



Seewiesen Colloquia

Speaker invited by: Niels Rattenborg

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Possible mechanisms of memory consolidation during sleep

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At first glance, sleep can be seen as a state of rest and restitution. Recent studies, however, have drawn a much more complex picture of sleep. During sleep, the brain is active, but functions in an entirely different mode than during wakefulness. During sleep, electrophysiological properties, the state of modulatory neurotransmitters and the neurohormonal environment of the brain are all entirely unlike those of the wake state. More and more studies now show that the brain uses the sleep period to reprocess and consolidate newly learned memories. Depending on the type of memory system, several characteristics of sleep can be made out which contribute to systems or synaptic processes of memory consolidation. Tonic features of sleep set the brain in the mode for memory consolidation, phasic features actually process the new information. For example, for declarative memory (i.e. memory for facts and events), the reduced levels of the neurotransmitter acetylcholine are thought to switch the hippocampus from a “recording” to a replay” mode. In this mode, traces of recently acquired memories are repeatedly reactivated, in order to allow their integration into the more static neocortical networks. The actual information transfer can then be coordinated between brain areas by the slow oscillation of electrical brain activity prominent during deep, slow-wave sleep. This slow oscillation entrains other rhythms like the hippocampal ripple and cortical spindle activity, and might thus allow a very effective, precisely timed dialogue between distant brain regions.

Who is Steffen Gais

1999-2004	PhD in human biology, University of Luebeck, Germany
2005-2007	Postdoc at the Cyclotron Research Centre, University of Liège, Belgium, with Prof. Dr. Maquet
2007-2008	Postdoc at the University of Luebeck, Germany with Prof. Dr. Born
since 2008	Head of an Emmy-Noether-research group in the department of General and Experimental Psychology, Ludwig-Maximilian-University, Munich, Germany

Selected publications:

- [Gais, S., Rasch, B., Wagner, U. & Born, J. \(2008\) Visual-procedural memory consolidation during sleep blocked by glutamatergic receptor antagonists. *J. Neurosci.* 28 \(21\):5513-8.](#)
- [Gais, S., Albouy, G., Boly, M., Dang-Vu, T. T., Darsaud, A., Desseilles, M., Rauchs, G., Schabus, M., Sterpenich, V., Vandewalle, G., Maquet, P. & Peigneux, P. \(2007\) Sleep transforms the cerebral trace of declarative memories. *Proc. Natl. Acad. Sci. U.S.A.* 104 \(47\):18778-83.](#)
- [Rasch, B., Büchel, C., Gais, S. & Born, J. \(2007\) Odor cues during slow-wave sleep prompt declarative memory consolidation. *Science* 315 \(5817\):1426-1429.](#)
- [Gais, S. & Born, J. \(2004\) Low acetylcholine during slow-wave sleep is critical for declarative memory consolidation. *Proc. Natl. Acad. Sci. U.S.A.* 101 \(7\):2140-2144.](#)
- [- Mölle, M., Marshall, L., Gais, S. & Born, J. \(2002\) Grouping of spindle activity during slow oscillations in human non-REM sleep. *J. Neurosci.* 22 \(24\):10941-10947.](#)