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### **Proceedings of the Annual Meeting of the Cognitive Science Society**

#### **Title**

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#### **Permalink**

<https://escholarship.org/uc/item/8w7740tg>

#### **Journal**

Proceedings of the Annual Meeting of the Cognitive Science Society, 28(28)

#### **ISSN**

1069-7977

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#### **Publication Date**

2006

Peer reviewed

# Sleep, Memory Consolidation, and Semantic Relationships in a Verbal Declarative Memory Task

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**Keywords:** Memory; memory consolidation; sleep

## Introduction

It remains unclear, but critically important, to determine whether sleep influences the consolidation of declarative memories. Although several recent studies suggest a beneficial role of sleep in the consolidation of verbal declarative memories, these studies have typically used a “split-night” procedure, where memory for word pairs was tested after 3 hours of early sleep, or after 3 hours of late sleep (e.g. Plihal and Born, 1997, although see Ellenbogen et al., in press). In this study, we used English translations of Gais and Born’s (2004) word-pairs, and compared performance on these original, semantically related word-pairs to performance on a matched list of unrelated word-pairs after a 12-hour period containing either sleep or wake.

## Method

Participants were randomly assigned into the sleep or wake group, and studied either semantically related or unrelated word-pairs. They then recalled these words after a 12-hour delay (wake: 9AM-9PM, or sleep: 9PM-9AM).

## Results

Across groups, we found that (i) subjects showed nearly identical performance at the end of training, but (ii) 12 hours later at retest, the overnight sleep group showed improved performance compared to the daytime wake group (81.3 vs. 73.1% correct, respectively,  $p < .05$ ). Although subjects showed similar improvements in the recall of related words across 12 hr of Sleep and Wake (7.0% vs. 7.1%,  $p=.9$ ), the Sleep group showed significant improvement in the recall of *unrelated* words, (6.2%,  $p<.005$ ), while the Wake group showed significant deterioration (-4.5%,  $p<.05$ ).

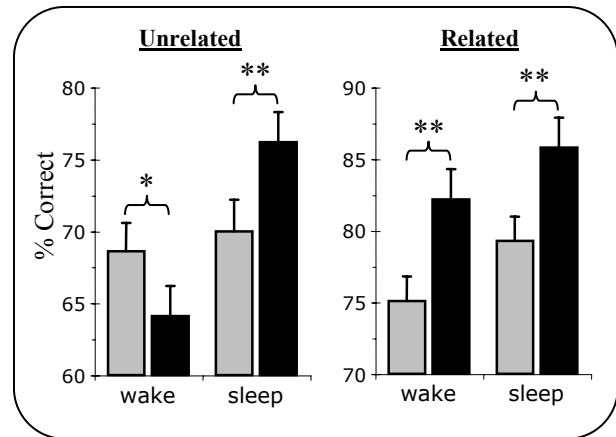


Figure 1: Mean % Recall Performance. Comparison of training (gray bars) and retest (black bars). \* $p < 0.05$ ; \*\* $p < 0.005$

## Conclusion

We have demonstrated that verbal declarative memories benefit from a full night of sleep. In contrast to the findings of Plihal & Born (1997), it was the semantically *unrelated* words that showed the greatest enhancement post-sleep. Our results suggest that sleep benefits the consolidation of newly formed semantic relationships, perhaps via their integration into pre-existing neocortical memory stores.

## Acknowledgments

This research was supported by NIH grant MH-48832.

## References

- Plihal, W. and J. Born (1997). Effects of early and late nocturnal sleep on declarative and procedural memory. *Journal of Cognitive Neuroscience*, 9, 534-547.  
Ellenbogen, J. M., Hulberg, J.C., Dinges, D.F., and Thompson-Schill, S.L. (in press). Interfering with Theories of sleep and memory: Sleep, declarative memory and associative interference.