensorimotor engagement demands. One week later, participants viewed several unfamiliar cartoon movies to which the previously experienced soundtracks, together with unfamiliar soundtracks, were added. Then, at delays of 1 – 4 weeks, participants recalled movie details, using the soundtracks as retrieval cues. The amount of IRMI during the delay period predicted both the accuracy of the memory for the music itself, as measured with a novel Musical Sequence Imagery Recognition task, and the amount of recalled movie knowledge. The movie recall effects were specific at the loop level, meaning that more details were recalled from those 30-second segments of the movies that coincided with loops consistently experienced as IRMI across the experiment. We conclude that IRMI serves as a spontaneous memory rehearsal mechanism for music and associated episodic information. These experiments thus demonstrate a functional interaction of the brain's procedural and declarative memory systems during memory consolidation, and help to explain why music serves as a potent memory retrieval cue throughout life, even in cases of Alzheimer's disease in which effortful memory retrieval abilities are compromised.

T7

Groove! Distinctive implication of auditory, motor and parietal areas in auditory temporal predictions

Benjamin Morillon[1, 2], Daniele Schön[1, 2]

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Temporal predictions are fundamental instruments for facilitating sensory selection, allowing humans to exploit regularities in the world. Recent evidence indicate that the motor system instantiates predictive timing mechanisms, helping to synchronize temporal fluctuations of attention with the timing of events in a task-relevant stream. Accordingly, in the auditory domain auditory-motor interactions are observed during perception of speech and music, two temporally structured sensory streams. However, the parameters governing the emergence of this auditory-motor coupling are unknown. In an experiment that combines behavior, computational modeling and magnetoencephalography (MEG), we show that the implication of the motor system during auditory perception depends on the temporal predictability of the sensory stream. Behaviorally, the feeling of groove induced by a melody –i.e. the wanting to move during passive listening– strongly depends on its temporal predictability, with a quadratic relation between the two. MEG results reveal that auditory and motor regions have a distinctive sensitivity to temporal information. While auditory regions are able to encode temporal information only when temporal regularity is high (strictly periodic melodies), motor areas are more flexible in their ability to encode temporal information. Finally, the feeling of groove is predicted by activity in inferior parietal regions, possibly reflecting the strength of the auditory-motor interaction. These results indicate that the wanting to move appears when motor –but not auditory– regions can encode temporal information and highlight the role of motor areas in sensory perception, which are notably implicated in the analysis of contextual temporal information.

T8

The sound of salience: how roughness enhances aversion through neural synchronization

Luc H. Arnal[1], Andreas Kleinschmidt[2], Laurent Spinelli[2], Anne-Lise Giraud[1], Pierre Mégevand[1, 2]

[1]Department of Fundamental Neuroscience; University of Geneva - Biotech Campus; Geneva 7 1202; Switzerland. , [2]Department of Clinical Neuroscience; University of Geneva - HUG; Geneva; 1205; Switzerland.

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Being able to emit sounds that capture attention of conspecifics and elicit their rapid reaction is perhaps the prime goal of communication. One strategy, exploited by many artefactual alarm signals, consists in emitting fast but perceptible amplitude modulations in the roughness (30-150 Hz) range. Here, we investigate the perceptual and neural mechanisms underlying aversion to such salient sounds. By measuring subjective aversion to a broad set of repetitive acoustic transients, we identify a non-linear pattern of aversion restricted to the roughness range. Using intracranial recordings, we show that rough sounds do not affect mere local auditory processes but instead synchronize large-scale, supramodal, salience-related networks in a steady-state, sustained manner. More specifically, rough sounds synchronize neural activity throughout superior temporal auditory regions, subcortical and cortical limbic areas, and the frontal cortex, a network classically involved in aversion processing. Importantly, the synchronization pattern correlates with subjective aversion in all these regions strongly, suggesting that roughness enhances auditory aversion through the spreading of neural synchronization. These results demonstrate that emitting salient rough sounds boosts perceptual salience by imposing neural communication through coherence in the receiver's brain.

Tuesday
Resting-States Networks

T9 ☆

The salience network and cognitive and neural flexibility

Lucina Uddin[1]

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An optimal amount of variability in neural responses and a balance of brain dynamics across large-scale networks underlie flexible brain function. We recently found evidence that in key nodes of the salience network (eg. anterior insula), brain signal variability shows different lifespan trajectories than most other brain regions such that while variability in most of the brain linearly decreases over the lifespan, variability in the anterior insula increases linearly over the lifespan. Findings from children with neurodevelopmental conditions including attention-deficit/hyperactivity disorder and autism spectrum disorder suggest that atypical development is characterized by marked alterations in brain signal variability that are related to symptomatology in these disorders. In recent analyses of the salience network, we find evidence for relationships between individual differences in self-control and cognitive flexibility that align with specific patterns of brain dynamics. Taken together, these results contribute to an emerging consensus that quantification of brain dynamics and brain signal variability can provide novel insights into the neural mechanisms underlying individual differences in cognitive and behavioral flexibility.

T10

Prism adaptation enhances decoupling between default mode network and attention for action network: evidence from fMRI connectivity during resting state and naturalistic stimuli

Meytal Wilf[1], Celine Dupuis[2], Stephanie Clarke[1], Sonia Crottaz-Herbette[1], Andrea Serino[1, 2]

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Prism adaptation (PA) is a procedure used for studying visuomotor plasticity in healthy individuals, as well as for rehabilitating spatial neglect patients. PA training consists of performing goal-directed movements while wearing prismatic lenses that induce a lateral shift of visual inputs. It results in a change of sensory-motor coordinates. However, it is unknown whether PA can change task-free resting-state connectivity or affect brain activity during naturalistic stimulation. Here we tested functional connectivity patterns before and after two types of PA training – one based on training with prismatic goggles, and the other on virtual reality-mediated PA training. Subjects performed a baseline fMRI session including resting-state and movie viewing ('pre-PA'), followed by a PA session outside the MRI, and a second identical fMRI session ('post-PA'). Comparison of pre-PA and post-PA connectivity patterns revealed significant decreases in functional connectivity in several nodes comprising of the default mode network (DMN), a network that is usually deactivated during tasks and is related to self-referential processing. A further ROI analysis showed specific connectivity decrease between DMN nodes and areas related to attention and action. Additionally, during naturalistic movie viewing we found a reduction in visual response in the left, but not the right, hemisphere. In conclusion, PA enhanced the decoupling between DMN and areas related to goal directed attention and action, as well as causes an imbalance in visual cortex processing of naturalistic stimuli. These results demonstrate how a brief exposure to PA can induce plasticity in functional connectivity networks during both rest and naturalistic stimulation.

T11

Noradrenergic responsiveness preserves attention across the adult lifespan

Markus Werkle-Bergner[1], Martin J. Dahl[1], Myriam C. Sander[1], Mara Mather[2]

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Attending to relevant information while blocking out distractors is crucial for goal-directed behavior, yet aging impairs attentional selectivity. Deficient selective attention has been associated with altered rhythmic neural activity and diminished neuromodulatory responsiveness. However, research linking both levels is scarce.

We studied how age-related changes in rhythmic neural activity in the alpha/beta band (~ 8–30 Hz) and in the central norepinephrine (NE) system help predict age differences in selective attention.

In samples of younger (N = 39; Mage = 25.2 ± 3.2 years) and older adults' (N = 38; Mage = 70.6 ± 2.7 years) we measured pupil dilation as a non-invasive marker of phasic NE release, while concurrently recording the electroencephalogram (EEG). Fear-conditioned (CS+) stimuli triggered NE release trial-by-trial. During conditioning, pupil and EEG markers related to heightened NE activity were identified. Afterwards, in a dichotic listening task, participants were cued to selectively attend either the left or the right ear, while highly similar consonant-vowel syllable pairs were presented to both ears.

During the dichotic listening task, presentation of CS+ stimuli re-activated the acquired fear response, as captured in pupil and EEG alpha/beta-band responses. Suggesting a common dependence on NE release, increased pupil reactivity to CS+ stimuli correlated with stronger alpha/beta desynchronization. Behaviorally, NE release facilitated selective attention. In particular, structural equation modeling revealed that the responsiveness of the NE system is associated with attention on a latent construct level. Results suggest the responsiveness of the NE system to support attention across the adult lifespan.

T12 ☆

Explorations into the default network of the human brain

Nathan Spreng[1]

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The default network, an assembly of functionally connected brain regions, has been one of the most robustly observed features of the brain, and is implicated in a vast array of cognitive abilities and disorders. Yet the specific functional role of the default network has remained controversial. Long-held perceptions of the default network has suggested that it is "task-negative," or behaviourally relevant only in its deactivation. My work has argued that, far from being 'task negative', these brain regions are actively involved in self-generated thought and necessary for flexible goal pursuit, allowing past knowledge and experience to guide ongoing thought and action. In this talk I will outline a series of studies demonstrating that the default network is involved in social cognition, memory, and future-oriented thinking. I will also describe how the architecture of the default network, and its connectivity with other brain systems, change across the lifespan, and how these changes predict individual differences in the trajectory of cognitive aging. To conclude, I extend these explorations of default network function to formulate a broader theoretical framework, integrating the shifting architectures of brain and cognitive aging, towards a new perspective on late life development.

Wednesday
Functional MRI in animal models

T13 ☆

Optogenetic interrogation of the attention network in primates

Wim Vanduffel[1]

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I will discuss results of a combined opto-fMRI-electrophysiology study aimed to determine differences in top-down and bottom-up control of attention. Optogenetic inactivation of LIP resulted in spatially selective and attention-dependent changes in single unit activity and behavioral performance. We also found surprisingly robust optogenetic-induced changes in fMRI activity throughout nodes of the attention network, as well as changes in task-driven functional connectivity. Our results show that ultra-short reversible inactivation of LIP only during the cue period can affect top-down and bottom-up driven covert spatial attention behavior, as well as local activity and network dynamics.

T14

Human brain responses to affective primate vocalizations: Acoustic properties and Phylogenetic perspectives

Coralie Debracque[1,2,3], Léonardo Ceravolo[1, 2, 3], Katie Slocombe[4], Zanna Clay[5,6], Thibaud Gruber[1, 2, 3], Didier Grandjean[1, 2, 3]

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"With many kinds of animals, man included, the vocal organs are efficient in the highest degree as a means of expression". In 1872, Darwin already highlighted the importance of an evolutionary approach to improve our knowledge, especially of emotions, about vocal expressions in humans. However, few have relied on this approach to understand behavioral and neural processes related to affective voice perception. To fill this gap, the present research aimed at investigating how humans categorize affective primate vocalizations using functional Magnetic Resonance Imaging (fMRI). To do so, participants were exposed to affective vocalizations produced by humans, chimpanzees, bonobos and macaques related to threatening, distress and affiliative situations. Preliminary results show enhanced brain activity in the bilateral middle superior temporal gyrus (STG) when participants were listening human and chimpanzee vocalizations compared to bonobo and macaque calls. Interestingly, activity in the right inferior frontal gyrus (IFG) was significantly increased for human against all other species expressing negative vs. positive voices. We also found that performance for explicitly processing of negative vs. positive vocalizations across species influenced BOLD signal with a significant increase in STG and IFG brain regions. Finally, the fMRI data revealed an important role of voice acoustic properties, in particular the energy of agonistic vocalizations in comparison to the fundamental frequency (F0) of agonistic or affiliative calls. To conclude, our data suggest that both acoustic properties and phylogenetic proximity between species may be key for the recognition of affective contents in primate vocalizations.

T15

Neuroplasticity and Cognitive Benefits Associated with Chronic Intranasal Oxytocin Administration in Aging

Natalie Ebner[1], Kristoffer Månsson[2], Tian Lin[1], Desiree Lussier[1], Marilyn Horta[1], Ian Frazier[1], Devon Weir[1], David Feifel[3], Håkan Fischer[2]

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Oxytocin (OT) is a crucial chemical modulator of social behavior, and intranasal OT administration has potential as treatment for social deficits. Considerably less is known about OT's effects on non-social cognition, a functional domain of particular relevance in aging. Brain mechanisms underlying OT's benefits are not well understood but recent animal work suggests that repeated OT administration induces brain changes. To test this neuroplastic role of OT on the human brain and its potential for cognitive improvement in aging, we conducted a randomized double-blind study in older men (> 56 years), with 34 participants self-administering either 24 IUs OT or placebo (P) twice daily. Before and after 4-weeks intranasal administration, participants underwent MRI and processing speed assessment. Using voxel-based morphometry, gray matter (GM) volume was measured on T1-weighted anatomical images. Age, education, physical health, and image quality served as covariates and family-wise error rate determined statistical significance in regions of interest. Analyses were performed without awareness of the assigned treatment labels. Significant interactions between treatment (OT vs. P) and time (pre- vs. post-intervention) on GM volume for left amygdala, hippocampus, and putamen suggested increased regional GM volume following OT but not P. Further, OT-induced enlargement in putamen was associated with improved processing speed, while there was no brain−behavior correlation in the P group. These findings support the notion that amygdala, hippocampus, and putamen are key targets of OT's neuroplastic potential on the human brain and chronic OT administration may constitute a potential treatment in counteracting cognitive decline in aging.

T16 ☆

The spatial and temporal dynamics of attention: insights from direct access to the attentional spotlight

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Recent accumulating evidence challenges the traditional view of attention as a continuously active spotlight over which we have direct voluntary control, suggesting instead a rhythmic operation. However, the precise mechanism through which this rhythmic exploration of space is subserved remains unknown. Recent work proposes that specific inter-areal synchronization mechanisms in the theta range play an important role in this respect. I will present monkey electrophysiological data reconciling these two views. I will apply machine learning methods to reconstruct, at high spatial and temporal resolution, the spatial attentional spotlight from monkey prefrontal neuronal activity. I will first describe behavioral and neuronal evidence for distinct spatial filtering mechanisms, the attentional spotlight serving to filter in task relevant information while at the same time filtering out task irrelevant information. I will then provide evidence for rhythmic spatial attention exploration by this prefrontal attentional spotlight in the alpha (7-12Hz) frequency range. I will discuss this rhythmic exploration of space both from the perspective of sensory encoding and behavioral trial outcome, when processing either task relevant or task irrelevant information. While these oscillations are task-independent, I will describe how their spatial unfoldment flexibly adjusts to the ongoing behavioral demands. I will conclude by bridging the gap between this alpha rhythmic exploration by the attentional spotlight and previous reports on a contribution of long-range theta oscillations in attentional exploration and I will propose a novel integrated account of a dynamic attentional spotlight.

Thursday
Modelling and encoding

T17 ☆

AI-Driven Neuroscience

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In the last couple of years we have witnessed how both artificial intelligence (AI) and neuroscience have made significant progress. Fueled by advances such as deep learning, AI has made its way into real-world applications. Driven by neurotechnological breakthroughs, neuroscientists are equipped with new techniques to probe the brain. In this talk, I will show how by combining AI and neuroscience exciting new research directions emerge. I will demonstrate this by means of several examples that are developed by my research group (www.artcogsys.com). I will pay particular attention to the development of AI techniques that facilitate a better understanding of human brain function and provide new approaches in to interface humans and machines.

