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Napping and its Effect on Short Term Memory[1]

Abbie Leverich
Robert Morris University

In this study, the effect of loss of sleep on short-term memory among college students was examined. Specifically, a multiple baseline design was used to assess the potential benefits of napping on memory following sleep disruptions. Participants were four college seniors from a small college in Southwestern Pennsylvania. It was expected that taking a nap for up to 90-minutes would reverse negative effects on memory of being tired. The participants were given a short-term memory test the morning after a night of sleep loss. One of the participants was then randomly selected to nap for no more than 90-minutes. All participants were then retested to compare whether napping had the only effect or if passing of time also played a role in the second test results.

Introduction

Sleep is inevitable. However, not everyone gets the desired sleep they would like. Many of those who have trouble sleeping, because they do not sleep enough or they do not sleep well, may find that they could benefit from a daytime nap. If sleep is a necessity, and people are missing out on either quantity or quality of sleep or both, then it would seem that napping might be helpful to compensate for sleep loss.

There are 4 stages of sleep including Rapid Eye Movement (REM) sleep. The exact purpose of the stages of sleep is still unclear. The stages of sleep follow an approximately 90-minute cycle of REM and slow-wave sleep. Horne and Minard (1985) found that after mental exercise the brain needs to stay in stage 4 longer than it would without mental exercise. Without sleep, side effects may consist of perceptual distortions, hallucinations, and trouble completing certain tasks (Carlson, 2007). Some research has supported the behavioral effects of napping and discovered that alertness, productivity, mood, and restoration of perceptual deterioration were improved (Mednick, Nakayama, & Stickgold, 2003). However, it is also important to note that a change in regular sleeping patterns could cause behavioral and psychological deficits (Taub, Tanguay, & Clarkson, 1976).

Humans spend about a third of their life in some form of sleep state (Jensen, 2003). Sleep disorders (SD) are one serious concern for researchers because the quantity and quality of sleep are both essential (Jensen, 2003). Nonetheless, about 40 million U.S. residents suffer from sleep difficulties (Jensen, 2003). Researchers have found it difficult to understand why sleep does not come naturally and easily for all. Therefore, they have focused on college students and their sleep disorders/difficulties (Buboltz Jr., Brown, & Sopher, 2001). College students have become the focus of SD because results show an overall low level of sleep quality compared to a population of so called normal adults (Buboltz Jr., et al., 2001).

For college students there is plenty to lose from improper sleep. One study found that along with sleep, students also struggle in academics (Buboltz Jr., et al., 2001). Jensen (2003) found that if wake times varied about an hour over the weekdays and weekends, followed by later bedtimes both weekdays and weekends it could potentially drop a student's grade point average by .13. College is a mentally stressful environment for most students and it may be beneficial to them to get the best possible sleep.

Researchers are not the only ones noticing the SD in college students. College students themselves have insight on this problem, as a recent self report showed about 71% of students were not satisfied with their sleep (Jensen, 2003). There are a few reasons college students may experience unsatisfactory sleep. Some students

[1] Address correspondence to: Stephen T. Paul, Ph.D., 6001 University Blvd., Moon Township, PA 15108-1189, or via email at: paul@rmu.edu.

may experience difficulty falling asleep due to worry and stress while others may experience frequent waking during the night due to noise, using the restroom, among other reasons (Forquer, Camden, Babriau, & Johnson, 2008). The studies uniformly illustrate that inconsistency in sleep habits can affect student performance.

There are many dimensions to what makes both sleep and naps successful. Some include, but are not limited to, the quantity, quality, and consistency of the sleep or nap (Taub, et al., 1976). In a study with 1,276 participants, researchers found that 558, (44%), took a nap at least once a week (Vela-Bueno, et al., 2008). Those who napped consistently self-reported having better memory during the day than did the non-nappers (Vela-Bueno, et al., *2008).*

Many studies make use of surveys to collect data. Typically, a survey is sent out by mail, and researchers rely on the honor system for accurate data. One study took a more direct and experimental approach. Mednick, et al. (2003) examined the effects of a 60-90 minute nap containing both slow-wave sleep (SWS) and REM sleep. All of the participants reported having about 8 hours of sleep the night prior to the study. The participants were tested using a 19 x 19 target screen. The screen briefly flashed horizontal bars including three diagonal bars and a center target. After a specific amount of time a mask containing both bars appears. The participants were to look at the lower-left corner of the grid to determine if the diagonal bars formed a horizontal row or vertical column. The participants had to be at least 80% accurate to be considered successful. The researchers were comparing the first group (60 minute nap) who had about 20 minutes of SWS and 4 minutes of REM to the second group (90 minute nap) who had about 47 minutes of SWS and 25 minutes of REM and the control group who had no nap. The results showed that the control (no-nap) group did significantly worse on the retest than the two groups who had naps. When the 90-min nap group was tested they showed improvement from their first test before the nap. However, the 60-minute group showed very minimal improvements from the first test. The researchers attributed these results to the fact that those in the 90-minute group got more of both SWS and REM implying that both are needed to see improvement (Mednick, et al., 2003).

As the above studies suggested, napping is potentially an important component to alertness, productivity, mood, and grade point average. In the present study the effects of sleeping/napping patterns were measured with a short term memory test. The prediction was that napping within a 90-minute cycle could reverse some of the harmful effects of lack of sleep by improving memory and mood.

