



FALAN Satellite Meeting

“The doors of memory: The role of sleep on memory formation and modification”

Organizers

Dr. Cecilia Forcato (Argentina)

Dr. Felipe Beijamini (Brazil)

Venue

Universidad Nacional de Quilmes (UNQ),
Departamento de Ciencia y Tecnología
Roque Sáenz Peña 352,
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Buenos Aires
Argentina

Date

October 16th 2016

Purpose and nature of the course

This is the first Latin American Meeting of Sleep and Memory dealing with one of the most frontier topics in Neuroscience: the role of sleep in memory formation and modification. It will be held in the National University of Quilmes (UNQ), Buenos Aires on 16th October 2016 as a Satellite Event of the FALAN 2016 (Federation of Latin America and Caribbean Neuroscience, <http://falan-ibrolarc.org/drupal/es>). It counts with the support of the International Brain Research Organization (IBRO), Brazilian Sleep Society, the Brazilian Society of Neuroscience and Behaviour, the National University of Quilmes (UNQ), and the Argentinian Society of Neuroscience.

The aims of the meeting are:

- 1) To discuss theories and current results about the role of sleep in memory, as well as its application in education and psychotherapy in Latin America;
- 2) To promote the development of new lines of research in the region as well as making networking between Latin American Countries and also with countries outside the region and to strengthen the already established collaboration with Europe and North America;
- 3) To promote the participation of students and researchers generating a space for discussion and integration of the different steps of the scientific carrier;
- 4) To provide a space, outside the conference, for the students that are beginning the scientific carrier to reach the experts in an informal environment (lunch, cheese and wine) promoting the exchange of ideas.

This special meeting will include 11 talks of senior and young international researchers from the field Sleep, Memory and Consciousness. We will discuss the active role of sleep in memory formation, the electrophysiological mechanisms involved in the transfer of information between short-term to long-term stores during sleep, as well as the molecular mechanisms involved in the process. Furthermore, we will discuss the use of sleep protocols for memory improvement in education and psychotherapy. This meeting aims to encompass several a multidisciplinary discussion by presenting and discussing behavioural, electrophysiological, molecular, pharmacological and imaging approaches, of different types of memories (motor, emotional, episodic, autobiographical, schema memories), from animal models to humans.

Notwithstanding that research in the field of sleep and memory has achieve remarkable improvements in the past decades, in Argentina and several other countries from Latin America and Caribbean region are still playing a minor role in this field, with exception of Brazil, there are few laboratories dedicated to the study of sleep and more specifically sleep and memory in the region. This meeting was planned to bring some of the most important researchers of the field to present their own theories and research about sleep and memory. Furthermore, one of the most exciting goals of this meeting is to bring young exceptional researchers who are building their own career to contribute in the field of sleep and memory. Consequently, we also expect to promote a unique opportunity of interaction between young and senior researchers. We aim to stimulate discussion and the development of networks and collaborations. Notwithstanding, this meeting will be a fantastic opportunity for the popularization of the topic among Argentinian, Latin American and Caribbean fellows considering that the meeting is scheduled to occur as a satellite event for the reunion of the Federation of Latin American and Caribbean Neuroscience – FALAN. We also believe in the potential role of this meeting to contribute in education and clinical settings. Complimentary, we also believe that this meeting has a great potential for the advancement of the internationalization of Argentinian, Latin American and Caribbean fellows in this field. Finally, we would like to stress that this is the first attempt to bring such a great team of scientists from the sleep and memory field to Argentina, which may stimulate the participation of general public.

Program

Schedule of the meeting

- 7.30h Transfer to the National University of Quilmes
- 8.00h Registration
- 9.10h Welcome (Cecilia Forcato and Felipe Beijamini)
- 9.20-10h **Talk 1.** Memory formation during sleep – the role of spindles
by **Dr. Jan Born** (Germany).
- 10-10.40h **Talk 2.** Stress, Sleep, and Memory Consolidation: Independent and
Interactive Effects
by **Dr. Jessica Payne** (United States of America).
- 10.40-11.20h **Talk 3.** Sleep, consolidation, and semantic memory formation
by **Dr. Penelope Lewis** (England)
- 11.20-11.35h **Coffe-break**
- 11.35-12.15h **Talk 4.** Contribution of Sleep to Motor Skill Learning and Consolidation
by **Dr. Julien Doyon** (Canada).
- 12.15-12.55h **Talk 5.** Sleep and School Learning
by **Dr. Sidarta Ribeiro** (Brazil).
- 12.55-14.30h **Lunch (meeting the scientists)**
- 14.30-15.10h **Talk 6.** Reactivation of neuronal firing patterns of the ventral
tegmental area during sleep.
by **Dr. José Luis Valdés** (Chile).
- 15.10-15.50h **Talk 7.** How much we can remember after a nap? What if the nap is
under a sedative?
by **Dr. Tristán Bekinschtein** (England)
- 15.50-16.30h **Talk 8.** Sleep strengthens consolidation of contextual specificity of
operant behavior
by **Lic. Margarita Borquéz** (Chile).