T18

Dynamic modes of resting-state and task fMRI time series

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The human brain exhibits a spatio-temporal organization of activity when performing a task and during resting-state. Component analysis is a powerful tool to explore this functional organization, and methods such as principal component analysis or independent component analysis have been applied on fMRI data to identify the main brain networks shaping functional connectivity (FC). However, these approaches are static and recent findings suggest that FC dynamics encode richer information about brain functional organization. Therefore, we use a dynamic extension of component analysis, dynamic mode decomposition (DMD), to identify dynamic modes (DMs) of fMRI data. We use data of the human connectome project comprising resting-state and motor-task (hand, foot, tongue) functional MRI of 730 young and healthy participants. A classical pre-processing is performed including linear detrending, global signal regression, and parcellation into 400 cortical regions of interest. The DMs are identified from a first-order autoregressive model of fMRI time series. Each eigenvector of the model matrix defines one DM and the associated eigenvalue encodes its temporal properties. In resting-state, dominant DMs have strong resemblance with classical resting-state networks, with an additional temporal characterization in terms of oscillatory periods and damping times. In motor-task conditions, dominant DMs reveal interactions between several brain areas, including but not limited to the posterior parietal cortex and primary motor areas, that are not found with classical activation maps. Overall, these findings illustrate the benefits of the proposed dynamic component analysis framework, making it a promising tool to characterize the spatio-temporal organization of brain activity.

T19

Fundamental Differences: A Basis Set for Characterizing Inter-Individual Variation in fMRI Data

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Functional brain imaging data are massive and complex. It is an open question, however, whether these data differ across individuals in a correspondingly massive number of ways, or whether most differences take a small number of characteristic forms. We systematically investigated this question and found clear evidence of low-rank structure in which a modest number of connectomic components, around 50-150, account for a sizable portion of inter-individual variation. This number was convergently arrived at with multiple methods including estimation of intrinsic dimensionality and assessment of reconstruction of out-of-sample data. We demonstrate that these connectomic components enable prediction of a broad array of neurocognitive and clinical variables. In addition, using stochastic block modeling-based methods, we show these components exhibit extensive community structure reflecting interrelationships between intrinsic connectivity networks. We propose that these connectivity components form an effective basis set (Brain Basis Set - BBS) for quantifying and interpreting inter-individual connectomic differences, and for predicting behavioral/clinical phenotypes. These methods were established leveraging task and rest functional data from the Human Connectome Project (HCP) and the Adolescent Brain Cognitive Development (ABCD) study.
Preprints: https://www.biorxiv.org/content/early/2018/06/29/326082 & https://www.biorxiv.org/content/early/2018/09/09/412056

T20 ☆

State dependent neural interactions supporting decision and action.

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The nature of interactions between cortical regions and how these interactions flexibly coordinate behavior remains unclear. The synchronization of spiking activity with population activity measured by the local field potential may serve as a mechanism by which the timing of neural events across brain regions can coordinate behavior. In this talk, I will present recent results recording from the posterior parietal cortex of the non-human primate that reveals a form of neural coherence that we term "dual coherence". I will show that dual coherence reflects a state-dependent form of neural interaction that can support flexible behavior. I will then test the state dependence of neural interactions by using optogenetic and electrical stimulation to causally manipulating brain networks spanning the frontal and parietal lobes and their subcortical partners. These results will show that large-scale "modulation networks" gate and filter neural interactions. I will conclude by discussing the implications of these results for how we think about neural interactions in the primate brain, more broadly.

T21

HD-EEG source connectivity in focal epilepsy can predict post-operative seizure outcome in the presence and absence of scalp interictal epileptic discharges

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Goal: Between seizures, epileptic activity can be abundant on the cortex but invisible on scalp EEG and nevertheless cause cognitive deficits. In patients with pharmacoresistant focal epilepsy candidates for epilepsy surgery, we aimed at identifying those brain regions associated with altered functional dynamics during periods with and without EEG-visible interictal epileptic discharges (spikes). In particular, we wanted to identify the differences in the connectivity features in patients with good vs bad post-operative seizure outcome. Methods: in long-term HD-EEG recordings of 18 patients with focal epilepsy who subsequently underwent surgery, we analysed 1sec epochs with vs. without interictal epileptic discharges (spikes). Both during spike- and non-spike periods, we extracted the main drivers in the source space as the regions with the strongest outflow (sum of the information partial directed coherence (iPDC)). We statistically compared the overall connectivity values during the two types of periods for the two groups of patients. Subsequently, we calculated the number of main drivers within the clinically defined pathological lobe in the two conditions. Results: For “good outcome” patients, overall connectivity significantly differed between spike- and non-spike periods ($p<0.01$), but not for “bad outcome” patients ($p>0.05$). The number of main drivers localised outside the pathological lobe were higher in “bad” than in “good outcome” patients both during spike and non-spike periods. Significance: In patients with epilepsy with poor post-surgical outcome, brain activity during non-spike periods is comparable to spike periods. These patients also tend to have more widespread pathological activity during both conditions.

T22

Effects of right medial temporal lobe resections on the visual processing of emotional stimuli

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The amygdala is assumed to have a causal role in amplifying processing of emotionally negative stimuli in extended visual cortex. This is supported by fMRI and EEG data showing absence of emotional enhancement for fearful faces in patients with amygdala sclerosis. However, a more recent study has cast doubt on the general causality of amygdala for emotional enhancements, showing fully preserved visual cortex responses to emotional pictures following temporal lobe resections encompassing the amygdalae. Here, we investigate the issue in an ongoing study comparing the effects of different types of left and right temporal lobe resections on spontaneous processing of emotionally negative and neutral pictures, faces and words during free viewing in fMRI and EEG. So far, data from 10 right medial temporal lobe resections encompassing amygdala and hippocampus and 10 matched controls indicate a general reduction of visual cortex activity as well as a face-specific reduction in responses to fearful stimuli in an early visual area in the patients. Regarding EEG, on the early posterior negativity ERP, emotion effects, albeit descriptively reduced in patients, were found for all types of material. Moreover, a massive general amplitude reduction in the late positive potential was found following this type of resection. Overall, extant data indicate considerable general effects of temporal lobe resections on visual processing, and, to the extent that emotion effects are partly preserved in the patients, multiple generators of emotional visual enhancements outside the right medial temporal lobe. Material-specific reduction in emotion effects seems most pronounced for faces.

T23

Connectome and dysconnectome analyses to determine degree and patterns of motor recovery after stroke

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Finding predictors for the individual degree and courses of recovery after stroke has been a great challenge in the last years. Large variability in outcome with a significant number of patients with unsatisfying recovery implies the need for a deeper understanding of individual recovery courses guiding the design of novel individualized therapy approaches. Neuroimaging techniques have been used to try to identify neuronal correlates of recovery, the importance of lesion location(1) and network settings(2,3). Still, it remains unknown how residual network status and changes contribute and if there are network fingerprints of different specific patient groups. 63 Patients after stroke were evaluated by structural and diffusion imaging 3 weeks (TA) and 3 months (TC) after stroke. The recovery of motor function was assessed using the Fugl-Meyer Upper Extremity Score. Using microstructure informed tractography, whole brain structural connectomes were generated. We established a quantitative description of network disruption by integrating the spatial information of the lesion with the estimates of whole brain tractography. Support Vector Machine Classifiers were used to predict the motor recovery rate over time. Hereby, the initial Fractional Anisotropy Connectome was capable of predicting well good vs. poor recovery (Accuracy 0.93, Precision 0.96). Feature selection revealed that the white matter status at 3 weeks after stroke contributing to recovery has a different spatial distribution than the recovery-related connectomes change over time (TA to TC). Furthermore, when stratifying patients depending on their initial impairment different patterns of network contribution are detectable indicating differential recovery processes for the individual patients.

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POSTER ABSTRACTS

Ordered according to these categories:

Clinical Neuroscience

Emotion & Motivation

Language & Music

Learning & Memory

Methods

Perception

Clinical Neuroscience

P1

Neural origins of presence hallucination: insights from MR-compatible robotics and lesion network mapping

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Presence hallucination (PH) is the strange sensation that someone is nearby when actually nobody is present. PH does not have a clear etiology: it has been described in psychiatric (e.g. schizophrenia) and neurological disorders (e.g. Parkinson's disease) as well as in healthy subjects exposed to extreme conditions (e.g. mountaineers). Likewise, the anatomical origins of PH remain unclear, and are only described by lesion studies. Here, we investigated the neural origins of PH both in healthy subjects and in neurological patients experiencing PH, by combining MR-compatible robotics and lesion network analysis. We induced PH in 25 healthy participants using an MR-compatible robotic system able to generate sensorimotor conflicts between upper limb movements and somatosensory feedback on the back, while recording task-related brain activity using fMRI. We found four regions in the right fronto-temporal cortex associated with sensorimotor conflicts inducing PH: the dorso-lateral prefrontal cortex (dlPFc), the insula, the superior medial gyrus and the middle temporal gyrus (MTG). We compared these regions to the symptomatic PH network obtained by lesion network mapping analysis. The dlPFc and the MTG were activated in both networks suggesting that these regions play an important role in PH.

Clinical Neuroscience

P2

EEG signal diversity reflects capability for behavioral responsiveness during propofol sedation

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Background: Transitions between wakefulness and anesthesia are accompanied by profound changes in brain functioning. A key challenge is to disentangle neuronal mechanisms specific to loss and recovery of consciousness, from more general effects that are not directly related to the capacity for conscious experience. Measures of neuronal diversity have been recently proposed to constitute a robust correlate of the global states of consciousness. In the present study we investigated whether EEG signal diversity is indeed related to behavioral responsiveness during propofol sedation, or rather to the general drug-related effects.
Methods: We reanalyzed data collected from 20 subjects sedated with propofol. Based on the responsiveness to auditory stimuli all subjects were subdivided into two subgroups - responsive (n = 13), who remains awake throughout the experiment, and drowsy (n = 7), who becomes unresponsive during moderate sedation. Resting state EEG recorded during wakefulness and sedation was characterized by the Mean Information Gain - an information-theory measure estimating signal diversity.
Results: In line with our hypothesis, the drowsy group exhibited a decrease in diversity during sedation but, unexpectedly, the responsive group exhibited a robust increase in diversity (ANOVA group x state interaction: $F(3) = 7.81$, $p < 0.001$; $BF10 > 100$).
Conclusions: We revealed that propofol sedation is initially related to an increase in EEG signal diversity, and that only upon loss of responsiveness EEG diversity decreases. The qualitatively different pattern of changes in the responsive and drowsy groups makes EEG diversity a robust indirect index of responsiveness and, presumably, consciousness.

Clinical Neuroscience

P3

Asymmetric Effective Brain Connectivity in Depression during Rest: Analysis on High-Density Electroencephalography

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Deep brain stimulation (DBS) is a new approach for treating depression. Optimal stimulation targets have not yet been determined. Effective connectivity analysis provides a model of the influence of one brain region on another and may provide evidence for the influence of brain regions potentially suitable as DBS targets. Using Granger-causal modeling we investigated whether effective connectivity was altered in selected deep brain structures in patients with major depressive disorder (MDD) compared to healthy controls. Six MDD patients (four men, mean (± SD) age: 53 (±7.5) and six healthy controls (four men, mean (± SD) age: 52 (±7.7) underwent high-density EEG recording using 128 scalp electrodes during eyes closed resting conditions. Source activity was obtained for 90 regions of interest. The outflow from the Information Partial Directed Coherence matrix was computed for brain structures potentially involved in pathophysiology of MDD. In patients vs controls, the laterality index of the average outflow was +2% vs +5% (the anterior cingulate cortex), +7% vs +7% (the amygdala), +31% vs +7% (the pallidum), and -26% vs -5% (the thalamus). Thus, in the pallidum the left-lateralized and in the thalamus the right-lateralized information outflows were observed in MDD patients but not in controls. Our findings raise questions about the laterality of DBS treatment in depression and about relative value of unipolar versus bipolar approaches that now need to be resolved. The study has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 739939.

P4

Parkinson's disease: a model to study substance addictions?

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Background: Impulse control disorder behaviors in Parkinson's disease (PD) and drug addictions share several clinical manifestations and neurobiological substrates. However, mechanisms underlying these manifestations remain incompletely understood.
Objective: In order to establish PD as a neurodegenerative model for studying addiction, we investigated common clinical and imaging abnormalities in PD and heroin-dependent patients compared with healthy controls.
Methods: PD patients, heroin-dependent (HD) patients and healthy controls (HC) performed a detailed neuropsychological assessment and two resting state fMRI sessions. Patients were studied in two different drug conditions (drug-OFF and drug-ON states). Due to its critical role in the reward system, striatum seed connectivity was explored.
Results: 9 PD patients, 6 HD patients, and 5 HC were included. HD patients scored higher than PD patients and HC for impulsivity, depression and apathy. All PD patients presented with neuropsychiatric fluctuations. Neither PD patients nor HC presented with impulse control disorders. The connectivity between the associative striatum and the anterior and middle cingulate cortex was strongly reduced in HD patients as well as in PD patients but only in their ON L-dopa condition. When considering limbic striatum seed connectivity, the connectivity with the medial prefrontal cortex was reduced for HD and PD patients in their ON and OFF L-dopa conditions.
Conclusion: These preliminary results demonstrate alterations in connectivity between the striatum and cortical regions involved in control over behavior, occurring in both heroin-dependent and PD patients, suggesting that PD may be considered as a neurodegenerative model for addiction.

Clinical Neuroscience

P5

Towards brain-controlled neuromodulation in people with paraplegia: Decoding gait events from high density EEG in healthy volunteers

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Accurate decoding of gait events from electroencephalographic (EEG) recordings can be used to trigger spinal-cord stimulation in order to alleviate paralysis in people with paraplegia. We investigated cortical dynamics, reconstructed from high-density EEG recordings (128 electrodes) during different walking tasks (overground, treadmill and body weight-supported walking) in ten healthy volunteers. In order to track and study subjects' gait, we recorded electromyography (EMG) from seven leg muscles each in both legs, and used motion capture to acquire three-dimensional kinematics during the walking tasks. We identified foot strike and foot off gait events of both legs by analysis of EMG signal processing and reconstructed kinematics. We reconstructed cortical dynamics using EEG source imaging based on individual anatomy derived from structural magnetic resonance imaging scans. In accordance to previous literature, our preliminary results show low gamma (28-40 Hz) amplitude modulations related to the gait phase in the leg motor cortical areas. Surprisingly, we also find that these gait-related amplitude modulations are detectable at single trial level, which is a prerequisite for accurate decoding of gait events. We then calibrated a decoder that detected gait events from the reconstructed activity of cortical sources. Accordingly, we will present first results of this non-invasive gait event decoding.

