UNIVERSITÄT SALZBURG

LAB for SLEEP & CONSCIOUSNESS RESEARCH

Wintersymposium

"Sleep, Cognition and Consciousness"

02/03 – 05/03/2017 Kaprun / Austria

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FWF Der Wissenschaftsfonds.

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Welcome Letter

Dear Attendees,

It is our pleasure to welcome you to our 3rd Wintersymposium on "Sleep, Cognition and Consciousness"!

We are glad that again so many of you have agreed to come to Kaprun and join us for this exciting interdisciplinary winter symposium! We are looking forward to hearing talks from internationally renowned researchers on topics such as sleep, cognition, consciousness and circadian rhythmicity and we are especially happy that also a lot of young scientists have taken the opportunity to present their work during our “Data-Blitz” sessions on Saturday morning.

The meeting will start on Thursday, 2nd of March, at 2pm with an opening ceremony followed by the first talk at 2:30. Friday afternoon has been kept free to guarantee some time for skiing, hiking and enjoying the beautiful surroundings at the Kitzsteinhorn or the Maiskogel for colleagues who are unable to stay with us on Sunday. The official scientific meeting will be concluded on Saturday at 6 pm but we hope that you will stay with us including Sunday to join us on the beautiful skiing slopes of Kaprun and continue scientific exchange!

We are looking forward to fruitful discussions and plenty of fun during our meeting on sleep, cognition, consciousness,… snow and skiing!

Enjoy the meeting!

Manuel Schabus & Kerstin Hoedlmoser

Notes:

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Program - Thursday, 02/03/2017

Opening Ceremony **14:00**

Thien Thanh Dang-Vu **14:30**

Sleep spindles: from physiological mechanisms to clinical applications

Oliviero Bruni **15:00**

The relations between sleep microstructure, spindling activity and cognition in healthy children and in children with neurodevelopmental disabilities

COFFEE BREAK **15:30 – 16:00**

Eus van Someren **16:00**

Wake watchers: a different perspective on insomnia disorder

Srivas Chennu **16:30**

Brain microstate dynamics modulate connectivity and predict responsiveness as we fall asleep

Christian Cajochen **17:00**

Blue is not blue: impact of light on human sleep and circadian physiology

Program - Friday, 03/03/2017

Julien Doyon **09:00**

Sleep Contribution to Motor Memory Consolidation

Steffen Gais **09:30**

Sleep and the interactions in multiple memory systems

COFFEE BREAK **10:00 – 10:30**

Wolfgang Klimesch **10:30**

Brain Oscillations and Consciousness: Towards a System Approach of Coupled Oscillators

Lucia Melloni **11:00**

Cortical tracking of natural and artificial online speech

Nathan Weisz **11:30**

Studying large-scale neural dynamics of conscious auditory perception

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Program - Saturday, 04/03/2017

09:00 Data-Blitz – Part 1

09:00 Mohamed S. Ameen
Power and Phase connectivity analysis after transcranial Alternating Current Stimulation (tACS) in different conscious states

09:13 Tessa F. Blanken
From heterogeneous insomnia to (more) homogeneous subtypes – results of a latent class cluster analysis

09:26 Christine Blume
A Clue to Consciousness? Significance of Circadian Rhythms in Severe Brain Injury

09:39 Monika Schönauer
Decoding material-specific memory reprocessing during sleep in humans

09:52 Michael Hahn
The impact of developmental changes of sleep spindles on declarative learning and general cognitive abilities – a longitudinal approach

10:05 Dylan M. Smith
The Relationship Between Sleep Misperception and Spindle Architecture in Primary Insomnia

10:18 Diego Vidaurre
Task-free consciousness segregates into two distinct modes of dynamical activity

10:31 Angus B. A. Stevner
Whole-brain dynamic functional connectivity of transitions between wakefulness and sleep

10:44 Simon Henin
Speech segmentation in the human brain: Insights from intracranial EEG

11:00 – 11:15 COFFEE BREAK

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Program - Saturday, 04/03/2017

Data-Blitz – Part 2 11:15

Péter P. Ujma **11:15**

The sleep EEG spectrum as a sexually dimorphic marker of general IQ

Frank Jasper van Schalkwijk **11:28**

The effect of napping on the consolidation of declarative and procedural information

Rick Wassing **11:41**

Targeted emotional memory reactivation during sleep

Tomasz Wielek **11:54**

Sleep in patients with disorders of consciousness and machine learning

Kathrin Bothe **12:07**

Sleep and gross-motor performance in adolescents- the inverse steering bicycle task

Malgorzata Wislowska **12:20**

Oscillatory Brain Dynamics of Newborns

Eva van Poppel **12:33**

Targeted Reactivation in a Slow Wave to enhance vocabulary memory

Andrés Canales-Johnson **12:46**

When conflict is out of control: alertness levels differentially modulate behavioural and neural markers of conflict and conflict adaption

LUNCH BREAK **13:00 – 14:30**

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Program - Saturday, 04/03/2017

14:30 Phillippe Peigneux

Lack of frequency-tagged magnetic responses suggests statistical regularities remain undetected during sleep

15:00 Róbert Bódizs

On the sexual dimorphism of sleep spindles

15:30 Nayantara Santhi

Rhythms of the Mind: Sex Differences in the Circadian and Sleep-Wake Dependent Oscillations in Attention and Visuospatial Working Memory

COFFEE BREAK 16:00 – 16:30

16:30 Lucia M. Talamini

Memory enhancement during sleep, using slow oscillation up-state-targeted memory cues

17:00 Gio Piantoni

0.0002 Hz Fluctuations in Human Intracranial Recordings

17:30 Kerstin Hödlmoser & Manuel Schabus

Concluding words and perhaps some recent data …

Program - Sunday, 05/03/2017

Time for

Meetings in small groups & social events

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Thursday, 02/03/2017, 14:30

Sleep spindles: from physiological mechanisms to clinical applications

Thien Thanh Dang-Vu

Concordia University, Montreal, Canada
Centre de Recherche de l'Institut Universitaire de Gériatrie de Montrea, Canada
University of Montreal, Canada

Sleep spindles have been increasingly reported to have important functions in the maintenance of sleep stability and the offline consolidation of memory traces. But few studies have systematically investigated the involvement of sleep spindles in the pathophysiology sleep disorders. Recent data in my lab suggest that lower spindle activity increases the risk to develop insomnia symptoms in a longitudinal study. We have also shown that weaker spindle activity predicts lower treatment response to cognitive-behavioral therapy for chronic insomnia. These relationships between spindle activity and insomnia may be due to the functions of sleep spindles in regulating sleep continuity and mediating sleep-dependent memory consolidation, and constitute one of the facets supporting an neurobiological phenotyping of insomnia. They illustrate the potential use of sleep spindle activity as a prognostic tool for guiding a personalized treatment approach in the clinical management of insomnia.

