Alpine Brain Imaging Meeting

Champéry, Switzerland, January 7-11, 2018

P R O G R A M

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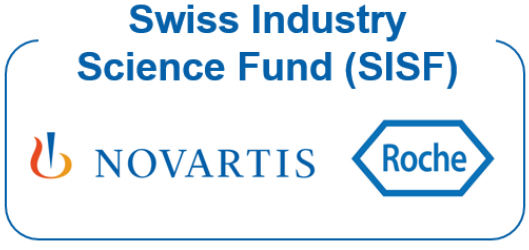

ABIM cover from Isabelle Pasquier,

Born March 21, 1950 in Saxon, Isabelle Pasquier graduated from the Lausanne Fine Arts School in 1974. She organizes various exhibitions of engravings, photos, watercolor paintings or oil paintings in the canton of Vaud and Valais (under the name Rousselot or Pasquier).

Alpine Brain Imaging Meeting

Champéry 2018

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For more information, see website: http://www.unige.ch/ABIM/
For maps and information about Champéry: http://www.champery.ch/

The opening keynote lecture on Sunday will be held at Salle Villageoise.
The welcome reception and registration on Sunday will be held at the Hotel Suisse.
Talks and poster sessions will take place at the Palladium Sport and Conference Center.

GENERAL INFORMATION

The main hotels for the conference are the Hotel Suisse, Palladium, Chalet Eden and Hotel des Alpes, all located within a 300m distance from each other (see map).

Registration will take place at the Hotel Suisse on Sunday, the 7th of January from 18:30 to 20:30, and 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, only during meeting hours, from 15:00 to 20:00. Additional information can also be obtained at the Hotel Suisse outside these hours.

All **talks** and **poster sessions** 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 9th (odd numbers) and Wednesday 10th of January (even numbers) in the afternoon. Speakers are invited to give a copy of their presentation (e.g., powerpoint files) to the organizers, or alternatively they may use their own laptop; but in all cases, they should check the presentation in the conference room no later than at 3:00 pm on the day of their lecture.

There are several **restaurants** in Champéry (see map), including one at the Palladium (which is open all day including evenings). Since many restaurants in town are relatively small, you are encouraged to have dinner early and place your order before 21:00 or to book in advance. If you plan to go with a large group, you are advised to call the restaurant and book a table. The staff at the Hotel Suisse or at the Palladium can help you with this. Breakfast is included in the room price for participants at the Hotel Suisse, Palladium and Chalet Eden.

A **farewell dinner** is planned on Thursday night at the restaurant *Le Gueullhi*. You will have the opportunity to taste a famous *fondue*, a traditional local dish made of melted cheese. This menu will be free for all registered participants, except for beverages. An alternative vegetarian dish is also available; please let us know if you prefer this option. More details will be provided during the conference. Please sign up at the registration desk before 15:30 on Monday 8th of January if you would like to join us for the fondue dinner.

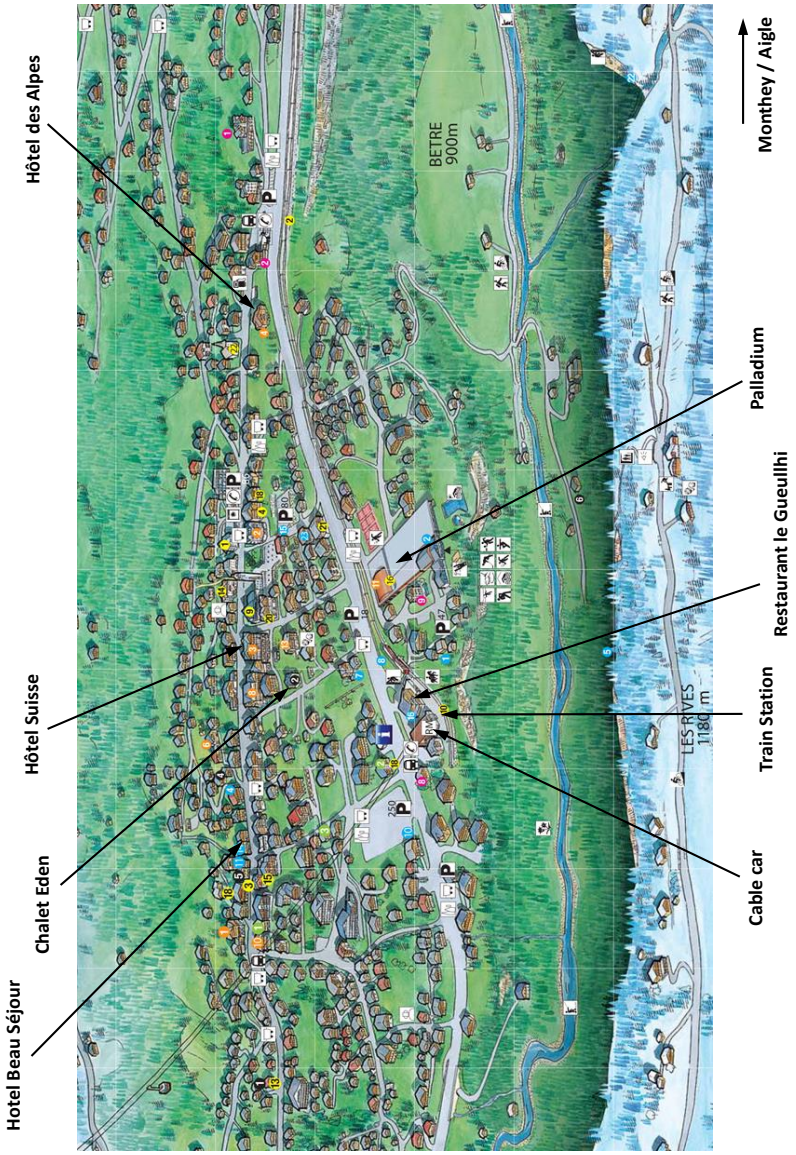
Free **internet access** by WiFi is available in the lounge and in the café of the Hotel Suisse, as well as in the Palladium meeting room. There is also a Cybercafé in the Palladium.

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 reduced price (CHF 5.-/entrance) is available for the swimming pool for ABIM participants.

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
Hôtel Suisse
Chalet Eden
Hotel Beau Séjour
Palladium
Restaurant le Gueullhi
Train Station
Cable car
Monthey / Aigle
BETRE
900m
LES RIVES
1180 m

Alpine Brain Imaging Meeting 2018

PROGRAM OVERVIEW

SUNDAY, January 7

OPENING KEYNOTE LECTURE

17:30 **Maurizio CORBETTA** | *University of Padua, Italy* ☆

- Stroke: brain networks, behavior, and computational modeling

18:30 > 20:30

- **Welcome Reception & Registration (Hotel Suisse)**

MONDAY, January 8

NEUROSTIMULATION

15:30 **Vince CLARK** | *University of New Mexico, USA* ☆

- Brain imaging integrated with neurostimulation: new frontiers in cognitive neuroscience

16:20 **Kristoffer FEHER** | *University of Bern, Switzerland*

- Phase-synchronized tACS-induced oscillatory activity modulates cortico-cortical signaling efficacy

16:40 **Monica ROSENBERG** | *Yale University, USA*

- Real-time neurofeedback of functional connectivity in large-scale brain networks that predict attention

17:00 ***Coffee break***

17:30 **Christoph HERRMANN** | *University of Oldenburg, Germany* ☆

- Transcranial alternating current stimulation: models, brain oscillations, and cognition

18:20 **Marco SOLCÀ** | *Ecole Polytechnique Fédérale de Lausanne, Switzerland*

- Merging virtual reality and Single-cell recording to study interoception and multisensory integration in thalamic nuclei

18:40 **Leyla LOUED-KHENISSI** | *Ecole Polytechnique Fédérale de Lausanne, Switzerland*

- Confidence and Information as prediction and Accuracy in Human Decision-Making

19:00 **Michael PEREIRA** | *Ecole Polytechnique Fédérale de Lausanne, Switzerland*

- Electrophysiological and hemodynamic correlates of self-committed and observed decision-making

T U E S D A Y, January 9

A F F E C T I V E & S O C I A L C O G N I T I O N

15:30 **Tom JOHNSTONE** | *University of Reading, UK* ☆

- To be announced

16:20 **Rafal SKIBA** | *University of Geneva, Switzerland*

- Holistic and analytic processing of dynamic facial expression

16:40 **Giada DIRUPO** | *University of Geneva, Switzerland*

- Neural networks underlying feedback-based learning explain pain underestimation in medical practitioners

17:00 ***Coffee break***

17:30 **Karine ROELOFS** | *University of Nijmegen, The Netherlands* ☆

- Neural control of emotional action

18:20 **Camille PIGUET** | *University of Geneva, Switzerland*

- Resting state BOLD signal variability correlates with clinical dimensions in euthymic bipolar patients

18:40 > 20:00

- **Poster session (Odd numbers – see abstract lists)**
  Buffet with Swiss snacks and wine in the poster area

W E D N E S D A Y, January 10

N E T W O R K A N A L Y S I S & M O D E L I N G

15:30 **Rosalyn MORAN** | *University of Bristol, UK* ☆

- Pushing Beliefs, Neuromodulators and Computational Psychiatry

16:20 **Lucie BRECHET** | *Ecole polytechnique Fédérale de Lausanne, Switzerland*

- Manipulation of EEG microstates and fMRI resting state network by externally and internally oriented cognitive tasks

16:40 **Thomas KOENIG** | *University of Bern, Switzerland*

- BOLD correlated of EEG microstates and fMRI resting state networks: There is overlap, but no identity

17:00 ***Coffee break***

17:30 **Mark WOOLRICH** | *University of Oxford, UK* ☆

- Transient dynamic brain networks in MEG and fMRI

18:20 > 20:00

- **Poster session (Even numbers – see abstract list)**
  Buffet with Swiss snacks and wine in the poster area

T H U R S D A Y, January 11

L A N G U A G E

15:30 **Riitta SALMELIN** | *University of Aalto, Finland* ☆

- MEG measures as probes of cortical language function

16:20 **Pierre MEGEVAND** | *University of Geneva, Switzerland*

- Dynamics of crossmodal speech signal tracking in the human auditory and visual cortex

16:40 **Michael BEAUCHAMP** | *Baylor College of Medicine, USA*

- Frontal cortex selects representations of the talker's mouth to aid in speech perception

17:00 ***Coffee break***

17:30 **Matt DAVIS** | *University of Cambridge, UK* ☆

- Predicting and perceiving degraded speech

18:20 **Sanne RUTTEN** | *University of Geneva, Switzerland*

- Contextual effects on the neural encoding of speech in the auditory cortex

18:40 **David PASCUCCI** | *University of Fribourg, Switzerland*

- A constrained Kalman filter approach to inform dynamic functional connectivity with anatomical priors: a simulation study

19:00 **Else SCHNEIDER** | *University of Bern, Switzerland*

- The unconscious episodic memory

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

- Swiss Fondue restaurant ***"Le Gueullhi"***

ABSTRACTS OF ORAL PRESENTATIONS

The themes of the days are:

Sunday: **OPENING KEY LECTURE**

Monday: **NEUROSTIMULATION**

Tuesday: **AFFECTIVE & SOCIAL COGNITION**

Wednesday: **NETWORK ANALYSIS & MODELING**

Thursday: **LANGUAGE**

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

Sunday
Opening key lecture

T01 ☆

Stroke: brain networks, behavior, and computational modeling

Maurizio Corbetta[1]

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I will review a series of studies in stroke patients indicating that focal lesions at the population level cause a low dimensional pattern of behavioral deficits that correspond to low dimensional abnormalities in functional connectivity. Moreover, while sensory and motor deficits are better explained by lesion information, cognitive deficits are better explained by abnormal functional connectivity. Finally, computational studies show that strokes decrease the variability of neural states (entropy). This set of results support a new framework to think about brain-behavior abnormalities and the treatment of stroke.

Monday
Neurostimulation

T02 ☆

Brain Imaging Integrated with Neurostimulation: New Frontiers in Cognitive Neuroscience

Vince Clark[1]

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In this talk, I will review our successes and failures over the past decade integrating neurostimulation with neuroimaging. There are many reasons for combining these two areas of research. In previous work, imaging has made great strides in understanding the mechanisms of normal and abnormal human brain function. However, this has been mostly observational, unable to prove causation, and has provided few real-world benefits for treating mental illness or cognitive enhancement in healthy people. By contrast, stimulation offers the hope of developing new methods for treating clinical disorders and producing cognitive enhancement, but has been plagued by failed replications, uncertainty regarding its mechanisms and the effects of individual variability, and makes a nearly infinite variety of protocols available, while offering few efficient methods for selecting among them. The combination of imaging and stimulation may provide many mutual benefits to help solve these problems. I will describe a number of our studies that illustrate these advantages. These include using fMRI to guide tDCS placement in order to produce large enhancements in visual learning and attention; using closed-loop EEG to guide tACS to improve sleep quality and memory consolidation; using MEPs, EEG, MEG or MRS to help infer neurostimulation's mechanisms of action, including the effects of tDCS on hallucinations in schizophrenia and transcranial ultrasound (TUS) effects on brain excitability, among others. Possible future directions for these combined areas of research will be discussed.

T03

Phase-synchronized tACS-induced oscillatory activity modulates cortico-cortical signaling efficacy

Kristoffer Fehér[1], Yosuke Morishima[1]

[1]Division of Systems Neuroscience of Psychopathology, Translational Research Center, University Hospital of Psychiatry, University of Bern, Switzerland

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Synchronized brain oscillations are considered a basis for inter-regional neuronal communication. However, the causal role of inter-regional oscillatory phase-synchrony in modulating cortico-cortical signalling efficacy has so far not been directly demonstrated. We addressed the causal relationship through the simultaneous use of transcranial alternating current stimulation (tACS), TMS and EEG. Through tACS we introduced theta oscillatory activity in two regions of the human frontoparietal network; the dorsolateral prefrontal cortex (DLPFC) and posterior parietal cortex (PPC). We applied 6 Hz tACS to the DLPFC and PPC simultaneously in an in-phase or anti-phase manner. For assessing resultant changes in transmission in the frontoparietal network, we simultaneously applied subthreshold single-pulse TMS over the DLPFC at four different phases of tACS (90°, 180°, 270°, 360°) and measured the spread of TMS-evoked EEG potentials (TEPs). The amount of current spread is modulated by the functional status of the neural network, thereby providing a measure of changes in signalling efficacy. We found that the amplitude of TEPs depended on the phase of the introduced 6 Hz activity during in-phase and anti-phase tACS. In the in-phase condition, these phase-dependent changes in TEPs propagated from the DLPFC to occipital areas 80 ms after TMS. However, in the anti-phase condition, phase-dependent changes in TEPs did not reach occipital areas before 100 ms after the TMS. This suggests that the tACS-induced de-synchronization of the frontoparietal network reduced the efficacy of information transfer across the network. Our results demonstrate the causal role of phase-synchronized endogenous oscillatory activity in modulating inter-regional neuronal communication, in accordance with the proposed communication-through-coherence model.