Clinical Neuroscience

P6

Social anxiety is characterized by biased learning about the self

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People's perception of themselves is shaped by social feedback, and recent work suggests that healthy adults show a positivity bias when updating self-related information. In contrast, social anxiety disorder (SAD) is characterized by a persistently negative view of the self. Yet what causes and maintains this negative self-view is not well understood. In two studies (behavior and fMRI), we employed a novel experimental paradigm to test the hypothesis that biased social learning regarding self-evaluation represents a core feature that distinguishes adults with SAD from healthy controls (HC). Participants performed a speech in front of three judges, subsequently evaluated themselves, and received performance feedback from the judges. A subsequent second round of self-evaluative ratings allowed us to assess how participants updated their views of the self based on the feedback they received. The behavioral results showed a positivity bias in learning about the self in HC, which was absent in SAD. On the brain level, activation of the anterior insula mediated the effect of negative compared to positive feedback on changes in self-perception, and was associated with individual differences in learning bias. These findings demonstrate the presence and long-term endurance of positively biased social learning about the self among healthy adults, a bias that is absent or reversed among socially anxious adults.

P7

Altered frequency, functional connectivity patterns and network features during "hidden" epileptic spikes: a simultaneous scalp and intracranial EEG study

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Goal: Simultaneous recordings of scalp and intracranial EEG (scalp-icEEG) show that only a minority of interictal epileptic discharges (spikes) are visible on the scalp. We aimed at comparing frequency spectrum and functional source connectivity during visual spike-free scalp EEG epochs with or without intracranial recorded hidden spikes. Method: We analysed simultaneous high-density scalp-icEEG of four patients suffering from drug-resistant focal epilepsy. 1s epochs without spikes visible on the scalp were classified into two categories: (a) hidden-spike: epileptic activity visible only on icEEG; (b) no-spike: absence of detectable epileptic activity in both ic-EEG and scalp EEG. We extracted the time course of 72 cortical regions and calculated frequency content, summed outflow based on information Partial directed coherence (iPDC) and global efficiency of the network in each condition. Using Mann-Whitney U test, we statistically compared the two categories in all the canonical frequency bands both for power and connectivity. Results: Frequency content and connectivity analysis based on scalp EEG were significantly altered during hidden epileptic activity compared to spike-free resting state. In 3/4 patients, we found statistically significant increase ($p<0.01$) in the frequency content of the low frequency bands (theta and alpha) during hidden spikes compared to no spikes. In 3/4 patients, connectivity patterns and global efficiency also differed between the two categories in broad band and low frequency bands. Conclusion: Frequency and connectivity patterns as well as efficiency of the network of interictal high-density scalp EEG are altered in periods containing intracerebral epileptic activity that is visually undetected on scalp EEG.

Clinical Neuroscience

P8

Combination of EEG and EEG-fMRI connectivity analysis for the characterization of epileptic networks in interictal state and in resting state

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Goal: This study aimed at describing the epileptic networks differences between interictal epileptic activity and resting states by means of directed functional connectivity of the EEG-sources signal. We evaluated the contribution of defining the epileptic network nodes using functional connectivity (FC) patterns derived from EEG-fMRI.
Method: We recorded long-term high-density-EEG (hdEEG) and simultaneous hdEEG-fMRI at 3 Tesla of 6 epilepsy patients. Both in interictal activity and resting state (no visible interictal activity in the hdEEG), we performed information Partial Directed coherence (iPDC), a Ganger causality measure, on the EEG signal in the inverse space. For the network nodes, we considered: i) 72 anatomical ROIs (aROIs); ii) functional ROIs (fROIs) obtained by seed-based FC of the EEG-fMRI data. We assessed the statistical differences between rest and interictal state outflows. We evaluated the fROIs selection contribution to the EEG signal with a permutation test (99 networks of randomly distributed fROIs).

Results In 5/6 patients the summed outflow distribution for 72 aROIs was statistical different between interictal and resting state. In 3/6 patients the fROIs–network was statistically different from random-distibuted fROIs-network in both interictal and rest states; while for 1/6 patient, fROIs-network was different from random in interictal state only.
Conclusion: The spatial resolution of epileptic network detected during EEG-fMRI recording could allow a better comprehension of rest versus interictal state in EEG studies, by the integration of the higher spatial definition in targeting the epileptogenic network.

P9

Detecting scalp-invisible epileptic activity with topographic clustering of simultaneous scalp and intracranial EEG

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Simultaneous scalp – intracranial EEG studies show that only a minority of interictal epileptic discharges (spikes) are visible on the scalp. We aimed at comparing topographic maps embedded in resting-state scalp EEG with or without the presence of spikes visible only intracranially.

Simultaneous high-density scalp – stereo-EEG (SEEG) was performed in four patients suffering from drug-resistant focal epilepsy. Two-second epochs centered around SEEG spikes and control epochs without SEEG spikes were marked: (a) “hidden” spike: epileptic activity visible only on SEEG, separated into 10 different types across all patients; (b) “spike-free”: absence of detectable epileptic activity in both modalities. We used K-means clustering with resampling for segmenting the EEG into 4-8 microstates best explaining the EEG epochs (148.8 on average). Topographic maps extracted for each condition were matched based on best correlation and the map from hidden spike condition with lowest correlation - the “stranger” map - was compared to the scalp voltage map obtained after averaging intracranial spikes. In addition, we applied electrical source imaging (ESI) to localize cortical sources of the “stranger” map.

High correlation was observed between topographic maps across conditions except for one “stranger” map, which was similar to the average spike map ($r = 0.59$). For 6/10 spikes, the ESI maximum obtained from the “stranger” map was closer (38mm) to SEEG contacts with maximal spiking amplitude than ESI obtained from the averaged SEEG spikes (47mm).

EEG segmentation into microstates is able to extract topographic features of interictal epileptic activity and differentiate between scalp-invisible spikes and spike-free resting-state EEG.

Clinical Neuroscience

P10

Differences between pre-operative and post-operative connectivity in patients with focal epilepsy

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Goal: Surgical resection can control seizures in well selected drug-resistant patients with focal epilepsy. However previous research has indicated that post-operative connectivity does not change regardless of seizure outcome, which is contrary to positive behavioural changes seen in long-term follow-up. Therefore, the current study will explore the presence of connectivity changes pre- and post- surgery and if seen, determine where in the brain these changes occur.

Methods: We gathered pre-operative and post-operative simultaneous EEG-fMRI data in five patients with focal epilepsy. A ROI-to-ROI functional connectivity analysis was performed on 1015 ROIs, which were extracted using the Lausanne parcellation. A paired t-test was performed on the connectivity pre- and post- surgery with a significance threshold of $p<0.05$. Furthermore, we determined whether the major drivers in fMRI for both pre- and post-connectivity were anatomically distant in reference to regions that were significantly changed due to surgical resection. This was done by calculating the differences between the summed outflow of the main drivers for both pre- and post- connectivity analyses compared to regions significantly changed as a result of surgical resection.

Results: We found a significant difference between pre-operative and post-operative functional connectivity. Furthermore, the regions driving the connectivity were altered such that connectivity decreased in areas associated with the focus post-surgery.

Significance: Focal resective surgery of epileptogenic cortex results in a shift in network performance. Future studies are needed to correlate these findings with post-operative outcome on seizures and cognition.

P11

Brain functional connectivity predicts outcome in comatose patients after cardiac arrest

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Clinical outcome prognostication in comatose patients following cardiac arrest is currently based on multimodal assessments of clinical and electrophysiological markers. This requires the intervention of trained experts and lacks standardization. Quantitative Electroencephalography (EEG) analysis could provide complementary and unbiased information about patients' chances of recovery. Here we investigate the properties of EEG-based functional brain networks in comatose patients and their predictive power regarding patient's outcome. During the first two days of coma, we used 63 channel EEG to prospectively record resting state activity in patients after cardiac arrest. On the first day, we included 92 patients (55 survived beyond unresponsive wakefulness); during the second day, we again recorded 67 patients (36 survived). Functional networks were based on the 'debiased weighted phase lag index' computed over epochs of five seconds. We derived topological features, including clustering coefficient, path length, modularity and participation coefficient. For all topological measures we investigated their variance over time and computed predictive values for patients' outcome by splitting the sample in training and test datasets. Group-level analysis revealed significantly different network organization during the first day in survivors and non-survivors. Time variance of path length provided the best test set prediction of good outcome on the first day of coma (PPV:.85, CI:.55-.98, Specificity:.89, CI:.65-.99). Excluding patients with epileptiform activity would have eliminated all false positive predictions. Overall, the time variance of path length in functional connectivity is highly informative of patients' outcome as survivors exhibit a richer repertoire of path length than non-survivors during the first day.

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P12

Neural Correlates of Socio-economic Status Indices in Multi-parametric MRI Maps

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The ill effects of socio-economic status (SES) on health have been widely described in the literature (Stringhini et al., 2010; Winkleby et al., 1992; Everson et al., 2002; Fotenos et al., 2008; Marmot, 2005). Less well known is the relationship between SES and neural integrity. We investigate the link between SES and neuroimaging data in a large dataset, the CoLaus cohort (Firman et al., 2008). This dataset comprises a large-scale study in the general population where several somatic and behavioral variables were collected, including SES indices. Within this cohort, 1310 individuals underwent quantitative MRI scanning. The CoLaus MRI data consist of high-resolution multi-parametric maps (MPMs) that yield indirect quantification of myelin, iron and brain tissue free water content (Draganski et al., 2011). Comparatively few studies have investigated the link between SES and the brain and most have probed brain structure in childhood (Staff et al., 2012, Brito & Noble, 2014; Lawson et al., 2013; Noble et al., 2015; Raizada et al., 2008). By contrast, MPMs offer a unique added value to traditional anatomical imaging. Further, we collected data on adults (mean age, 59.3 years), which provide a view of the life-long neural consequence of socio-economic status. Preliminary results show differences in several brain regions in three different MPMs quantifying iron (R2*), myelin (MT) and grey matter volumes (T1), with varying SES. These early results lay the groundwork for further study on the causal effects of SES on both neural integrity and behavioral function in old age.

P13

Developmental trajectories of neuroanatomical alterations associated with the 16p11.2 Copy Number Variations

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16p11.2 copy number variants (breakpoint 4-5) confer high risk for neurodevelopmental disorders and are associated with structural brain alterations of large effect size. Methods used in previous studies were unable to investigate the onset of these alterations and whether they evolve with age. In this study, we aim at characterizing age-related effects of 16p11.2 copy number variants by analyzing a group with a broad age range including younger individuals. A large normative developmental dataset was used to accurately adjust for effects of age. We normalized volumes of segmented brain regions as well as volumes of each voxel defined by tensor-based morphometry. Results show that the total intracranial volumes, the global gray and white matter volumes are respectively higher and lower in deletion and duplication carriers compared to control subjects at 4.5 years of age. These differences remain stable through childhood, adolescence, and adulthood until 23 years of age (range: 0.5 to 1.0 Z-score). Voxel-based results are consistent with previous findings in 16p11.2 copy number variant carriers, including the increased volume in the calcarine cortex and insula in deletions, compared to controls, with an inverse effect in duplication carriers (1.0 Z-score): All voxel-based differences are present at 4.5 years and remain stable until the age of 23. Our results highlight the stability of a neuroimaging endophenotype over 2 decades during which neurodevelopmental symptoms evolve at a rapid pace.

P14

Aggression distinctly modulates neural correlates of social intention attribution to different laughter types

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Human laughter is a powerful means of communicating social intention, varying across a spectrum from benign and welcoming to hostile and ridiculing. In order to be communicated accurately, however, the person perceiving the laughter must attribute the correct underlying social intention to it. Regular misattributions of the signals of social intention of others have been associated with maladaptive psychosocial development, in particular with aggressive behavior. We investigated the relationship between aggressive behavior and the neural correlates of social intention attributions of different laughter types in 50 healthy children and adolescents (29 female, 10 - 18 years, M 15.5, SD 2.2) using functional magnetic resonance imaging. The trial-by-trial association of BOLD response and behavioral hostility ratings was modulated by aggression distinctly for friendly laughter compared to tickling and taunting laughter. With increasing aggression, hostile misattributions of friendly laughter were associated with decreased activation of dorsolateral prefrontal (dlPFC), dorsal anterior cingulate and anterior insular cortex, within the social saliency network. In contrast, with increasing aggression, hostile attributions of tickling laughter were associated with increased dlPFC and bilateral caudate activity while hostile attributions of taunting laughter were associated with increased activity within the putamen, superior temporal and supplementary motor cortices of the mirror neuron and motor planning networks. Results indicate that aggression distinctly modulates functional neural networks during attribution of social intention to laughter, dependent on the type of laughter presented. Findings are discussed in light of incongruent information processing between perceived and expected social intentions and perceived provocation in aggressive individuals.

Clinical Neuroscience

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The effects of alcohol withdrawal on brain anatomy and mean diffusivity in alcohol-dependence : a MRI study.

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Alcohol-dependence is a psychiatric disorder characterized by large brain morphological alterations. Alcohol-withdrawal, is attended by large behavioral and inflammatory changes.
This pilot study aims at testing by MRI scans the hypothesis of a drinking related edema that would resolve during withdrawal.
19 alcohol dependent inpatients (AD) undergoing a detoxification, were tested on the first and 18th day of withdrawal, for MRI brain anatomy and DTI.
Results : Using paired T tests, alcohol withdrawal was attended by significant decreases in volume of 4th ventricle, choroid plexus, white matter, while the cortical volume was increasing. In parallel to these changes, we also observed a decrease in mean diffusivity in all the white matter regions tested, and these decreases were significant in 21 out of the 36 regions tested. A decrease in mean diffusivity was also observed in grey matter in 160 of the 180 regions tested and significant in 50 of these regions, but globally significant changes were observed in regions corresponding to the central executive, motor, salience, auditory, and most significant in the visual and default-mode grey matter regions. In only one region we observed a significant increase in mean diffusivity : the right pallidum.
Conclusion : Alcohol withdrawal is related to changes in brain anatomy and mean diffusivity in both white and grey matter regions. Comparison of these changes with plasma inflammatory markers, to evaluate whether these changes could express brain inflammation, is planned. We also plan to correlate these changes to those observed in functional connectivity and behavior.

