Memory Reactivation and Consolidation During Sleep

A Discussion

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The Questions Addressed

- 1. Is there a positive effect of sleep on learning and memory different from equivalent wake time?
- 2. If so how does it work? The role of SWS versus REM, the interactions of SWS and REM, and the microstructure of REM: phasic events versus REM time, the neurochemistry shifts over time of night and stages in relation to consolidation etc.
- 3. What kinds of learning tasks show a benefit of sleep? Declarative versus procedural, novel experience.

More Questions

- 4. What kinds of learners show these effects? Are there trait and state variables of importance, such as the role of prior waking state, meaning of the task and learning ability. Can the level of pre-sleep arousal be too high or too low, is there a U shaped curve where the waking activation level is just right to engage the sleep system to good effect?

The Big Question

- 5. And what do we know now about the 24 hour mind/brain functioning that moves us beyond Freud's three levels of unconscious, pre-conscious and conscious mind and Kleitman's BRAC (Basic Rest/Activity Cycles)? From the studies of the microstructure and functioning of the ultradian cycles is there a pay off in adding explanatory power to waking effects of sleep?

What We (I) Learned Today

- Dr. Riberio reported IEG zif 268 to be a link between the SWS neuronal reactivation following learning, and REM consolidation. With the zif-268 up-regulation occurring only during REM, and moving from hippocampus to neocortex, he gives us a map of how memories move through the two major sleep systems and come to change the synaptic structure to improve subsequent waking performance.

Next

- Dr. Smith has demonstrated the importance of, not REM time, but of the phasic events of REM as a key explanatory variable in increases and decreases in memory consolidation and performance: the correlation to EMs and IQ, their reduction following alcohol, and their prominence in the late night sleep relates well to the Payne and Nadel paper.

Next

- Dr. Stickgold's human studies are consistent with Dr. Ribeiro's work: that SWS stabilizes new learning and REM sleep enhances performance. That naps can halt deterioration of performance and if they contain REM can improve it. It would be exciting if he could do EM counts on those REM naps to confirm Dr. Smith's work.

Next, Again

- The paper by Drs. Payne and Nadel helps to bring this all together: the early night SWS role in episodic memory improvement and late night REM role in procedural improvement which they tie to the cortisol cycle and to the differences in the characteristics of the mentation reports from NREM versus REM sleep.

So What Is Left to Do?

- Lots. I missed any emphasis on the role of affect in this work. Is not the salience of waking experiences of importance in its reactivation in SWS and then what guides what memory networks are stimulated to represent it in REM/dreaming?
- There are experiments in nature, for example when EMs are increased in early sleep (in major depression) that can be usefully exploited to tease apart time of night, stage, and hormonal effects.

Thanks

- I applaud what I have heard and look forward to seeing the new models of how the mind/brain works around the clock to keep track of who we are, what we have learned, and how we plan to get where we think we want to be going.