{{Conference}}

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Scientific Programme

Friday, 21 May 2021

SYMPOSIUM
10:45 – 12:00 Channel 4

S31 Sleep and wake brain activities and memory processes. / Activités cérébrales pendant l'éveil et le sommeil en lien avec les processus de mémorisation.

C. Peyron (Bron)

S31.1 **Hippocampal rhythms, brain hemodynamics and functional Ultrasound (fUS): a novel approach to study brain function during sleep and wake. / Rythmes de l'hippocampe, réseau vasculaire et ultrasons fonctionnels (fUS): une nouvelle approche pour l´étude du cerveau pendant le sommeil et l'éveil** 10:45 – 11:00

A. Bergel (Paris)

Functional Ultrasound (fUS) imaging is a novel neuroimaging modality which measures brain hemodynamics with good temporal resolution (200 milliseconds) and low experimental constraint. Coupled to electrophysiology, it is powerful in revealing global “activation patterns” associated with a specific behavior and associated brain rhythms. Here, we combined fUS, local field potentials and video to study the large-scale activation maps associated with hippocampal theta and gamma rhythms. We illustrate our approach in three different contexts:
1- during spontaneous sleep in rodents, showing that REM sleep is characterized by brain-wide hyperemia associated with local gamma oscillations
2- during locomotion in a running task, showing that hemodynamics are strongly adaptive despite stereotyped running behavior
3- during sleep/wake transitions in a reptile model, showing that vascular neural and vascular patterns are coupled with long delays (10-15 seconds).
Our approach shows that fUS brings novel information about the neurovascular patterns associated with sleep and wake and that the overall picture of neurovascular interactions during spontaneous behavior is highly complex.

S31.2 **Characterizing the activity and function of neural assemblies occurring in the hippocampus during rapid eye movement sleep. / Activité et fonction des assemblées de neurones hippocampiques pendant le sommeil paradoxal.** 11:00 – 11:15

R. Boyce (Marseille)

Recent work has demonstrated that rapid eye movement sleep (REMs) is involved in the formation of spatial memory. However, detailed mechanistic insight into precisely how neural activity occurring during REMs influences the processing of spatial information is currently lacking. In this presentation I will provide an overview of recent work which cumulatively aims to help address this issue. To start, I will discuss unpublished single-unit data obtained from mice implanted with microdrives which had spatial memory impairments induced by REMs-selective optogenetic inhibition of septal GABAergic neurons. Particular focus will be given to the characteristics of potentially memory-associated synchronous neural activity patterns identified from these recordings during REMs. To better explore the full extent of these events, I will next supplement the results with a characterization of large-scale 2-photon calcium imaging data obtained across the full sleep-wake cycle in fully habituated head-fixed mice. I will then provide an update on ongoing 2-photon imaging experiments which, through the use of spatially precise photoinhibition of select neurons, are designed to directly test the involvement of neural assemblies

occurring during REMs in the processing of spatial information. A brief discussion of the implications of this data will conclude the presentation.

S31.3 **Investigating the developmental advantage of slow sleep oscillations on memory-related brain connectivity mechanisms in children and adults. / Bénéfice développemental des oscillations lentes pendant sommeil sur la connectivité cérébrale chez les enfants et les adultes.** 11:15 – 11:30

C. Urbain (Bruxelles)

It has been hypothesized that slow wave sleep (SWS) benefits the consolidation of hippocampus-dependent declarative memories (i.e., memory for facts and events). In this presentation, focusing on the developmental role of sleep mechanisms underlying memory consolidation processes, I will show how slow brain synchronization processes occurring during slow wave sleep (SWS, 0.5-4Hz) may trigger memory consolidation processes across development by transferring newly learned information from the hippocampi (short term store) towards the prefrontal brain regions (long term store). We recently showed using MEG and a verbal declarative memory task where children had to remember the association between non-objects and their functions that, whereas learning-dependent changes in brain activity were observed within (para)hippocampal regions (compared to pre-learning session, p< .0001), 90-minute daytime nap (including mainly SWS) after learning was sufficient to trigger the reorganization of memory-related brain activity toward prefrontal areas, whereas no equivalent change was observed after a similar period of wakeful rest (p< .05). Moreover, behavioural results comparing healthy adults and children who differ by the amounts of SWS for an equivalent period of sleep (more SWS in children) suggest that memory consolidation processes related to slow brain synchronization during SWS occur at a faster pace in children (p< .05). We will also present preliminary MEG results where we compared, the impact of sleep (vs. wakefulness) on the brain connectivity mechanisms associated with the immediate and delayed retrieval of new declarative memories in children.
Finally, I will show how such findings open up novel avenues to investigate the pathophysiological brain processes underlying memory consolidation deficits in children with brain disorders (such as in childhood epilepsies), linking abnormal sleep patterns, cognitive disturbances and impaired plasticity processes throughout development.

S31.4 **The role of sleep in memory, vocabulary learning and cognitive development in children. / Le role du sommeil dans la mémoire, l´apprentissage du langage et le développement cognitif chez l'enfant.** 11:30 – 11:45

A.R. Weighall (Sheffield)

Sleep has a crucial role to play in our most basic cognitive functioning, including an active role in everyday learning and memory consolidation, which is especially important in the context of cognitive development. The ways in which sleep can affect our ability to lay down new information and to learn will be discussed with reference to a series of experiments which investigated spoken word learning in children (e.g., Henderson, Weighall, Brown & Gaskell, 2012; Weighall et al., 2017).Vocabulary acquisition in young children can appear rapid and seamless. Yet research with adults suggests integration of novel and existing knowledge (measured by engagement in lexical competition) requires a consolidation period associated with sleep (e.g., Dumay & Gaskell, 2007). These findings are well explained by neural models of learning in which sleep provides an opportunity for hippocampal information to be fed into long-term neocortical memory. The talk will provide an overview of a programme of research which investigated whether this time course dissociation also characterises word learning in children between the ages of 5 and 12 years, using a range of research methods including eyetracking and polysomnography (EEG during sleep). Our results suggest that children, like adults, require a period of offline (sleep-associated) consolidation in order to establish new words in the lexicon - and that these findings hold true across a range of different learning paradigms. Furthermore, a richer established body of vocabulary knowledge may support consolidation and integration of new vocabulary. The implications of these findings for our understanding of memory and learning, and cognitive development more generally will be considered throughout the talk.

Discussion 11:45 – 12:00