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Newsletter

Timothy J. Walter, M.D.

Uma Marar, M.D.

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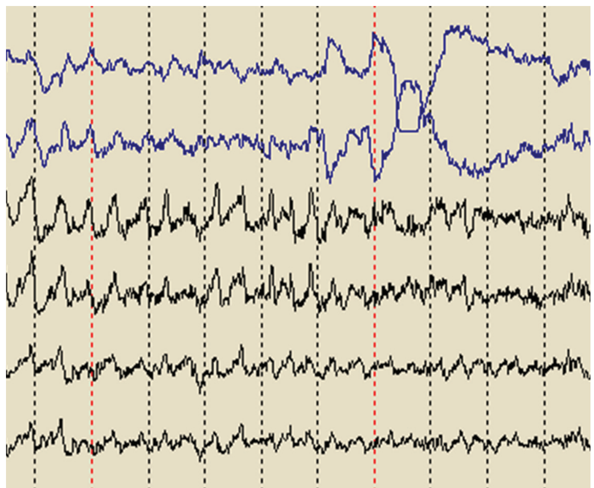
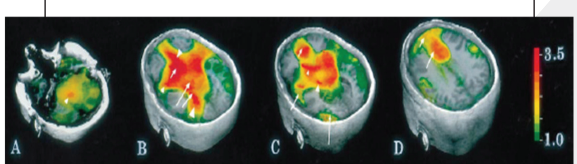
REM Sleep and Memory Part II: How it might Work

In rats, a number of studies have demonstrated the link between REM sleep and memory.[1] Other studies have shown that when rats are deprived of REM sleep following training, learning is impaired.[2] In humans, an increase in REM sleep has been reported following training in various experiments including trampolining[3], intensive learning of a foreign language[4], and learning Morse code.[5] Brain imaging in humans reveals an increase in brain activity may be seen during learning in the appropriate parts of the brain that are involved with the task at hand. The same regions of the brain are again activated during subsequent REM sleep.[6 7]



If it is true that rapid eye movements represent action or actual visual scanning in the dream by the dreamer, then it may be that this process is crucial in the learning process.[8] A possibility is that the dream itself, and specifically action in the dream correlates with bursts of eye movements, which are really just the cortical representation of this process. In other words, we may wake up and realize that we just had a dream. The evolutionary purpose of the dream may be how the brain connects and consolidates recent memories of the past several days or weeks with other associated memories already present in the matrix of memories of the dreamer. The emotion sensed during the dream may represent the mechanism that forms the connection between the two memories, and it may be that the brainstem impulses that drive the actual rapid eye movements serve to weld the connection between the recent and previously existing memories. Emotional relevance provided by the amygdala and the rest of the limbic system is what decides which memories of the day are worthy to be "burned" into temporary storage in the hippocampus. Dreams can be highly emotional. Therefore, it is at least conceivable that emotions felt while dreaming during REM sleep may also be integral in making the memory connection, bridging the recent memory with the matrix of memories previously existing. This idea is simply a hypothesis and has yet to be proven. Nevertheless, the thought remains intriguing.



During learning, it is the four to eight cycle per second theta frequency which is crucial in the temporary transfer of experiences from the cerebral cortex to the hippocampus. The temporary hippocampal "roots" of the memory trace sprout and grow at the theta frequency of 3-8 cycles per second. The neurons activated in this process are then reactivated as the memory trace in the hippocampus is transferred back to cortex during sleep.[9]

Sawtooth waves are seen in REM sleep, usually right before a burst of rapid eye movements. Sawtooth waves look like rows of shark fins on a sleep study as they slowly buzz at the theta frequency of about four to eight cycles per second.[10] This theta frequency is the same as that which is seen when the memories are initially stored in the hippocampus during waking consciousness. It is unclear as to what exactly is going on, but it may be that the sawtooth waves set the stage of the recent memory in the dream just before the brainstem impulses that drive rapid eye movements "weld" the connections of the recent memory into the matrix of existing memory. This idea has yet to be explored experimentally. Whatever the case, sawtooth waves are happening for a reason.[11]

REM sleep is important in memory but it is not the whole story. More recently much evidence has also attributed a role for part of the memory consolidation process to slow wave sleep and the sleep spindles of stage II sleep. Stay tuned to upcoming newsletters to see how slow wave sleep and stage II sleep are involved in the process….

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11 Walter, T (2007) Chapter 11, REM Sleep and Memory. In REM Illumination Memory Consolidation (pp. 115-129), Grove City; OH: Lotus Magnus.