Clinical Neuroscience

P16

Electrical source imaging of attempted movements in patients with amyotrophic lateral sclerosis

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For people with motor neuron diseases, such as amyotrophic lateral sclerosis (ALS), a brain-computer interface (BCI) may be the only way to provide a means of communication. Bypassing any muscular output function, a BCI directly translates brain patterns into control signals for communication and environmental control. To this end, we studied the brain patterns in response to different movement attempts in five people with ALS with different severity of paralysis, ranging from partial paralysis to complete locked-in syndrome. The subjects performed a delayed instructed movement task with a range of movements. Movement instructions were presented on a screen (3 participants) or as spoken words from a loudspeaker (2 participants), and were followed after two seconds by a go cue. As the subjects performed the task, we recorded high-density electroencephalogram (EEG), electrooculogram, and electromyogram using a 128-channel recording system (ANT Neuro). We co-registered the EEG electrode positions with the structural magnetic resonance imaging scans to accurately reconstruct the sources of cortical activity. Here, we characterize the subjects' motor-evoked responses, even in the absence of any actual movements. We found preparatory and movement-related cortical potentials in the low-frequency range as well as event-related synchronization and desynchronization responses present in different frequency bands for different subjects. Surprisingly, these responses can be identified in single trials. These results demonstrate the potential to develop an effective communication BCI based on high-density EEG cortical source reconstruction for people with locked-in syndrome.

Clinical Neuroscience

P17

Asynchronous decoding of attempted movements for brain-computer interfaces using source reconstructed cortical potentials.

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Around 2% of people worldwide live with some form of paralysis, with a severe impact on their quality of life. Brain-computer interfaces (BCIs) can help them regain independence by providing the ability to control communication interfaces, interact with ICT technologies (brain-controlled computer cursor), or restore movements of their paralyzed limbs using brain-controlled neuroprostheses (e.g. muscle or spinal stimulators). Non-invasive BCIs have been used to restore communication to people with paralysis. Yet, the communication rates were low and BCIs required frequent (daily) recalibration by highly skilled engineers. We designed a method that aims to achieve stable performance of EEG-based BCIs using reconstructed activity of sources from the cortical motor regions. Subjects performed a delayed instructed movement task, where each movement instruction was followed by a go cue following a fixed delay. We reconstructed activity of motor cortical sources from high-density EEG recordings made while the subjects performed the task. We then calibrated a regularized linear discriminant analysis decoder on movement-related cortical potentials (MRCPs), and event-related desynchronization and synchronization (ERDS) responses in the beta frequency bands. Our decoder successfully detects feet, wrist and finger movements in an asynchronous test scenario. These results open the way for developing efficient, stable and user-friendly communication BCI using high-density EEG and source reconstructed responses for people with locked-in syndrome.

Clinical Neuroscience

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Structural and functional brain rewiring in children born without the corpus callosum: myth or reality?

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Developmental absence (agenesis) of the corpus callosum (AgCC) is a congenital brain malformation resulting from disruption of corpus callosum formation, the largest white matter pathway in the brain. Evidence suggests the existence of neuroplastic response in white matter tracts crossing the midline via the anterior and posterior commissures to preserve interhemispheric transfer. In particular, the existence of extensive brain rewiring with interhemispheric tracts linking parietal cortices has been suggested.

In a cohort of children with AgCC compared to typically developing children, this study aimed to investigate the presence of neuroplastic responses in structural (SC) and functional (FC) connectivity in white matter tracts crossing the midline via the anterior and posterior commissures.

Anatomical T1, diffusion-weighted and resting-state functional Magnetic Resonance Imaging sequences were acquired in 20 children with AgCC and 30 typically developing controls aged 8 to 17 years. Streamlines linking temporal, occipital and parietal cortices via the anterior and posterior commissures were individually drawn and microstructural parameters were used as SC measures. Seed-based FC was computed using the endpoints of the streamlines as seeds.

For typical interhemispheric tracts linking temporal and occipital cortices, there was no group difference for SC nor FC. Atypical interhemispheric parietal tracts were present in 30% of AgCC children for the anterior and 40% for the posterior commissures and there was no correlation between SC and FC across AgCC children.

Contrary to what has been suggested in the literature, our findings in a large cohort of children with AgCC do not suggest extensive brain rewiring and neural plasticity in the anterior and posterior commissures.

P19

The role of spatial processing for awareness of memory deficits in Alzheimer's Disease: a virtual reality-based study concept

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A lack of awareness of memory deficits (commonly defined as "anosognosia") is quite common in patients suffering from dementia. Anosognosia largely varies in dementia patients, especially in the different phases of the disease, and its presence dramatically affects the management and quality of life of the patients. Several theoretical models have been developed to explain awareness deficits in dementia, but there is not yet a full understanding of why self-awareness breaks down in this population. A growing body of study investigated which cognitive factors might be implicated in self-awareness. In particular, studies exploring metacognitive abilities in both neurological and psychiatric patients suggested that the way in which the information is presented (i.e., perspective-taking) has a key role in affecting patients' awareness of their deficits. Here we present the development of a novel Virtual Reality-based protocol aimed at further investigating the role of different spatial processing in updating self-awareness. In particular , individuals will be asked to predict their performance in three different virtual navigations: 1) a first-person perspective navigation; 2) an aerial perspective navigation; 3) a first-person perspective including a map oriented according to participants' movements. We discuss the development, the structure and potential clinical implications of this novel approach for individuals with dementia.

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P20

Functional disconnection within the presence hallucination network in psychotic patients with first-rank symptoms

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Psychosis is an abnormal mental state including hallucinations and delusions. Recent theories posit that psychosis is driven by inaccurate sensorimotor predictions causing the misattribution of self-related events to external sources, which has been linked to first-rank symptoms (FRS). Important features of FRS are a loss of sense of agency and, particularly, the occurrence of an alien agent. The subjective experience of an alien agent while no one is actually there is called presence hallucination (PH). PH has been observed in schizophrenia, Parkinson's disease and neurological patients with circumscribed brain lesions. In healthy participants, PH can be induced by exerting sensorimotor conflicts between the participants' upper-limb movements and a tactile feedback received on the back using MRI-compatible robotics. Crucially, the neural network associated with this robotically-induced version of PH overlap with the symptomatic-PH network derived from neurological patients suffering from PH in right dorso-lateral prefrontal cortex (dlPFC) and middle temporal gyrus (MTG), suggesting a common neural mechanism (PH network). Given that experiencing an alien agent is a specific feature of FRS, we tested whether bilateral functional connectivity in this PH network can specifically differentiate psychotic patients with vs. without FRS. We observed reduced functional connectivity in patients with FRS (as compared to patients without FRS) between the right MTG and the dlPFC bilaterally. Interestingly, connectivity between these areas was negatively correlated with the FRS severity. We propose that reduced functional connectivity between the right MTG and bilateral dlPFC areas could be a specific biomarker of FRS in patients with psychosis.

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P21

Evaluating the relationship of late endogenous ERP components and fluid intelligence in healthy older people

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The aim of this study was to assess whether late endogenous ERP components, like P3b and the late positive component (LPC) works as a marker of fluid intelligence (gf) in healthy older people. 57 participants underwent an oddball and a continuous performance task (CPT) with simultaneous EEG recording. Participants were divided in gf high- (HP) and low-performance (LP) groups using as criteria if their Raven Advanced Progressive Matrices (RAPM) scores were above or below the median, respectively. Group comparisons were analyzed considering amplitude and latency of P3b and LPC. Furthermore, a bivariate correlation between RAPM scores and P3b and LPC amplitudes and latencies, as well as, a multiple linear regression were run to test if these ERP components could predict gf. Results showed a decreased LPC amplitude during the CPT for LP, whilst P3b latency during the oddball task was increased, when compared to the HP group. Additionally, P3b latency and LPC amplitude were significantly correlated with RAPM performance. Linear regression analysis showed that the LPC amplitude was a predictor of RAPM scores. Indeed, as confirmed by a ROC curve analysis, the model derived from this linear regression was able to discriminate HP and LP individuals. Overall, the results indicate a relationship between P3b and LPC with gf, as well as, the LPC amplitude predictive value of gf proficiency. Our findings extend prior evidence of such relationship already observed in young adults and highlighting LPC amplitude as a proxy of gf abilities in the elderly.

P22

You're laughing at me: neurobiological correlates of attenuated benign intent attribution during laughter perception in adults with high functioning autism

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Introduction

Laughter is a very powerful social signal to express acceptance or rejection. The intention of the laugher can be identified well above chance level from recordings of laughter sequences even without any contextual information. Adults with high functioning autism (HFA), however, show a tendency to interpret laughter as less benign as compared to typically developed controls (TDC). Here, we examined HFA-related cerebral activation and connectivity differences during perception of laughter.

Methods

Ten persons with HFA (age 34.1 ± 10.5 years) and 23 TDC persons (age 30 ± SD 10.4 years) matched with regard to age, level of education and intelligence participated in the study. During fMRI-measurements (3T) participants rated laughter-sequences (60 video sequences) as friendly versus hostile in intent on a four point scale. Cerebral activation and connectivity was analyzed using SPM8.

Results

At behavioral level, significantly less benign intent ratings were observed for happy laughter in HFA as compared to TDC (HFA = 2.2 ± 0.4, TDC = 1.9 ± 3, p = 0.03). This attenuation of benign social intent attribution was associated to hypo-activation within the left inferior frontal gyrus and the right superior temporal cortex during laughter perception. Moreover, attribution dependent hypo-connectivity has been observed between the AMY and the left inferior frontal and bilateral medio-frontal cortex as well as parietal and occipital regions. These findings corroborate the hypothesis that alterations in cerebral connectivity within the social perception network might underlie the deficits in social cue processing in subjects with HFA.

P23

Large-scale brain network dynamics reveal functional signatures of anxiety in 22q11.2 deletion syndrome.

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In 22q11.2 deletion syndrome (22q11DS), a neurodevelopmental disorder coming with an extremely high risk for schizophrenia, anxiety has emerged as clinical risk factor for developing schizophrenia. Investigation of large-scale brain network dynamics during rest is promising to probe into aberrant brain function and uncover imaging markers for psychosis vulnerability. Innovation-driven co-activation patterns (iCAPs) rely on the detection of transient activity to recover brain networks and their dynamics and stands out by the ability to robustly retrieve spatially and temporally overlapping brain networks.

Here, we applied iCAPs to resting-state functional magnetic imaging scans of 78 patients with 22q11DS and 85 age-matched healthy controls. Activation and coupling duration of the extracted brain networks were compared between groups using t-tests and further, multivariate partial least squares correlation was used to uncover the functional signature of anxiety.

Patients with 22q11DS had shorter activation in cognitive networks, longer activation in emotion processing networks and globally increased segregation between networks. The functional signature of anxiety uncovered differential roles of dorsal and ventral sub-divisions of anterior cingulate (ACC) and medial prefrontal cortices (mPFC). Coupling of amygdala and hippocampus with dorsal ACC and mPFC was promoting anxiety, whereas coupling with more ventral ACC and mPFC regions had a protective function.

In summary, using iCAPs for dynamic brain network analysis, we uncovered patterns of aberrant brain dynamics in a clinical risk factor for psychosis in 22q11DS. Our results confirm that the dynamic nature of brain network activation may be essential in characterizing imaging markers for psychosis proneness.

P24

Beyond Unpleasantness. Social exclusion affects the experience of pain, but not of comparably-unpleasant disgust

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Seminal theories suggest that social rejection and physical pain underlie partly common representational code. Indeed, exclusion can influence the subjective experience of subsequent painful stimuli. Furthermore, social and physical pain have been associated with a partly-overlapping neural activations at the level of secondary somatosensory cortex, dorsal cingulate cortex and anterior insula. It is unclear, however, whether these effects underlie a modality-specific component of pain, or rather a supra-modal representation reflecting properties common to other unpleasant experiences, even painless. To address this question we engaged neurotypical volunteers in a virtual ball-tossing game with virtual players who either interacted with the participant (inclusion condition), or ignored him/her (exclusion condition). After each game interaction, we delivered painful (thermal) or disgusting (gustatory/olfactory) stimuli carefully matched for subjective unpleasantness. We found converging evidence of reduced sensitivity to pain following exclusion (as opposed to inclusion), as revealed by the analysis of both subjective ratings and physiological responses. This effect was more pronounced in the first-half of the experimental session (and became less systematic in the remaining trials), and in those participants who were most sensitive to the exclusion. Crucially, these effects were not observed for the response to disgust, who was unaffected by the gaming manipulation. Neuroimaging data underline differential interplays between social exclusion and experiences of pain and disgust. Overall, these findings indicate that the relationship between social exclusion and physical pain is modality-specific and does not generalize to disgust.

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P25

Carry-over effects of empathy for suffering in the brain activity and connectivity of elderly people

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While empathy is well studied in younger adults, empathy-related brain functions in elderly are poorly understood. In order to assess 1) neural representations of empathy in elderly and 2) whether empathy-related situations produce carry-over effects on brain activity and connectivity, we acquired functional resonance imaging (fMRI) data while 122 participants over 65 years watched emotional video clips from the Socio-affective Video Task (SoVT) followed by resting periods of 90s. Participants also provided self-reports on their feelings in response to each video.
While confirming previous findings from younger adults (Klimecki et al., 2013; Cerebral Cortex) on higher empathy and negative feelings, and lower positive feelings in response to others' suffering compared to everyday life situations, we additionally observe higher emotional responses in elderly compared to young participants. Furthermore, the confrontation with others' suffering induced greater brain activity in areas related to empathy and social cognition, including anterior insula, middle cingulate gyrus, and medial prefrontal cortex. Additional analyses during the resting periods revealed different patterns of activity and connectivity in regions related to the default mode network following videos depicting other's suffering compared to videos depicting everyday life situations. Our results suggest that being faced with others' suffering induces emotional states that can persist over time and modulate the brain's resting state in elderly participants.

P26

Differential influences of hemisphere and Parkinson's disease lateralization on the oscillatory correlates of emotional prosody decoding in the parkinsonian subthalamic nucleus

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A critical contribution of the subthalamic nucleus (STN) in the recognition of emotional prosody has been demonstrated by ERP recordings from deep-brain stimulation electrodes in parkinsonian patients. However, the temporal dynamics and hemispheric lateralization of local field potential activity in different frequency bands subtending emotional prosody decoding in this structure remain unclear. In the current study, we analyzed local field potential activity in the STN of two groups of Parkinsonian patients (8 whom disease started on the left side (LSP) and 6 whom disease started on the right side (RSP)) that had just undergone deep brain electrode implantation while they listened to angry, happy and neutral voices as well as synthetic controlled sounds. In the theta band (2-6 Hz), a happiness specific event-related synchronization (ERS) occurred bilaterally in RSP patients. In LSP patients, an emotion specific ERS was observed in the left STN. In both groups, we observed a lower ERS for happiness in the contact contralateral to the most affected side. In the alpha band (6-12 Hz), an anger specific event-related desynchronization (ERD) occurred bilaterally in RSP patients. Conversely, LSP patients presented the bilateral maintenance of a higher level of alpha band activity for emotional compared to neutral voices. Finally, in the low-beta band (12-20 Hz), a phasic happiness specific ERS was observed for both groups in the left STN. This ERS was, however, decreased in LSP patients. Altogether, these results suggest a hemispherically lateralized pattern of oscillatory activity in the subthalamic nucleus during emotional prosody decoding.