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Thursday, 02/03/2017, 15:00

The relations between sleep microstructure, spindling activity and cognition in healthy children and in children with neurodevelopmental disabilities

Oliviero Bruni
Department of Developmental and Social Psychology
Sapienza University, Rome, Italy

The fundamental role of sleep for daytime functioning and neurocognitive performance in infants and children has been the object of several publications in the last few years. The reactivation and redistribution of memories during SWS are regulated by a dialogue between the neocortex and the hippocampus that is essentially under the feed-forward control of the slow oscillations, which hallmark the EEG during SWS and occur at a spectral frequency of approximately 0.75 Hz. This “cognitive” role of SWS is extremely important in childhood because NREM sleep EEG synchronization changes considerably with age, and the highest levels of SWS and of slow wave activity (SWA) occur during childhood. The slow EEG oscillations in SWS characterize the A1 subtypes of the so-called cyclic alternating pattern (CAP) that map over the frontal and prefrontal regions of the scalp (Ferri et al., 2005) and play a role in sleep-related cognitive processes (Ferri et al., 2008a, 2008b, 2010; Aricò et al., 2010; Drago et al., 2011; Bruni et al., 2012) and showed a high correlation with the IQ in normal children and even in children with a condition like Asperger syndrome. On the other hand, children with neurodevelopmental disabilities and mental retardation exhibited a global decrease of EEG slow oscillations directly related to the degree of mental retardation. CAP analysis in dyslexic subjects revealed a higher A1 index in SWS than in controls and a significant positive correlation between A1 index in SWS and verbal and full-scale IQ (Bruni et al., 2009). Furthermore, dyslexic children showed an increase of spindle density during N2 that was positively correlated with the degree of dyslexic impairment. The correlation between spindle activity and cognitive performances (working memory test) has been also demonstrated in children with mild OSA.
The correlation found supports the hypothesis of a role for NREM and spindles in sleep-related neurocognitive processing

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Thursday, 02/03/2017, 16:00

Wake watchers: a different perspective on insomnia disorder

Eus van Someren

Department of Sleep and Cognition, Netherlands Institute for Neuroscience, Royal Academy of Arts and Sciences, Amsterdam, Netherlands
Dept. of Psychiatry, VU University Medical Center, Amsterdam, Netherlands
Dept. of Integrative Neurophysiology, VU University, Amsterdam, Netherlands

Insomnia is the most common complaint in general practice and Insomnia Disorder the most common sleep disorder. Efforts to find the malfunctions in sleep regulating circuits in the brain that could underlie the disorder have not been particularly successful. The present overview of recent findings suggests that it may be more fruitful to consider the possibility that Insomnia Disorder may not so much be rooted in sleep regulating systems, but rather in systems that are involved in maintenance of an optimally alert state. Within this perspective, insomnia rather represents a deficiency to shut off brain processes that, during evolution, have shown of crucial value for survival, notably monitoring the environment and being prepared for action. The presentation will moreover address the phenomenon of 'sleep state misperception'. It will be argued that the discrepancy between subjective and polysomnographic sleep duration that so many people with insomnia disorder report, may be a misperception of the judging clinician rather than of the patient. Ongoing mental content or 'consciousness' during sleep may be more common than we tend to believe.

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Thursday, 02/03/2017, 16:30

Brain microstate dynamics modulate connectivity and predict responsiveness as we fall asleep

Srivas Chennu
Department of Clinical Neurosciences, University of Cambridge, UK

As we fall asleep, our brain traverses a series of changes accompanying the loss of sensory awareness and responsiveness to the external world. Nevertheless, we know that stimuli are still represented in the cortex during light sleep, and that even motor response preparation is preserved. But what are the neural markers that track and predict our inability to respond even though we are still processing sensory information during the onset of sleep? By decomposing high-density EEG acquired during an semantic task with microstates and connectivity analyses, we unravel how the temporal and spectral dynamics of brain activity change and interact with the onset of sleep and the loss of behavioural responsiveness. We describe a previously unreported relationship between temporal microstates and spectral connectivity, showing how connectivity, but not power, during specific microstates shifts from the alpha to the theta band as we fall asleep. Further, using machine learning-based decoding analyses, we show that microstate dynamics before the presentation of an auditory stimulus predict the absence of a response to it. In the growing body of literature showing that the EEG consists of metastable patterns of activity changing at a much higher speed than previously thought, our results show that these rapid switches have a functional significance for understanding how the brain falls asleep. Deconstructing the binary states of “wakefulness” and “sleep” into a transition, we find a gradual slope going from one state to the other, with no clear disjunction between the two.

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Thursday, 02/03/2017, 17:00

Blue is not blue: impact of light on human sleep and circadian physiology

Christian Cajochen

Centre for Chronobiology, Psychiatric Hospital of the University of Basel, Switzerland
Transfaculty Research Platform Molecular and Cognitive Neurosciences,
University of Basel, Switzerland

Introduction: Conventional LED light sources have a discontinuous light spectrum with a prominent “blue” peak between 450-480nm, which potentially impacts on human circadian physiology and sleep. Thus, we investigated the effects of an advanced LED source simulating the natural daylight spectrum on visual comfort, daytime alertness and sleep.

Methods: Twelve male young good sleepers spent twice 2.5-days in the laboratory, once under a conventional (convLED) and once a daylight simulating LED (dayLED) condition (16 hours LED exposure during scheduled wakefulness) in a balanced cross over design flanked by a 8-h baseline and a post-light exposure night. The same light settings were used for convLED and dayLED (100 photopic lux at the eye level with a color temperature of 4000K). However, the light spectrum and the color rendering index differed considerably between convLED and dayLED. Subjective visual comfort and sleepiness were continuously rated on conventional scales, and the PSGs were quantified for sleep stages and EEG spectral power density during nonREM sleep.

Results: The volunteers rated the light quality of the dayLED as being more pleasant than the convLED ($p=0.07$). They also felt significantly more alert during the dayLED condition compared to convLED ($p<0.01$), particularly in the morning/midday hours between 9 and 13h. In comparison to the baseline night, convLED significantly decreased the proportion of NREMS (-4.4 %, $p<0.03$) at the cost of an increase in REM sleep (+5.2%, $p<0.004$) and reduced EEG power density in the lower spindle frequency range between 11.5- 13.5 Hz ($p<0.04$), while such changes in sleep were not present for dayLED.

Conclusions: We have preliminary evidence that a daylight LED lighting solution has beneficial effects on visual comfort and alertness and does not affect all-night sleep EEG activity when compared to a conventional LED solution.