- 16.30-16.45h ***Coffe-break***
- 16.45-17.25h **Talk 9.** The role of sleep in long-term true and false memories
by **MA. Enmanuelle Pardilla-Delgado** (United States of America).
- 17.25-18.05h **Talk 10.** The Role of Reconsolidation in Memory Strengthening during
sleep
by **Dr. Cecilia Forcato** (Argentina).
- 18.05-18.45h **Talk 11.** Sleep and Problem Solving
by **Dr. Felipe Beijamini** (Brazil).
- 19h ***Cheese and Wine (meeting the scientists)***
- 20.30h Transfer to Capital Federal.

Abstracts of the Talks

Talk 1.

“Memory formation during sleep – the role of spindles”

By Jan Born

Whereas memories are encoded and retrieved optimally when the brain is awake, the consolidation of memory requires an offline mode of processing as established optimally only during sleep. Recent studies have elucidated some of the neurophysiological mechanisms underlying the consolidation of memories during sleep, especially in the hippocampus-dependent declarative memory system. This system is capable of rapidly forming an initial memory representation for an episode upon its one-time occurrence, and is thus at the basis of the formation of any long-term memory. The consolidation of hippocampus-dependent memories represents an active system consolidation process that takes place mainly during slow wave sleep (SWS) rather than REM sleep, and critically relies on the neural reactivation of newly encoded representations. This reactivation originates from hippocampal circuitry and likely stimulates a gradual redistribution of the representations towards extra-hippocampal, mainly neocortical networks serving as long-term store. The redistribution of the representation goes along with a qualitative transformation of the memory towards a more abstract schema-like representation. The hippocampo-to-neocortical transfer of reactivated memory information appears to be primed by the occurrence of a hierarchical nesting of SWS-related EEG oscillations, where hippocampal ripples (and enwrapped reactivated memory information) nest into the excitable troughs of a

thalamic spindle, and where such spindle-ripple events themselves nest into the excitable up-states of the neocortical (<1Hz) slow oscillation. Thalamic spindle play a central role in this transfer because they do not only phase-lock hippocampal reactivations but also contribute to the generation of neocortical slow oscillations.

Talk 2.

“Stress, Sleep, and Memory Consolidation: Independent and Interactive Effects”

By Jessica Payne

Separate lines of research demonstrate that elevated cortisol can selectively benefit the consolidation of emotional memories, as can the occurrence of sleep soon after learning. The first part of my talk will examine the separate roles that stress and sleep play in the formation of emotional memories. In the second part, I will discuss new evidence, from behavioral, psychophysiological, and neuroimaging studies, suggesting that stress and arousal interact with sleep to benefit memory consolidation, particularly for negative arousing information. I will conclude by presenting a model suggesting that stress hormones may help ‘tag’ attended information as important to remember at the time of encoding, thus enabling subsequent, sleep-based processes to optimally consolidate information in a selective manner.

Talk 3.

“Sleep, consolidation, and semantic memory formation By Penelope Lewis”

By Penelope Lewis

Semantic memory can be thought of as the decontextualised gist of multiple related episodes. At a more theoretical level, it can also be thought of as the abstracted statistical properties which define a particular type of experience. Recent research has shown that sleep enhances integration across multiple stimuli, abstraction of general rules, insight into hidden solutions, and even creativity. I will build on this literature by presenting evidence that sleep is also important for the abstraction of statistical rules which define a particular dataset, for the off-line decontextualisation of episodic memories, and for the integration of newly learned information into existing knowledge. Taken together, these findings support a role for sleep in the formation of new aspects of semantic knowledge.

Talk 4.

“Contribution of Sleep to Motor Skill Learning and Consolidation”

By Julien Doyon

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.

Talk 5.
"Sleep and School Learning"
By Sidarta Ribeiro

Post-training sleep is important for declarative memory consolidation. However, the educational potential of sleep is yet to be tapped. This talk will present published and unpublished results of class-room experiments on the educational utility of post-training sleep. Altogether, the results indicate that sleep benefits formal academic performance.