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Valenced Smells Cause Transient Emotional States in Resting State

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Physiological data and functional neuroimaging have provided evidence for sustained effects of transient emotional episodes (usually caused by movies or music) on subsequent brain activity patterns during resting state. In this fMRI study we investigated whether transient emotions induced by pleasant or unpleasant smells could impact resting state connectivity for prolonged intervals. Participants were presented with pleasant or unpleasant odors, after which they lay quietly and let their minds wander. We first delineated significant changes in whole-brain connectivity at rest according to the previous smell, and then used random forests classification to examine which connectivity patterns were most predictive of the affective value of the preceding smells. Resting state after pleasant smells showed increased connectivity to the dlPFC from the precuneus and thalamus, between the insula and dlPFC, and between the mOG and precuneus after unpleasant smells. The random forest results showed that connections to the left insula from the dlPFC, hippocampal area, and amygdala were the most important in accurate predictions of the affective valence of the received smell. Our study demonstrates lingering effects induced by odorants on brain activity patterns and the important roles that the insula and mOG play in this. It suggests that the precuneus mediates changes in emotional state by providing a connection between olfactory processing and resting state areas. More generally, our study illustrates a novel approach that allows for a differentiation of valence during rest, and showcases the close functional relationships of olfactory processing with emotional and self-monitoring brain circuits.

P28

The influence of context on the recognition of facial expressions of pain

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The ability to correctly diagnose pain from others' faces is critical for healthcare systems, especially for those individuals unable to provide verbal reports. However, pain expressions are difficult to disentangle from other states (e.g., disgust), thus opening the issue of whether complementary sources of information might help the diagnostic process. Here, we tested the hypothesis that the context in which the facial expression is perceived can influence its recognition and evaluation.

Across two separate experiments, participants evaluated videos of painful and disgusting facial expressions after having read a sentence suggestive of a congruent or incongruent state. In a behavioral study, we found that contexts shaped the appraisal of subsequent facial expressions, both when explicitly asked to categorize the state observed and when prompted to assess the unpleasantness felt by the displayed person.

In a subsequent neuroimaging experiment, we found that contextual information evoked activation of state-specific networks, with Supramarginal and Postcentral Gyrii (SMG/PCG) responding to pain, and Temporo-Parietal Junction (TPJ) and Superior Temporal Sulcus (STS) responding to disgust. Instead, facial information triggered overlapping responses of the Anterior Insula (AI) and the Inferior Frontal Gyrus (IFG). Critically, the IFG showed enhanced activity whenever expressions were preceded by a consistent context, thus suggesting a major role in the integration of the two sources of information.

Overall, these data reveal that contextual information can influence the appraisal of facial expressions, an effect that appears mediated by the IFG.

P29

Divergent effects of oxytocin in men and women: Increased dorsomedial prefrontal cortex activity to negative emotion displays in men but not in women

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The neuropeptide oxytocin plays a prominent role in social and emotional cognition. Findings suggest that intranasal oxytocin administration facilitates emotion recognition in humans, but individual and contextual differences may have moderating effects. A major caveat in this line of work is its predominant focus on young males, which limits current knowledge and generalizability across gender. To uncover potential gender effects, the present study included 32 men (mean age 45.78, sd. 22.87) and 39 women (mean 47.87, sd. 22.59). Utilizing a randomized, double-blind, placebo-controlled, within-subjects design, participants self-administered a single-dose of 40 IUs intranasal oxytocin 40 minutes prior to completion of a dynamic emotion recognition task in the MRI scanning. The task paradigm used positive and negative stimuli from the Geneva Multimodal Emotion Portrayals Core Set. Preliminary analyses show that oxytocin induced dorsomedial prefrontal cortex (dmPFC) activity reductions during exposure to negative (relative to positive) stimuli in women, while dmPCF activity was increased under this condition in men. We observed no effect of sex in the behavioral data, however, the results show a similar trend as in brain data. We speculate that the effects of oxytocin on brain activity during emotion recognition may be related to emotion-regulatory and mentalization processes. The observed gender-differential modulatory role of oxytocin raises concern of a bias in the previous oxytocin literature on emotion recognition and associated brain activity by neglecting women in the examination. Next, we will determine the role of age effects on gender-by-treatment interactions, as well as consider modality of the emotion stimulus presentation.

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P30

Investigating the neural predictors of flow using fMRI

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Flow, popularly referred as being in the zone, can be described as a state of optimal performance. The subjective experience corresponding to this state has been well characterized using 9 psychological constructs, such as concentration, transformation of time or sense of control, as measured through a self-report questionnaire called the Flow State Scale (Jackson & Marsh, 1996). However, little is known of the neural correlates of flow. Only a handful of brain imaging studies have investigated the neural correlates of flow and all have done so by contrasting two different task conditions, making it unclear whether the observed differences in activity are truly flow-related rather than task-related.

To remedy this, we take here a different approach based on the method presented in Rosenberg et al. (2016), where sustained attention-related networks were defined using resting state connectivity and performance on a sustained attention task administered at a different time. Similarly, we identify flow-related neural markers using resting state connectivity and a measure of flow collected at a different time. Importantly, this approach avoids any possible confounds from task-related differences since the behavioural and connectivity data are not acquired simultaneously.

We have already validated our ability to measure the propensity to enter flow by contrasting flow questionnaire responses after playing a video game at an optimal level of challenge versus at an over-challenging level. As in Rosenberg et al. (2016), we ask whether individual flow states can be predicted from patterns of resting state connectivity. We predict these patterns will reveal a rather unique network highlighting the combined contribution of attention-related, emotion-related and reward-related networks to the experience of Flow.

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Sleep deprivation increases reward sensitivity to food intake in vulnerable individuals

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Growing evidence points at a strong link between sleep loss and obesity. A few studies suggest that sleep deprived individuals may increase food intake, particularly more palatable and high-calorie food, so as to exceed their actual caloric needs. This change in behavior may eventually lead to weight gain and obesity. Yet the underlying mechanisms are not yet fully understood, and findings in humans are varied. Here we tested the hypothesis that sleep deprivation disrupts reward processing, with enhanced sensitivity to high-calorie food paired with reduced inhibition to food consumption. Using a food incentive delay task, we assessed the impact of sleep deprivation on the drive to obtain high (vs. low) quantity of high- (vs. low-) calorie of food. We found that sleep deprivation significantly and selectively increased motivation for high quantity of high-calorie food. Critically, this effect predominated in those individuals most affected by sleep deprivation (i.e. those showing a general slowing of reaction times). These findings indicate that vulnerability to sleep loss determines the impact of one night of sleep deprivation on reward sensitivity to high-calorie food and give new insights into the relation between sleep and food consumption.

P32

Dynamic Casual Modeling of holistic and analytic processing of dynamic facial expressions

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It has been proposed that two distinct processes may contribute to the recognition of face identity and emotion expression: one based on the features of the face, and the other implicated in grouping those features into a holistic representation. Most research has examined these processes using static pictures of faces. In our current fMRI investigation we explored the role of local and global visual information with novel dynamic facial stimuli expressing four different emotions (Anger, Happiness, Joy, Sadness), displayed synchronously or asynchronously across face features. Dynamic expressions were presented with the bottom face part moving before, together with, or after the face top part or vice, therefore favoring featural/analytic or global/holistic processing to different degrees. Our GLM results showed that synchronous facial expression expressions (holistic mechanism) distinctively engaged the Anterior Cingulate Cortex, medial premotor areas and bilateral Superior Frontal Gyrus. In contrast, asynchronous expressions in which one part of the face unfolded before the other (e.g., eye then mouth) activated the right Superior Temporal Sulcus (STS) and right Inferior Frontal Gyrus. Dynamic Casual Modeling (DCM) revealed a divergence of analytic and holistic temporal information from the Inferior Occipital Gyrus with distinct projections to higher-level areas such as STS for asynchronous expressions and Fusiform Gyrus for synchronous expressions. Overall, our results suggest that holistic processing of dynamic facial movements is performed in Medial Prefrontal Cortex rather than Occipital and Temporal parts of human brain, and proceeds along a hierarchical pathway.

Language & Music

P33

Frequency-specific connectivity patterns at rest are associated with speech-in-noise comprehension ability

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Speech-in-noise comprehension ability is highly variable across individuals. Several cognitive factors may contribute to this variability, such as working memory, processing speed and executive functions. It has recently been demonstrated that resting-state brain connectivity predicts individual patterns of performance on batteries of cognitive tests. Here, we analyse whole-brain connectivity at rest in MEG data from 89 normally-hearing participants to evaluate whether speech-in-noise perception can be related to resting-state brain activity. Speech-in-noise (SiN) performance was evaluated using the NIH Toolbox Words-in-Noise Test that evaluated a subject's ability to understand single words embedded in varying levels of background noise.
MEG recordings (~3 * 5 minutes per participant) were source-reconstructed and source leakage corrected. Functional connectivity was evaluated over the whole brain divided into 100 parcels, over the frequency range of 1-38 Hz, in 18 overlapping bins). Connectivity for each pair of regions ('edges') within each frequency bin over all participants were concatenated, and submitted to PCA for data reduction. Multiple regression was used to derive an optimal linear weighting of connectivity patterns across frequency bands ('mode') correlating with SiN performance ($r=0.59$, $p<0.05$, after permutation testing). Post-hoc analysis of this mode revealed a set of relevant edges related to this mode with a spectral focus in beta [21-30 Hz] and theta/delta. Increased connectivity in the lower frequency range was generally associated with worse performance, while beta-band connectivity was a sign of better performance in the task. This demonstrates the functional relevance of MEG whole-brain connectivity for inter-individual variation in speech-in-noise comprehension.

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Multivariate Concavity Amplitude Index (MCAI) for characterizing Heschl's gyrus shape

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Heschl's gyrus (HG), which includes primary auditory cortex, displays considerable variation in shape (i.e. gyrification patterns) across individuals and hemispheres. Current definitions categorize the most common gyrification patterns as single HG, common stem duplications and complete posterior duplications. Moreover, other less frequent patterns have also been reported, such as lateral duplications, or the presence of three or more transverse temporal gyri. These characterizations of HG gyrification patterns are based on visual identification of possible existing sulci (i.e. surface shape concavities), without clearly delineated thresholds for defining the presence of sulci. Here we propose a novel Multivariate Concavity Amplitude Index (MCAI), which characterizes the shape of transverse temporal gyri by a set of continuous measures based on the proportional amplitude of the existing concavities, taking in account the respective direction of the displacement (anterior, posterior, medial, lateral). MCAI is fully automated, and allows the application of standardized and reproducible criteria for characterizing the shape of the transverse temporal gyri in the auditory cortex. We also present results of an application of MCAI to brain structural data in professional musicians; these results are consistent with previously reported gyrification differences between musicians and non-musicians. Possible future applications of MCAI include a wide range of contexts, such as exploration of auditory cortex shape differences in the context of expertise, disease, genetics and brain plasticity.

P35

Music and the Fetal brain – Auditory Task fMRI triggered by Maternal Singing?

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Fetal brain fMRI is typically limited to resting state fMRI, however, resting states can be influenced by multiple factors, including whether the fetus is awake or sleeping[1], or hypercapnia[2]. Some teams have done auditory task fMRI, with an external sound stimulus directly on the abdomen of the mother; but recently there have been methodological and ethical concerns raised about that type of stimulus[2]. We postulate that having the mother hum or sing, as the auditory stimulus, would also result in activation in the fetal primary auditory cortex. Four volunteers carrying singleton fetuses with a gestational age (GA) of 36-37 weeks underwent two task-based block design BOLD fMRI series. The data was segmented, and co-registered to the respective CRL5 GA fetal atlas. The segmented functional data were analyzed using SPM 12 (v7219)6 as a task fMRI ($p < 0.05$). Each region was overlaid onto the activation map to determine which areas in the brain had activation during task phases. Our preliminary results suggest that there are 20 regions consistently activated by the four fetuses when they were exposed to the acoustic stimulus. Specifically, regions known to be part of the auditory network such as the right Heschl's gyrus, the right middle cingulate cortex (MCC), the left MCC (3/4 subjects) and the left putamen. This preliminary study demonstrates that having the mother hum or sing for blocks of time, one can activate and image the auditory network of the fetus.

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P36

Resting-State Perisylvian Beta-Gamma MEG Power Predicts Words-in-Noise Recognition

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Resting-state (RS) brain activity has been shown to be predictive of both behavior and task-related brain activation. We examined the relationship between RS-MEG activity and speech-in-noise (SIN) recognition performance in 89 participants provided by the Human Connectome Project. The Words-in-Noise (WIN) test was used to establish individual signal-to-noise ratio thresholds for word identification. Power spectral density of the source-reconstructed standardized time series of RS-MEG recordings (approximately 15mins per subject) was calculated from 1 to 40 Hz, in 1hz bins at each source point. In order to accommodate the similarity of adjoining frequency bands, k-means clustering (k=6) was applied. Voxelwise power averaged over frequencies of each cluster was tested for correlation with WIN score. After cluster-based permutation testing (cluster-wise $\alpha<.05$, corrected for multiple comparisons), significant relationships were revealed between WIN and voxel power. In the range 21-29Hz, a principally left-lateralised perisylvian cluster of voxels spanning from inferior frontal gyrus to temporo-parietal junction (TPJ) showed a negative correlation with WIN ($p=.0045$, $r=-.31$). In the range 30-40Hz a cluster in mid to posterior right temporal cortex, including TPJ, was also found to be associated with WIN score ($p=.0042$, $r=-.31$). In both cases, higher RS power was associated with better WIN performance. The spatial distribution of voxels associated with WIN performance is consistent with the ventral, word-recognition, stream of models of speech processing. This suggests that individual differences in such fundamental properties as intrinsic baseline activity are predictive of behavioural outcomes in speech recognition tasks, in a spatially and spectrally specific manner.

P37

Combining predictive coding with neural oscillations optimizes on-line speech processing

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Theoretical and empirical work suggests that neural oscillations play a role in bottom-up speech processing. In particular, coupled theta and gamma oscillations could segment continuous speech into syllable-like units and organize gamma activity into decipherable spike-trains. On the other hand, speech comprehension is heavily dependent on top-down predictive processes that permit to infer the structure and content of speech, some of which also involve neural oscillations. To explore how theta-gamma coupling relates to top-down and bottom-up processes during speech perception, we built a generative model that recognizes, on-line, syllables in continuous speech. In the model, a theta oscillation detects syllable onsets in the envelope, which then serve to align the model's gamma activity with syllable boundaries, and predictions with the incoming input. Although internal expectations about syllable duration could provide an alternative way to predict syllable boundaries, the simulations demonstrate the model performs best when theta oscillations were used to align the models gamma activity with input syllables, i.e. when bottom-up and top-down information flows were coordinated and accumulated evidence about syllable identity was reset by an internal timing mechanism. These results suggest that the interaction of theta oscillations with top-down and bottom-up information flows (e.g., by theta-gamma coupling), is an essential factor for continuous speech perception. More broadly, this work demonstrates the relevance of combining the notion of predictive coding with that of neural oscillations to account for dynamic on-line sensory processing.