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Friday, 03/03/2017, 09:00

Sleep Contribution to Motor Memory Consolidation

Julien Doyon
Functional Neuroimaging Unit, C.R.I.U.G.M., University of Montreal, Canada

Motor sequence learning (MSL) refers to the process by which movement elements come to be performed effortlessly as a unitary sequence through multiple sessions of practice. Numerous studies, including those from my own laboratory, have convincingly demonstrated that sleep (at night and daytime) and spindles during NREM sleep in particular, play a critical role in MSL consolidation. Furthermore, changes in striatal and hippocampal activity after learning have been thought to contribute to the consolidation of MSL. Up until now, however, evidence supporting these views has been entirely indirect, as studies have only reported correlations between spindle characteristics and brain activity before and after, *but not during*, a post-learning night of sleep. In this presentation, I will discuss the results of a series of studies that either used functional magnetic resonance imaging (fMRI) either alone or combined with electroencephalographic (EEG) recordings during the night following training of a new sequence of movements, or used a motor sequence-olfactory conditioning paradigm, in order to investigate the nature of the mnemonic process implicated, the role of sleep spindles and the sleep stages during which the off-line consolidation of a newly acquired motor memory trace takes place.

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Sleep and the interactions in multiple memory systems

Steffen Gais

Institute for Medical Psychology and Behavioural Neurobiology,
University of Tübingen, Germany

Previous evidence indicates that the brain stores memory in complementary memory systems, allowing both rapid plasticity and stable representations at different sites. Moreover, different aspects of a memory (e.g. explicit, implicit) might also be stored in different parts of the brain. It can be assumed that successful memory recall often depends on more than one of these representations. Memory consolidation is thought to strengthen newly learned memories. Systems memory consolidation in particular has been suggested also to transform the representation of the memory in the brain. This might come from changes in how memory systems interact, in the system used during later retrieval, or in the quality of the stored memory trace itself. Sleep has been shown to strengthen memory consolidation. Reactivation of new memory traces has been proposed to be one mechanism causing this effect. Beyond strengthening, sleep may also change the quality of memories by allowing systems consolidation. I will present a series of studies that investigate how the contributions of different memory systems develop over encoding repetitions, wakefulness and sleep. In particular, the roles of the hippocampus, the parietal cortex, and the striatum are discussed.

Friday, 03/03/2017, 10:30

Brain Oscillations and Consciousness: Towards a System Approach of Coupled Oscillators

Wolfgang Klimesch
Centre for Cognitive Neuroscience, University of Salzburg, Austria

There is evidence that consciousness is associated with activity in networks of specific brain areas and frequency specific brain oscillations. But the same holds true for any type of cognitive process, such as memory or perception. Here, it will be argued that a key aspect for consciousness may be based on a basic principle which is the best possible cross talk (communication) between oscillations. Theoretical considerations show that a binary hierarchy of oscillations fulfills this principle and also allows for the best possible frequency separation, avoiding spurious phase synchronization. According to this principle, the best possible cross talk is phase coupling between selected frequencies (m:n) where the higher frequency (n) always is a binary multiple (n = m*(2x), x = 1, 2, etc.; e.g., n = 2m, 4m, etc.) of the lower frequency. The hypothesis will be proposed that transient phase coupling between frequencies of this binary hierarchy is closely associated with consciousness. It will be argued that this type of phase coupling can be observed only during conscious cognition, but not during sleep. Empirical evidence from event related oscillations and evoked oscillations will be used to evaluate the proposed hypothesis.

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Friday, 03/03/2017, 11:00

Cortical tracking of natural and artificial online speech

Lucia Melloni

Department of Neurology, New York University Langone Medical Center, NY, USA
Department of Psychiatry, Columbia University, NY, USA
Department of Neurophysiology, Max-Planck Institute for Brain Research, Frankfurt, Germany

Linguistic units such as syllables, words, phrases, and sentences simultaneously unravel during speech processing. How does the brain parse, track, and process these concurrent linguistic units? In this talk, I will discuss our recent efforts to understand whether and how natural speech is processed online, and what role brain rhythms might play in this process. Specifically, I will discuss studies demonstrating that rhythmic cortical activity entrains to the time course of large linguist units, even in the absence of any acoustic cues for the boundaries between phrases and sentences. Similar entrainment is also observed during second language acquisition, and can rapidly appear when learning to parse an artificial language. Together, these studies show that cortical entrainment to linguistic units reliably tracks online speech processing, offering endless possibilities to objectively assess language processing in children, difficult-to-test-populations (e.g., minimally conscious patients), as well as language precursors in animal preparations to allow for cross-species comparison.

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Friday, 03/03/2017, 11:30

Studying large-scale neural dynamics of conscious auditory perception

Nathan Weisz
OBOB Lab, University of Salzburg, Austria
Centre for Cognitive Neuroscience, University of Salzburg, Austria

How we reach coherent, meaningful auditory percepts from the noisy patterns caused at the level of our hearing receptors is an outstanding challenge in neuroscience. Apart from "low level" issues pertaining to processes directly elicited by an acoustic stimulus at the level of the basilar membrane, this question also involves "high-level" neural processes such as wide-spread networks enabling conscious access as well as top-down control by which processes such as attention or predictions could affect auditory processing. Within this talk I intend to present the background of my group's research focus and present works that address following issues: 1) What are the (macroscopic) predispositions for a conscious auditory percept? 2) What are the signatures of conscious access to presented auditory information? How do efferent processes influence auditory processing? Making progress on these issues has direct clinical implications for advancing also clinical issues such as understanding the neural mechanisms underlying tinnitus or factors influencing rehabilitation following cochlear implantation.

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DATA BLITZ

Power and Phase connectivity analysis after transcranial Alternating Current Stimulation (tACS) in different conscious states

Mohamed S. Ameen
Department of Clinical Neurosciences, University of Cambridge, UK

Transcranial alternating current stimulation (tACS) is a novel technique that has been previously shown to affect cortical activity and excitability. Recent evidence suggests that tACS influences performance in cognitive tasks during wakefulness as well as conscious experience during sleep. However, there is still an ongoing debate on the efficacy as well as the underlying mechanism of tACS activity. We aimed at characterizing the effects of tACS on oscillatory activity in the brain during the transition from wakefulness to sleep. We adapted an intermittent stimulation paradigm where we conducted four tACS sessions of 3 minutes each, followed by 2 minutes of baseline recordings. This paradigm enabled the stimulation in different conscious states i.e. wakefulness, drowsiness and slow wave sleep (SWS). We used 40 Hz as the frequency of stimulation which has been shown to correspond to high cognitive functions such as increased awareness during sleep. Power analysis of the post-stimulation periods showed a persistent increase in the power of the 40 Hz oscillations in all three conscious states. However, only during SWS trials was there a significant trend of the increase of 40 Hz oscillatory power after the stimulation. Moreover, weighted Phase Locking Index (wPLI) analysis of the post-stimulation recordings showed no persistent changes in the phase synchronized activity in any of the three conditions. These findings, for the first time, show different effects of tACS depending on the conscious state and suggest a potential mechanism for tACS activity based on the induction of persistent changes in cortical organization.