T04

Real-time neurofeedback of functional connectivity in large-scale brain networks that predict attention

Monica Rosenberg[1], Dustin Scheinost[2], Wei-Ting Hsu[3], Emily Avery[1], Michelle Hampson[2], Todd Constable[2], Marvin Chun[2]

[1]Department of Psychology, Yale University [2]Department of Radiology and Biomedical Imaging, Yale School of Medicine [3]Department of Psychology, Stanford University

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Recent work demonstrates that real-time neurofeedback based on fMRI activity can be used to train attention (deBettencourt et al., 2015; Zilverstand et al., 2017). Given that attention relies on coordinated activity across the brain, we explored the feasibility of using connectome-based feedback to train focus. Specifically, we used neurofeedback to modulate functional connectivity in two networks that predict attention across datasets: the "high-attention" and "low-attention" networks (Rosenberg et al., 2016). To this end, participants performed blocks of a sustained attention task and saw feedback (visualized as a gas gauge) during fMRI. For neurofeedback participants (n = 10), the position of the gauge reflected high-attention relative to low-attention network strength during the preceding task block. Stronger high-attention and weaker low-attention networks resulted in better feedback. Control participants (n = 10) saw a yoked participant's feedback. Demonstrating the feasibility of connectome-based feedback, network strength calculated in real-time and after data collection using published methods was more strongly correlated in feedback than control participants (mean feedback r= .74; mean control r = .03; $t_{18} = 5.5$, $p = 4.8 \times 10^{-5}$). There was a numerical trend such that the feedback group showed greater improvements in resting-state functional connectivity signatures of attention (i.e., increases in high-attention and decreases in low-attention network strength) from pre- to post-training ($t_{14} = 1.6$, $p = .14$). These results provide preliminary evidence that whole-brain connectivity-based neurofeedback is feasible and may be useful for attention training.

T05 ☆

Transcranial alternating current stimulation: models, brain oscillations, and cognition

Christoph Herrmann[1]

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It has been repeatedly demonstrated that EEG oscillations reflect cognitive processes. So far, however, EEG oscillations have only been correlated with cognitive functions. A new method now allows to demonstrate their causal role in brain function. During transcranial alternating current stimulation (tACS) an alternating current is applied to the scalp of human subjects and interferes with EEG oscillations. In order to determine the placement of stimulation electrodes, finite element models are used to predict intracranial current flow at the target location. A network of simulated neurons is used to demonstrate that tACS results in an entrainment of ongoing brain oscillations. Multiple experiments will be introduced that all apply tACS at different frequencies in order to modulate both EEG oscillations and cognitive processes. The results demonstrate that tACS can modulate ongoing EEG oscillations. This modulation, in turn, modulates cognitive processes such as detection and perception.

T06

Merging virtual reality and Single-cell recording to study interoception and multisensory integration in thalamic nuclei

Marco Solcà[1], Vibhor Krishna[2], Hyeong-Dong Park[1], Fosco Bernasconi[1], Nicole Young[2], Francesco Sammartino[2], Andrea Serino[1], Ali Rezai[2] , Olaf Blanke[1]

[1]Laboratory of Cognitive Neuroscience, Brain Mind Institute, School of Life Sciences, Ecole Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland [2]Center for Neuromodulation, The Ohio State University, 480 Medical Center Dr, Columbus, OH, 43210, USA.

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Recent functional neuroimaging and electrophysiological studies in humans have highlighted a specific network of cortical brain regions (e.g. insular and cingulate cortices) as being important for representing the visceral state of the body. Although animal studies and prominent theories suggest that interoceptive information is already processed in subcortical structures, there is currently no study in humans recoding neural response to visceral signals in the basal-ganglia or thalamus. We measured brain activity in response to heartbeats in thalamic and subthalamic nuclei of 12 patients undergoing deep brain stimulation (DBS) surgery for movement disorder. We recorded local field potential and single unit activity and computed intertrial coherence (ITC) and spikes distribution across cardiac cycle. Preliminary results demonstrate an increase in ITC in subcortical structures around 200ms after R peak, extending previous findings (Park et al. 2017). These results further show that the phase concentration of neural response to heartbeat was not accompanied by spectral power changes, suggesting a phase resetting mechanism underlying HEP generation. This study provides – for the first time in human – evidence that interoceptive signals are processed in both thalamic and subthalamic nuclei.

T07

Confidence and Information as Prediction and Accuracy in Human Decision-Making

Leyla Loued-Khenissi[1], Kerstin Preuschoff[2]

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The notion of surprise as information is intriguing. If the brain is an inference machine that generates predictive models of its environment, improbable events will a) elicit surprise; b) inform a prior distribution. Information theoretic accounts describe surprise as information. However it has been noted that maximal surprise may imply minimal information, in the form of Shannon entropy. Importantly, maximal surprise at outcome results from maximal confidence as cue. Does the brain differentiate between surprise and information or are these quantities correlated? Are these variables represented in common or disparate neural regions? If we consider information to be a measure of accuracy at the outcome of a decision, then confidence can be cast as the precision related to the outcome's prediction. By assigning formal accounts to these decision variables in a gambling task during fMRI acquisition, we seek to identify their neural representation. Specifically, we assign confidence as inverse risk prediction and surprise as absolute prediction error in parallel to reward and reward prediction errors at distinct time-points in a task. We find surprise-specific BOLD activity in the anterior cingulate cortex, insula and in the vicinity of the locus coeruleus. Intriguingly, anterior insula activation is shared in BOLD activity related to information, even when controlling for surprise. Information further elicits activity in frontal regions, underlining its distinction from surprise. Finally, confidence elicits anterior insula activation as well as activity in the vicinity of the locus coeruleus. Our results inform accounts of decision-making under uncertainty above and beyond reward-related variables.

T08

Electrophysiological and hemodynamic correlates of self-committed and observed decision monitoring

Michael Pereira[1], Nathan Faivre[2], Iñaki Iturrate[1], Luana Serafini[2], Stéphanie Martin[1], Arnaud Desvachez[1], Olaf Blanke[2], Dimitri Van De Ville[3], José del R. Millán[1]

[1]Chair in Brain-Machine Interface, Center for Neuroprosthetics, Swiss Federal Institute of Lausanne, Geneva CH-1202, Switzerland [2]Laboratory of Cognitive Neuroscience, Center for Neuroprosthetics, Swiss Federal Institute of Lausanne, Geneva CH-1202, Switzerland [3]MIPLab, Center for Neuroprosthetics, Swiss Federal Institute of Lausanne, Geneva CH-1202, Switzerland

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Humans can monitor their own mental lives and build knowledge about themselves. This capacity to introspect and report one's own mental states, or in other words "knowing how much one knows", is termed metacognition. Here, we assessed the contribution of motor signals to metacognition by identifying the behavioral and neural correlates for monitoring self-committed vs. observed decisions. We recruited healthy volunteers for a simultaneous EEG-fMRI experiment, in which they had to decide which of two stimuli contained the more dots by pressing a key (first-order task, active condition), or to observe the computer deciding for them (observation condition). Subsequently, they had to indicate their confidence in the choice made (second-order response). Metacognitive performance, defined as the extent to which confidence tracks first-order performance, was better in the active compared to the observation condition, indicating that the monitoring of motor actions occurring in the active condition improved the sense of confidence. During the active condition, EEG over the midline of the scalp predicted confidence as early as 50 ms after the response, while in the observation condition this prediction was shifted in time by around 270 ms and in space from the midline to sensorimotor regions. We found common hemodynamical correlates of confidence estimates in both conditions in the supplementary motor area (SMA), left insula and right posterior parietal cortex. Based on these results, we discuss how the computation of confidence may be grounded onto action monitoring, in line with recent theoretical frameworks suggesting that predictions about bodily signals shape cognition.

Tuesday
Affective & Social Cognition

T09 ☆

To be defined

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T10

Holistic and Analytic Processing of Dynamic Facial Expressions

Rafal Skiba[1], Patrik Vuilleumier[1]

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Although much behavioral research documents existence of two cognitive processes in decoding faces: one based on the features of the face, and the other focused on grouping those features into holistic representation their neural mechanisms are still debated. Previous fMRI results from our laboratory showed distinct networks recruited by these processes when observing static happy and angry faces (Meaux and Vuilleumier, 2016). However, in real life, expression features are not only seen together but also move together, hence their grouping might also depend on temporal synchrony. Building on those results we investigated brain systems for analytic and holistic processing of dynamic facial expressions where eye and mouth features could move at the same or different points in time. 24 participants in our study viewed dynamically changing facial stimuli with different emotions (angry, happy, joy or sad) expressed either in both parts together (full condition) or in one part (upper or lower) before the other (feature condition). The analysis revealed that both right and left Inferior Occipital Gyrus, bilateral Fusiform Gyrus, right Anterior Cingulate Cortex and bilateral Inferior Frontal Gyrus are involved in processing holistic dynamic facial expressions, that is, full faces. Whereas seeing expressions in which one part of the face unfolded before the other (e.g. eye then mouth) activated Superior Temporal Sulcus. Moreover, STS activity was also enhanced when fixation predominated on the eye regions for both angry and happy expressions. Overall, these results highlight a distinctive role for STS in analytic processing of dynamic expression features, while more ventral occipito-temporal areas in the face processing network are sensitive to holistic synchronous features.

T11

Neural networks underlying feedback-based learning explain pain underestimation in medical practitioners

Giada Dirupo[1], Corrado Corradi-Dell'Acqua[1]

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Medical Practitioners often underestimate patients' pain, sometimes even disregarding their self-reports. We tested whether this phenomenon could be explained through the neural mechanisms underlying feedback-based learning, according to which anterior cingulate cortex (ACC) codes error signals and promotes behavioral adjustments, whereas the ventral striatum processes a "reward-like" response triggered by feedbacks of good proficiency. We engaged medical students and controls in an experiment in which they rated the unpleasantness of painful facial expression videos. After each evaluation, they were exposed to two independent feedback cues: the self-report of the person in the video and the average rating of 20 physicians who examined the same expressions. In both populations, ACC and insular cortex displayed an activity which parametrically increased with the distance between participants' initial evaluation and that of the feedback cues (error signal). Furthermore, control individuals showed enhanced activity in the ventral striatum the more their initial ratings matched that of the person in the video (but not that of other physicians). Critically, this striatal response was significantly reduced in medical students. In conclusion, we found that medical students are less sensitive than controls to positive feedbacks about their pain assessment, specifically whether this matches self-reports of the person in pain. This could explain why patients' pain is often underestimated in medical practice.

T12 ☆

Neural control of emotional action

Karine Roelofs[1]

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The ability to control automatic emotional actions constitutes a critical component of emotion regulation. For instance, under acute threat, goal directed decision-making largely depends on the capacity to override automatic defensive actions, such as freezing or fight-or-flight reactions. Distinct parts of the frontal cortex are implicated in regulating these defensive reactions. I will present a number of experimental paradigms by which we assess the neural control over these defensive reactions in humans, combining decision tasks with neural and autonomic measures. First, I will present a series of studies suggesting that down-regulation of amygdala activity by the anterior prefrontal cortex (aPFC) is involved when people need to override their automatic approach-avoidance action tendencies. I will show that the functioning of this neural circuitry is sensitive to individual differences in emotional states of anxiety and aggression and I will discuss recent manipulations of this neural circuitry by steroid hormone administration and brain stimulation (TMS). Our results suggest that the ability to control automatic approach-avoidance actions by this circuitry is central in explaining human emotional responses and may constitute an important factor in explaining anxious and aggressive symptomatology. Second, I will present a series of studies investigating the shift from the parasympathetic state of freezing to sympathetically-driven fight-or-flight reactions in humans. Likewise freezing in animals, human freezing is associated with amygdala projections to the midbrain periaqueductal gray. The shift from freezing to action involves recruitment of the perigenual part of the anterior cingulate cortex (pgACC) as well as pgACC-amygdala connections. Together, both series of studies suggest that the ability to flexibly shift between different defensive response modes is critical for adequate coping with threat and may fail in emotional disorders.

T13

Resting state BOLD signal variability correlates with clinical dimensions in euthymic bipolar patients

Camille Piguet[1], Valeria Kebets[2], Josselin Houenou[3], Alexandre Dayer[2,4], Jean-Michel Aubry[5], Dimitri Van de Ville[4,6]

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Resting-state (RS) fMRI is increasingly used in clinical populations to explore alterations in the organization of brain networks. In euthymic bipolar patients (BD), RS fMRI studies have shown inconclusive results, both because of the disparities in technics and clinical heterogeneity of BD. We here use an approach to link clinical dimensions and BOLD signal variability in large-scale networks. We included euthymic patients with BD and controls in 2 sites (Geneva and Paris). After preprocessing, BOLD signal variability was computed using the standard deviation of each voxel's signal across the timecourse. We applied partial least-squares correlations (PLSC) in order to link voxel-wise BOLD variability and clinical measures, maximizing the covariance between two modalities. The optimal brain-behavior links are represented in terms of latent variables. We found that rumination tendency and depression were associated with increased variability in the ACC, vmPFC, but also the orbitofrontal cortex, pallidum, cerebellum and brain stem (N=53 [23 patients, 30 controls], first latent variable significant at p=0.022). On the other hand, increased markers of affective instability, depression and mania were associated with less reactive occipital cortex, cerebellum, cingulate gyrus and other medial limbic regions in BD (N=34 patients, first latent variable significant at p=0.047). Decreased variability of brain signal in limbic regions associated with increased level of affective lability and residual symptoms might represent a marker of non-efficient emotion regulation processes in bipolar patients. In both patients and controls, tendency to ruminate and depression correlated with increased variability not only in self-related regions but also subcortical areas.

Wednesday
Network Analysis & Memory

T14 ☆

Pushing Beliefs, Neuromodulators and Computational Psychiatry

Rosalyn Moran[1]

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The neuromodulatory systems play a critical role in mediating cortical circuitry; supporting attention, learning, inference, memory and decision-making. In this talk, I will present theoretical models of neuromodulatory function as well as novel data from human brains that provide new insights on the role of noradrenaline and serotonin and how their dysfunction may contribute to psychiatric disturbance. Both systems have features that suggest that they respond to errors in predictions or beliefs. Noradrenaline has traditionally been viewed as a critical mediator of arousal, a neurochemical that supports transitions from explorative to exploitative behavior (as well as sleep and wake). Here I will describe how state-action prediction errors (developed under the theory of Active Inference) can recapitulate classic tonic-phasic shifts in LC firing activity during conditioning and foraging tasks. In the second part of my talk, I will describe new data from the human striatum where fast scan cyclic voltammetry was used to measure serotonin levels during a betting game. From these data I will show that serotonin responds to negative reward prediction errors and changes subsequent behavior enforcing 'damage limitation' in the context of this game.

T15

Manipulation of EEG microstates and fMRI resting state networks by externally and internally oriented cognitive tasks

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FMRI studies have shown that large-scale functional networks are inherently active in the brain at rest. Several distinct resting-state networks (RSNs) have been attributed to different functional states, and shown to be non-stationary in time, but partitioned into stable epochs (Zalesky, 2014). Periods of stable activity have also been robustly described in EEG recordings at rest, albeit on a faster temporal scale (~100ms). They appear recurrently in a reduced number of quasi-stable electrical field topographies, called microstates (Lehmann, 1980). A recent EEG-fMRI study has identified a relation between EEG microstates and fMRI RSNs – namely auditory, visual, salience and attention networks (Britz, 2010). The next step towards a more direct demonstration that different microstates reflect different functional (mental) states would be to show that well-defined cognitive tasks specifically modulate certain states, both in EEG and fMRI. In this study, we examine whether internally oriented autobiographical memory and externally oriented attentional tasks can differentially manipulate specific EEG microstates and fMRI RSNs. A group of 16 healthy subjects underwent high-density EEG and 7T-fMRI in three distinct paradigms: eyes-closed rest (6min), autobiographical memory retrieval induced by images of personal past episodes (15min), and mental arithmetic (serial subtraction, 15min). Consistently across subjects, EEG microstate analysis revealed task-specific alterations in the duration and occurrence of specific microstates. Fractional amplitude of low-frequency fluctuation (fALFF) for resting state fMRI revealed a robust double dissociation between memory retrieval and dorsal attentional networks. These results support the possibility of modulating specific electric and hemodynamic RSNs by appropriate cognitive tasks, corroborating their correspondence to specific mental states.

