RUHR-UNIVERSITÄT BOCHUM

RUB

IGSN - SYMPOSIUM

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The catecholaminergic regulation of cognition and memory

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Locus coeruleus activity after learning: implication for off-line memory consolidation

Brain networks activated by experience undergo various changes at the molecular, synaptic and systems levels that ultimately lead to stabilization and storage of newly encoded information. According to the consolidation hypothesis, memory formation is a long-lasting process and thus continues after actual learning experience, i.e. off-line. Noradrenaline (NA), a neuromodulator that is released from the terminals of the Locus Coeruleus (LC) neurons, promotes both synaptic strengthening and weakening. It is well established that optimal level of NA-neurotransmission is essential during information encoding and retrieval; however, we only begin to understand the role LC after learning. Earlier studies identified a ~ 2h after post-learning time window when LC-NA influence on memory consolidation is most pronounced; this time window coincides with the protein-dependent phase of synaptic plasticity. At present, the LC firing pattern and the temporal dynamics of LC activity after learning remain largely unexplored. The hippocampal ripples and thalamo-cortical sleep spindles are considered to mediate off-line consolidation. During sleep, LC firing is phase-locked to cortical slow oscillations, NA release promotes cortical activated state when sleep spindles occur. At the same time, LC activity is transiently suppressed around times of ripple/spindle coupling when information transfer is thought to take place. Indeed, experimentally induced phasic LC activation at times of ripples was detrimental for spatial memory. Furthermore, elevated tonic LC firing suppresses generation of both sleep-associated oscillations. Suppression of NA-neurotransmission potentiates thalamocortical oscillations, while suppresses ripple generation. Our new results suggest that reduced NA-neurotransmission may be necessary for generation of a brain state that is favorable for 'off-line' inter-regional information transfer. The temporal windows of elevated LC activity during off-line states and the functional significance of LC activation for off-line consolidation remain yet to be discovered.

Host:

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Guests are welcome!

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