From heterogeneous insomnia to (more) homogeneous subtypes – results of a latent class cluster analysis

Tessa F. Blanken
Department of Sleep and Cognition, Netherlands Institute for Neuroscience, Royal Academy of Arts and Sciences, Amsterdam, Netherlands

Background: Despite insomnia's high prevalence and moderate heritability, it has been shown remarkable difficult to find characteristics that are consistently associated with insomnia [1]. In this project we considered the possibility that insomnia comes in different subtypes of pathophysiology that are reflected in traits and other stable characteristics, and not necessarily also in the specificity of sleep complaints.
Methods: To evaluate this possibility we used the Sleep Registry [2] to assess, in n=2,254 people suffering from insomnia, non-sleep characteristics with respect to life history, cognitions and personality traits. The large-scale multivariate psychometric assessment allowed for bottom-up, data-driven search for subtypes using latent class profile analysis, as well as for network analysis of how associations between characteristics may differ between subgroups.
Results: The latent class cluster analysis consistently identified five subtypes, or profiles, that show differential patterns across, most notably, personality factors, affect and life history.
Conclusions: Identifying these subtypes will help us to better understand the heterogeneous character of insomnia – an understanding that will hopefully (i) result in better classification of people with insomnia; (ii) benefit research on underlying mechanisms; and (iii) ultimately allow for better and more personalized treatment of insomnia.

Morin CM, LeBlanc M, Daley M, Gregoire JP, Merette C. Epidemiology of insomnia: prevalence, self-help treatments, consultations, and determinants of help-seeking behaviors. *Sleep Med*. 7, 123-130 (2006).
Benjamins JS, Migliorati F, Dekker K, Wassing R, Moens S, Blanken TF, te Lindert BHW, Sjauw Mook J, Van Someren, EJW. Insomnia heterogeneity: characteristics to consider for data-driven multivariate subtyping. *Sleep Med Rev*. in press (2016).

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A Clue to Consciousness?
Significance of Circadian Rhythms in Severe Brain Injury

Christine Blume
Lab for Sleep, Cognition and Consciousness Research, University of Salzburg, Austria
Centre for Cognitive Neuroscience, University of Salzburg, Austria

Background: Physiological and psychological functions extending from cellular processes to higher cognitive functions have been shown to vary rhythmically with a period length of about 24 hours (i.e. a circadian rhythm). In healthy individuals, also consciousness varies with a circadian pattern paralleling the sleep-wake cycle. From a clinical perspective, misalignment of circadian rhythms, that is when the sleep-wake schedule is at odds with the light-dark cycle can cause considerable stress, impair cognitive abilities such as attention and learning and have detrimental effects on the immune system.

Methods: Here, we investigated the integrity of circadian temperature rhythms in n = 18 patients suffering from disorders of consciousness (i.e. vegetative state/unresponsive wakefulness syndrome [VS/UWS], minimally conscious state [MCS] or minimally conscious state plus [MCS+]) following severe traumatic or non-traumatic brain injury. Variations in body temperature were analysed using Lomb-Scargle periodograms. The association between the circadian rhythms and results obtained from neuropsychological assessment using the Coma Recovery Scale-Revised (CRS-R) was evaluated with correlation analyses. Beyond this, we piloted in a subsample of n = 8 patients whether bright light stimulation has a beneficial effect on circadian rhythms.

Results: Interestingly, analyses revealed that all patients still had a significant circadian temperature rhythm (range 23.5-26.3h). Furthermore, we found that especially scores on the arousal subscale of the CRS-R were closely linked to the integrity of circadian variations in body temperature. Finally, we found positive evidence for bright light stimulation being able to support circadian rhythmicity in two out of eight patients.

Conclusion: In conclusion, this study provides first evidence for an association between circadian body temperature rhythms and patients' arousal levels. Intriguingly, sufficient arousal levels are a precondition for consciousness suggesting that the integrity of circadian rhythmicity may be crucial for the emergence of consciousness in severely brain-injured patients. Thereby, our findings also make a case for circadian rhythms as a target for treatment as well as the application of diagnostic and therapeutic means at times when cognitive performance is expected to peak.

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Decoding material-specific memory reprocessing during sleep in humans

Monika Schönauer
Institute for Medical Psychology and Behavioural Neurobiology,
University of Tübingen, Germany

Learning-related neuronal activity is reactivated during sleep. Studies in humans that externally target this reactivation process suggest its functional significance for memory consolidation. We used multivariate pattern classification to detect spontaneous memory reprocessing. Decoding human electrical brain activity during sleep, we were able to determine what type of images participants had viewed in a preceding learning session. We find significant patterns of learning-related processing during rapid eye movement (REM) and non-REM (NREM) sleep, which are generalizable across subjects. This processing did not occur uniformly across the night, but during times congruous to critical periods of synaptic plasticity. Importantly, the amount of memory reprocessing during slow-wave sleep (SWS) predicted overnight memory retention, explaining more variance than the mere time spent in slow-wave sleep. The spatial distribution of electrodes informative about the preceding learning content, as well as relevant frequencies, differ between NREM and REM sleep. Moreover, only the strength of reprocessing in SWS influenced later memory performance, speaking for at least two distinct underlying mechanisms between these states. We thus demonstrate that memory reprocessing occurs in both NREM and REM sleep in humans, and that it pertains to different aspects of the consolidation process.

LAB for SLEEP & CONSCIOUSNESS RESEARCH

The impact of developmental changes of sleep spindles on declarative learning and general cognitive abilities – a longitudinal approach

Michael Hahn
Lab for Sleep, Cognition and Consciousness Research, University of Salzburg, Austria
Centre for Cognitive Neuroscience, University of Salzburg, Austria

Objectives: This longitudinal approach strives to investigate developmental changes in spindle activity (i.e. spindle density & frequency) from pre- to post-puberty that can best explain individual differences in declarative learning, memory consolidation and general cognitive abilities.
Methods: Sleep polysomnography, declarative learning (word pair association task) and general cognitive ability assessments were performed in 34 healthy subjects (10 male, 24 female) at pre-pubertal age (8-11) and 7 years later at post-pubertal age (14-18 years). Polysomnography was recorded ambulatory during 4 nights per subject (2 nights pre-pubertal, 2 nights post-pubertal). Furthermore, we investigated the effect of prior learning (experimental night) vs. non-learning (baseline night) on sleep spindle density and frequency. General cognitive ability was assessed using the Wechsler Intelligence Scale.
Results: At pre-pubertal age subjects showed higher slow (11-13Hz) than fast spindle density (13-15Hz) on frontal (F4) and central (C4) electrodes. However, at post-pubertal age slow spindle density was only higher than fast spindle density on F4. The pattern shifted in favour of fast spindle density on C4. This change was also accompanied by a general increase in mean spindle frequency. Adolescents with superior over-night memory consolidation displayed an increase in fast spindle density from baseline to experimental night. For children, similar results were found for the mean spindle frequency.
Conclusions: The typical spindle topography develops during puberty and reflects biological brain maturation. The acceleration of thalamo-cortical sleep spindles is crucial for successful over-night memory consolidation.

