COGNITIVE PSYCHOLOGY

**Research Paper Review**

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# The Paper

REM, not incubation, improves creativity by priming associative networks [Denise J. Cai, Sarnoff A. Mednick, Elizabeth M. Harrison, Jennifer C. Kanady , and Sara C. Mednick]

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## Experimental Setup and Procedures

### Setup

The subject were administered a RAT test with 30 RAT items at 9 am and given 40 minutes to complete it. At 09:40 they were given word analogies on 30 items, 15 of which would have the same solution as those administer after the Resting Period. In the Resting Period, the subjects were separated into 3 polysomatographically (PSG) monitored groups, one having quiet rest listening their choice of instrumental music (QR), another having a Non-Rapid Eye Movement nap time (NREM) and another with Rapid Eye Movement laden nap time (REM), all at 1 pm. At 5 pm they were again administered the RAT test at, some of it primed from answers before and finally another Word Analogies test at 17:40 sharing 15 out of 30 answers from before.

### Procedure and methodology

* Subjects : 77 native English speakers between the age of 18 and 35, that were required to sleep at least 6 hrs a day for 5 days preceding the experiment and at least 6.5 hrs just the day prior with restrictions on alcohol and coffee use so as to eliminate an chemical interference.
* RAT Test : RAT is a paper-and-pencil task adapted from Mednick.Each RAT item contains a triplet of words presented horizontally along with a blank space. Each item requires the subject to combine or relate the three words drawn from mutually remote associative clusters (e.g., COOKIES, SIXTEEN, HEART: ). The subject is required to find a fourth word that could serve as an associative link between these three words. The answer to this item is SWEET (cookies are sweet, sweet sixteen, sweetheart). The three test words HEART, SIXTEEN, COOKIE are associated with the solution SWEET by formation of a compound (sweetheart), by a syntactic association (sweet sixteen), and by a semantic relationship (cookies are sweet). Thus,reaching a solution requires ‘‘creative thought’’ because the first, most highly probable associate to each of the items is often not correct, so the solver must think of more distantly related information to connect the three words. RAT Test in the AM se
* Word Analogies : Analogies (e.g., FAST:SLOW as HARD:E), were administered in the AM session. The first letter of each answer was given. Half of the analogy answers served as primes for the answers to the RAT administered during the PM session. There was no time limit for completing the analogies.
* Statistical parameters : Confidence limit is set at 95 ℅ and the hypothesis testis 2-tailed

## Results and Inferences

### Finding

* Subjects were first tested on the RAT at 9 AM and retested at 5 PM. To compare sleep and the passage of time, subjects were administered the same RAT in both the morning and afternoon sessions. No differences were found between groups and post hoc analysis showed that all three groups, NREM sleep, REM sleep, and quiet rest, improved similarly on the repeated items compared with the morning baseline performance.
* Subjects that had REM sleep displayed a significant improvement above NREM sleep and quiet rest groups for primed items. Strikingly, although the quiet rest and NREM sleep groups received the same priming, they displayed no improvement on the primed RAT items, whereas the REM sleep group improved by almost 40% above the morning performance.
* No group (NREM, REM, quiet rest) differences were found on the non-primed RAT items and no improvement in PM performance above baseline was observed in the three groups.
* No difference was observed among the three groups (NREM, REM, and quiet rest) for any of the memory measures, including recognition, cued recall, explicit, and implicit. Furthermore, No significant differences were seen from baseline.

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### Inferences

* The passage of time (i.e., incubation period) improves problem solving for previously exposed items, and this was independent of the sleep condition.
* Sleep enhanced creative problem solving for items that were primed before sleep, but this was only true for naps that included REM sleep
* REM sleep improvements in creative problem solving are not the result of selective improvements in memory.
* General problem-solving abilities were not improved in wake or sleep conditions.

### Authors’ hypothesis

The author hypothesis is that the Brain is subconsciously spreading activation (activations spreads along the associated pathway to related areas of memory) of previously activated nodes which were previously unrelated for example previously unrelated nodes ["heart", "sixteen" and "Cookies" ] . After priming with word "Sweet" the subsequent spreading activation occurs. Thereby activating the associated nodes i.e. ["heart", "sixteen" and "Cookies" ]. These nodes are now related through "Sweet" and the answer "Sweet" becomes a probabilistic response in the RAT exercise.

The proposed the possible mechanism For spreading activation during REM sleep

* During Wake: high level of norepinephrine and acetylcholine restraints the recurrent connection in neocortex.
* During REM: high level of acetylcholine in hippocampus suppresses feedback from hippocampus to neocortex and low level of norepinephrine facilitates the spread of activity within the neocortical area.

**They then propose that REM sleep is important for assimilating new information into past experiences to create network of association for future use.**

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## Our Thoughts

Experts generally agree that the hippocampus plays a role in the formation of new memories and in the detection of new surroundings, occurrences and stimuli, kind of act as data storage also hippocampus is responsible for special navigation

Neocortex it is responsible for logical analysis it creates results and give feedback to hippocampus that means learning data goes into hippocampus. High ordered functions and spatial reasoning happens in your cortex. During REM high level of acetylcholine suppress the feedback from hippocampus to neocortex which results in low input of spatial navigation data which we can relate to incorrect spatial reasoning while we are dreaming.

### Appreciation

This shows the adage of ‘Sleeping over one’s problems’ rings true. If you go to bed with a mental conundrum in your head, you have primed yourself with all the possible data that you have over a problem, and then, during REM sleep, increased associativity leads to new creative approaches and even solutions to our problem. Thus from Kekule to Ramanajunan, from Bob Ross to Speilberg we may finally have, at our hands a thread that connects them all.

### Criticisms

Authors mention the Spreading-Activation hypothesis as concerning with formation of new associations in REM sleep and integrations of unassociated nodes in Neocortex. However they do not provide evidential support for high level activity in Neocortex while in REM sleep. Subjects being monitored with PSG would suggest that this may have been within the authors’ scope. If not, it would have been better to either cite a source which would support that claim, or make an explicit note of the fact that there maybe a gap in understanding here.

### Further Suggestions

As of now the research focuses on REM session within a nap period. A further topic of research could be effect of REM sessions in a night’s sleep as night’s sleep would have more REM sessions than a single nap time. Does