T16

BOLD correlates of EEG microstates and fMRI resting state networks: There is overlap, but no identity

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Brain functional resting state networks (RSNs) come in many flavors: EEG yields evidence for putatively large scale integration of brain activity, supported by the observation of so called microstates; i.e. subsecond periods of quasi stable field configuration that can only be reasonably explained by transient synchronization of potentially remote sources. fMRI data also makes a strong case for the existence of particular types of RSNs by showing that the spontaneous patterns of BOLD fluctuation correlate among regions that also tend to coactivate during particular tasks. As the physiological and functional underpinnings of EEG and fMRI are quite different, it is of interest to know to which degree EEG and fMRI indices of resting state connectivity are identical and thereby reflect similar neuronal mechanisms. Our analysis of simultaneously recorded resting state EEG-fMRI in 68 healthy young subjects found that the BOLD correlates of the "canonical" 4 microstate classes all significantly overlapped with a set of 10 well-known fMRI-RSNs. At the same time, there were no one-to-one relationships: Each microstate features BOLD correlates overlapped with several fMRI-RSNs, and each fMRI-RSN overlapped with the BOLD correlates of several microstate features. In addition, the BOLD correlates of EEG microstates were about equally positive and negative. We thus conclude that a simple theory of identity of EEG and fMRI RSN does not hold, and these different types of connectivity serve different, and potentially complementary functions. A particularly meaningful example for this conclusion will be made for RSN associated with auditory verbal hallucinations in schizophrenia.

T17 ☆

Transient dynamic brain networks in MEG and fMRI

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In recent years interest has grown in the study of large-scale networks of functionally specific brain regions. However, it is unclear how the apparently slow dynamics typically associated with fMRI resting state networks relate to the much faster time scales of cognitive processing. In this talk, I will present a new perspective, using hidden Markov models and a combination of fMRI and MEG data to reveal how different networks switch on and off over time across a range of time-scales. In MEG, we see switching at fast 50-100ms time-scales, characterised by transient bursts of phase-locking networks. In resting MEG and fMRI, we established that the switching is not random, with certain transitions being much more frequent than others. Intriguingly, we found that there was a tendency for the brain to either switch between networks associated with sensorimotor processing, or to switch between networks associated with more complex cognition, with only occasional switches between the two types. The patterns of this dynamic switching was also found to be heritable, and related to the individual subject's psychology.

Thursday
Language

T18 ☆

MEG measures as probes of cortical language function

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After two decades of work, we know what kind of MEG responses to expect in basic language paradigms, such as spoken and written word perception and picture naming. Based on this groundwork, it has been possible to address neural correlates of language development, learning and disorders, and even begin to elucidate brain organization of meaning and knowledge. The choice of imaging measures can importantly influence the way we interpret brain function. MEG evoked responses, oscillatory power and real-time connectivity, as well as fMRI activation and slow haemodynamic interareal correlations allow complementary views to language processing. Together, these various measures can offer rich possibilities to multiview imaging that will reach beyond mere combination of location and timing of neural activation and help to uncover the organizational principles of language function in the human brain.

T19

Dynamics of crossmodal speech signal tracking in the human auditory and visual cortex

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While we ordinarily conceive of speech as an auditory signal, it is essentially multisensory: we must move to speak, and these movements are visible to our interlocutors. While previous studies showed that crossmodal speech signals influence the activity of sensory cortex in humans, the exact nature of this influence remains uncertain. We investigated this question in human patients undergoing monitoring with intracranial EEG (iEEG) electrodes as part of the surgical treatment of their epilepsy. Patients watched or listened to 10 second-long segments of naturalistic speech, either in the auditory or visual modality. We performed a time-frequency analysis of neuronal activity in auditory and visual cortex. We found that both auditory and visual cortex responded to crossmodal speech signals with a sustained increase in high-gamma power (HGP), an iEEG index of local neuronal activation. Importantly, auditory cortex aligned the phase of its delta (1-3 Hz) oscillations in response to visual speech, whereas visual cortex failed to do so in response to auditory speech. The auditory cortex electrodes that showed this phase alignment to visual speech did not display any increase in the power of their delta oscillations; neither did they coincide with the electrodes that showed increased HGP, suggesting that this phase alignment represents pure phase reset of oscillatory activity rather than an evoked response. Our results confirm the multisensory nature of sensory cortex in humans and reveal the neuronal mechanisms likely involved in crossmodal speech perception and multisensory integration.

T20

Frontal Cortex Selects Representations of the Talker's Mouth to Aid in Speech Perception

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Humans integrate visual speech information from the mouth of the talker's face with auditory speech information from the talker's voice to aid in perception. However, human faces contain many sources of information, raising the question of how visual speech information is selected for integration. To answer this question, we directly recorded neural responses from small populations of neurons in patients implanted with electrodes and observed enhanced visual cortex responses to speech when auditory speech was absent, a situation in which visual speech is especially relevant. This enhancement was specific to regions of the visual cortex with retinotopic representations of the mouth of the talker, and was mirrored by enhanced responses in frontal cortex to visual-only speech. Enhanced frontal responses preceded visual cortex enhancement by an average of 230 ms. Connectivity between frontal cortex and other brain regions was measured with trial-by-trial power correlations. Strong connectivity was observed between frontal cortex and mouth regions of visual cortex; connectivity was weak between frontal cortex and either non-mouth regions of visual cortex or auditory cortex. These results suggest that selection of visual information from the talker's mouth by frontal cortex plays a key role in audiovisual speech perception.

T21 ☆

Predicting and perceiving degraded speech

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This talk will illustrate the neural mechanisms by which listeners achieve their remarkable success at understanding degraded speech. In line with Bayesian perceptual inference, perception of degraded speech is guided by prior knowledge. MEG and multivariate fMRI data collected during the recognition of degraded spoken words allow us to explore the underlying neural computations that support speech perception. A key method in this work is to assess the perceptual and neural impact of written text (subtitles) that precedes artificially degraded (noise-vocoded) spoken words. Multi-voxel similarity of fMRI response patterns in the superior temporal gyrus (STG) show interactions between the provision of prior knowledge and speech clarity when written text matches degraded speech. Furthermore, multi-voxel fMRI patterns represent mismatching segments when listeners reject partially-matching prior knowledge, and fail to signal matching segments when listeners misperceive degraded speech as matching their expectations. Both of these neural observations are uniquely explained by computational simulations in which the STG represents the difference between heard and expected speech sounds (prediction error), but not by alternative implementations of Bayesian perceptual inference (e.g. sharpening). Patients with frontal neuro-degeneration leading to progressive non-fluent aphasia (PNFA) show abnormal perception and MEG responses when written text must be integrated with degraded speech signals. However, STG responses remain normal during perception of speech with bottom-up manipulations of clarity. These findings demonstrate a causal role of top-down frontal mechanisms in integrating prior predictions with speech signals and suggests oscillatory neural correlates of key computations proposed in predictive-coding accounts.

T22

Contextual effects on the neural encoding of speech in the auditory cortex

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Speech is the most important signal in our auditory environment and its processing is highly context dependent. However, it is unknown how task demands influence cortical speech encoding. In our 7 Tesla fMRI study, participants performed a linguistic and a paralinguistic task on the very same speech sounds. We applied a computational model to simulate cochlear processing as well as acoustic sound decomposition within the auditory cortex in order to examine task-specific sound encoding along different acoustic dimensions, i.e. frequency, spectral modulation and temporal modulation. We found that performing different tasks on the same speech sounds affects sound encoding at the earliest levels of auditory cortical processing in a manner that is largely consistent with the acoustic information that is critically relevant for task performance. During performance of the paralinguistic task, we found increased encoding of higher spectral modulations (> 1.1 cycles/octave) in early auditory areas (Heschl's gyrus, planum temporale and planum polare) as well as in later auditory areas (middle and posterior superior temporal gyrus). In contrast, during performance of the linguistic task, we found increased encoding of lower spectral modulations (< 1.1 cycles/octave) and of faster temporal modulations (up to 50 Hz) in later auditory areas. Consistently with the imaging results, analysis of the stimuli themselves show that respective acoustic information was most informative for successful performance of the corresponding task. Our work provides important insights into the mechanisms that enable amplification of task-relevant information within our rich and dynamic auditory environment.

T23

A constrained Kalman filter approach to inform dynamic functional connectivity with anatomical priors: a simulation study

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The dynamic repertoire of functional brain networks depends on the underlying topology of structural connections: the lack of a specific neural pathway between two regions should make a direct functional interaction biologically impossible. Despite the intrinsic link between structural (SC) and functional connectivity (FC), an efficient approach to integrate the two is still lacking and most FC measures may therefore contain indirect connections. In the present work, we propose an anatomically constrained Kalman Filtering method (cKF), within the Granger causality framework, which allows to estimate multivariate autoregressive (MVAR) models and to track large-scale directed and dynamic brain interactions while incorporating SC priors. In a set of simulations with varying signal-to-noise-ratio, we used binary SC matrices to impose constraints on the recursive estimation of MVAR models. We then compared the performance of cKF with non-constrained Kalman filtering in terms of prediction accuracy, detection of main network drivers and model residuals. Our preliminary results show that incorporating SC priors increases prediction accuracy and the proportion of correctly identified network drivers (>5%) while reducing the amount of unexplained network activity. This fresh new approach represents a first step toward the incorporation of individual connectomes and SC indexes (e.g., fiber length and density, degree of myelination) into the estimation of FC measures.

T24

The unconscious episodic memory

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Episodic memory is believed to depend on conscious perception and mentation. But there is growing evidence against this consciousness-centred view. Findings suggest that humans can learn and retrieve new associations rapidly even if the information is presented subliminally, i.e. invisible to the conscious mind. Based on these findings, we investigated in three different experiments (two behavioural, one using functional magnetic resonance imaging) whether humans were able to unconsciously encode and later retrieve complex what-where-when associations (a proxy for episodic memory) by way of their hippocampus. Therefore, we presented 36 different subliminal movie clips in each experiment (N=21, 24, 28). The movie clips depicted always 5 animals subsequently entering a scene, disappearing in an opaque hiding place, reappearing and leaving the scene. The entrance- and exit sequences were orchestrated in such a way that some but not all animals met inside the hiding place. After every third film clip, participants took a forced-choice memory task and had to indicate which animals had met and which had not based on their intuition. As hiding places were opaque, participants needed to infer which animals met based on the animals' entrance- and exit sequences. In all three experiments, participants evidenced unconscious what-where-when memory by giving correct answers significantly faster than incorrect answers. Furthermore, participants exhibited activity changes in areas of the episodic memory system, especially in the hippocampus. These results suggest that humans can perceive, integrate, memorize and retrieve action sequences without conscious awareness and, thus, suggest an unconscious form of episodic memory.

POSTER ABSTRACTS

Ordered according to these categories:

Action

Clinical Neuroscience

Emotion & Motivation

Language & Music

Learning & Memory

Methods

Perception

Other

Action

P01

Inhibition of a response to a social stimulus: a developmental study

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Social behavior changes drastically during adolescence. In parallel, cognitive control also improves. These behavioral changes are concordant with MRI studies showing development in frontal cortex and areas linked to "the social brain". Our goal is to understand how the interaction between cognitive control and social perception changes from late childhood until early adulthood. Recent data using the anti-saccade task with face, car and noise stimuli showed that adolescents (15-18 years) and adults make more anti-saccade errors towards faces than cars or noise patterns. Younger adolescents showed no stimulus effect while children had the same difficulty for cars and faces, as compared to noise patterns. To investigate how these effects could relate to developmental changes in brain activity, we scanned using fMRI 15 children, 19 adolescents and 15 adults. Preliminary results replicate previously reported involvement of frontal and supplementary eye-fields, intraparietal sulcus, lateral occipital cortex, insula and precuneus, in producing anti-saccades. We also observed activity in the anterior cingulate cortex only in adults and adolescents. We observed an interaction between task and stimulus in the lateral occipital cortex in adults and the cingulate gyrus in adolescents, reflecting higher difference between anti- and pro-saccades to faces than cars. No interaction was reported for children. These results suggest that behavioral differences might be due to age-related differences in brain activation, with children showing the same level of activity during anti-saccades to social and non-social stimuli, while inhibiting responses to faces was expressed in cognitive control regions for adolescents or in perceptual regions for adults.

Clinical Neuroscience

P02

Altered functional connectivity of the praxis network in Parkinson's disease

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Apraxia is a deficit in central motor planning affecting the performance of learned, skilled movements such as tool use or gesture production. We aimed to analyze the functional connectivity of the fronto-parietal praxis network in patients with mild Parkinson's disease (PD) and to investigate the impact of dopaminergic therapy. 13 PD patients (ON and OFF dopaminergic therapy) and 13 healthy controls performed a praxis sensitive fMRI task and clinical apraxia assessments. Although none of the patients was apraxic according to clinical cut-off scores, patients in the OFF phase exhibited significantly lower apraxia scores than controls. Graph theoretical analysis revealed that the patients displayed significantly higher global efficiency within the praxis network than controls. The supramarginal gyrus (SMG) turned out to be a hub within this network and the most significant area (left posterior SMG) served as a seed region for the seed-to-voxel connectivity analysis. Compared to controls, patients OFF showed a significantly increased functional connectivity of the seed area to right inferior parietal and frontal areas. In the ON phase patients exhibited a significantly higher functional connectivity between the left SMG and the left primary motor cortex, left basal ganglia, and right inferior frontal gyrus than in the OFF phase. The increased connectivity of inferior parietal areas containing long-term representations of object-related actions might serve as a compensatory mechanism in early stages of PD. The increased functional connectivity of the SMG to motor areas in the ON phase indicates that dopaminergic therapy facilitates appropriate gesture production.

Clinical Neuroscience

P03

Cerebral Mediation of Attention Biases in Social Anxiety: a Near-Infrared Spectroscopy (NIRS) Neurofeedback Trial

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Introduction: Attentional biases towards threat have been linked to the etiology and symptomatology of social anxiety disorder (SAD). Dysfunction of the dorsolateral prefrontal cortex (DLPFC) is proposed to play a key role in the maintenance of attentional biases and symptomatology in SAD. This study aimed to investigate the feasibility of NIRS neurofeedback (NF) training – targeting the DLPFC – and its effects on attentional biases of SAD patients. Methods: 14 individuals with SAD participated in the NIRS-NF training where they learned to modulate DLPFC activation. Changes in attentional biases (i.e. response time interference) and brain activation before and after the NIRS-NF were assessed with a laughter perception experiment during NIRS recording. In the laughter perception experiment, laughter and non-social control stimuli were used as task-irrelevant distractors during a face rating task. Results and Conclusions: First, the low drop out rate (n=2) and an increase in NF performance demonstrate the feasibility of such trainings in SAD promoting increased DLPFC control. Moreover, decreases in a laughter-induced attention bias and social anxiety occurred. Individually, NF performance and symptom reduction correlated with decreased cerebral responses to threat-related stimuli in the attentional control network. This activation decrease might reflect the facilitated attentional disengagement from task-irrelevant social threat associated with increased DLPFC control and consequently reduced social anxiety. Therefore, NIRS neurofeedback seems not only suitable to investigate the potential causal role of the DLPFC in the processing of attentional biases in SAD, but could also be a gateway to developing new, conceivably effective treatment methods for anxiety disorders.