This study was funded by the Austrian Science Fund (T397-B02, P25000) and the Jacobs Foundation (JS1112H).

LAB for SLEEP & CONSCIOUSNESS RESEARCH

The Relationship Between Sleep Misperception and Spindle Architecture in Primary Insomnia

Dylan M. Smith
Centre for Studies in Behavioral Neurobiology / PERFORM Centre
Dept. of Exercise Science & Dept. of Psychology
Concordia University, Montreal, Canada

Sleep misperception, the discrepancy between self-reported and objectively-recorded sleep duration, is often observed in insomnia, and may result from dysfunction in underlying neural mechanisms as indexed by electroencephalogram during sleep. Recently, evidence has suggested that sleep protection mechanisms, indexed by sleep spindle architecture may be associated with sleep misperception. However, the specific relationship between spindle architecture and sleep misperception index (MI) is not known. In the current study, 22 individuals (17 females, 5 males, mean age = 42.0, SD = 15.3) diagnosed with primary insomnia completed an overnight polysomnographic (PSG) recording in the sleep laboratory, and spindle density, duration, frequency, and amplitude were calculated using automatic detection during stage N2 sleep. MI was calculated as the degree of discrepancy between total sleep time as measured by PSG compared to self-reported sleep time from 1-week sleep diaries. A significant positive correlation (.364, p = .048) was observed between MI and spindle density per 30 second epoch, as well as MI and spindle amplitude (.378, p = .042), where greater sleep misperception was associated with higher spindle density and larger spindle amplitude. Interestingly, the strongest correlation was observed between MI and REM duration (.477, p = .012). No significant correlation was observed between MI and N1, N2, or N3 duration, spindle duration, spindle frequency, or spindle power (a trend, .352, p = .054 was observed for spindle power). These results support a subgrouping approach to insomnia, whereas individuals with objective psychophysiological insomnia exhibit spindle dysfunction, and differ from individuals with a high MI where spindles remain intact. These results further suggest that REM may contribute less to an individuals' perception of time spent asleep compared to slow wave sleep.

LAB for SLEEP & CONSCIOUSNESS RESEARCH

Task-free consciousness segregates into two distinct modes of dynamical activity

Diego Vidaurre

Oxford Centre for Human Brain Activity, University of Oxford, UK

Brain activity can be described as a succession of states, each representing a characteristic pattern of activation and connectivity. Whereas the temporal distribution of these states is to some extent predictable in task, their dynamics during task-free consciousness are largely uncharacterised. Using fMRI data from 820 subjects, we report a strong hierarchical organisation of the brain dynamics, segregating the obtained brain states into two superstates that are characterised by neat differences in spatial distribution, connectivity and balance between integration and segregation of information. One of the superstates involves areas that are related to higher cognition (including regions of the default mode network, language and extensive prefrontal) whereas the other is associated with sensorimotor and perceptual (visual and auditory) regions. Furthermore, the superstate distribution is a reliable subject fingerprint and bears a statistically significant relationship with the psychology of the subjects, quantified by 49 different measures of well-being, intelligence and personality.

Whole-brain dynamic functional connectivity of transitions between wakefulness and sleep

Angus B. A. Stevner
Department of Psychiatry, University of Oxford, UK
Center for Music in the Brain, Department of Clinical Medicine, Aarhus University, Denmark
Oxford Centre for Human Brain Activity, University of Oxford, Warneford Hospital UK

The understanding of spontaneous whole-brain activity during sleep is paramount to the understanding of brain mechanisms supporting consciousness, and vice versa. Sleep represents the most striking change in brain state experienced in everyday life, yet many of the signatures in whole-brain dynamics, such as resting-state networks, believed to be essential to waking function, have been shown to persist well into the consolidated stages of non-REM sleep. While this challenges our understanding of spontaneous brain activity, it also adds to the perplexity that surrounds sleep as a brain state, the potential cognitive functions of which are inherently difficult to investigate, due to the lack of subject reporting.
Inspired by a number of more recent studies showing that more sophisticated measures derived from functional connectivity can in fact be used to distinguish between wakefulness and sleep, Tagliazucchi and colleagues (2012, 2014) were able to discriminate sleep stages (as defined by traditional, EEG-based sleep-scoring) only using fMRI whole-brain functional connectivity networks.
Using the same dataset as in Tagliazucchi et al (2014) we present a novel method for resolving dynamic functional connectivity from spontaneous fMRI activity, which in a completely data- driven fashion (i.e. with no prior information or training regarding sleep staging) is able to extract states of functional connectivity that are strongly predictive of the underlying sleep architecture. These states of functional connectivity are consistent across participants and – given their dynamic nature – allow us to investigate how the whole-brain functional network transitions between stages of vigilance.

LAB for SLEEP & CONSCIOUSNESS RESEARCH

Speech segmentation in the human brain: Insights from intracranial EEG

Simon Henin
Department of Neurology, NYU School of Medicine, NY, USA

Recent evidence suggests that the brain tracks the slow acoustic fluctuations in speech and reflects entrainment to various linguistic units of connected speech, such as syllables and words. Using a statistical learning paradigm shown to assess speech learning, we investigated how and where continuous speech is segmented into meaningful units (e.g. words) in humans using intracranial EEG. Participants were exposed to streams of repeating 3-syllable nonsense words and online learning of the segmental boundaries between words was assessed via neural measures of synchrony (inter-trial coherence, ITC) that quantifies entrainment at the different segmental units (i.e. at the syllabic and the word level). From the index of entrainment, we are able to track where the learning process occurs and at what timescale this learning process evolves. Preliminary analysis revealed that sources of segmentation are broadly distributed, but show selective representation of the syllable and/or word rates (e.g. 4 Hz and 1.33Hz, respectively). At the syllabic rate, responses are found in areas typically associated with general auditory processing, such as the superior temporal gyrus, whereas cortical responses at the timescale of words typically appear in other association areas. Learning of the nonsense words also appeared to evolve over time, with ITC at the word level appearing to grow stronger over time, whereas purely syllabic responses remained stable across time. In addition, analysis of high-gamma power in hippocampal depth electrodes revealed neural signatures of statistical learning, indicating that the hippocampus also plays a role in statistical learning.

