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REM Sleep Windows

Some of the most impressive research on REM sleep and memory to date is that of REM sleep windows. The nutshell of what this research shows is that there are specific time windows following learning during which REM sleep must be allowed to occur in order for the consolidation of memory to occur. For NASA, there are specific windows in time during which it would be feasible to launch a rocket or space shuttle. This is known as the launch window. Simply stated, the REM sleep window is the specific window of time for REM sleep to occur after learning, so that the material learned will then become consolidated into the pre-existing matrix of memories.

The concept of the REM sleep window was first developed while doing continuous long term brainwave recording and REM sleep deprivation experiments on rats while having them learn trials in a rat training exercise. The studies involved teaching rats a task commonly used in rat memory research called the shuttle avoidance task. Each group of rats received 100 training sessions. The first group of rats received all 100 training sessions on the first day.[1] The second group of rats were required to learn the task during 2 consecutive daily sessions of 50 trials per day,[2] and the third group of rats to learned the task in 20 trials per day over 5 consecutive days.[3] Thus, while all animals were ultimately exposed to 100 training trials in this task, it was the distribution of sessions that varied.

For the rats that had all 100 training sessions on the same day, the increase in REM sleep was the greatest and was also seen to happen the earliest after the end of training. For the other two groups, REM sleep actually maximized in two smaller peaks that were more delayed from the training sessions. The rats that had 20 training trials over five days had the smallest increases in REM sleep. Rats that were trained but were not able to learn and rats that were never taught the task did not have this increase in REM sleep. The increase in REM sleep occurred during a narrow range of time following training. These are the REM sleep windows. Preventing REM sleep from occurring during these specific times was sufficient for preventing learning.[4] Also quite interesting is that REM sleep deprivation at any times other than the specific REM sleep windows did not result in any appreciable reduction in learning.[5]

Since this initial research using the shuttle avoidance task in rats, the finding of the importance of REM sleep windows has subsequently been replicated in a number of other standard rat research tasks, such as the complex operant appetitive task,[6] the Morris water maze,[7,8] the 8-arm radial maze,[9] and a conditioned cue preference task.[10] The timing of the REM sleep windows may vary slightly for different types of tasks. This may be because different types of tasks entail different kinds of learning. REM sleep windows can also be seen in monkeys.[11]

It is unclear as to whether the exact timing of REM sleep windows differs for different types of learning. The research done to date implies that once something is experienced or learned, there may be a finite amount of time that the event must be incorporated into memory. If we are deprived of REM sleep during certain times of the night for a certain number of nights following an event, our ability to store that event or information may be lost forever.[12]

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