Clinical Neuroscience

P04

Changes in functional connectivity within the network supporting presence hallucinations in psychosis

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Schizophrenia is a psychiatric condition characterized by abnormal mental states including hallucinations and delusions. Recent theories suggest that psychosis is driven by inaccurate sensorimotor predictions causing the misattribution of self-related events to external sources. This misattribution is linked to first-rank symptoms such as delusions of control, auditory hallucinations and thought insertion. Important features of first-rank symptoms are the loss of sense of agency and occurrence of an alien agent. The subjective experience of an alien agent while there is actually none is called presence hallucination (PH). PH has been observed in schizophrenia, Parkinson's disease and neurological patients with circumscribed lesions in temporo-parietal, insular, and especially fronto-parietal cortex (presence hallucination network). At the neural level, inaccurate sensorimotor predictions may be related to the decreased cortical communication (e.g. functional connectivity) of fronto-parietal areas found in patients with schizophrenia. Principally, this study focuses on the brain mechanisms responsible for the generation of the PH. We analyzed functional connectivity changes in the presence hallucination network during resting state fMRI in patients with early and late psychosis, and controls. We observed reduced presence hallucination network connectivity in patients with late psychosis compared to controls. Specifically, the disconnection is expressed seeding from left temporo-parietal area to insula bilaterally and right superior-parietal areas. Patients with early psychosis show decreased functional connectivity between insula bilaterally.

P05

Combining fMRI dynamic functional connectivity and EEG epileptic-topography mapping to reveal epileptic networks "at rest"

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Background: Stationary functional connectivity in focal epilepsy has demonstrated the presence of pathological networks even when no interictal epileptiform activity (spikes) is detected on the scalp-EEG. The use of spike-specific EEG voltage maps in EEG-fMRI can successfully detect epilepsy-related haemodynamic changes when no significant pathological activity is visible on the scalp EEG. Dynamic-functional-connectivity (dFC) investigates brain connection fluctuations. Our aim was to investigate the dynamics of epileptic network connections and to analyse their dependency on the epileptic activity, as expressed by the spike-specific EEG voltage map. Methods: We selected 7 patients with drug-resistant focal epilepsy having a multifocal-BOLD response in EEG-fMRI. For each patient, we performed seed-based functional connectivity with the seed overlapping the area at maximal BOLD response and we considered the clusters in the BOLD map exhibiting positive correlation with the seed. We performed sliding-window dFC for cluster-to-cluster connections. Then, to investigate whether the cluster-to-cluster connectivity was dependent of the epileptic activity, we computed the sliding-window covariance of the EEG voltage maps and we calculated the Spearman correlation of this signal with the cluster-to-cluster dFC. Results: Cluster-to-cluster connections in epileptic networks did not significantly correlate with the presence of the spike-specific voltage map ($p>0.05$). Conclusion: The dynamics of connections in the epileptic network does not depend on the epileptic activity suggesting a persistent pathological alteration of the resting-epileptic-brain. This could help understand neurological and cognitive comorbidities and further characterisation of these networks might help predict post-surgical outcomes.

Clinical Neuroscience

P06

Conduction delays estimated by cortico-cortical evoked potentials

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Background: Direct brain measurements using intracranial electroencephalography (iEEG) provide important insights into epilepsy and have the potential to accurately measure functional brain connectivity. However, functional connectivity metrics are highly influenced by assumptions on conduction delays that are seldom measured. Indeed, current models of functional connectivity based on Granger causality do not take into account the variability of conduction delay across the human brain. Methods: We applied cortico-cortical evoked potentials (CCEP) to estimate effective functional connectivity and derive conduction delays for early (0 to 50 ms post-stimulus onset) and late (50 to 500 ms post-stimulus onset) evoked responses in 1 patient with depth electrodes. We extracted the latency at the peak of the response, at the rising phase and at the response onset. Results: Early responses showed an average latency of 7.21 ± 4.14, 11.79 ± 5.42 and 22.73 ± 8.62 ms at the onset of the response, at the maximal slope of the rising phase and at the peak respectively. Late responses showed an average latency of 54.98 ± 13.92, 86.37 ± 39.93 and 128.25 ± 55.62 ms at response onset, rising phase and peak respectively. Discussion: The variability of these latencies suggests that conduction delays contain valuable information that might improve functional brain connectivity models.

P07

Contribution of fronto-parietal cortex to the processing of behavioral relevance and attentional capture

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The ability to identify and orient attention toward external stimuli is sustained by a cortical network distributed over the parietal and prefrontal cortices. The aim of this study was to examine the contribution of different regions of this network to specific components of spatial attention. We tested 53 patients with right-hemispheric lesions separated into different subgroups, and 10 healthy controls. Patients underwent structural MRI, a baseline neuropsychological evaluation and a spatial attention task. In this task they had to react to peripheral targets defined by their color, which were preceded by an ipsilateral or contralateral distracter stimulus. Targets were defined by colour, and the distracter was either behaviourally relevant (i.e., shared the target colour), or irrelevant. Patients were divided into those with frontal, subcortical or multilobar damage. While all patient groups showed a global contralesional slowing, only patients with multilobar damage affecting fronto-parietal networks were particularly slowed when a relevant, ipsilesional cue preceded the contralesional target. These findings support the involvement of fronto-parietal networks in the processing of behavioural relevance effects leading to exaggerated attentional capture.

Clinical Neuroscience

P08

Electrophysiological correlates of amnesia after medial-temporal lesion

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Immediately repeated stimuli are less well recognized after a delay than stimuli repeated after intervening items, an effect known as the Spacing effect. We found that stimuli repeated immediately within a continuous recognition task evoke a frontal potential at 200-300 ms, which emanates from the (left) medial temporal lobe (MTL) (James et al., 2009; Nahum et al., 2011) and has a protective effect on the memory trace (Thézé et al., 2016). Patients with Wernicke-Korsakoff syndrome lack this frontal potential (Nahum et al., 2015). Here, we tested 11 patients with focal left and 4 patients with right medial temporal lesions and amnesia, compared to 11 age matched healthy controls, to verify whether this frontal potential would also be absent in patients. Brain activity was measured with high-density EEG as subjects made a continuous recognition task containing both immediately repeated stimuli and stimuli repeated after 9 intervening items. Both patients and controls had a spacing effect: after 30 minutes, they recognized new presentations and pictures repeated after intervening items better than immediate repetitions. Patients' performance was significantly poorer than controls during encoding and delayed recognition tasks. Importantly, only controls, but not the patients, expressed the frontal positive potential between 200 and 300 ms in response to immediate item repetition. The observations lend further support to the idea that the frontal potential in response to immediate repetitions is associated with MTL function.

P09

Executive Reaction Time Test as a measure of brain health – impact of repeated testing on performance

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Efficient executive functions (EF) depend on intact frontal networks. However, wellbeing of these networks may be compromised by disorders or treatments affecting the brain. EF tests done at different time points can be used to assess changes in brain health, but after the first test learning may confound results of successive tests. In this study we analyzed learning in a computer-based EF test, Executive Reaction Time Test. Executive RT test is an experimental go/no-go test with emotional distractors testing working memory, attention and inhibition. Healthy subjects performed the test twice, three weeks apart. When tests were compared, subjects were faster and did less working memory errors in the second test, but attention and inhibition related errors didn't differ. When only latter half of the tests were compared, no difference in response speed nor in errors were detected. Thus, in this simple and fast paced computerized test learning occurred primarily in the early section of the first test and performance remained stable after that. We also compared the performance of older and younger participants. In the first test, emotional distractors prolonged reaction times of younger but not older participants. This may be due to reactions to negative stimuli weakening along with aging or older people using faster strategy to suppress negative emotions (attention shift vs. re-appraisal). There was no difference between the groups in second test, i.e. young participants learned to ignore emotional distractors during first test. Simple, fast paced computerized tests show promise for repeated testing of executive functions.

P10

Fronto-parietal cortices mediate specific psychosis-like states induced by sensorimotor conflicts: a robotics-fMRI study

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The ability to recognize whether sensory consequences have been self-generated or externally produced is an important element of motor control. Prominent accounts posit that self-monitoring can be explained by forward models where efferent copies based on motor commands are used to predict the sensory consequences of one's own action. Deficits in self-monitoring have been proposed to lead to abnormal bodily experience, hallucinations, and psychosis. Based on this work, a recent study induced controlled alterations of bodily experience and psychosis-like states (e.g. presence hallucination and passivity sensation) in healthy subjects by generating conditions of abnormal, robot-controlled, sensorimotor stimulation. Here, we investigated the brain mechanisms underlying the presence hallucination and passivity sensations in healthy subjects. To this purpose, we developed a new MR-compatible robotic system able to generate sensorimotor conflicts between the upper limb and the somatosensory feedback on the back of the participants, while recording subjects' brain activity using fMRI. We initially validated that the new robotic system could reliably activate motor and sensory regions. Secondly, we were able to replicate the induction of the illusory experiences and showed an extended network composed of right dominant fronto-parietal cortices and subcortical areas to be more activated in the psychosis-like states inducing condition. Comparison with a lesion analysis in neurological patients highlighted bilateral insular and temporo-parietal junction activations in both analyses suggesting an important role of these areas. Collectively, these findings provide further insights into the neural correlates of presence hallucinations and passivity sensations, advancing the scientific understanding of hallucinations and psychosis.

Clinical Neuroscience

P11

Social anxiety is characterized by biased learning about the self

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People learn about their self from social information, and recent work suggests that healthy adults show a positive bias for learning self-related information. In contrast, social anxiety disorder (SAD) is characterized by a 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 and computational model to test the hypothesis that biased social learning regarding self-evaluation and self-feelings 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. Affective updating (i.e., change in feelings about the self over time, in response to feedback from the judges) was modeled using an adapted Rescorla-Wagner learning model. HC demonstrated a positivity bias in affective updating, which was absent in SAD. Further, self-performance ratings revealed group differences in learning from positive feedback. 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.

Clinical Neuroscience

P12

The effects of alcohol withdrawal on brain anatomy and functionnal connectivity in alcohol-dependence.

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Alcohol-dependence is a psychiatric disorder with large alterations in the brain anatomy. Alcohol-withdrawal, the first step of the alcohol rehabilitation programs is attended by large behavioral improvements (depression, anxiety or alcohol-craving), that have been related to a decrease in inflammation. This pilot study attemps to observe whether changes in brain anatomy and in functionnal connectivity can be observed during withdrawal. 25 alcohol-dependent inpatients were tested on the first and 18th day of withdrawal, for behavior (depression, anxiety, alcohol-craving) and for brain anatomy and functional connectivity under resting state conditions. Results : we observed a significant decrease in the volume of the 4th ventricle, in the volume of the choroid plexus, of the white matter, while the cortical volume was increasing. We also observed differences in the functional connectivty of the default mode network that was correlated to the level of depression. More specifically, there was a correlation between the level of depression and the correlation between a part of the right cerebellum and the two amygdala and hippocampus, and a negative correlation between depression and the connectivity between the inferior frontal gyrus, and the ACC or the superior frontal gyrus, and between the subgenual cingulate and the DLPFC. Conclusion: Alcohol-withdrawal is related to changes in brain anatomy and functional connectivity, that are for some related to the symptomatology of the disease. Whether these changes are due to changes in the levels of inflammation remain to be tested.

P13

Impaired mismatch negativity response in adolescents with 22q11.2 Deletion Syndrome: A high density EEG study

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The 22q11.2 deletion syndrome (22q11.2 DS) is one of the highest genetic risk factors for the development of schizophrenia spectrum disorders. Here, we examined the maturation of the mismatch negativity response in children and adolescents with 22q11.2 DS with high density EEG. Using a cross-sectional approach, auditory evoked potentials were measured in 20 children (mean age :10) and 19 adolescents (mean age:16) with 22q11.2 DS, and 39, age and gender matched controls. In addition, we present data from a longitudinal follow-up for 10 participants with 22q11.2 DS and 9 controls at two time points (T1, mean age: 12; T2:16 years). We used an oddball paradigm with pure tone stimuli, 1000Hz - as standards and 1200Hz -as deviants, presented binaurally with an 8:2 ratio. We found significant decreases in amplitude during the mismatch response on fronto-central channels, in adolescents with 22q11.2 DS compared to children with 22q11.2 DS and to healthy adolescents. In addition, adolescents with 22q11.2 DS displayed a significant increase in amplitude over central electrodes during the auditory N1 component. In the longitudinal design, we observe both a decreased MMN response and increased auditory N1 component at T2 (during adolescence) for the participants with 22q11.2 DS, whereas no such differences were seen in the healthy group. These findings suggest that the auditory N1 and mismatch response follow a different developmental trajectory during adolescence in 22q11.2 DS. These maturational changes in auditory oddball detection during a critical period might co-occur with increased risk for schizophrenia spectrum disorders.

P14

Visual masking and schizophrenia: enhancement deficit 200 ms after stimulus onset

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Masking is strongly deteriorated in schizophrenia patients and to a lesser extent in their healthy relatives. For this reason, masking is a good endophenotype. Here, we show the EEG correlates of masking across the schizophrenia continuum in order to tackle the underlying mechanisms. First, we found that schizophrenia patients have strongly reduced amplitudes, as measured with the Global Field Power (GFP), compared to controls. The reduced amplitudes speak for attention allocation deficits in schizophrenia. Second, patients with first-episodes psychosis have reduced GFP amplitudes compared to controls, but higher amplitudes compared to schizophrenia patients. Their neural correlates are in an intermediate state, indicating a progressive development of the disease through time. In addition, the amplitude remains stable for at least one year, suggesting that serious deficits emerge at a later stage of the disease. Third, healthy participants with high schizotypal traits have reduced GFP amplitudes compared to low schizotypal participants. These deficits are similar to the ones of patients, though strongly attenuated, showing that the mechanism is independent of the individual's state (health or disease). Fourth, healthy siblings of schizophrenia patients have, surprisingly, higher GFP amplitudes compared to controls. We propose that the siblings use a compensation mechanism to counterbalance for their masking deficits. Finally, patients with the 22q11.2 deletion syndrome have slightly higher GFP amplitudes compared to controls. We speculate it is due to a high co-morbidity. In conclusion, observers with psychosis traits/symptoms have difficulties to enhance faint visual information 200 ms after their onset which explains their lower performance.

P15

Electrophysiological brain abnormities in major depressive disorder: microstate analysis on high-density EEG in resting conditions

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The aim of the study was to identify electrophysiological biomarkers of major depressive disorder (MDD) through high-density EEG technique. Ten patients (7men and 3 women, mean age 53±7 years) suffering from MDD and ten healthy controls (7men and 3 women, mean age 49±8 years) underwent EEG recording using 128 or 256 scalp electrodes during eyes closed resting-state condition. Microstate analysis was performed at individual and group levels. Microstate variants were identified and their parameters such as mean correlation, mean duration, time coverage, and frequency of occurrence were evaluated. Cross-validation criterion used to determine the most dominant topographies revealed five (A-E) microstate classes explaining 79 % of global variance. Results of two-way repeated measures ANOVA revealed significant group x microstate interaction for frequency of occurrence, mean duration, and time coverage. Post-hoc tests revealed significant group difference for class A microstate, which showed decreased values in MDD patients. Parameters revealed by microstate analysis are suggested to be possible electrophysiological biomarkers of functional brain abnormities in MDD patients. The study has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłlodowska-Curie grant agreement No 739939.