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The sleep EEG spectrum as a sexually dimorphic marker of general IQ

Péter P. Ujma
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The shape of the EEG spectrum in sleep relies on genetic and anatomical factors and forms an individual “EEG fingerprint”. Spectral components of EEG were shown to be connected to mental ability both in sleep and wakefulness. However, sex may play an important role in the neural correlates of intelligence. In a sample of 151 healthy individuals, we investigated how intelligence is related to spectral components of full-night EEG, while controlling for the effects of age. A positive linear association between intelligence and NREM central sigma (and to a lesser extent, temporal alpha), as well as REM anterior beta power was found in females. REM sleep frontal high delta power was a negative correlate of intelligence. In males, no statistically significant correlation was found. These results suggest that the neural oscillatory correlates of intelligence in sleep are sexually dimorphic and they are not restricted to either sleep spindles or NREM sleep. Further research is advised into the functional role and generating mechanisms of sleep EEG oscillations other than slow waves and sleep spindles.

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The effect of napping on the consolidation of declarative and procedural information

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Centre for Cognitive Neuroscience, University of Salzburg, Austria

The majority of studies investigating the effects of sleep for memory consolidation have evaluated nocturnal sleep rather than alternative sleep periods such as day-time naps. This study aimed to investigate the relevance of a day-time nap for the consolidation of declarative and procedural information. Participants (N = 76, M_{age} = 23.34 years, SD = 2.40) were randomly assigned to a group (nap or wake) and paradigm (declarative or procedural memory task). Performance changes from baseline (i.e. 1h before a retention period) to 1h after 90 min retention were evaluated between groups. Retention included either a day-time nap or period of quiet wakefulness. Twenty-one channel electroencephalography was recorded throughout the paradigm, with polysomnography recorded during the retention period. Associations between performance changes, sleep architecture, spindles, and slow oscillations were investigated. Whereas a day-time nap did not affect performance changes for declarative memory, it did prevent deterioration of performance for procedural memory as compared to the wake group. No relations were found between sleep stages, spindles or slow oscillations, and performance changes. In addition, we found a positive correlation between slow spindles and IQ in male participants only. In summary, data indicate that day-time naps may protect procedural memories from deterioration. Interestingly, data do not confirm the previously reported benefits of naps for consolidation of declarative memories, or the association of specific sleep stages and spindles with performance change as a result of sleep.

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Targeted emotional memory reactivation during sleep

Rick Wassing
Department of Sleep and Cognition, Netherlands Institute for Neuroscience, Amsterdam, Netherlands

Background: The long-standing hyperarousal theory of insomnia disorder (ID) places increased cortical and autonomic excitability and subjective emotional reactivity at the core of the disorder. Recently, perturbed REM sleep was proposed to contribute to hyperarousal by interfering with overnight regulation of emotional experiences (1). The current study aimed to uncover direct evidence for a role of REM sleep in the regulation of emotional experiences and show that this process is disrupted by perturbed REM sleep in ID.
Methods: 56 participants (26 ID, 30 without sleep complaints) were subjected to emotional stimuli during two fMRI sessions with either a sleep or a wake interval. Stimuli consisted of negative affective pictures, shame-eliciting karaoke fragments, and cued reactivation of emotional autobiographical episodes. For control trials, participants were exposed to neutral counterparts of these stimuli. For 26 participants (16 ID, 10 without sleep complaints), the negative (US+) and neutral (US-) stimuli were differentially conditioned with odors (CS+ and CS-). During the wake or sleep interval, these participants were intermittently re-exposed to the CS+ and CS- to induce targeted emotional memory reactivation. Two main hypotheses are presently investigated in ongoing analyses. Firstly, the overnight attenuation of elicited emotions is dependent on the individual differences in the amount of targeted emotional memory reactivation during consolidated REM sleep. Secondly, perturbed REM sleep would not enable such overnight attenuation of elicited emotions, and may even lead to overnight enhancement of elicited emotions.

Wassing, R., *et al.* (2016). Slow dissolving of emotional distress contributes to hyperarousal. *Proceedings of the National Academy of Sciences*, *113*(9), 2538-2543.

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Sleep in patients with disorders of consciousness and machine learning

Tomasz Wielek

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Centre for Cognitive Neuroscience, University of Salzburg, Austria

Sleep cycles in patients suffering from disorders of consciousness (DOC) have been proposed to be indicative of the preserved residual brain functions. However, reliable and valid sleep staging in this clinical group continues to be challenging for neuroscientists. Eye opening and closing might correlate with sleep-wake cycles yet be too inaccurate to yield a conclusive picture.

In our approach we exploit the potential of both nonlinear EEG analysis combined with machine learning techniques to evaluate the patients' sleep. We recorded long-term polysomnography (alongside with a video recording) in two light condition (called day and night) in a sample of 24 DOC patients (12 UWS, 12 MCS). Additionally, 8 hour EEG recordings of healthy sleepers (N=26) have been recorded and scored according to the standard AASM rules. We computed EEG complexity by using Permutation Entropy (PE) on 12 scalp electrodes and performed an unsupervised data analysis by using hierarchical cluster analysis. A random forest classifier has been fitted to healthy data and used to generate predictions on patients sleep. The output from the classifier (wake, N1, N2, N3 or rem) has been validated by using videos, and thus the eye opening and closing periods.

Larger number of clusters in MCS data suggests higher diversity of states and possibly a subdivision of the night period into sleep stages. The single 'night' cluster in VS suggest stronger impairment of sleep organization. Moreover single subject evaluation revealed high correspondence between both wake predictions and *eyes open*, and between N2 predictions and *eyes closed* for most of the patients.

The project is supported by a grant from the Austrian Science Fund FWF (Y-777).

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Sleep and gross motor performance in adolescents – the inverse steering bicycle

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Centre for Cognitive Neuroscience, University of Salzburg, Austria

Although there is now compelling evidence that sleep plays a functional role in the consolidation of fine-motor sequence learning, the impact of sleep on complex gross-motor learning, especially in children and adolescents, is still debated. The aim of our study was to investigate the effects of sleep and wakefulness on a complex gross-motor (re)-learning task in adolescents, i.e riding an inverse steering bicycle. 32 healthy subjects (M=12,47 years, SD= 0,76) were trained to ride an inverse steering bicycle with training wheels. Training took place either in the morning (WAKE group) or in the evening (SLEEP group) and was followed by a 9 hour WAKE or SLEEP retention interval. Subsequently, riding performance was tested in a slalom parcours. Furthermore, the inverse steering bicycle task was counterbalanced with a control task, i.e. riding a stationary bicycle ergometer. EEG was recorded in the SLEEP group during training sessions and in the respective test nights (INVERSE, CONTROL). Results showed no differences in sleep architecture between INVERSE and CONTROL night. However, participants with a higher overnight reduction in riding errors spent more time in tonic REM compared to the CONTROL night and compared to participants with less overnight improvement. Furthermore, behavioral results showed that both SLEEP and WAKE retention intervals seemed to be favorable for performance improvement in our adolescent population. While the SLEEP group was able to reduce the amount of errors during slalom riding (i.e. accuracy), the WAKE group improved in runtime (i.e. speed). In summary, our results might support the interpretation that adolescents are able to show gross-motor performance changes over intervals of both sleep and wakefulness.

