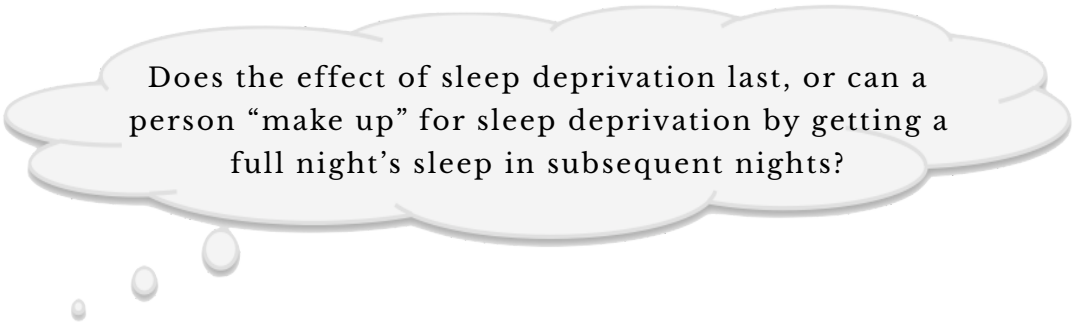
# Sleep Deprivation

Sleep deprivation has been shown to have harmful effects such as fatigue, daytime sleepiness, clumsiness and weight loss or weight gain. Researchers have also established that sleep deprivation has a harmful effect on learning. But do these effects linger for several days, or can a person "make up" for sleep deprivation by getting a full night's sleep in subsequent nights?

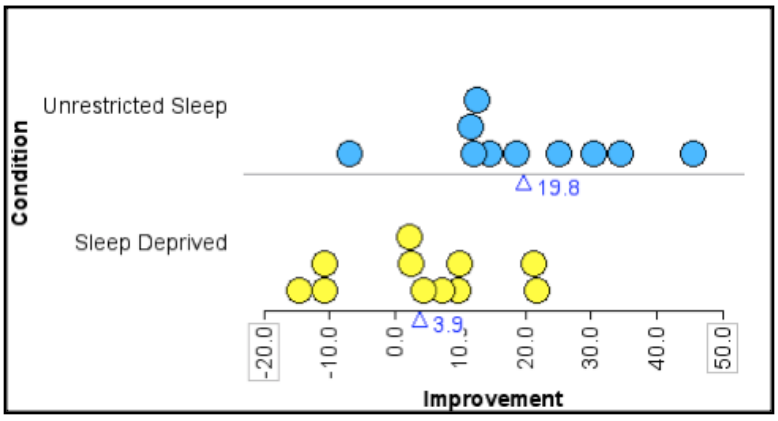
Stickgold, James, and Hobson (2000), in a recent study, investigated this question by randomly assigning 21 subjects (volunteers between the ages of 18 and 25) to one of two groups: One group was deprived of sleep on the night following training and pre-testing with a visual discrimination task, and the other group was permitted unrestricted sleep on that first night. Both groups were then allowed as much sleep as they wanted on the following two nights. All subjects were then re-tested on the third day.

In this activity, you will be exploring the following research question:



Subjects' performance on the test was recorded as the minimum time (in milliseconds) between stimuli appearing on a computer screen for which they could accurately report what they had seen on the screen. The sorted data and plots presented here are the improvements in those reporting times between the pre-test and post-test (a negative value indicates a decrease in performance):

| **Sleep Deprived** ($n$ = 11) | **Unrestricted Sleep** ($n$ = 10) |
|---|---|
| −14.7 | −7.0 |
| −10.7 | 11.6 |
| −10.7 | 12.1 |
| 2.2 | 12.6 |
| 2.4 | 14.5 |
| 4.5 | 18.6 |
| 7.2 | 25.2 |
| 9.6 | 30.5 |
| 10.0 | 34.5 |
| 21.3 | 45.6 |
| 21.8 | |




*Observed data and plot of the observed data for the sleep deprivation study. The triangle under each plot indicates the mean improvement score for the respective group.*

**Discuss the following questions.**

1. Does it appear that subjects who got unrestricted sleep on the first night tended to have higher improvement scores than subjects who were sleep deprived on the first night? Explain briefly.

2. Is the mean improvement higher for those who got unrestricted sleep? Calculate the difference in the means of the improvement scores.

3. Is it possible that there is really no harmful effect of sleep deprivation, and random chance alone produced the observed differences between these two groups?

### Model the Experimental Variation Due to RaNdom Assignment

- Set up a sampling device that will produce the **fixed responses** for the subjects under the "no effect" model.
- Link another sampling device that includes the **fixed group/condition labels**.
- Run the model.

### Simulate and Evaluate the Results

- Use TinkerPlots™ to plot the randomized data and collect the mean for each condition. Then use the Formula Editor to compute the difference in means. Simulate an additional 499 randomizations (trials) of the data (500 total).
- Plot the results (difference in means) from the 500 randomizations.

4. Sketch the plot of the results (i.e., mean differences) from the 500 simulated trials below.

5. What are the cases in the plot? (Hint: Ask yourself what each individual dot represents.)

6. Where is the plot of the results centered (at which value)? Explain why this makes sense. (Hint: Think about what the hypothesis for the "no effect" model is.)

7. Use TinkerPlots™ to compute the standard deviation of the differences in means. Record that value below.

8. Using the mean and standard deviation, provide a range of likely values under the model that assumes the difference in means is due completely to random chance.

9. Now include a vertical line at the difference in means for the original (observed) data. How compatible is the observed difference in means with the results produced by the model specified in the null hypothesis?

10. Based on your response to the previous question, is the “no effect” model supported by the observed data or not? What does this suggest about the answer the research question? Explain.