P16

Fronto-insular dysconnection underlies robot-induced presence hallucination in healthy participants and discriminates first-rank symptoms in early psychosis patients

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The presence hallucination (PH), the sensation that somebody is nearby when no one is actually present, is among the Schneider's first-rank symptoms (FRS) for schizophrenia. Recent findings demonstrated that sensorimotor conflicts between upper limb movements and somatosensory feedback on the back could induce the PH in healthy subjects, suggesting that PH is caused by misperceiving the source and identity of sensorimotor signals of one's own body. Despite this new insight, very little is known about the neural basis of the PH. Here we applied the same sensorimotor conflict in healthy volunteers, while brain activity was measured with EEG. Behaviourally, we replicated previous findings, showing that strong sensorimotor conflict can induce the PH in healthy subjects. Electrophysiologically, our results show that strong sensorimotor conflict results in a modulation of the alpha band power, and a functional dysconnection within the right frontoparietal-insular network, specific for the gamma band. In addition, this modulation of functional connectivity was associated with the subjective experience of PH. Interestingly, the dysconnection within the same right frontoparietal-insular network and frequency, allowed us to distinguish between early psychosis patients with vs. without FRS, with a fully data-driven approach. Our results provide for the first time the electrophysiological correlates of the PH, consistent with the evidence that PH can be caused by lesions in three distinct brain regions: temporo-parietal, insular, but especially in the frontoparietal cortex, and show that gamma oscillations and the frontoparietal network as critically associated with PH and FRS.

P17

Visual association, motor and attention networks are involved in recovery of drug-naïve essential tremor patients after stereotactic radiosurgical thalamotomy: a resting-state fMRI study

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Drug-resistant essential tremor can benefit from standard procedures (deep brain stimulation, thalamotomy) or minimally invasive high-intensity focused ultrasound (HIFU) or stereotactic radiosurgical thalamotomy (SRT). Resting state fMRI (rs-fMRI) is a non-invasive imaging method acquired in absence of a task. We examined whether rs-fMRI correlates with tremor score on the treated hand (TSTH) improvement 1 year after SRT. We included 17 consecutive patients treated with left unilateral SRT in Marseille, France. Tremor score evaluation and rs-fMRI were acquired at baseline and 1 year after SRT. Resting-state data (34 scans) were analyzed using Independent Component Analysis (e.g. GIFT), in Lausanne, Switzerland. Based on degree of improvement in TSTH, to consider SRT at least as effective as medication, we separated two groups: 1, <= 50% (n=6, 35.3%); 2, > 50% (n=11, 64.7%). They did not differ statistically by age, duration of symptoms or MR-signature volume at 1 year ($p>0.05$). We report, TSTH improvement correlated with interconnectivity strength between salience network with left claustrum and putamen (pFWE-cor=0.001, Kc=86, MNI -30 8 0), as well as between bilateral motor cortex with right visual associative area (pFWE-cor=0.001, Kc=87, MNI 32 -80 10, the former also with lesion volume). Longitudinal changes showed additional associations in inter-connectivity strength between right dorsal attention network with ventro-lateral prefrontal cortex and salience network with fusiform gyrus. Brain connectivity measured by resting-state fMRI relates to clinical response after SRT. Relevant networks are visual, motor

and attention. Inter-connectivity between visual and motor areas is a novel finding, revealing implication in movement sensory guidance.

P18

Increased network segregation as a bio-marker in focal epilepsy

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Background: Epilepsy is one of the most common neurological disorders, characterised by recurrent and unpredictable seizures. High-density EEG (hd-EEG) plays a central role in diagnosis and management of patients with seizure disorders contributing to the multi-axial diagnosis of epilepsy. In many patients, rather than a single region, a complex network is involved in the seizure onset and the interictal epileptiform discharges (IEDs), detected on EEG recordings. Effective connectivity analysis, which describes directionality of information transfer between one brain region to another, and graph analysis are promising tools to reveal the network patterns involved in epileptic activity and predict post-operative seizure control basing on hd-EEG. Methods: We analysed 12 patients with focal epilepsy who had hd-EEG containing IED and subsequently underwent epilepsy surgery applied source-based directed connectivity analysis and graph analysis on the IED. Information Partial Directed Coherence was estimated between 82 atlas-based cortical regions of the individual brain MRI. Results: We found an increased network segregation in the values of directed transitivity during the spike ($p<0.05$) in patients suffering from focal epilepsy showing a good post-surgical outcome (N=7), compared to poor outcomes (N=5). Discussion: This phenomenon may represent an important bio-marker for predicting the surgery outcome. It may also help understand network adaptation resulting in "isolation" of epileptic activity, thus limiting the extent of the epileptic network in patients that will recover after surgery. Describing and understanding the dynamic mechanisms operating in large-scale human brain networks might offer key insights into focal human epilepsy.

Clinical Neuroscience

P19

Towards biomarkers of neuro-rehabilitation derived from EEG resting state

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Recent technological advances in treatments of stroke require the definition of sensitive biomarkers to delineate recovery mechanisms and responses to therapy. Currently patients are evaluated by clinical symptoms, rather than on quantitative measure of their underlying neural reorganization. Recently, we showed that the dynamical organization of electroencephalography (EEG) topographies recorded at rest correlates with motor control strategies, offering as such the prospect of a novel and robust tool for the definition of biomarkers that characterize neural plasticity and recovery following stroke. Here we explored whether, and to what extent, EEG resting-state topographies represent more sensitive and specific biomarkers as compared to behavioral measures and clinical standards, and whether this sensitivity would hold over repeated evaluations. We examined a group of twenty post-stroke patients and healthy control subjects who were evaluated for symptoms of unilateral neglect, and a group of six patients suffering right hemiplegia and undergoing robotic-assisted rehabilitation for four weeks. In the first group of patients, we found an enhancement of spatially-distributed low-frequency power and a decrease of faster brain oscillations after the injury, which provided a higher sensitivity in discriminating patients and healthy subjects as compared to behavioral tests. Changes in global brain oscillations were also observed after the loss of motor skills and were predictive of movement performances following robotic-assisted rehabilitation. Our results demonstrate that resting-state EEG topographies can provide a more reliable index of the dynamics of recovery than some of the most adopted clinical standards and they can assess the effects of rehabilitation interventions, emphasizing their potential for clinical decision-making.

P20

Functional and structural organisation of brain networks in human development investigated through spatio-temporal connectomics

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Recent advances in functional magnetic resonance imaging (fMRI) and diffusion spectrum imaging (DSI) have allowed for the characterisation of brain's functional and structural connectivity. By bringing these two modalities together in the spatio-temporal connectomes it is possible to probe into how the brain blood oxygen level dependent (BOLD) activity expresses itself on the white-matter scaffold. This approach rests on the assumption of two brain regions being connected only when functionally co-active and structurally connected. The aim of this study was to use this conceptual framework in an analysis of human development and thus inform on the fundamental functional brain reorganisations related to age. We analysed fMRI and DSI recordings of 87 healthy subjects ranging from 5 to 35 years of age. After computing the spatio-temporal connectomes for the individual subjects, we firstly showed that the usage of long-distance edges increased with age whereas the short-distance edge usage was decreasing with age. Secondly, we observed that the affiliation of different brain regions to the known functional systems becomes more heterogeneous with age i.e., the state entropy increases, suggestive of brain activity being more functionally spread-out. Lastly, we developed a new measure, termed functional diversity (FD), and showed that in younger subjects the brain activity is temporally more diverse as opposed to the older subjects. All considered, the results support the existing concept of pruning and maturation as with increasing age functional integration increases but that the repertoire of connectivity patterns decreases.

Clinical Neuroscience

P21

Upper limb cortical maps in amputees with targeted muscle and sensory reinnervation

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Targeted muscle and sensory reinnervation (TMSR) consists in rerouting motor and sensory nerves from the residual limb towards intact muscles and skin regions. Prosthesis movements are decoded from reinnervated muscles activity and touch sensations on the missing limb are induced by stimulation of the reinnervated skin areas. Here we ask whether and how motor control and redirected somatosensory stimulation provided via TMSR affected the maps of the upper limb in primary motor (M1) and primary somatosensory (S1) cortex, as well as their functional connections. To this aim, we tested three TMSR patients and investigated the organization of the missing limb in M1 and S1 at ultra high-field (7T) fMRI. These data were compared with those of control amputee patients (n=6) and healthy controls (n=12). We found that M1 maps and M1 connectivity in TMSR patients were similar to healthy controls and different from non-TMSR patients. S1 maps and S1 connectivity in TMSR patients were also more similar to normal conditions as compared to non-TMSR patients, but still different compared to healthy controls. This was associated with the absence of a well-established multisensory effect (visual enhancement of touch) in TMSR patients. Collectively, these results show how M1 and S1 process signals related to movement and touch in TMSR patients. Moreover, they suggest that TMSR may counteract maladaptive cortical plasticity typically found after limb loss. The lack of multisensory interaction in the present data suggests that further engineering advances are necessary to design prostheses that move and feel as real limbs.

Emotion & Motivation

P22

Cortical oscillatory mechanisms supporting the control of human social-emotional actions

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The human anterior prefrontal cortex (aPFC) is involved in regulating social-emotional behavior, presumably by modulating effective connectivity with down-stream parietal, limbic, and motor cortices. Regulating that connectivity might rely on theta-band oscillations (4-8 Hz), a brain rhythm known to create overlapping periods of excitability between distant regions by temporally releasing neurons from inhibition. Here, we use magnetoencephalography (MEG) to understand how aPFC theta-band oscillations implement control over prepotent social-emotional behaviors, i.e. the control over automatically elicited approach and avoidance actions. Forty male participants performed a social approach-avoidance task, in which they approached or avoided visually displayed emotional faces (happy or angry) by pulling or pushing a joystick. Approaching angry and avoiding happy faces (incongruent condition) requires rapid application of cognitive control to override prepotent habitual action tendencies to approach appetitive and to avoid aversive situations. In the time window prior to response delivery, trial-by-trial variations in aPFC theta-band power (6 Hz) predicted reaction time increases during emotional control, and were inversely related to beta-band power (14-22 Hz) over parieto-frontal cortex. In sensorimotor areas contralateral to the moving hand, pre-movement gamma-band rhythms (60-90 Hz) were stronger during incongruent than congruent trials, with power increases phase-locked to peaks of the aPFC theta-band oscillations. These findings define a mechanistic relation between cortical areas involved in implementing rapid control over human social-emotional behavior. The aPFC may bias neural processing towards rule-driven actions and away from automatic emotional tendencies by coordinating tonic disinhibition and phasic enhancement of parieto-frontal circuits involved in action selection.

Emotion & Motivation

P23

Local amygdala responses to emotion, unisensory and multisensory information: intracranial EEG evidence

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The amygdala is a limbic nucleus that responds preferentially to emotion over neutral information. In addition, neuroimaging data suggest a possible role of this nucleus in the multisensory integration of emotional input. However, the selectivity and temporal dynamics of uni- and multisensory responses in the amygdala are still unknown. We recorded Local Field Potentials in 10 amygdalae using iEEG in presurgical epileptic patients and compared activity to the presentation of happy, fearful, or neutral stimuli which could be either voices alone, faces alone, or voices and faces simultaneously delivered with congruent emotional content and gender. Results showed differential amygdala responses to emotional information, in relation to neutral information, around 100-150 ms after stimulus onset, regardless of the sensory modality. Later, around 200 ms, amygdala responses to audiovisual information were consistently larger in relation to unimodal, being this effect only apparent when stimuli were neutral. Subsequent analyses suggest that this preferential response to multisensory information was equivalent to a pure additive (i.e. auditory plus visual) response, rather than to genuine multisensory integration (i.e. super-subadditive response). These results suggest that multisensory responses in the amygdala, which may not reflect sensory integration, may occur in distinct time windows in respect to emotion responses. It is possible that unimodal input is sufficient to trigger strong response when emotionally relevant, but the processing of neutral input may rely preferentially on the summation of multiple sensory cues.

Emotion & Motivation

P24

Neural correlates of optimistic expectancies influencing visual attention

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Optimism bias and positive attention bias are both important for mental health but have so far only been examined separately. In support of the idea that the two biases interact, we have previously shown that optimistic expectancies causally influence attention deployment. The current study's goal was to investigate the neural mechanisms underlying such expectancy-attention interactions. We hypothesized that optimistic (pessimistic) expectancies guide attention to rewarding (punishing) information and that optimistic expectancies influence attention more strongly than pessimistic ones. Moreover, we anticipated enhanced activation in salience and executive control networks (e.g., insula, anterior and posterior cingulate cortex) when attention is reoriented to unexpected information and differential activation in these networks for unexpected information following optimistic and pessimistic expectancies. Expectancies were induced by verbal cues and participants' visual attention to rewarding and punishing information was subsequently tested in a visual search task. As hypothesized optimistic and pessimistic expectancies guided attention to rewarding and punishing information - indicated by faster reaction times to expected compared to unexpected stimuli and enhanced activation in nodes of the salience and executive control networks during reorientation of attention to unexpected stimuli. Moreover, optimistic expectancies had a stronger effect on attention than pessimistic ones - accompanied by stronger insula activation during reorientation of attention to punishing information following optimistic expectancies. Our findings show that being optimistic strongly guides attention to reward and makes unexpected punishing information especially surprising and salient. This supports the idea that optimistic expectancies are particularly powerful and robust emphasizing their importance for mental health.

P25

Rapid orienting of spatial attention toward and away from aggressive voices

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Salient vocalizations, especially aggressive voices, elicit a prioritized spatial attentional deployment, although there is no exhaustive evidence of the temporal dynamics of such process. We demonstrated that attentional capture and reorienting was influenced by threatening vocal signals at different stages of processing, using markers of spatial attentional orienting (N2ac and LPCpc). Our findings highlight attention mechanisms toward survival-relevant vocal events and illustrate the temporal dynamics of a fundamental preference of the human attentional system for threatening information.

Emotion & Motivation

P26

Repetition suppression effect for emotional content

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Emotional sounds processing involves interactions between the auditory cortex (AC) and the amygdala (Amy) (Fecteau et al., 2007; Frühholz et al., 2016). Repetition suppression (RS) effect has been observed for non-emotional environmental sounds within the early-stage auditory areas (Da Costa et al., 2015). In this study, we investigate the representation of emotional sounds within early-stage auditory areas, the voice area (VA) (Belin et al., 2000) and Amy, using a RS paradigm. Subjects listen to a battery of emotional sounds (Aeschlimann et al., 2008) comprising two categories (human vocalizations and non-vocalizations) and three valences (positive, neutral and negative), resulting in six conditions. Classic GLM analysis revealed a strong effect for the contrast 'Sounds vs. Silence' on the supratemporal plane, STG and STS ($q(FDR)<0.05$, $p<0.002$). The contrast 'Human vocalizations vs. Non-vocalizations' highlighted a strong activation in STS, in the region corresponding to VA ($q(FDR)<0.05$, $p<0.0004$). Finally the contrast 'Emotional sounds vs. Neutral sounds' resulted in restricted activations in STG ($q(FDR)<0.05$, $p<0.0001$), and Amy ($p<0.009$, uncorrected). BOLD time-courses revealed a clear preference of VA for human vocalizations. This preference was also present, to a lesser extent, in the AC. Amy preferred emotional sounds compared to neutral sounds, while AC and VA showed the reverse. We observed a general effect of RS in each region, with a stronger effect for human vocalizations in VA and emotional sounds in Amy. Overall, our results showed a strong repetition suppression effect for the affective information of vocal and environmental sounds in both auditory areas and amygdalae.

