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Fachbereich Psychologie & Salzburger Gesellschaft für Psychologie
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Sleep-wake interactions and human cognition

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Memory consolidation is the process by which fresh, initially labile, memories are reorganized into enduring stable memories. At the systems level, memory consolidation results in a progressive rearrangement of memories which can eventually be stored in circuits different from those in which they were initially encoded. For instance, declarative memories, originally heavily dependent on mesio-temporal structures, are thought to be gradually restructured in mature memories stored in more distributed cortical networks.

A growing body of data suggests that sleep is involved in the consolidation of declarative memories. We will provide evidence from fMRI studies that sleep deprivation hinders the plastic changes that normally occur during sleep and alters the brain responses subsequently recorded at retest. One possible mechanism underpinning memory consolidation consists in the replay of firing sequences in neuronal populations involved in learning during sleep. Evidence for a replay of neuronal firing sequences has been collected in rodents during both NREM and REM sleep within the hippocampus, as well as in the neocortex. Consistent with data collected in rodents, we reported task-related experience-dependent increases in the hippocampal and neocortical activity in humans during NREM sleep following spatial learning.

An offline coordinated reactivation of distributed components of memory traces has also been observed during immediate post-training wakefulness in non human Primates and rodents. Likewise, using fMRI in humans, we were recently able to indirectly identify learning-related changes in spontaneous brain activity during wakefulness, by characterizing the modulation they impose on responses to an unrelated cognitive challenge.