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Oscillatory Brain Dynamics of Newborns

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Centre for Cognitive Neuroscience, University of Salzburg, Austria

Topographical and spectral organization of spontaneous brain oscillations has been observed to be evolving from childhood to adulthood. However little is known about brain rhythms of newborns at the age of only few weeks. In this project we made use of anatomically accurate head models, to investigate oscillatory brain dynamics of 2 and 5 weeks old infants. We recorded electrophysiological data from the head surface of 22 newborns, with high density array of 128 scalp electrodes. Subsequently, the recorded signal was reconstructed on the source level via Linearly Constrained Minimum Variance (LCMV) spatial filtering, for 3188 grid points covering brain volume. The exact frequency borders of brain oscillations were selected based on the frequency of the infants' heartbeat. Ultimately, we investigated topographical distribution of the spectral power at rest as well as during the different stimulus conditions where we varied the familiarity of voice and familiarity of a replayed rhyme.

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Targeted Reactivation in a Slow Wave to enhance vocabulary memory

Eva van Poppel
Department of Biopsychology and Methods, University of Fribourg, Switzerland

Introduction: Targeted Memory Reactivation (TMR) is the deliberate reactivation of a memory trace during sleep by presenting the pre-learned stimuli. This can boost the vocabulary knowledge (Schreiner & Rasch, 2014). Since spontaneous memory reactivation supposedly occurs in a “Slow Wave” (SW) upstate, we hypothesised that TMR with prior-learned words would boost the vocabulary the most in this phase of the SW. To compare, we also cued prior learned words in a SW downstate and left a third of the learned words uncued.
Methods: Participants learned words in a foreign language. To present words in a SW upstate, we developed a script that analyses the amplitude of channel Fz. When this signal crossed the threshold from -80μV to -75μV, an upstate was detected and a word was replayed. When the signal crossed the threshold from 80 to 75μV, another word was replayed in the downstate. After three hours of night-time sleep, the word knowledge was tested again.
Results: Words replayed in a SW upstate were remembered 98.4% correct after sleep, whereas words replayed in a downstate were remembered 96.8%, and the words left uncued 93.6%. Phase accuracy analysis showed that most upstate words ended up between 0º and 90º, whereas this was between 90º and 180º for the downstate.
Conclusion: The boosting of the vocabulary corresponded to the SW phase, suggesting that TMR is more likely to be processed and enhance memory when the stimuli are played during a SW upstate. These findings support the idea that reactivation of memory traces is present during SW upstates.
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When conflict is out of control: alertness levels differentially modulate behavioural and neural markers of conflict and conflict adaption

Andrés Canales-Johnson
University of Cambridge, UK

Instantaneous conflict as well as across-trial conflict adaptation, two sub processes of cognitive control, can occur in the absence of conflict awareness. Conflict monitoring thus does not seem to depend on content of consciousness, but it remains unclear at which extent it relies on the *level* of consciousness. Here we use the transition from wakefulness to sleep as a model for studying the behavioral and neural markers of conflict under different levels of alertness. We used an auditory task in which participants listened to the words 'left' or 'right' presented either to the left or right ear while transitioning towards sleep. Participants had to press a button matching the meaning of the word (i.e. 'left' or 'right') with the corresponding hand (left or right), ignoring the location where the stimuli were presented. We hypothesized that instantaneous conflict is the result of an automatic process and would therefore be independent of conscious level. Contrarily, since conflict adaptation requiring the integration of information over time, we expected it to depend on the level of consciousness. Regarding conflict processing, our results revealed longer reaction times and higher frontal theta-band power in incongruent trials (e.g. 'left' word coming from the right ear) compared to congruent trials (e.g. 'right' word coming from the right ear) during awake and drowsy states. However, these behavioural and neural markers were only observed during the awake state in the case of conflict adaptation. This results suggest that alertness levels differentially modulate the processing of conflictual information in the brain.

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Saturday, 04/03/2017, 14:30

Lack of frequency-tagged magnetic responses suggests statistical regularities remain undetected during sleep

Philippe Peigneux

Université Libre de Bruxelles, Belgium

Recently, it was demonstrated that acquisition of reflex stimulus-response associations is possible during sleep. Whether sleep allows more complex forms of learning, such as stimulus-stimulus contingencies, remains an open question. In the current study, we recorded during diurnal sleep auditory magnetoencephalographic (MEG) frequency-tagged responses mirroring ongoing statistical implicit learning. Sleeping participants were exposed at non-awakenings thresholds to fast auditory streams of tones either randomly organized or structured in such a way that the stream could be statistically segmented in which tones set of 3 elements (tritones). Although unambiguous tone-related frequency-tagged MEG responses were found in all participants during sleep, there was no evidence of segmentation, i.e. no tritone frequency-tagged responses. In the ensuing wake period however, all participants exhibited robust tritone-related responses during exposure to statistical streams. Finally, the temporal evolution of segmentation-related MEG responses during exposure at wake was not different between participants exposed vs. not to statistical streams during prior sleep. Consequently, our results suggest that complex stimulus-stimulus associations embedded in statistical regularities are not detected during sleep, and that learning capabilities during sleep restrict to simpler elementary associations.

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Saturday, 04/03/2017, 15:00

On the sexual dimorphism of sleep spindles

Róbert Bódizs
Institute of Behavioural Sciences, Semmelweis University Budapest, Hungary

Sleep spindles are episodic bursts of mid-frequency (between wakefulness related alpha and REM-sleep specific beta waves) oscillatory EEG activities emerging on the background of irregular, coloured noise-type or slow wave activity of NREM sleep. Spindle-related offline neuroplasticity, as well as anatomical-microstructural and trait like cognitive correlates of these sleep-related events are of special interest for cognitive neuroscientists. Although theoretically and practically relevant, findings on the sex differences in sleep spindles are sparse and controversial. After reviewing the literature on the sexual dimorphism of sleep spindle oscillations, the presentation will focus on new findings providing evidence for sex differences in spindle density (female > male), amplitude (female > male), frequency (female > male), hemispheric lateralization (female < male), local-global nature (females more global), as well as inter- and intra-hemispheric synchronization (females > males). Some of the sex differences revealed in our studies are depending on age (density, amplitude, and frequency), menstrual cycle phase (oestrogen and progesterone levels → frequency) and contraceptive use (frequency, hemispheric laterality). We suggest that the sexual dimorphism of sleep spindles reflects the sex differences in neurocognitive architectures. Moreover, clinical and basic investigations relying on sleep spindle analyses have to consider the sex differences in spindle activity in order to increase the reliability and validity of their findings.