Emotion & Motivation

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Representations of first-hand aversive experiences influence social cognition both in terms of modality-specific and supramodal dimensions

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Embodied models of social cognition point that others' affective states are processed by re-enacting a representation of the same state in the observer, along with the corresponding neural and physiological reactions. However, it remains unclear whether the information shared between self and others is modality-specific, or rather codes for supramodal dimensions (e.g., unpleasantness, arousal, salience) common to many qualitatively-different experiences, such as pain and disgust. Here we investigated whether representation of first-hand pain and disgust influences the subsequent evaluation of facial expressions in modality-specific fashion (PainSelf → PainFace), in supramodal fashion in terms of unpleasantness (PainSelf → [PainFace & DisgustFace]), or in supramodal fashion in terms of arousal (PainSelf → [PainFace & SurpriseFace]). 30 volunteers were subjected to thermal painful and olfactory disgusting events carefully matched for unpleasantness. After each stimulus, they were asked to classify computer-generated facial expressions. We found that pain and disgust faces were biased by the prior stimulus, with more frequent misclassifications of pain following thermal stimuli, and more frequent misclassifications of disgust following olfactory stimuli. In addition, physiological data showed that disgusting faces elicited enhanced electrodermal activity after olfactory (vs. thermal) stimulation, whereas pain faces induced enhanced cardiac response after thermal (vs. olfactory) stimulation. Surprise faces were never influenced by the preceding stimulation, neither behaviourally nor physiologically. Overall, our data suggest that first-hand pain and disgust influence the evaluation of others' states both in terms modality-specific (from physiology) and supramodal representation of unpleasantness (from behaviour), but rule out a more general role of arousal.

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Exploring the neural network of empathy and its modulation in the ageing brain

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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 empathic-related situations produce carryover effects on brain activity, we acquired functional resonance imaging (fMRI) data while 31 participants over 65 years watched emotional video-clips from the Socio-affective Video Task (SoVT) followed by resting periods. Participants also provided self-reports on their feelings in response to each video. Confirming previous studies in younger adults (Klimecki et al., 2013; Cerebral Cortex), self-reports indicated that participants experienced more empathy, more negative feelings, and less positive feelings in response to others' suffering than to everyday life situations. FMRI results showed that compared to neutral situations, the confrontation with others' suffering induced greater brain activity in brain areas related to empathy and social cognition, such as left anterior insula, bilateral middle cingulate gyrus, and superior temporal gyrus. Correlations between participants' brain activity and self-reports, showed that areas related to motivated behaviors (anterior cingulate gyrus and ventral striatum) were positively modulated by the intensity of empathy participants felt towards the characters of the videos. Furthermore, we found that the amygdala - a brain region processing relevance - was deactivated during resting periods followed by neutral situations, but remained activated when followed by suffering situations, suggesting that being faced with others' suffering also induces lasting carry-over effects on brain state in elderly participants.

Emotion & Motivation

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Electrophysiological responses to emotional auditory stimuli during sleep and wakefulness

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Emotional sounds elicit enhanced cortical responses in conditions of wakefulness. However, it is unknown whether this effect is similarly present during sleep. On one hand, even in deep sleep, evidence shows that the brain is not fully disconnected from its acoustic environment. On the other hand, sleep is characterized by an over-activation of limbic regions, related to emotion encoding, and a hypo-activation of executive function regions, compared to wakefulness. In the present study, we examined event-related potential (ERP) responses to angry and neutral voices in 17 healthy subjects, both during wakefulness and sleep. With a general linear model (GLM) analysis of the EEG signal variation over time, we observed emotion processing responses over medial temporal electrodes around 150ms post-stimulus onset, and over frontal electrodes around 250-350 ms, during wakefulness. Furthermore, the medial temporal, but not the frontally distributed emotion modulations were still present during non-REM. Finally, no reliable effects were observed during REM. These results demonstrate that emotion encoding from external stimulation is preserved even in conditions of altered consciousness, at least during non-REM sleep.

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Sleep deprivation alters affective and neural responses to erotic stimuli in heterosexual males

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Sexual behavior as well as sleep represent two fundamental needs. Based on recent data evidencing the impact of sleep loss on reward brain functions, here we hypothesized that sex and sleep may actually interact. Specifically, we tested whether sleep loss may affect the processing of sexual stimuli. Seventeen healthy young heterosexual men underwent functional neuroimaging (fMRI) while they were exposed to erotic pictures of women and men (as well as heterosexual couples, and non-erotic pictures) after a night of normal sleep and also following 24h of total sleep deprivation. We collected judgments of emotional arousal and valence elicited by these pictures. We found that sleep deprivation decreased arousal ratings for erotic pictures of men and decreased brain responses to erotic pictures of women in the prefrontal cortex. Critically, we show here that sleep deprivation increased amygdala activation when individuals rated the erotic pictures as more arousing, while it decreased left prefrontal cortex activity for pictures judged as more positive (i.e. erotic pictures of women). Sleep deprivation do not affect to highly salient stimuli, such as erotic pictures of women but decreased the emotional arousal elicited by negative stimuli (erotic pictures of men).

P31

Brain structural correlates of dyslexia

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Dyslexia is a neurodevelopmental disorder affecting the acquisition of reading and spelling abilities in the absence of other neurological disorders, damage, and despite typical intelligence and a favorable socio-educational environment. 3–7% of the population is affected and difficulties remain throughout adulthood. There is a long history of studying neuroanatomical abnormalities in the dyslexic brain, first ex vivo in post mortem brains at both micro- and macroscopic scales, and in vivo using magnetic resonance imaging (MRI) at the macrostructure level. Among main findings, altered brain anatomy was found in regions constituting the auditory cortex and visual word form area, crucial for reading. We use ultra-high field quantitative MRI at 7 Tesla (CIBM, EPFL) to compare brain anatomy of 10 adults with a history of dyslexia and 16 matched healthy controls (0.6 mm3isotropic). The quantitative measure we were interested in is R1, providing an index of myelin. We analysed individual R1 maps at mid-cortical thickness. Preliminary results indicate increased myelin in dyslexic individuals compared to controls in the left planum temporale (PT) and in the visual word form area; the former is in line with early reports of myelinated scars in the PT in dyslexics. We also find different relationships between myelin of these regions and behavioural measures of reading between groups, suggesting that the myelin has different functional consequences in dyslexics compared to controls. Next steps will involve expanding the sample size and exploring further relationships between myelination and individual differences in phonological awareness, reading, spelling and working memory.

P32

Inter-laminar connectivity implements transient phase-amplitude coupling for speech encoding

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Neuronal oscillations are thought to be involved in the parsing and representation of speech constituents at the corresponding temporal scale. However, it is unclear how sensory information interacts with ongoing spontaneous brain activity, what are the features of the neuronal microcircuitry that underlie spontaneous and stimulus-evoked spectral fingerprints, and what are their consequences for stimulus encoding. We address these questions using a combination of human invasive electrophysiology, computational modeling, spectral analysis and decoding techniques to link the spectral characteristics of brain activity with the neuronal architectures that could underlie their generation, and to assess their information encoding properties. We recorded intracranially from 10 patients. Channels recording activity from early cortical auditory regions often exhibited power spectra with a shoulder in the delta range and a small bump in the beta range. Speech stimulation decreased power in the beta range, and sometimes increased power in the gamma and delta-theta ranges. A computational model comprising distinct subnetworks for the superficial and deep layers reproduces some of the spectral features of iEEG activity during both rest and stimulation, as well as the observed pattern of phase-amplitude coupling. An interlaminar connectivity pattern implementing a negative feedback loop between the superficial and the deep layer is the one which is most consistent with the data. We show that this interlaminar connectivity pattern enables transient phase-amplitude coupling, which could be advantageous for the encoding of time-varying signals with pseudo-rhythmic structure on multiple time-scales such as speech.

P33

Reinstating functional sampling in dyslexics using non-invasive brain stimulation

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Developmental dyslexia is a common reading disorder that cannot be ascribed to low IQ, poor education, or a neurological damage. According to one of the main theoretical frameworks proposed to explain the phonological deficit associated to this condition, dyslexia might be due to a cognitive impairment specific to the representation of speech units (Ramus, 2003). As for the underlying neural basis, dyslexia has been associated with atypical neural oscillations in the auditory cortex as compared to normo-readers (Goswami, 2011). However, the involvement of specific neural oscillations in the phonological deficit remains debated. A previous study has shown that dyslexics present a decreased response to amplitude modulation to auditory stimuli in frequencies optimal for phonemic processing, within the low gamma range in the left auditory cortex (Lehongre et al, 2011). Here we propose the use of transcranial alternating current stimulation (tACS), applied at the optimal frequency for phonemic processing (i.e. 30 Hz) over the left auditory cortex, in order to reinstate functional sampling in the low gamma range. Results show that tACS induce an improvement in phonemic representation and phonological retrieval, thus corroborating the causal role of cortical gamma oscillations in phonemic encoding. Furthermore, we expect to observe an increased response in the low gamma range after the tACS stimulation, as compared to a sham stimulation. Our results support the role of low gamma oscillations in phonemic processing and their involvement in dyslexia, together with paving the way to the use of an experimental approach to restore the dysfunctional neural circuits.

P34

Altering the phonemic rhythm with 30 Hz tACS in dyslexics

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Developmental dyslexia is a failure to acquire reading and writing abilities. According to the phonological theory deficit, the core underlying cause of dyslexia is a reduced representation of speech units (Ramus, 2001). Dyslexia is now associated with atypical neural oscillations in the auditory cortex as compared to controls: cross-linguistic research and recent neurophysiological findings point towards a general auditory sampling deficit (Goswami, 2011; Tallal & Gaab, 2006). However, specific involvement of atypical neural oscillations in the phonological deficit is still debated. In this study, we propose that the phonological deficit in dyslexia could result from a deficit in temporal processing in the left auditory cortex involving low gamma oscillations (25-35 Hz), which would manifest as a decreased response to amplitude modulation to auditory stimuli (Lehongre, Ramus, Villiermet, Schwartz, & Giraud, 2011). The goal of the present study is to boost neural responses at this specific location and frequency with transcranial alternating current stimulation (tACS). We thus hypothesize that unusual phonemic representation format could be normalized by applying tACS at the optimal frequency for phonemic processing (i.e. 30 Hz). We expect to improve the phonological processing of language in dyslexics and to demonstrate a causal role of cortical gamma oscillations in phonemic encoding. Result show that tACS induced an improvement in phonemic representation and phonological retrieval, which corroborates the role of low gamma oscillations in the phonemic processing efficiency, and the involvement of this frequency range as potential cause of the phonological disorder in dyslexia.

P35

Audio Visual Integration in the brain: differences in the neural signatures of McGurk illusions

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In this work we study the neural correlates of audiovisual integration in the brain. Using Electroencephalographic recordings we show fundamentals differences between Congruent, Fusion and Combination percepts. Evoked response analysis show a reduced response in audiovisual integration related areas when the subjects report the Combination phenomenon compared to the perception of congruent stimuli and Fusion. Furthermore, using dynamical causal modeling we show that combination involve enhanced connectivity between the Anterior Temporal Cortex (ATC), Superior temporal Sulcus (STS) and Superior Temporal Gryrus (STG), while Fusion involve increase in top-down connectivity between high order areas (ATC, STS and STG) with sensory areas in the Primary Auditory Cortex and Motion Cortex.

P36

TASH: Toolbox for the Automated Segmentation of Heschl's gyrus

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Differences in auditory cortex size and morphology have been observed in the context of phonetic learning skill and expertise, professional musicianship and dyslexia. Heschl's gyrus (HG), which includes primary auditory cortex, displays variable anatomy across individuals and hemispheres. The most common gyrification patterns include single HG, common stem duplications and complete posterior duplications. Our novel toolbox, named TASH ('Toolbox for the Automated Segmentation of Heschl's gyrus'), serves to automatically segment HG, including possible duplications. TASH builds upon FreeSurfer for an initial segmentation, and then implements further MATLAB and TCSH shell-based scripts for finer auditory cortex feature selection. Given the small and highly variable morphology of HG, manual labelling remains the gold standard for segmenting the auditory cortex. However, manual labelling is time consuming and error prone. Existing automated software such as FreeSurfer makes a number of labelling errors, in particular (but not only) in the case of common stem duplications. TASH provides improved auditory cortex feature selection, both qualitatively and quantitatively. Here we present and discuss the application of TASH in the context of phonetic learning skill, professional musicianship and multilingualism. TASH effectively segments HG in a fully automated and reproducible manner, opening up a wide range of applications in the context of expertise, disease, genetics and brain plasticity.

P37

Effect of acute physical exercise on motor sequence learning

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Strong evidence suggests that regular physical exercise improves cognitive functions, especially in the memory domain by increasing neurogenesis in the hippocampus. The effects of acute physical exercise on cognition are less well understood. In animals, a single session of physical exercise has been shown to boost BDNF (Brain Derived Neurotrophic Factor) levels, a growth factor known to enhance neurogenesis and plasticity in the hippocampus. In this study we combined blood biomarkers, behavioral measures and fMRI to assess the impact of medium and high intensity acute physical exercise on motor sequence learning and underlying biomechanisms in humans. For this, we tested fifteen healthy participants across three visits using a serial reaction time task (SRTT) performed in fMRI before and after a period of exercise (moderate or high intensity) or rest. Additionally, participants wore a near infrared spectroscopy (NIRS) probe over the prefrontal cortex during exercise and rest and blood samples were taken before and after exercise and rest. We report an overarching effect of physical exercise: increasing performance levels ($p=0.05$), enhancing BDNF ($p=0.012$) and NIRS signaling ($p=0.004$). Further, concerning selectively the moderate intensity condition, we report a correlation between performance and BDNF levels, associated with increased right hippocampal activation during SRTT after moderate intensity exercise vs SRTT after rest. Links between performance, BDNF, NIRS and fMRI measures are being further explored. Overall, these findings shed light on the biomechanisms underlying the beneficial influence of acute physical exercise on motor memory functions.

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Relationships between white matter integrity and cognitive performance in aging: differentiation between good and poor performing older adults

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Aging is traditionally associated with cognitive decline, including slower processing speed and lower working memory abilities. This has been related to deterioration of the white matter (WM) in some regions of the brain. Yet, functional brain studies of aging suggest that older adults with preserved cognitive function do not necessarily differ from young adults. In this presentation, we explore the relationship between WM integrity and cognitive performance in 25 young adults, and 53 older adults subdivided into two groups based on their task performance. Cognitive evaluation was based on reaction times (RTs) in a battery of cognitive tasks, and accuracy in spatial working memory. Magnetic resonance diffusion tensor imaging (DTI) and tract-based spatial statistics (TBSS) were performed to assess voxelwise group differences in fractional anisotropy (FA). Results showed a significantly higher FA in young vs older adults (both groups) in several brain regions associated with both performance in RT and working memory. In addition, significant FA differences were found in the corpus callosum and bilateral posterior corona radiata between the two groups of older adults when differentiated (good versus poor) in the working memory task. This difference was not observed when the analyses were based on RT performance. This result suggests that WM integrity underlies age-related differences beween young and older adults in both processing speed and spatial working memory. Within older adults, disruption of WM was only related to accuracy in spatial working memory.

P39

Acute physical exercise improves memory consolidation in humans via BDNF and endocannabinoid signaling

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Regular physical exercise enhances memory functions and neurogenesis in the hippocampus, an effect partially mediated by BDNF (Brain Derived Neurotrophic Factor). Acute exercise promotes the release of endocannabinoids (especially anandamide, AEA), which are small lipophilic molecules that enhance BDNF release and have been shown to improve hippocampal plasticity in rodents. How a single session of exercise affects BDNF and AEA levels, and how these biomarkers influence memory performance remains to date unknown. Here we combined blood biomarkers, behavioral and fMRI measurements to assess the impact of moderate and high intensity acute physical exercise on memory and underlying neurophysiological mechanisms in humans. We hypothesized that moderate intensity exercise would optimize memory consolidation and enhance hippocampal activity via BDNF and/or endocannabinoid signaling. We tested associative memory performance in nineteen healthy participants across three visits: each visit consisted of a learning and a test part performed in fMRI separated by a period of exercise (moderate or high intensity) or rest. A long-term memory retest took place 3 months later. We report a selective increase in memory performance after moderate but not after high intensity exercise or rest at test and at long-term retest. Acute exercise boosted both BDNF and AEA levels: AEA increase after moderate intensity exercise correlated with hippocampal activity during retrieval suggesting that AEA may have an acute effect on synaptic plasticity in human. Whereas exercise-induced BDNF correlated with enhanced hippocampal memory representations measured using a decoding approach after moderate intensity exercise and with long-term, memory effects.