P38

Non-invasive brain stimulation transiently reinstates low gamma sampling and boosts phonological processing in adults with dyslexia

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Recent findings have linked developmental dyslexia to altered auditory cortical sampling within the low gamma range. Building upon the evidence that adults with dyslexia have reduced responses in left auditory cortex around 30 Hz, we used transcranial alternating current stimulation (tACS) to reinstate functional sampling in the left auditory region and assess whether it can selectively boost phonological abilities.

For each participant (15 dyslexics, 15 normo-readers), we evaluated phonological abilities in a battery of linguistic tests performed before a 20 minutes 30 Hz tACS session, immediately after and 1h after, as well as for 60 Hz and sham tACS. We used auditory steady state EEG responses to amplitude modulated sounds to entrain brain oscillations in a frequency specific manner.

We found that phonological processing improved immediately after 30 Hz tACS but neither after 60 Hz tACS, nor after sham stimulation. No significant 30 Hz effect was observed in a control group. Performance increases immediately after 30 Hz tACS was accompanied by a selective increase in auditory cortex response to acoustic stimuli modulated at 30 Hz. This effect correlated positively with the severity of dyslexia. Power analysis in the source space showed, in dyslexics, an increased activation in the left superior temporal sulcus, together with an antagonist effect in the right hemisphere.

These results support the causal role of gamma oscillations in phonological processing and its deficits. They further demonstrate that 30 Hz tACS boosts phonological processing in adults with dyslexia by reinstating low gamma sampling.

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Altering phonemic representations with 30Hz tACS in Dyslexia

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Phonological dyslexia is an hereditary developmental disorder mostly explained by a phonological awareness deficit. Here we propose to use transcranial alternating current stimulation (tACS), a non-invasive brain stimulation technique used to modulate brain oscillations at specific frequencies, as a rehabilitation tool for the dyslexic impairment. According to recent neurophysiological findings (Lehongre et al. 2013), dyslexia has been linked to altered auditory processing and atypical neural activity in the left auditory cortex.

Stemming upon this evidence, we hypothesize that by applying tACS over the left auditory cortex, linguistic skills affected by this condition would improve. Fifteen adults with dyslexia and fifteen normo-readers received tACS at 30Hz, 60Hz and a sham condition across three separate experimental sessions. To evaluate the tACS effectiveness, participants performed a battery of linguistic tests before, immediately after and one hour after the tACS stimulation.

In accordance to our predictions, we could observe in dyslexics participants, an increase in performance immediately after the 30Hz stimulation. This effect was due to an improvement in (1) discriminating acoustic differences within the same phonemic category, (2) in exchanging phonemes between two words and (3) in reading fluency. Moreover, this improvement positively correlates with the severity of phonological dyslexia. Our data point towards the importance of phonemic perception and categorization in phonological awareness and confirm the involvement of low gamma oscillations (i.e. 30Hz) in phonemic representation and in phonological awareness. Importantly, our findings emphasize the relevance of using tACS as an intervention tool to increase phonological awareness in individuals affected by dyslexia.

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Recalibration of speech sound categories at two timescales

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Speech perception can be derived from internal models of how speech sounds are systematically associated with sensory features. When features associated with a speech sound change, the listener should recalibrate its internal model by appropriately weighing new versus old evidence in a volatility dependent manner. Models of speech recalibration have classically ignored volatility. On the other hand, models that explicitly consider volatility have been designed to describe the behavior of human participants in tasks where sensory cues are associated with arbitrary experimenter defined categories or rewards. In that setting, a model that maintains a single representation of the category but continuously adapts the learning rate works well. We propose that recalibration of existing “natural” categories is better described by a model that represents sound categories at different time scales. We illustrate our proposal by modeling the reported rapid and transient recalibration of speech categories after experiencing the McGurk effect.

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Neural correlates of communicative intent in the eye of experts

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Our capacity to coordinate with one another during complex processes, using non-verbal communication, is key at an evolutionary level, allowing us to achieve tasks that could not be managed individually. The ability to predict others' actions in a social interaction are based on one's own action representations and the use of an internal forward model. To shed light on the subtle mechanisms of communicative intent, we recruited expert violinists and matched control participants who evaluated the visual dynamics of short pieces of violin solos with the violinist represented as a point-light display (PLD) following motion capture recordings. Musicians show higher accuracy in all conditions, indicating close links between perception and action competence. At the brain level, our results reveal a strong activation of the parietal-frontal network, associated with observation of actions. This network is supplemented in our case by pre motor area, consistently activated for musician during motor imagery and musical practice. Together, these findings outline the expertise-related brain networks involved in the interplay between expectations and predictions that subserve the active inference of other individuals' expressive /communicative intent.

P42

A magnetoencephalography Study on The Effect of Language Proficiency and Exposure on Lexical Semantic Processing in Monolingual, Semi-Bilingual and Bilingual Learners of English

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The effect of proficiency has been well confirmed in second language learners and increased activation has been reported in more proficient learners. Learners with higher proficiency showed greater activation in temporo-parietal regions when performing linguistic tasks than their peers with lower proficiency. Such difference can be highlighted by studying language processing, from sensory analysis to linguistic assessment, memory and motor function. The latency of the brain response to semantic anomalies (N400 effect) is a crucial research avenue for studying semantic aspect of language input. The most advanced functional technique for fast tracking of brain activations at millisecond time resolution and reasonable spatial accuracy is Magnetoencephalography (MEG). We investigated the effect of language proficiency on N400 elicited by lexical semantic violations in English sentences using MEG device. Our participants were enrolled from three different schools (monolingual, semi-bilingual and Bilingual) with different amount of exposure to second language instructions which led to different levels of proficiency. According to our findings, more proficient learners showed enhanced N400 responses to semantic violations relative to control sentences. Moreover, the N400 appeared to have an earlier onset and greater amplitude for more proficient learners than less proficient ones. Increased latency and earlier onset of N400 appeared to be influenced by the amount of exposure to the second language. These results clarify the activation and timing of brain processes that contribute to our judgment that a word such as any is or is not permitted in a given context.

P43

The bodily-self retroactively and selectively strengthens episodic memory

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Neurobiological models of long-term memory suggest a mechanism, by which initially unstable and weak memories are retroactively strengthened by conceptually related strong events (Frey and Morris, 1997). Only recently, the behavioral tagging effect has been shown in humans (Dunsmoor et al., 2015; Patil et al., 2017) by demonstrating that meaningful events (fear conditioning or reward motivation) may selectively consolidate memory for prior, seemingly insignificant information at the time of encoding. Personally meaningful past episodes, defined as episodic autobiographical memories, are related to our sense of bodily-self, the so-called bodily self-consciousness. Using an immersive virtual reality system, here we argue that the presence of one's own physical body creates a strong retroactive effect and selectively strengthens self-relevant past events. First, we show that the presence of congruent multisensory, visual and proprioceptive, cues from one's own physical body experimentally enhances memory performance (N=15). Second, we demonstrate that these salient, bodily self-related cues can selectively and retroactively modify post-encoding memory consolidation (N=16). Our findings bring a new evidence that personally meaningful memories of our past are not fixed, but may be strengthened by later events that involve participants' own body as a salient stimulus.

Learning & Memory

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The anti-correlation of activities of the Default Mode Network with the Dorsal Attention Network in older adults is a function of BOLD signal variability

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BOLD signal variability (BOLDsv) is an emerging index of cognitive health in aging, believed to reflect the brain's dynamical ability to undergo fast moment-to-moment network reconfigurations. Higher regional BOLDsv can be associated with enhanced performance on task switching for example [1]. Similarly, DMN-DAN (default mode network-dorsal attention network) anticorrelation is a known metric of cognitive ability [2]. We aimed to better understand the relationship between BOLDsv and inter-network connectivity in healthy subjects, since there are some controversies in the literature (Zhu [2] showed reduced anti-correlations among DMN-DAN in Alzheimer's, but another study reported higher BOLDsv in some regions of patients with Alzheihmer's [3]). We hypothesize that subjects with a strong DMN-DAN anti-correlation show higher network BOLDsv. 28 adults (mean 71.6 ± 6 yrs) had a task and a resting state fMRI. Functional connectivity (FC) between the DMN (seed medial prefrontal cortex, mMPFC) and DAN (seed intraparietal sulcus, IPS) was assessed. BOLDsv was calculated using the standard deviation of the signal. Inter-network correlation was computed using a general linear model.
Between-networks comparative tests showed strong negative connectivity between DMN mPFC and DAN IPS. Linear regression was calculated to predict BOLDsv in network regions based on DMN mPFC and DAN IPS anti-correlation. Overall, anticorrelation between the activities of the DMN and the DAN was observed. Adults that showed strong negative FC between DMN mPFC and DAN IPS also showed higher BOLDsv in left intraparietal sulcus and left middle frontal gyrus. This suggests these regions may play a role in facilitating dynamic inter-network FC in older subjects.

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P45

Get Real: the orbitofrontal cortex mediates pre-teens' sense of reality

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Reality filtering (RF) is a memory mechanism that distinguishes if a thought is relevant to present reality or not. In adults it is mediated by the orbitofrontal cortex (OFC). In children the prefrontal cortex, which includes the OFC, is still not fully developed. However, RF is already active from 7 years old, with the response accuracy increasing with age.

Here, we probe the neural correlates of RF in children aged 10–14 years old. We hypothesise that, as in adults, the OFC mediates the sense of reality in this population. Functional magnetic resonance images (fMRI) were acquired from 22 children while performing a task composed of two runs: run 1 measures recognition capacity; run 2 measures RF; each containing two types of images (conditions): 1) distrators (D: not currently revelant) and targets (T: relevant to current reality). Group region of interest (ROI) analysis was performed in a flexible factorial design with two factors ("run" and "condition") using SPM12.

We found significant main effects for the experimental "run" ($p < 0.05$) and "condition" ($p < 0.05$). The overall bilateral OFC activation was higher during RF (run 2) than during the first run of the experiment ($p < 0.05$). Additionally, the OFC was more highly active while processing distractors than target stimuli ($p < 0.001$). These results confirm, for the first time, the role of the OFC in reality filtering in pre-teenagers.

P46

Outcome valence bias confidence and impact decision strategies in reinforcement learning tasks.

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A confidence judgment is a subjective prediction of the probability of one's action being correct. Unbiased and accurate confidence judgments are critical for adaptive behavior. In perceptual decision tasks, incentivizing confidence accuracy paradoxically biases confidence judgments: prospects of gains (resp. losses) increase (resp. decrease) confidence. Here, we hypothesized that this bias would replicate in reinforcement-learning tasks, and would have important consequences on learning performances when competing decision strategies are available. We used an instrumental probabilistic reinforcement-learning task. Participants repeatedly faced pairs of abstract symbols probabilistically associated with monetary outcomes (gains or losses). Participants learned to choose the most advantageous symbol of each pair. At each trial, participants reported their confidence in their choice. Results from two versions of this task show that although learning performance was unaffected by the outcome valence, confidence judgments were significantly lower in the loss conditions. In a third experiment, the probabilistic associations between symbols and outcomes reversed halfway through learning in half of the pairs, requiring participants to switch decision strategy. Before the reversal, results were similar to the previous experiments. Yet, after the reversal, the behavioral switch was more pronounced and faster in the loss than in the gain conditions. Confirming our hypothesis, this work show that confidence is lower when individuals learn from losses vs gains, despite identical performances. It also shows that individuals are consequently more prone to switch decision strategies when probabilistic contingencies change in loss contexts. These results have fundamental implications for the neural and computational basis of goal-directed behavior.

P47

Was It About Me? Exploring How Self-Referential Processing and Valence Modulate the Time-Course of Correct Source Memory Attributions

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Studies probing the role of emotion on source memory (SM; memory for the origins of an event) have been yielding mixed findings. Considering that the encoding strategy might modulate the influence of emotion on source memory, the current study aimed to determine the effects of stimulus valence (negative/neutral/positive) on internal SM when the encoding strategy (self-reference/common judgment task) was also manipulated. Thirty-five healthy participants completed five study-test cycles together with simultaneous EEG recording. Our behaviour results showed a valence dissociation; i.e., whereas a SM benefit was observed for self-referentially neutral/positive words in contrast to negative words, the emotional words were associated with worse SM than neutral words in the common task. Typical early frontal, parietal, and right-frontal old-new event-related potentials were observed when contrasting self-source hits with correct rejections obtained during the test phase. Interestingly, the late posterior negativity amplitude of self-referenced negative words was more negative than new words, suggesting that participants were trying to reconstruct source features from the study episode. This result fits with the lower SM performance observed for these items, which might be related with shallow elaboration during encoding, as negative words are less likely to fit the current self-scheme. Moreover, in the right-frontal old-new time window (800-1200 ms), the amplitude of self-source hits was higher than common-source hits, which might indicate that self-reference conditions facilitate the retrieval of source features. Overall, this study shows that the way information is encoded can elucidate some of the discrepant findings in the field of SM and emotion.

P48

Overconfidence: a product of biased learning?

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Humans are overconfident: our estimates of the probability of having made a correct choice are often higher than our empirical accuracy. We recently demonstrated that motivational aspects, especially context value, can affect this bias, increasing confidence linearly with outcome desirability. Illustrating a similarly optimistic deviation from a normative perspective, we also showed in another study that, in reinforcement learning tasks, individuals weight new information more for positive than negative outcomes.

Here, we bridge those two lines of research and investigate if, in an environment requiring learning to maximize reward, overconfidence could stem from this unequal weighting of desirable and undesirable information. For this purpose, we use a dataset of five different learning experiments (N = 90), where participants chose between pairs of abstract stimuli probabilistically paired with monetary outcomes and reported confidence judgment about their choices, while outcome valence (gains vs losses) and counterfactual information (outcome of the unchosen option revealed or not) were manipulated.

We re-analyze this unique dataset using a hybrid computational model including context-dependent values and separate learning rates for desirable vs undesirable outcomes. Confirming our hypotheses, we show that 1) context values bias confidence reports, and 2) the magnitude of the confirmatory-learning bias predicts the magnitude of the overconfidence bias across subjects. In line with some of our recent studies, we expect that deeper insight into the cognitive computations involved in learning and decision-making will provide new hints about their neural implementation.

P49

Cerebellar transcranial alternating current stimulation in the gamma range applied during the acquisition of a novel motor skill

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The cerebellum serves a fundamental role in motor control and learning. The underlying cortical processing has been linked to oscillatory activity. Specifically, gamma oscillations have been associated to Purkinje cell's basal firing rate (PC) and are shaped by concurrent input from local GABAergic interneurons. In humans, cerebellar cortical function can be studied and modulated in vivo with oscillatory non-invasive brain stimulation (NIBS). First evidence suggest that NIBS in the gamma range can enhance motor function. Here, we investigated the effect of 50 Hz transcranial alternating current stimulation (tACS) applied to the cerebellum during the acquisition of a novel motor skill. We will present first behavioral results of a current double-blind, sham-controlled, cross-over study in 15 young healthy participants. Furthermore, we will discuss concepts for further analysis of the concomitantly acquired multi-modal neuroimaging data.