Talk 6.
"Reactivation of neuronal firing patterns of the ventral tegmental area during sleep"
By José Luis Valdés

It has been demonstrated that during sleep, different structures in the brain such as the hippocampus, neocortex, and striatum exhibit spatiotemporal correlation patterns resembling those observed during the task. This reactivation phenomenon has been proposed as a neurophysiological substrate for memory consolidation. Here we show new evidence that rodent ventral tegmental area (VTA) neurons actively reactivate during a rest period following a task, which involves stimuli with different valence. Reactivation occurred primarily during slow wave sleep and during quiet awakeness. The patterns of reactivation in the VTA showed uncompressed timing and occurred at the firing rate level, rather than on a spike-to-spike basis. Mildly aversive stimuli were reactivated more often than positive ones. Currently it is well known that VTA is a structure involved in the perception and prediction of rewards and stimulus salience and is an essential neuromodulatory system involved in synaptic plasticity. This new evidence suggests new ways in which dopaminergic signals could contribute to the biophysical mechanisms of memory consolidation, during sleep.

Talk 7.

“Sleep strengthens consolidation of contextual specificity of operant behavior”

By Margarita Borquéz

Numerous studies have reported that the consolidation of recently acquired memories is favored by the later sleep. The aim of this research was to determine whether sleep benefits the contextual specificity of extinction memory of operant behavior. 48 Sprague Dawley rats separated into three groups (ns = 16, Sleep, Sleep Deprivation, Control wake) were used, trained subjects on a task of operant conditioning in context A, then extinction was carried out in context B. The testing was performed both in the context B as in a novel context (context C). The Sleep group was tested after retention interval of three hours in which they were allowed to sleep, the Sleep Deprivation group was tested after an interval of 3 hours in which they were not allowed to sleep. The Wake Control group was disposed to control circadian factors. The response rate of subjects in each experimental phase was recorded and was acquired EEG (electroencephalograms) registered. The results indicate that Sleep group had a lower response recovery in extinction context (context B) and a higher response recovery (renewal) in a novel context (context C) than Sleep Deprivation group. These results provide evidence that context specificity of extinction is favored by post-training sleep.

Talk 8.

“How much we can remember after a nap? What if the nap is under a sedative?”

By Tristán Bekinschtein

The memory consolidation framework does not accommodate drug-induced naps under in its realm, nor is amenable to information presented during the transition to sleep. In this talk I would like to discuss the strength and weaknesses of the sleep consolidation framework in light of this two challenging experiments.

These results suggest that sleep spindle activity marks schema-dependent consolidation, possibly through a role in the integration of newly acquired memories into pre-existing neocortical schemas.

Talk 9.

“The role of sleep in long-term true and false memories”

By Enmanuelle Pardilla-Delgado

While the influence of sleep on memory has a long history, sleep's role in the formation of false memories is less clear. Although technically a false memory, remembering information that is strongly related to the theme, or gist, of an experience can be considered an adaptive process. While some evidence suggests that sleep, compared to a wake period, increases both true and gist-based false memories in the DRM task, not all studies have returned this result, and most studies cannot completely rule out the possibility that sleep is merely protecting the information from interference, as opposed to actively aiding its consolidation. Here, to equate the amount of time spent awake and asleep across groups, we assessed how the

positioning of sleep relative to memory encoding impacts true and false memory formation across longer delays of 24 and 48 hours. Participants encoded 16 DRM lists in the morning (WAKE 1st Groups) or evening (SLEEP 1st Groups), and were tested either 24 or 48 hours later at the same time of day. Results demonstrate that true memory is better when participants sleep soon after learning. To a lesser extent, sleeping first also increased false memory. Importantly, and similar to previous studies, a negative correlation between slow wave sleep (SWS) and false recognition was found, suggesting that SWS may be detrimental for semantic/gist processing.

Talk 10.

“The role of Reconsolidation on Memory Strengthening during Sleep”

By Cecilia Forcato

Memory reactivation exerts different effects on declarative memories depending on whether reminders are presented during wakefulness or sleep. In the wake state reactivation labilizes memories requiring reconsolidation, whereas reactivation during sleep promotes memory stabilization. A mismatch between current and past events is necessary in order to initiate memory labilization/restabilization during wakefulness. I will discuss new data supporting that a mismatch is also required to trigger long term memory strengthening during sleep but not for short term strengthening.

Talk 11.

“Sleep and Problem Solving”

By Felipe Beijamini

Sleep facilitates the strengthening of previously learned experiences by reactivating memory. Furthermore, there is evidence of memory transformation and reorganization during sleep. Accordingly, the active system consolidation hypothesis claims that this reorganization process involves the transfer of recently encoded memories from the hippocampus to preexisting, more stable and long-lasting networks located in the neocortex. This process is believed to promote generalization and abstraction of rules, knowledge and extraction of the gist, and probably also insight into solution for problems. In the past years we have been testing the hypothesis that memory reactivation during sleep can improve the consolidation of triggered memories to facilitate subsequent problem solving by exposing subjects to a video-game based problem and evaluating their performance after a nap, or a night of sleep. According to our findings sleep increases the chance to solve a problem.