P40

Sensory adaptation after exposure to incongruent audiovisual McGurk stimuli suggests recalibration processes occurring at two temporal scales

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Speech sound categorization is subject to recalibration in response to incongruent audio-visual stimuli such as that eliciting the McGurk effect. The stereotypical McGurk effect occurs when listeners report hearing /ada/ in response to an /aba/ sound presented together with the video of a speaker saying /aga/. Interestingly, recent experimental work showed that listeners processed a purely acoustic /aba/ differently specifically when they had experienced the McGurk effect in the preceding trial but not otherwise. To elucidate the mechanisms of recalibration, we used a computational model of audiovisual speech integration that progressed in two stages: categorical perception and recalibration, a process by which the model is updated after each trial thus minimizing perceptual conflict. When considering how the residual prediction error was used to update model parameters, we found that rules typically used in parameter learning such as the recursive Bayesian updating or the delta rule could not account for the behavioural effect observed specifically after fused McGurk trials. The effect could be reproduced, however, when considering that speech category recalibration was determined by a dual time-scale process: a short time-scale update driven by the current trial's prediction error, decaying quickly over time, and a longer timescale one resulting in slower changes, maintaining the stable stimulus characteristics present over a longer time span. This computational modelling work suggests that speech sound category recalibration is differentially driven by recent and past prediction errors, which provides an optimal way of maintaining stable perception in the presence of varying sensory realizations.

P41

Cluster Mass tests for ERPs with complex designs

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Often researchers in psychology or neurosciences want to compare signals - e.g. event related potentials (ERPs) - at each time point in different conditions. This allows them to evaluate the timing of an effect without having to predefine arbitrary intervals (like the average from 100 to 200ms) or to make a priori hypotheses on this time course. However, since many tests are run simultaneously, a multiple comparison strategy must be used, to preserve what is known as the familywise error rate (FWER). The cluster mass test based on permutation is well known in this context to compare two conditions. Frequently, the experiments have much more than merely two conditions, which implies that if the researcher want to test a main effect or an interaction effect, the procedure has to take into account all other effects, including between subject and within subject effects. We present a method that can handle designs of any complexity as well as the use of continuous covariates for ERP analyses. One can show that this method controls the FWER. We also propose a freely available R package that provides tests and plots to analyze these data (https://github.com/jaromilfrossard/permuco).

P42

Dynamics of functional connectivity at high spatial resolution reveal long-range interactions and fine-scale organization

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Advances on functional magnetic resonance imaging have recently revealed the non-stationary nature of large-scale functional brain networks during resting-state. Methods of dynamic functional connectivity (dFC) aiming at unveiling the temporal reconfigurations of brain connections have thus gained increasing success in the last decade. Due to computational limits, dFC is typically computed using pre-defined atlases, a non-trivial choice that might influence results. Here, we first leverage new computational methods to retrieve voxel-level dFC in terms of dominant patterns of fluctuations, then, second, we demonstrate that this new representation is informative to derive meaningful brain parcellations, capturing both long-range interactions and fine-scale local organization. We analyzed resting-state fMRI of 54 healthy participants from the Human Connectome Project. Voxelwise dFC dominant patterns were captured through eigenvector centrality followed by clustering across time/subjects to yield most representative dominant patterns (RDPs). Voxel-wise labeling according to positive/negative contributions to RDPs, led to 37 unique labels representing the finest scale at which it is meaningful to investigate dFC and identifying strikingly symmetric dFC long-range patterns. These included 449 contiguous regions, defining a fine-scale parcellation consistent with known cortical/subcortical subdivisions. The reproducibility of the analysis was tested by using a different dataset and different window lengths. Our contribution provides the first whole-brain parcellation driven by voxelwise dFC and bridges the gap between voxel-based approaches and graph theoretical analysis.

P43

Leakage correction for EEG source space analyses based on spatial resolution properties

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Electroencephalographic (EEG) source imaging enables studying brain dynamics at high temporal resolution. Due to ambiguities in EEG scalp recordings caused by electrical volume conduction, EEG source reconstruction is mandatory for studying interactions of different brain regions. State-of-art methods ignore zero-phase lag interactions or orthogonalize source space signals, preventing analyses of zero-phase coherence. However, quasi zero phase-lag coherent fluctuations are hypothesized to form so called microstates, i.e., global states of neuronal activity on systems level. In this work, we introduce an alternative approach for leakage correction based on the spatial resolution properties to enable zero phase-lag coherence analyses. Spatial leakage between certain brain regions is exactly determined by their point-spread functions, i.e., columns of the resolution matrix. Therefore, our leakage correction approach is to pseudo-invert the resolution matrix using truncated singular value decomposition and weight source signals accordingly. We validate our leakage correction approach using simulations based on forward and inverse models derived from real data by imposing frequency-specific coherence between certain brain regions. After applying the proposed leakage correction method, we re-establish the imposed cross-coherence matrices from inverse source estimates. Spurious connections that are prominently present in the uncorrected source estimates were diminished to the noise level we used in the simulation. Further, given by the linearity of the models, spurious leakage of region-specific frequencies towards other areas could equally be suppressed to noise levels, while reconstructing the imposed frequency-specific network precisely. In summary, we consider our work as further step towards studying large-scale brain networks at milliseconds time resolution.

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Methodological tools to characterise the network integration power of different brain regions

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Information processing in the brain is regulated by the capability of the network to temporarily become functionally integrated in response to incoming local stimuli. Our study aims to characterise how local activity influences global computation in different contexts. We propose two approaches to quantify the power of a given brain area to transmit information to other regions. The intrinsic ignition framework studies the global effects of naturally occurring local intrinsic perturbations as they are propagated. To do so, it measures changes in the global integration after an intrinsic event. The perturbational approach measures the spatiotemporal propagation of external stimuli in an off-line fashion, i.e. using a computational model based on a Hopf bifurcation. We locally apply a long lasting perturbation promoting synchronization or desynchronization across brain regions and measure the relaxation time for the integration to recover its basal state. The methods were tested in different contexts. The brain network was found to have higher ignition in wakefulness when compared to coma (fMRI). The fitting of the Hopf model revealed that the working point is state-dependent. In particular, results indicate that the brain is more rigid to external perturbations during coma, whereas the awake state integrates perturbations for a longer time period. The methodological tools presented here have proven to be useful to characterise the dynamical complexity of different brain states. These methods can be used to explain general principles of brain processing.

P45

White matter inpainting via structurally informed diffusion of functional data

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One of the major challenges in neuroscience today is the integration of function and structure. In the past year, there has been a growing interest in tackling the problem in a graph signal processing (GSP) perspective. In this work, we take advantage of the high-resolution structural data that can be derived using diffusion-weighted magnetic resonance imaging (DW-MRI), in order to construct a whole brain 3D graph at a voxel-level resolution. By taking the eigendecomposition of the graph Laplacian, we obtain a set of orthogonal eigenvectors (i.e., brain eigenmodes) that together forms a basis for representing any signal on the graph. In parallel to this, we initialize the blood-oxygenation level dependent (BOLD) signal obtained from functional MRI at the boundary nodes of the gray matter and white matter (WM) interface. A generalized linear diffusion model that is expressed on the graph is used to diffuse the signals, and effectively inpaint major WM structures. The diffusion process is applied to all the functional volumes of all resting-state (RS) sessions downloaded from the Human Connectome Project (HCP). Our method reveals, for the first time, a voxel-level resolution of human brain eigenmodes that show structurally meaningful, and functionally relevant major white matter tracts. In addition to this, the outcomes of our work expand the limited number of studies that tackle the integration of brain structure and function, and at the same time, demonstrate the powerful use of GSP operations in the study of functional brain imaging.

P46

Psychophysiological Interaction of Co-Activation Patterns: Tracking Task-Modulated Brain Activity

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Investigating task-related modulations of Functional Connectivity (FC) with functional magnetic resonance imaging (fMRI) is crucial to reveal the neurological underpinnings of cognitive processing. Existing analytical methods hypothesise sustained FC within the duration of a task, but this assumption has been shown too limiting by recent imaging studies. Chang and Glover (2010) were the first of many to show that FC fluctuates over time in resting state recordings, suggesting that dynamic features of FC are essential in obtaining an accurate picture of brain function. Along the same line, activation time courses during task execution are also known to show exquisite complexity that cannot be captured by standard stationary approaches (Gonzalez-Castillo et al., 2012). While resting-state FC research increasingly probes non-stationary configurations of brain activity, task-based settings are yet to fully exploit these approaches. Unveiling the dynamics of task-dependent FC may thus shed light on previously uncharacterised brain function during performance of cognitive tasks. Here, we describe a new seed-based method, called Psychophysiological Interation of Co-Activation Patterns (PPI-CAPs), that extracts task-dependent patterns of brain activity from a subset of the available fMRI data. To demonstrate the method's validity, we used recordings from 10 subjects watching a film with scenes tagged as "science" or "fun". First, frames were selected in which the seed activity was high; then, those were clustered into groups of co-activation patterns (CAPs); finaly, CAP occurences for each scene type were analysed, providing insight on context-dependent patterns. This approach contributes to the state-of-the-art methodologies for tracking brain function dynamics.

P47

Sequel analysis of peripheral blood flow

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Traditional methods of analyzing human peripheral blood flow (PBF) do not account for its continuous nature or small-scale variation. Till now PBF measurement is mainly based on estimating the inter-beat interval (IBI). We present sequel transformation as an alternative methodology for measuring variations within the PBF. By using the sequel analysis, information can be extracted that is consistent with the influence of several physiological and psychological factors. This kind of variation is reflected in the PBF signal. After determining and extracting relevant events from vascular volume data generated by sequel transformation, we use template analysis to estimate patterns of events as time courses of activation. The additional benefit of the sequel analysis is demonstrated on a data-set (n= 10 participants) with music induced emotional events.

P48

Evolutionary approach to emotion using affective prosody: a fNIRS study

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In this study, our goal was to investigate via functional Near Infrared Spectroscopy (fNIRS, Artinis) how humans categorize and discriminate emotions in primate vocalizations. All participants were exposed to the same stimuli, consisting for human voices of onomatopoeias (extracted from the Montreal Affective Voices-MAV) and calls produced by chimpanzees, bonobos and macaques for other primate vocalizations. These stimuli were expressed by two male and two female speakers in an angry, fearful or happiness tone for human voices. Equivalent calls for primate vocalizations expressed: anger (aggressors screams), fear (victim screams) and happiness (food grunts). 36 different stimuli were presented during a mini-block design with two tasks: "categorization" and "discrimination" repeated three times resulting in 6 blocks, the order of which was pseudo-randomly assigned to each participant. The same stimuli were used in a discrimination and categorization task to test the hypothesis of lateralization of the cerebral processing. We predicted that the emotion task would induce an increase of the OxyHemoglobin (the most relevant signal from the Hemodynamic Response function) in the Bilateral IFC more or less important and specific according to the species that produced the vocalizations (Human > Chimpanzee = Bonobo>Macaque). Furthermore, we expected that the behavioural results: time reactions (RT) and the number of correct answers would follow the same phylogenetic pattern, as the fNIRS data, with an increase of RT and a decrease of answer accuracy for macaques in opposite to chimpanzees and bonobos. We present here the preliminary results of this experiment in fNIRS.

P49

An Introduction to the Microstate EEGlab toolbox

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EEG microstate analysis offers a sparse characterisation of the spatio-temporal features of large-scale brain network activity. However, despite the concept of microstates is relatively straight-forward and offers various quantifications of the EEG signal with a relatively clear neurophysiological interpretation, a number of important aspects about the currently applied methods are not readily comprehensible. Here, we aim to increase the transparency about the methods to facilitate widespread application and reproducibility of EEG microstate analysis by introducing an EEGlab toolbox for Matlab. The software is open source, allowing the user to keep track about all details in every analysis step. The toolbox is designed to facilitate the development of future methods (e.g. cluster algorithms). While the toolbox can be controlled with a GUI, making it easier for novices to take their first steps, the Matlab framework allows advanced users to create scripts to automatise analysis for multiple subjects to avoid tediously repeating manual operation. Here we provide an overview of the Microstate EEGlab toolbox functions by analysing a publicly available dataset of resting EEG. We compare the resulting fit measures, microstate topographies, and microstate statistics to results obtained with the two widely used software packages CARTOOL and sLORETA and another EEGlab toolbox, which is dedicated to microstate analysis. The comparisons between the microstate analyses yield all-in-all similar, yet distinct results. The differences are difficult to explain as not all the details about the procedures in the existing software are fully transparent. We take this finding as an argument to promote open source software.

P50

Estimating EEG source dipoles based on singular-value decomposition for connectivity analysis

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High-density electrode arrays in EEG recordings and source reconstruction algorithms have allowed the investigation of brain-networks dynamics. Time-varying effective connectivity is a powerful tool for investigating large-scale functional brain-networks. Due to computational and interpretation limitations, it is necessary to parcel the brain into regions-of-interests (ROIs) before computing EEG connectivity in the inverse space. One specific need and still open problem is to summarize the information carried by hundreds of solution points in each ROI with a unique time-series. The main aim of this work is to provide a method to compute a signal that explains most the variability of the data to represent the source signals within a ROI and to overcome the common procedure of averaging all the time-series contained in the same ROI before computing time-varying connectivity. The proposed representative time-series is the first eigenvector computed by a Singular Value Decomposition (SVD) of all dipoles in the same ROI. We applied this method to a dataset of spikes of epileptic patients and we evaluated the time-course and the frequency content of the obtained signal. In each source space ROI, both the time-course and the frequency content of the proposed method resembled the expected scalp-EEG spike-time-course and frequency content. We were able to sum up the information carried by hundreds of time-series in a unique signal representing the most of the variability of the sources (~80%), providing a solution for both challenges, i.e., estimating the dipole orientation and summarizing information in a specific ROI, while overcoming common computational limitations.

P51

Joint estimation of activity and haemodynamic response from functional MRI data

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The investigation of spontaneous brain activity from fMRI data is a central preoccupation in contemporary neuroscience. As this trend grows, activity detection methods that can adapt to different activation scenarios must be developed. A remarkable recent work, in this sense, is the "Total Activation" framework. This deconvolution approach combines temporal and spatial regularization to reveal neuronal events without incorporating prior knowledge on their placing, timinig or duration. However, this approach needs a full prior characterisation of cerebral hemodynamics; the hemodynamic response function (HRF), used to conduct the deconvolution task, is assumed to be completely known and the same over the entire brain. In the present work, we pursue the efforts towards having non-parametric methods by performing the deconvolution task while estimating the HRF. More precisely, we exploit the sparsity of the neural activity to estimate the Taylor expansion coefficients of the HRF. These coefficients are inherently linked to three values of interests that characterize the hemodynamics: height, time-to-peak and the width of the response.

P52

Synchronized power activity derived from EEG source imaging as a connectivity measure for dynamic network modeling

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In EEG, an increase or decrease in local synchrony in a certain frequency band can be measured by "induced activity", i.e. an increase or decrease in power over the respective locations in response to a stimulus. On the other hand, the communication through coherence framework suggests that distant cell assemblies communicate by synchronizing in a specific frequency band. We propose to connect these two concepts by assessing functional connectivity (FC) based on power modulations that are close in time. We show the feasibility of this approach by analyzing source space ROI data acquired with high density EEG with a simple visual task. We compute power envelopes in different bands (alpha, beta, gamma) and transform the resulting time courses of power modulation into a point process, as has proven successful for fMRI. This allows us to define frequency specific, time-varying FC by considering co-occurring "events". Effects of volume conduction are removed by discarding simultaneous events. A maximum temporal distance between events is chosen, taking into account wavelength and plausible delays. Thus, directionality is recovered and the flow of information can be analyzed.