Methods

P50

Listen to your brain!

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Functional magnetic resonance imaging (fMRI) is a profound source of information to advance our understanding of brain function. In particular, more and more work focuses on the dynamics of fMRI regional interplays, a field known as dynamic functional connectivity (dFC).

Albeit contributing to broaden our knowledge about the brain, most dFC methodologies are particularly sophisticated. Their output metrics must efficiently summarize the joint evolution of fMRI data along time and space, which is typically achieved through visual displays.

Rather than addressing the rising complexity of dFC results through increasingly nebulous figures, we propose to simply listen to the brain, and consider an extracted audio recording representative of functional brain dynamics.

The use of audio signals to represent fMRI data bears several interpretation promises: first, the facilitated integration of information across time scales. Second, the more natural coding of spatio-temporal signal changes by amplitude and pitch adjustments. Third, the simplified identification of whole-brain FC states.

Here, we deployed this approach on a set of high-resolution (temporal: 0.72s, spatial: 2mm x 2mm x 2mm) task-based and resting-state fMRI data from the Human Connectome Project. Through a Hilbert transform, dynamically evolving magnitude and phase information of the time courses subjected to analysis were extracted, and converted into amplitude and pitch for the generation of audio signals. Each separate signal source (i.e., brain region or whole-brain building block) was assigned the timbre of a different instrument to yield a final symphony of functional brain activation.

Methods

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Dynamic Functional Connectivity of the Robotically-Induced Presence Hallucination

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The Presence Hallucination (PH) is the strange sensation of perceiving someone close by, when no one is there. This hallucination, reported by neurological and psychiatric patients, was successfully induced by brain stimulation in epileptic patients, and through robotically-controlled sensorimotor-conflicts in healthy participants. Previous work using fMRI-compatible robotics associated the hyperactivity of four regions, including the posterior middle temporal gyrus (pMTG) and anterior insula (aINS), to the PH-induction. Here, we set out to study the possibility that networks associated with the aforementioned regions have specific connectivity changes during PH-induction, and also to identify the temporal dynamics of these connectivity changes. For this purpose, we investigated the dynamic functional connectivity during the PH-inducting condition, a non-inducting condition, and rest, through Co-activation Patterns. Our results show that two networks connect significantly more with the pMTG and aINS, respectively, during PH-induction. These two networks share a significant number of regions, such as the angular gyrus (AG), the MTG and the meSFG. The main distinctive feature of the pMTG-network is a hyperactivation over the right-AG. For the aINS-network, it is the presence of the dorso-medial PFC, aINS and lateral occipital cortex. With this investigation, we identified, for the first time, networks that are specific to the PH-induction, and that might show body-related signal disintegration, and action attribution to other. Although we do not have significant power to make any strong claims regarding transitions between the networks, our analysis suggests that once the pMTG-network occurs the next transition is likely to itself or baseline (and from baseline to pMTG-network).

P52

Unfold: A new toolbox for regression-based EEG analyses and (non-)linear deconvolution

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Electrophysiological research is increasingly moving from simple, highly controlled stimulus-response paradigms to more naturalistic tasks with complex motor behavior. Examples are experiments that record the EEG during free viewing or whole-body motion. A common problem when analyzing this type of data is that the brain responses from subsequent experimental events overlap with each other in time. In addition, the recorded neural responses are often confounded by numerous low-level covariates which can influence the measured activity in a linear or nonlinear fashion. However, as demonstrated at the ABIM meeting in 2010, even datasets from "traditional", highly controlled ERP experiments often contain hidden overlapping brain activity, for example from involuntary microsaccades. Here we introduce Unfold, a powerful yet easy-to-use MATLAB toolbox for regression-based EEG analyses that combines the concepts of massive univariate modeling ("regression ERPs"), linear deconvolution, and non-linear generalized additive modeling (GAM) into one coherent analysis framework. To illustrate the advantages of this approach, we apply the toolbox to data from two combined EEG/eye-tracking experiments. In the first example, we show how the toolbox can effectively remove overlapping muscle and brain potentials evoked by microsaccades during a standard face recognition task. In the second example, we analyze an experiment on natural sentence reading. Here it was possible to isolate the neural effects of preprocessing the upcoming word in parafoveal vision, even though the amount of temporal overlap (i.e. the average fixation duration) and other oculomotor covariates differed systematically between conditions. The EEGLAB-compatible toolbox is freely available at http://www.unfoldtoolbox.org.

P53

The effect of stimulator, waveform and current direction on intracortical inhibition and facilitation: a TMS comparison study.

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Cortical function is dependent on the balance between excitatory and inhibitory influences. With the use of double-pulse transcranial magnetic stimulation (dp-TMS), it is possible to study cortical inhibitory and excitatory interneuronal circuits in vivo in the human motor cortex. Well-established protocols are short intracortical inhibition (SICI) and intracortical facilitation (ICF). The efficacy of TMS protocols depends on different variables, such as type of stimulator, waveform and current direction. Therefore, it is of pivotal importance to compare different experimental set-ups to explore confounding influences.

Here, we compared the effect of two TMS stimulators (Magstim BiStim² and MagVenture MagPro X100), waveforms (monophasic and biphasic), current directions (anterior-posterior and posterior-anterior) and inter-stimulus-intervals (ISI) (1, 3, 10 and 15 ms) on SICI and ICF in 15 young healthy subjects. We assessed four different stimulation conditions on two separate sessions in a pseudorandom order. The results showed that the four different conditions were comparable in regard of SICI and ICF modulation, except for the comparison of the SICI paradigm with an ISI of 3 ms with the unconventional anterior-to-posterior current direction. The modulation of the MEP amplitudes was effective in SICI, but not in ICF.

In conclusion, the tested stimulation conditions lead to a comparable modulation of SICI and ICF within the commonly used stimulators and respective parameters. These data support the view that study results applying these parameters can be well compared and offer the opportunity to combine data (big data) from different sources using different dp-TMS set-ups in terms of the described parameters.

P54

Hæmodynamic Brain Parcellation from Resting-State fMRI Data

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Functional magnetic resonance imaging (fMRI) enables to observe fluctuations in blood oxygen levels across the brain. This serves as a slow proxy for measuring the underlying neural activity. In practice, activity moments can be uncovered using deconvolution techniques to undo the signal from the hæmodynamic response function (HRF). In this work, we use deconvolved fMRI signals to estimate variations in cerebral hæmodynamics in sesting-state. More precisely, we use a parametric model in which the Taylor expansion coefficients of the HRF are estimated by fitting back activity moments to the original signal. These coefficients are intrinsically related to the dynamics of the HRF as they control peak-time and duration. We applied this technique to a group of healthy subjects from the Human Connectme Project (HCP) data and we estimated spatial time-to-peak and dispersion maps. The obtained maps suggest the existence of two types of gradients in variations; a posterior-anterior one and subcortical-cortical one. These variations can be linked to the brain vasculature, specifically, the fact that blood is supplied to the brain by three main arteries (anterior, middle and superior).

Methods

P55

Modeling Age and Brain Maturation Contributions to the Development of Fluid Reasoning Using Accelerated Cohort-Sequential Data

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Studying the time-related course of psychological processes over long developmental periods is a challenging endeavor. Accelerated longitudinal designs (ALD) allow capturing such periods with a limited number of assessments in a much shorter time framework. In ALDs, participants from different age cohorts are measured repeatedly but the measures provided by each participant cover only a fraction of the study period. In this presentation we use data from an ALD and latent change score (LCS) models to investigate the development of fluid reasoning from childhood to adolescence (years 6 to 19). First, we report results from a simulation study examining the performance of discrete- and continuous-time LCS models for recovering the trajectories of a developmental process from data obtained through different ALD designs. These results support the effectiveness of LCS models to study developmental processes using data from ALDs under various conditions of sampling. When all individuals are drawn from the same population, both types of models are able to recover the parameters defining the underlying developmental process. However, discrete-time models yield estimates with bias when time lags between observations are not constant. Second, we use LCS models and data from an empirical ALD to examine the developmental changes in fluid reasoning from childhood and adolescence as well as the contribution of brain structure maturation to such developmental changes.

P56

A novel 256-channel HD-EEG cap with dry electrodes

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Multichannel Electroencephalography (EEG) is widely used in clinical neurology and neuroscientific research. Wet Silver/Silver-Chloride (Ag/AgCl) electrodes represent an often-used standard. Electrode-skin contact for these electrodes is ensured by electrolyte gel or paste. Skin preparation, gel application and subsequent cleaning require skilled personnel and extensive laboratory time especially in HD-EEG setups with 128 or 256 electrodes. Dry electrodes eliminate skin preparation requirements and can be self-applied.
We introduce a novel 256-channel HD-EEG cap with dry electrodes. A new design using smaller dry electrodes with only 19 pins was developed based on our previous dry electrodes with up to 30 pins. Polyurethane serves as the substrate material and an Ag/AgCl coating provides electrical conductivity of these semi-rigid electrodes. We compare in a proof of principle study with 6 volunteers the novel 256-channel dry EEG cap with a conventional 256-channel wet EEG cap using a previously established validation paradigm.
Resting state EEG, eye movements, alpha activity, and pattern reversal VEP can be recorded with the 256-channel dry electrode HD-EEG cap without considerable differences in signal quality compared to a conventional wet cap. For the dry EEG cap, we obtained an average channel reliability of 96 % and a reduction of the preparation time by at least 75 %. All volunteers reported good wearing comfort and favored the dry EEG cap.
In conclusion, the proposed 256-channel HD-EEG cap with dry electrodes can potentially replace conventional wet multichannel EEG caps and thus enable new fields of application like brain-computer-interfaces and mobile EEG acquisition.

Methods

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Exploring the dynamics of spinal cord functional activity

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In the last decades, functional magnetic resonance imaging (fMRI) has been extensively deployed to explore the function of the human central nervous system. Notably, resting-state studies have shed light on the functional organization of the brain. Yet, only few investigations have focused on the spinal cord, despite its important role in processing sensorimotor signals. Specifically, no study has so far probed the non-stationary nature of spinal resting-state fluctuations.

Here, we aimed at assessing the spatial and temporal properties of spinal cord resting-state functional activity. We performed cervical fMRI in healthy volunteers at 3.0 Tesla. In order to overcome the challenges inherent to this region, we employed a dedicated processing pipeline (slice-wise motion correction, physiological noise modelling, motion regression, smoothing along the spinal cord and normalization to a spinal cord template). Then, transient activity (i.e., the innovation signal) was extracted by applying total activation, a regularized deconvolution of fMRI signals. Frames with significant and similar transitioning activities were clustered together to obtain innovation-driven coactivation patterns (iCAPs). Finally, the temporal dynamics of those iCAPs at the subject-level were recovered, using transient-informed spatio-temporal regression.

We identified distinct iCAPs spanning a limited rostrocaudal extent, likely reflecting the underlying anatomy, and separated into unilateral and bilateral sensorimotor components. Not only these networks presented specific spatial characteristics, they also exhibited differences in temporal properties (e.g., duration, couplings, etc.).

Our approach enables to disentangle the spatiotemporal organization of spinal networks and could be extended to understand how spinal pathways can be disrupted following neurological conditions.

P58

Pathways in the brain: linking structure and function with graph signal processing

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Magnetic resonance imaging (MRI) is a versatile modality that allows measuring brain structural connectivity (i.e. by virtually reconstructing whiter matter fiber bundles with diffusion MRI) as well as functional activity (with functional MRI). How to optimally integrate structure and function in the study of connectivity is still an open question. In this work, we employed graph signal processing (GSP) as a novel framework to integrate brain structure, represented by a graph, with brain function, characterized by regional timecourses that can be viewed as time-dependent graph signals. With this approach, we aimed at elucidating how brain function exploits the underlying structural architecture, in particular by measuring the degree of alignment of functional signals to the structural connectome. Twenty-one healthy subjects from the Human Connectome Project (HCP) were analysed. By means of GSP, we could identify two components of the functional signal at every timepoint: one more aligned to the structure, which resulted to be focused on sensory networks, and one that is more liberal, including high-level cognitive regions. Our findings showed strong congruence with genetic studies, illustrating that these particular two networks are characterized by different genetic expression: the sensory network preferentially expressing genes favoring faster responses, which can be seen in line with the functional signal being constrained to the underlying structural paths; viceversa, the high-level cognitive network expressing genes favoring a slower, more sustained activity, concordant with the observation of functional pathways that can detach from the structure and be more liberal.

P59

Concurrent EEG- and fMRI-derived functional connectomes exhibit linked dynamics

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Large-scale functional connectivity of the human brain, commonly observed using functional Magnetic Resonance Imaging (fMRI), exhibits a whole-brain spatial organization termed the functional connectome. The fMRI-derived connectome shows dynamic reconfigurations that are behaviorally relevant. Due to the indirect nature of fMRI, it is unclear whether such topographic changes reliably reflect modulation in neuronal connectivity patterns. Here, we directly compared concurrent fMRI-derived and electrophysiological connectivity dynamics on a connection-wise basis across the whole connectome. Dynamic whole-brain functional connectivity (dFC) was assessed during resting-state in two independent concurrent fMRI-electroencephalography (EEG) datasets (42 subjects total) using a sliding window approach. FMRI- and EEG-derived dFC shared significant mutual information in all canonical EEG frequency bands. Notably, this was true for virtually all connections. Across all EEG frequency bands, connections with the strongest link between EEG and fMRI dynamics tied the default mode network (DMN) to the rest of the brain. Beyond this frequency-independent multimodal dFC, fMRI connectivity covaried with EEG connectivity in a frequency-specific manner in two distributed sets of connections for delta and gamma bands, respectively. These results generalized across the two datasets. Our findings promote the DMN as a universal hub of dynamics across frequencies, but also show that spatial distribution of fMRI and EEG dFC differ across the canonical EEG-frequency bands. This study reveals a close relationship between time-varying changes in whole-brain connectivity patterns of electrophysiological and hemodynamic signals. The results support the value of EEG for studying the whole-brain connectome and provide evidence for a neuronal basis of fMRI-derived dFC.

Perception

P60

Tactile and motor representations of hands with 6 fully developed fingers

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Polydactyly is the congenital anomaly of developing a supernumerary finger (SF). Polydactyly is not a rare condition with an incidence of about 0.2% and the presence of polydactyly individuals has been documented as far as in the Mesoamerican civilization. However, SFs are often not fully developed and are typically removed at birth as they are considered not useful. Here, we recruited a unique individual with 6 fully developed fingers including dedicated muscles and nerves for SF. Using high-resolution fMRI, we investigated the functional organization of the primary sensorimotor cortices using both finger tactile stimulation and a finger tapping task. In order to highlight the specific representations of each finger, we compared the activity patterns associated with tactile stimulation and movement of each individual finger using representational similarity analysis. The results show that the representation of SF in the primary sensorimotor cortices was distinct from the representations of all other fingers. This demonstrates that separate neural resources are dedicated to feeling and moving SF in this 6-fingered subject. This suggests that the human nervous system is able to deal with the increased complexity of feeling and controlling an augmented body with more degrees-of-freedom.