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Saturday, 04/03/2017, 15:30

Rhythms of the Mind: Sex Differences in the Circadian and Sleep-Wake Dependent Oscillations in Attention and Visuospatial Working Memory

Nayantara Santhi
Surrey Sleep Research Centre, University of Surrey, Guilford, UK

The sleep-wake cycle constitutes a daily rhythm of recovery and deterioration of functional capacity generated by the interaction between the circadian timing system and a homeostatic sleep drive. The circadian timing system regulates the structure and timing of sleep such that temporary recovery and deterioration of functional capacity normally occur during the night and day respectively. It also contributes directly to bin function, independent of the timing of sleep and wake, which in real life occurs during shift work or jetlag. How the circadian and sleep-wake dependent regulation in cognition differs between individuals is still an open question. Emerging evidence points to sex differences in human circadian and sleep characteristics; timing of clock gene rhythms in the brain, period of the body temperature and melatonin rhythms, and timing and duration of sleep differ between the sexes. Whether this difference extends to the circadian regulation in cognition is unclear. The talk will discuss experimental data highlighting sex differences in the contributions of circadian phase, prior sleep and elapsed time awake on attention and visuospatial working memory and discuss their real-world implications.

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Memory enhancement during sleep, using slow oscillation up-state-targeted memory cues

Lucia M. Talamini
Amsterdam Brain and Cognition, University of Amsterdam, Netherlands

Closed-loop stimulation is a hot topic in sleep research. It enables presentation of stimuli in alignment with specific patterns in ongoing biophysical signals. We have previously developed a closed-loop procedure for targeting stimuli to selected phases of EEG oscillations, which we used to demonstrate differential processing of stimuli presented in slow oscillation up- and down-states (Cox *et al.,* 2014, *Plos One*). We have now developed a new procedure for oscillatory phase targeting, in combination with hd-EEG recording, that is faster and more accurate than any previously reported methods, and more convenient to implement. Using this procedure, we show that the tight alignment of specific memory cues to slow oscillation up states during sleep enhances performance on a pre-sleep presented vocabulary-learning task, compared to either no cueing or down-state cueing. These results provide strong evidence for the notion that sleep-related memory consolidation occurs during slow oscillation up-states.

Saturday, 04/03/2017, 17:00

0.0002 Hz Fluctuations in Human Intracranial Recordings

Gio Piantoni
Massachusetts General Hospital / Harvard Medical School, Boston, USA

Neural activity is organized in rhythms at multiple temporal scales. While EEG commonly records oscillations in the range of 0.1 to 100 Hz, the presence of very slow fluctuations has been difficult to assess due to the widespread use of high-pass filters. In this study, recordings were acquired with a full-band amplifier in intracranial electrodes implanted for clinical purposes in patients with intractable epilepsy, continuously over the course of a few days. We measured the difference in DC potentials between neighboring channels belonging to depth electrodes in prefrontal and temporal cortices.

We show the existence of fluctuations with a period of 1-2 hours in the human brain. These ultra-slow fluctuations had an amplitude in the order of mV, which is considerably larger than previously reported brain rhythms, and were present during wakefulness and sleep. Crucially, the cycle of the ultra-slow fluctuations was correlated with the sleep cycle. This observation was confirmed by the cross-frequency coupling which was present exclusively during sleep: the phase of the ultra-slow fluctuations entrained the power in the slow wave band (1 Hz).

In conclusion, we show that the human brain generates ultra-slow fluctuations of very large amplitude in the order of 1-2 hours. These ultra-slow fluctuations synchronize the sleep cycle and their phase might indicate the propensity to fall asleep. We speculate that they might represent a potential correlate of the Basic Rest-Activity Cycle (BRAC), a putative rhythm that organizes the level of vigilance during wakefulness and the sleep cycle during sleep.

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Saturday, 04/03/2017, 17:30

Concluding words

Kerstin Hödlmoser & Manuel Schabus
Lab for Sleep, Cognition and Consciousness Research, University of Salzburg, Austria
Center for Cognitive Neuroscience, University of Salzburg, Austria

Sunday, 05/03/2017

Meetings in small groups, social events,…

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Notes:

Notes:

Congress Information

1. Venue:

Sonja Alpine Resort Hotel ****
Kapruner Straße 51
5721 Piesendorf - AUSTRIA
Hotel: ☏: +43 (0) 6549 20200

Sleep lab team ☏: +43 (0) 664 8525419

2. Transportation: Kapruner Taxi: ☏: **+43 (0) 664 3070319**

3. Registration & Badges
On-site registration will be handled by the hotel staff. You will receive your badge upon check-in.

4. Speakers and Data-Blitz Candidates,
please ensure that you are available in the seminar room at least ten minutes before the start of your session (please check program for more details). It is recommended that all **speakers** load their PowerPoint slides on the computer at least 2 hours prior to the start of the session. **Data-Blitz Candidates** visit the registration desk to load up their PowerPoint slides at least 1 hour (i.e. Saturday, 04-03-2017 at 8am) prior to the start of their session. You may also send them to Ann-Kathrin Jöchner (Ann.Joechner@stud.sbg.ac.at) in advance.

Preferably, all presentations should be in PowerPoint (the computer is running Windows 7 and PowerPoint 2010). To avoid compatibility issues, we would kindly like to ask you to convert presentations prepared on a Mac to PDF. If this is not possible, please be prepared to use your own Mac for the presentation.

We would appreciate if the **speakers** prepared a talk for a maximum of 20 min + 10 min discussion. **Data-Blitz Candidates** are expected to prepare a talk for a maximum of 8 min + 5 min discussion. Please be aware that time arrangements will be very strict and no overtime can be granted. There will be a countdown and after 12:30 min the next speaker will enter the stage to take over at 13:00 min.

5. Refreshments and Meals
Coffee, tea and water will be served during the coffee breaks. Breakfast is included, whereas costs for lunch and dinner will have to be covered by you.

6. Wifi
Wifi is available at the hotel. There is no password required.

7. Leisure activities
There are two skiing areas nearby, a larger (Kitzsteinhorn, www.kitzsteinhorn.at) and a smaller one (Maiskogel, www.maiskogel.at). Shuttle busses bringing you there leave in front of the hotel and are free of charge. For those, who would rather like to relax, the Tauern Spa Kaprun (www.tauernspakaprun.com) is within walking distance from the hotel. Regarding more information on leisure activities, please approach the hotel staff. They will be happy to help you!

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