# Functional activity of the human locus coeruleus in the wake-sleep transition measured with concurrent EEG-fMRI

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**Background**: During the process of falling asleep, humans lose consciousness and thereby lose the ability to process, store and respond to environmental information.
**Methods**: We characterize the step-wise wake-sleep transition process in an EEG-fMRI setting. 33 participants (97 sessions) were listening to an audio book and reacting to tones while falling asleep in multiple sessions throughout one night. After waking up, participants indicated on a sentence-by-sentence basis what parts of the audio book content they could still remember. This experimental paradigm allows to disentangle memory processing and reactivity.
**Results**: The last recallable memory happened consistently before the last tone response. The transition from remembering to not remembering was accompanied by a decrease in associative auditory area activation. The change from responsiveness to no responsiveness related to activation patterns in early auditory areas, the cerebellum, the supplementary motor area (SMA) and the thalamus. Region-specific modulations by oscillations implicated in sleep were found with an apparent overlap to the regions involved in different cognitive states. Alpha power changes related to brain stem and cerebellar activation patterns, theta power to SMA and the spindle power band to auditory cortex activation patterns. Different subparts of the thalamus related on different time scales to these power band changes. Overall, the transition between different cognitive states entailed activity changes in process-relevant regions showing that higher cognitive areas ceased their activity before lower-level processing areas.
**Conclusions**: The results clearly indicate that different information processing components become uncoupled while falling asleep.