P53

Test-retest reliability of resting and task-related EEG measures

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To date, limitations to the utility of EEG and eye tracking in clinical contexts include the lack of standardized testing and analysis protocols, large normative databases for comparison and the evaluation of psychometric properties such as test-retest reliability. Thus, the purpose of the current study was to assess the test-retest reliability of a newly developed test battery combining electrophysiology, eye tracking and behavioral modeling intended as a resource for the quantification of the components (i.e. processing steps) that are required to perform cognitive tasks and hence better understand why individual differences may occur. This neurocognitive test battery consists of seven EEG and eye-tracking based paradigms that can be applied within 90 minutes. The paradigms assess resting state, perception, attention, working memory, episodic memory, cognitive control, and processing speed, reflecting key cognitive functions. 30 healthy elderly subjects (mean age 68.9, sd. 2.9) attended two sessions at the University of Zurich, with a between-session interval of two weeks. The reliability of the measurements was estimated with intra-class correlation measures. The results revealed high test-retest reliability of resting state measure (e.g. alpha peak, 1/f, frequency spectra and microstate parameters; $.6 < r < .9$)) but also shows that the task-based measures (e.g. P300, SSVEP, theta-phase gamma-amplitude coupling) are stable over time ($.5 < r < .8$). These results suggest that resting and task-related EEG has numerous features with adequate test-retest reliability to assess cognitive aging on a continuum between what is considered as “normal” and “dysfunctional”.

P54

Target selection in auditory cortex for real-time fMRI neurofeedback in tinnitus

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Recent advances in real-time functional magnetic resonance imaging (rt-fMRI) have permitted the setup of increasingly elaborated rt-fMRI neurofeedback training paradigms, allowing participants to learn a volitional control of complex brain activity patterns. In this context, with the fast development of online processing tools, many questions on optimal parameters within specific rt-fMRI neurofeedback experimental designs are left behind and remain unanswered. Nonetheless, several proof-of-concept studies are supporting the potential of neurofeedback-mediated learning in the induction of long-term behavioral changes in clinical populations. A particular focus among those is chronic tinnitus, a permanent ringing in the ears and often arising from an auditory trauma, which severely impairs the quality of life of affected people. Chronic tinnitus is also often associated with neuronal hyperactivity in the primary and secondary auditory cortices. While the exact source of its percept is not clear, down-regulation of auditory cortex using rt-fMRI neurofeedback has been attempted in a small sample of patients, resulting in a slight subjective improvement of the symptom in five out of six patients. In this work, we further complement these results with an analysis of the target regions of interest (ROIs) selected within the auditory cortex. In particular, we look at the different responses within these regions during the down-regulation task in healthy and tinnitus patients. Preliminary results suggest that a strategy for fine-tuning the patient-specific ROIs could be applied between each rt-fMRI session, potentially contributing to enhance the learning curve of future neurofeedback training.

Perception

P55

A predictive coding model of speech perception with neural oscillations

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Theoretical and empirical works suggest that neural oscillations play a role in several aspects of speech processing. In particular, coupled theta and gamma oscillations could help segmenting continuous speech into syllable-like units and organizing gamma activity into stimulus-induced and theta-modulated decipherable spike-trains. On the other hand, speech comprehension is heavily dependent on contextual cues, and the notion of online top-down control is hence also a determinant factor of speech processing. Although both neural oscillations and neural predictions seem to play a role in speech perception, it is still unclear how the two notions can co-exist and complement each other. In this study, we created a syllable identification generative model to address how theta oscillations interact with top-down and bottom-up information flows in the brain during speech perception. In this model, the information about syllable boundaries is signaled by theta oscillations entrained to the speech envelope and is used to align the model's gamma activity with the input. The modeling results show that such an alignment significantly improves the cooperation of top-down and bottom-up information flows, which appears as a crucial factor for speech encoding accuracy. Although internal expectations about syllable duration could provide an alternative way to predict syllable boundary, the simulations demonstrate that the model performs best when it combines top-down temporal expectations about syllable duration, with bottom-up information about syllable onsets and intersyllabic distance. These results suggest that the interaction of theta oscillations, with top-down and bottom-up information flows, is an important factor for speech perception in the brain.

Perception

P56

Resting-state activity in high-order visual areas as a window into natural human brain activations

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A major limitation of conventional human brain research has been its basis in highly artificial laboratory experiments. Due to technical constraints, little is known about the nature of cortical activations during ecological real life. We have previously proposed the "spontaneous trait reactivation (STR)" hypothesis arguing that resting-state patterns, which emerge spontaneously in the absence of external stimulus, reflect the statistics of habitual cortical activations during real life. Therefore, these patterns can serve as a window into daily life cortical activity. A straightforward prediction of the STR hypothesis is that spontaneous patterns should preferentially correlate to patterns generated by naturalistic stimuli compared to artificial ones. Here we targeted high-level category-selective visual areas and tested this prediction by comparing BOLD functional connectivity patterns formed during resting-state to patterns formed in response to naturalistic stimuli (audio-visual movie segment), as well as to more artificial category-selective and dynamic stimuli. Our results revealed a significant correlation between the resting-state patterns and functional connectivity patterns generated by naturalistic stimuli. Furthermore, the correlations to naturalistic stimuli were significantly higher than those found between resting-state patterns and those generated by artificial control stimuli. These findings provide evidence of a stringent link between spontaneous patterns and the activation patterns during natural vision.

P57

The layer-wise information profile of mental imagery and illusory perception in primary visual cortex (V1)

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Mental imagery and illusory perception are both sensory experiences in the absence of corresponding input. The currently dominant view is that mental imagery is 'perception-like' in nature. This notion is based on previous research, which has shown that the processing of mental images in primary visual cortex (V1) resembles that of physical images. However, the experience of voluntary mental imagery is clearly distinguishable from physical stimulation, whereas illusory perception seems (almost) 'real'. This phenomenological difference cannot be explained by the notion that neural activity patterns in visual cortex are identical during mental imagery and perception. Maybe this conclusion was premature: Mental imagery relies on the top-down recruitment of visual cortex by higher-level areas. Top-down projections arrive in different V1 layers than bottom-up projections from the eye. As a result, perception and mental imagery might differ in their laminar information profiles: imagery-related information might be primarily present in top-down input layers, whereas perceptual information should be expected in both bottom-up and top-down input layers. In addition, in light of the perceived 'realness' of illusory perception, it is possible that its laminar information profile is more similar to that of physical stimulation. These differences in layer-specific information profiles may have been missed by conventional fMRI methods, which do not distinguish signals at different cortical depths. Using the novel high-field layer-specific fMRI approach together with multi-voxel pattern analysis, we aim to investigate this issue and identify the different functional characteristics of (illusory) perception and mental imagery. Here we present the first results.

Perception

P58

The sound of salience: enhancing behavioural efficiency and neural coherence through communication.

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Being able to emit salient sounds, capture attention and elicit rapid reactions in conspecifics is the most elementary goal of communication. To be perceptually salient in a noisy environment, one strategy consists in temporally enriching stimuli up to the sampling limit of the receiver's sensory system. Here, we show that at low signal-to-noise ratio, providing fast, roughtemporal cues (40–130 Hz) enhances behavioural efficiency (sound detection and localization) and increases subjective salience. Beyond this range, where events cannot be temporally discretized and are perceived as continuous (pitch), efficiency consistently drops across tasks. Using intracranial recordings, we show that temporally salient sounds induce large-scale synchronization of auditory and non-auditory networks involved in exogenous attention and arousal in a sustained manner. These results demonstrate that emitting sounds in the roughness range enhances perceptual salience and neural coherence through communication in the receiver's brain.

P59

Dynamic neural mechanisms of feature-based attentional control as revealed by fMRI and EEG

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To compensate for the limited capacity of our visual system, mechanisms of selective attention allow to prioritize the processing of behaviorally relevant locations and features. In the present work, we investigate the brain mechanisms underlying feature-based attention at a central location when relevant and irrelevant visual features either coexist independently or are fused. We recorded fMRI and EEG in separate sessions, while twenty human participants performed either an orientation discrimination task or a motion discrimination task on stimuli with overlaid or merged features. Overlaid stimuli consisted of random dot kinematograms (RDK) and sinusoidal gratings (Gabor patches), such that RDK's coherent motion direction and Gabor orientation were independent features. For merged stimuli, by contrast, the features were not independent: orientation information emerged from sinusoidal contrast patterns in the RDK, and motion information was present in the shape of the oriented grating. fMRI results showed stronger responses for overlaid stimuli compared to merged stimuli in regions of the cingulate and orbitofrontal cortex. These findings suggest a higher involvement of cognitive control regions in the processing of overlaid stimuli, which may aid the attentional segregation of relevant and irrelevant features. EEG results showed a significant task effect (motion vs. orientation) only for overlaid stimuli. This effect was observed as an early increase in global field power (GFP) for the orientation task at around 110 ms, and a later increase in GFP for the motion task at around 220ms, suggesting feature-specific dynamics of attentional segregation.

Perception

P60

Posterior temporal voice areas and parahippocampal gyri allow noise-free voice perception

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The organization of the human cortex evolved toward a functional specialization of distributed brain regions, and the superior temporal cortex was found to preferentially respond to human voice stimuli. We explored functional connectivity between/within temporal voice areas in 98 who listened to vocal and non-vocal stimuli. Whole-brain regions were used as regions of interest (ROI) for functional connectivity analyses revealing high-coupled functional connectivity between bilateral temporal cortex (TC) regions and inferior frontal cortices as well as uncoupled connectivity with the parahippocampal gyrus. Our specific analyses highlighted a crucial yet poorly known player in voice perception, namely the parahippocampal gyrus. The parahippocampal gyrus seems to contribute to voice perception in a fundamental way by having feed-forward and/or feedback functional connectivity with posterior temporal brain areas (negative connections), regions that are extremely sensitive to perceiving environmental noise. The posterior TC and the posterior parahippocampal gyrus would hence form a coupled functional network allowing for a clear, noise-free perception of voice in Humans.

Perception

P61

Properties of face localizers and their application in fMRI fingerprinting

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Functional localizers are particularly prevalent in functional magnetic resonance imaging (fMRI) studies concerning face processing. In this study, we extend the knowledge on face localizers regarding four important aspects: First, activation differences in occipital and fusiform face areas (OFA/FFA) and amygdala are characterized by increased activation while precuneus and medial prefrontal cortex show decreased deactivation to faces versus control stimuli. The face-selective posterior superior temporal sulcus is a hybrid area exhibiting increased activation within its inferior and decreased deactivation within its superior part. Second, the employed control stimuli can impact on whether a region is classified as face-selective or not. We specifically investigated this for recently described subregions of the FFA (FFA-1/FFA-2). While FFA-2 responded stronger to faces than to objects, houses, or landscapes, FFA-1 was only detected with landscapes as control condition. Third, reproducibility of individual peak activations is excellent for right FFA and quite good for right OFA, whereas within all other areas it was too low to provide valid information on time-invariant individual peaks. Finally, the fine-grained spatial activation patterns in right OFA and FFA are both time-invariant within each individual and sufficiently different between individuals to enable identification of individual participants with near-perfect precision (fMRI fingerprinting).

Other

P62

Neurophysiological synchronous spiking in the auditory steady-state: EEG study

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Periodic stimuli are widely used to study perceptual and neuronal responses in animal and human, contributing to the characterization of the transmission and transformation of information in the complex systems such as the nervous system. Despite the large amount of accumulated data, the nature of the response to periodic stimulation remains unresolved: signature of entrainment of intrinsic oscillators or superposition of the evoked response or combination of both. This study adds to the field the following information: 1. a systematic observation on 30 subjects recorded with 40 different stimulation rates of auditory clicks trains, 2. a display of the full waveform of the grand average waveform without filters and a good signal/noise ratio, 3. advanced spectral and phase analysis highlighting synchronous spiking phenomena at the EEG level , 4. a simulation reproducing the waveform and showing the most preeminent phenomena. The evoked potential seems to be the preeminent phenomena in the auditory periodic responses recorded with EEG. Steady-state response amplitude and response peaks and valleys can be explained by the constructive and destructive interference of the electric fields produced by the multiple generators along the auditory pathway. The literature reports potential intrinsic oscillators in the auditory cortex (with preferred frequency around 40Hz) and their entrainment by auditory stimulation might be hidden by the strong ERP responses shown in this study. More importantly, this study proposes to consider the synchronous spiking involment in the process.

Other

P63

Spontaneous and voluntary modulation of the first-person perspective using gravitational cues and an own-body transformation task: an fMRI study

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Recent neuroscientific research suggests that the fundamental sensation of being the 'I' of subjective experience that is attached to a body is composed of three necessary and sufficient components: self-identification, self-location and first-person perspective (1PP). 1PP is defined as the subjective directedness of the 'self' upon the world. Previous research has shown that its directional experience can be modulated by visual gravitational cues when lying in supine position, so one perceives the world as up-looking or down-looking at it. In a behavioral study, we were able to produce changes in experienced direction of the subjective 1PP by means of visual gravitational cues on a trial-by-trial basis. Following-up on this study and to investigate the neural network related to 1PP, we conducted an fMRI study comprising the above-mentioned task (i.e. spontaneous perspective taking) as well as a top-down task in which participants had to voluntarily change 1PP (forced perspective-taking). Moreover, participants completed an own-body transformation task (OBT), where they had to take the place of an avatar, as if the body they saw were their body. We hypothesized that these three tasks would allow us to isolate the commonalities and specificities of neural mechanisms underlying 1PP. In the GLM, factors included the direction of both the gravitational cues and the voluntary 1PP as well as the rotation angles of the OBT task. In an additional regression analysis, 1PP ratings were entered as a covariate. Our results are discussed based on the theory of multisensory integration of bodily stimuli underlying bodily self-consciousness.

Other

P64

Adopting the Brain Imaging Data Structure (BIDS) in the Connectome Mapper

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Connectome Mapper is an open-source software pipeline that has been developed since 2012 to help researchers through the tedious process of organizing, processing and analyzing diffusion MRI data to perform global brain connectivity analysis. At this time, there had been no standard tools to describe data and its organization on storage devices, despite initiatives such as the eXtensible Markup Language (XML)-based Clinical Experiment Data Exchange schema (XCEDE) or the openfMRI convention, which had been poorly adopted. This was mainly caused by the adoption of tools not trivial to be used for non-informatics experts, together with the lack of file format specifications (XCEDE), and by the lack of explicit support for a number of important data types such as diffusion MRI (openfMRI). Consequently, the Connectome Mapper adopted its own standard for description and organization of anatomical and diffusion MRI, which requires reorganization of open datasets and limits the inter-operability with other software. Last year, a standard, known as the Brain Imaging Data Structure (BIDS), has emerged and been increasingly used. BIDS gives specifications on data description based on simple text-based file formats, a comprehensive data organization, and the use of NIfTI for images. Such standard is indeed essential to guarantee data understanding for people not implicated in the acquisition, easy data sharing and re-using within or between the labs, and application of automated analysis workflows for enhanced reproducibility and efficiency. In this work, we present a new version of the Connectome Mapper that adopts BIDS as standard for datasets.

PARTICIPANTS

Poster abstracts are preceded by a ‘P’,

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