Perception

P61

Learning a representation of the peripersonal space in a neural network model

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The Peripersonal Space (PPS) is the region of space immediately surrounding the body. Studies on primates described a network of multisensory neurons, dedicated to PPS representation. Such neurons have visual or auditory receptive fields spatially anchored to specific body parts, and tactile receptive fields covering the same body parts [1].
Magosso and Serino developed a neural network model using two unisensory layers (auditory/visual, tactile) connected with a multisensory layer to build a PPS representation for the hand [2]. The model reproduces behavioral data, but it directly encodes the visual/auditory input in a hand-centered reference frame, without modeling the coordinate transformations needed to generate body-part centered coordinates.
To overcome this limitations, we add a proprioceptive layer to the model, and implement an Hebbian learning rule. The network is initialized with random connectivity, and trained by providing simulated ecological sensory inputs. We hypothesize that this is sufficient to model the spontaneous development of the connectivity scheme allowing for PPS representation and coordinate transformations.
The network learns to integrate the information across different reference frames, using the input from proprioceptive and visual populations to coherently predict tactile simulation in the presence of visual stimuli close to the hand. Therefore, the model shows how the same multi-sensory mechanisms that are responsible for the emergence of the PPS can also account for reference frame transformations. We confirmed the plausibility of the proposed architecture by running a behavioral experiment, showing that the integration of proprioceptive and visual information affects tactile processing on the hand.

P62

Differentiation of brain signal variability marks high cognitive performance

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The extent to which brain responses differ across varying cognitive demands is referred to as “neural differentiation,” and has been found to serve as a marker of better cognitive performance. An emerging approach has examined within-person neural differentiation using moment-to-moment brain signal variability (i.e., variability-based differentiation, or “VBD”) to characterize cognitive states. However, the factors driving signal variability to rise or fall within-person on a given task (and associated hypotheses) remain understudied. We hypothesized that the level of signal variability should ideally mirror differences in sensory (stimulus) input in top performers. In the current study, 46 older adults passively viewed face and house stimuli during fMRI. We found that participants expressing greater VBD in regions V1/V2 (higher SDBOLD for house relative to face stimuli) also exhibited faster and more consistent behavioral performance on a battery of offline visuo-cognitive tasks. Strikingly, low-level analyses of our stimuli and subsequent computational modelling of ventral visual stream responses (HMAX) showed that house images were indeed much more “feature-differentiated” than faces, with HMAX revealing particular sensitivity in V1/V2-like model layers. We conclude that the ability to align visuo-cortical signal variability to the differentiation of visual input may mark heightened trait-level behavioral performance in humans.

Perception

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The processing of vocal roughness is selectively enhanced during sleep

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During sleep, sensory systems partially disconnect from the environment, which limits our ability to respond to external events. In such a vulnerable state, it is however essential to preserve a minimal level of sensory responsivity to react to potential dangers. In the absence of visual inputs, auditory perception is particularly well-suited to detect relevant events. However, what makes a sound detectable and/or arousing during sleep remains unclear. Human alarm vocalizations are rapidly detected by the receiver's brain because they exploit an aversive acoustic feature called roughness, which selectively targets emotional processing centers (Arnal et al. 2015). Rough sounds are salient, even at low intensity, thereby making roughness an ideal tool to signal danger from a distance. Here, we tested the hypothesis that this acoustic feature may remain salient and prioritized for processing during sleep. We recorded whole-night sleep EEG in 17 participants who were exposed to low intensity vocalizations with varying levels of roughness and pitch. Using regression analyses across trials, we assessed the linear effects of pitch and roughness parameters on evoked response. As expected from our previous work, in the waking state, both pitch and roughness modulated relatively early sound-evoked brain responses. During NREM sleep, vocalizations generally promoted slow oscillations (a typical EEG marker of sleep). However, we also found that increasing roughness altered slow-oscillations shape, supporting the hypothesis that roughness selectively enhances brain responsivity during sleep. This study demonstrates that human alarm vocalizations are acoustically particularly well-adapted to induce rapid responding during both wakefulness and sleep.

Perception

P64

The role of posterior parietal cortex in anticipatory sensory processing: Macro- and micro-electrode recordings in a human patient

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Humans are able to exploit regularities in their sensory environment to optimize motor behavior. Sensorimotor pathways play a fundamental role in predicting when sensory stimuli will happen and in adapting the precise timing of the corresponding action. Here, we investigated the role of the PPC in sensory, predictive and/or decisional processing steps. We used electrocorticography in a patient with epilepsy to investigate the neuronal correlates of predictive timing in various regions of the sensorimotor network. Large portions of the premotor, motor, somatosensory and posterior parietal cortices were covered by macroelectrode grids, while a dense 10x10 microelectrode array was precisely inserted in the PPC, probing the activity of dozens of individual neurons in the area of interest. To decipher the timing and functional contribution of each cortical region in these inferential processes, we used a somatosensory oddball task. Several key nodes of the sensorimotor network, as sampled by macrocontacts, synchronized their neuronal activity with the rhythmic pattern of the task. Intriguingly, PPC displayed a decrease in neuronal firing to each individual stimulus, and an increase in neuronal firing during motor response. In addition, we found evidence of hierarchical predictive coding in the pre-motor, motor and sensory cortices, as reflected by two signatures of this framework: repetition suppression and expectation violations. Instead, the PPC integrated sensory evidence according to task demands rather than reflected stimulus-driven processes. Altogether, these results suggest that the PPC plays a pivotal role at the interface between perceptual and decisional processes.

Perception

P65

The Alice in Wonderland Syndrome: structural and functional etiology

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Alice in Wonderland syndrome (AIWS) is a migraine-related disorder characterized by altered body schema (aschematia) and erroneous perception of size and distance of objects (dysmetropsia). The prevalence of AIWS might be higher than expected, as an ongoing epidemiological study shows that more than 10% of migraineurs have experienced AIWS episodes. Here two cases are presented, showing neuroimaging evidence of structural and functional alterations related to the syndrome.

Case 1: a 54-year-old migraineur experienced in gradual succession: pelopsia, kinetopsia and aphasia, followed by a migraine attack. All symptoms lasted more than 10 minutes and resolved within 1 hour. EEG and TC were unremarkable. An MRI showed a brain malignant tumor in the left temporal-parietal-occipital junction (TPO-J), which was subsequently removed. In the following years the patient did not experience other AIWS episodes.

Case 2: a 47-years-old female patient with a history of major depression, reported a progressive change in her migraine aura with the appearance of mosaic vision and the feeling of elongation of her left hemiface and arm. These misperceptions were associated with aripiprazole intake after autonomous discontinuation. During an AIWS episode, video-EEG was negative, while a perfusion 99mTc-HMPAO brain SPECT revealed an increased focal uptake in right cuneus-precuneus regions and hypoperfusion in the right primary somatosensory cortex. An interictal SPECT showed a normal perfusion pattern.

Conclusion: AIWS symptoms may depend on the direct involvement of TPO-C or the impairment of primary visual or somatosensory cortices, which might cause spontaneous discharge and over-recruitment of associative areas where visual-spatial and somatosensory information are integrated.

P66

Dynamic signatures of feature-based visual selective attention in the human brain

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Visual selective attention prioritizes behaviorally relevant stimuli over irrelevant ones. To investigate the brain-wide activity and network changes that enable visual selective attention we presented identical visual stimuli under different task demands to eighteen healthy participants. Participants saw random dot kinematograms (RDK) and sinusoidal gratings (Gabor patches) that were simultaneously presented in the center of the screen. In alternating blocks, participants either performed orientation discrimination (Gabor relevant) or motion direction discrimination (RDK relevant). We recorded high-density EEG to investigate the neuronal responses supporting the selection of relevant over irrelevant features. The results showed pre-stimulus anticipatory increases in global field power (GFP) for motion discrimination, followed by increased GFP for orientation discrimination at around 100 ms after stimulus onset (P1), and increased GFP for motion discrimination at around 200 ms (P2). Spectral analysis on source-reconstructed signals revealed increased alpha and beta band activity for motion discrimination in parietal and occipital cortex. Time-varying directed connectivity analysis identified task-specific patterns of functional connections, suggesting that motion discrimination involved areas of the attentional systems in the right hemisphere, while orientation discrimination involved left temporo-parietal and middle occipital areas. We also observed task-dependent involvement of prefrontal areas that may play a key role in supporting selective processing through the presence of feature-based templates. Taken together our results suggest the presence of distinct task-specific dynamic networks that support the selective processing of behaviorally relevant features.

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Electrophysiological correlates of tactile awareness and associated confidence

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One way of studying perceptual consciousness experimentally is to contrast conscious and unconscious processing. In a detection task, we applied weak vibrotactile stimuli to participants while keeping stimulation intensity at the perceptual level using an adaptive procedure. We asked participants to report whether they perceived (hit) the stimuli or not (miss) and how confident they were in their response. Firstly, in 20 healthy participants, we found that confidence in misses was higher than confidence in hits, suggesting poor metacognitive abilities for tactile detection. Secondly, we found that hit rate and confidence fluctuated over time, with a 59%±8 (std. dev.) probability of hit when the previous trial was a hit (compared to a 38%±7 hit rate after misses). Similarly, we found 83%±6 of high confidence responses when high confidence was reported in the previous trial (compared to 76%±6 after low confidence response). These fluctuations could not be explained by the adaptive procedure, and indicate the existence of slow dynamics in the computation of confidence. Finally, we found that ERP correlates of tactile awareness over the sensorimotor cortices also encoded the confidence of subjects in their hits. Thus, by contrasting hits and misses while keeping the physical properties of the stimuli fixed, we show that the neural correlates of tactile awareness are partly overlapping with those of confidence.

Perception

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Inter-areal synchrony improves motion discrimination: a multisite cross-frequency tACS study

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Introduction: Mutually interacting oscillations in the alpha & gamma range regulate feedback and feedforward processing in the visual system. Coherence between these oscillatory signals improves bi-directional inter-areal communication. In this study, we aim to use multisite cross-frequency transcranial alternating current stimulation (tACS) to externally synchronize oscillatory activity between the primary visual area (V1) and a higher-order visual area (V5) to improve motion discrimination.
Methods: 45 healthy participants were divided into 3 groups constrained by a specific tACS frequency and phase relationship (in-phase α-tACS, out-of-phase α-tACS, in-phase α-γ-tACS. tACS was applied while participants were performing a motion discrimination task consisting in judging the global direction of moving dots. Performances, as measured by coherent motion thresholds and EEG-derived time-frequency signals and pairwise phase locking values were measured before, during, 10 and 30 minutes after tACS.
Results: Compared to baseline, the two “in-phase groups” showed similar enhanced performances, while learning was completely abolished for the Anti-phase α-tACS group. In-phase α-tACS showed a greater consolidation effect 10 minutes after stimulation compared to the two other groups, which were associated with a pronounced local alpha power decrease during visual processing. Poor consolidation in the anti-phase α-tACS group was further associated with a decrease in synchrony in the alpha band within the visual cortex.
Conclusion: Externally applied synchronized signals appear to improve visual discrimination capacity by boosting inter-areal communication. The offline consolidation effect suggests that this brain stimulation approach might be used as a new alternative to support visual field cortical deficits in patients.

Perception

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Cross-network couplings of spatiotemporally overlapping functional networks across sleep stages

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The previous two decades have seen a tremendous increase in the number of studies concerning resting-state functional magnetic resonance imaging (fMRI), from the conventional static point of view up to the state-of-the art dynamic perspective. The current consensus is that the brain is continuously active across different mental states, such as introspective processing or sleep.

Recently, a particular focus has been set on disentangling spatiotemporally overlapping resting-state networks (RSNs) through novel fMRI deconvolution tools. It has been found that these RSNs occur at varying durations and frequencies across different sleep stages, especially upon reaching non-rapid eye movement (NREM) stage 2.

In this work, we look into the activity of RSNs extracted from a dataset of subjects sleeping inside the scanner, recorded after playing a face-recognition and maze-survival game. We build upon a sparse coupled hidden Markov model (SCHMM) framework that leverages on the extracted activity profile of each RSN, jointly extracting the intrinsic dynamics of individual networks, as well as their cross-couplings. These interactions are further analyzed across different sleep stages.

Our results show a wide array of meaningful functional networks, whose interactions reveal strong cognitive relevance. In particular, and squaring well with the game performed during the first recording section, we found the visual networks containing visual memory-related regions to exert marked modulatory influences. Altogether, the outcome of our work contributes to the understanding of how large-scale functional networks interact across different levels of consciousness.

Perception

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Neural correlates of cross-modal influences in top-down processing of visual speech

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Audiovisual speech processing results from a mixture of bottom-up sensory information and top-down predictions, and it is hypothesized that the integration of information from each modality across cortical areas involves cortical oscillations. The aim of this study was to probe the interplay between bottom-up and top-down influences on audiovisual speech processing by dissociating them. We developed a cross-modal "pop-out" task where the same speech stimulus is presented thrice: first (V1) in visual modality only (i.e. silent movie, no sound), second (A) in the auditory modality only (i.e. soundtrack with no video) and third (V2) again in the visual modality only. This experimental design allowed us to disentangle purely bottom-up, stimulus-driven processes (in response to V1) from top-down, memory- and semantics-based processes (in response to V2). We built a set of 80 stimuli (i.e. sentence long video samples from known movies with a character speaking to the camera) and asked participants (n = 10) to rate the intelligibility on each presentation. On average, the videos were rated as not intelligible on the first presentation, and highly intelligible on the second. On the third presentation they were rated as significantly more intelligible than the first presentation but less than the second. In other words, a given visual speech stimulus became more intelligible if it immediately followed presentation of the corresponding auditory speech stimulus. Six patients with epilepsy agreed to participate in the experimental task while we recorded their brain activity with intracranial EEG electrodes (subdural grids and strips in one patient, depth electrodes in the others). Looking at broadband high-frequency activity (a biomarker of local cortical activation), we observed bottom-up processing of visual and auditory information in the occipital and temporal cortices, respectively. Importantly, we found that, although high-frequency activity in several areas did not respond to pure visual stimuli on the first presentation (V1), it tracked speech envelope during the second presentation of visual stimuli (V2), thus mirroring the behavior of subjective intelligibility ratings. Furthermore, we observed a similar pattern with phase alignment in the lower frequencies. These findings could reflect an offline top-down process on visual speech perception, which may help distinguish between complex bottom-up and top-down interaction in audio-visual speech perception.

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