Method

Participants

In the present study, 5 college-aged students volunteered to participate in the research. All students were in their last year of school and lived on campus. The students were picked based on willingness to complete the study. Students in the study were full time and enrolled at a small private university in south western Pennsylvania. The students were not compensated for their participation.

Design

A multiple baseline design was used across participants. After lack of sleep, the participant received one level of the Treatment (no-nap, yes-nap) which was assigned randomly to only one participant at a time (different days). The dependent variable was the effect of napping on short-term memory as measured by the Short-Term Memory Test (STMT); the participants were tested before lack of sleep, after lack of sleep/before treatment, and after treatment.

Materials

The STMT was administered through Microsoft PowerPoint using a white background all uppercase Calibri 40-point black font (see Appendix). The test flashed 2 random numbers for 5 seconds, cleared for 5 seconds, and repeated adding 2 numbers each time, up to 12 numbers. Scores were determined by how many number in a row the participants were able to accurately recall in the exact order they were presented. For any given trial, scores could range from 1 to 6. After each test the numbers were re-randomized to avoid familiarity effects on later memory tests. The participants were also given a sleepiness scale (see

Appendix) to report their level of tiredness. The sleepiness scale also allowed the participants to self report how they expected to perform on the memory test, as well as how many hours they slept.

Procedure

On the first day, all participants were tested with the STMT. Each participant was given a blank data-sheet. The students were asked to look at the computer screen as numbers flashed in front of them for 5 seconds. They were to remember the numbers and write them down (in order) only after the numbers disappeared from the screen. The examiner started the test, but it continued automatically.

The first memory test (P-Test) was given only after the participant reported not being tired using the sleepiness scale to get an average/base reading. This was repeated an additional day. All participants were then asked to sleep less than normal by either going to bed later or waking up earlier. All participants were given the sleepiness scale, if they reported not being affected by the lack of sleep then there should be no effect on their scores. They were then re-tested with the STMT (Test1-A) and their new scores were compared to their original score P-Test.

One participant was then randomly selected to take a nap up to 90-minutes in length while other participants did not nap. After the nap, all 4 students were tested (Test2-A). This was then repeated two days later, resulting in Test1-B, Test2-B and so on until each participant had received the opportunity to nap.

Participants were asked to follow their normal routines between tests. After 2 weeks of testing, the results were compared to determine whether, or to what degree, napping resulted in improvement of short term memory after lack of sleep.

Results

The results indicated no consistent pattern of improvement in memory with a nap. Not only did participants not improve as expected, but in some cases did worse after taking a nap. Overall, participants increased and decreased performance without a nap as well as increased and decreased performance with a nap.

Figure 1 presents the data for all conditions. The participant's answers were based on how many numbers they recalled in chronological order of appearance.

Figure 2 depicts the expected outcomes. Circled points indicate the data points during instances in which participants napped that day. In comparing the two figures there are few to no matches. The results do not follow the expected outcome of a multiple baseline design.

Figure 1. Difference scores in number of items correctly recalled between pre- and post-tests for each day of testing (circled points indicate nap days.

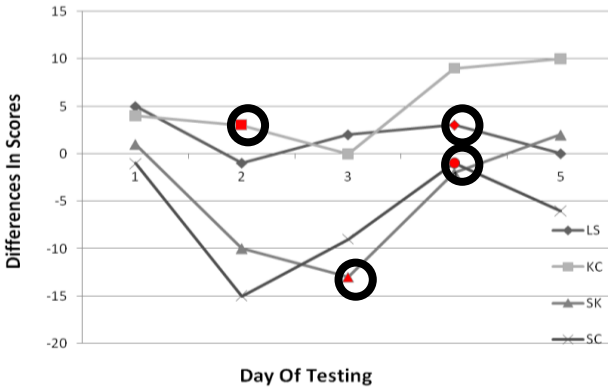
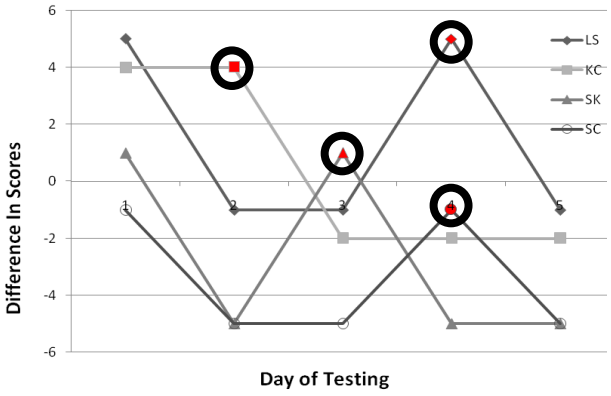


Figure 2. Idealized (expected) outcome in terms of difference scores.



Discussion

Although significance was not found in this study, it has been found in other studies that napping improved aspects such as alertness, productivity, and mood (Mednick, et al., 2003).

Possible reasons for failing to support previous literature are discussed below.

One potential reason for the present failure to identify beneficial effects of sleeping could be related to several limitations of the present design. First, there may have been too few participants to sufficiently examine the hypothesis. Also, the short-term memory test used may not have been sensitive enough to memory deficits due to a relative lack of sleep. Finally, more control over the conditions and timing of both sleep deprivation and napping may have reduced the variability in the data.

Future studies would improve upon the present design by having stricter control over the amount of sleep allowed the night prior to testing, consistent time for all tests, and a larger sample. By having stricter control over the amount of sleep the night before it allows for more specific and precise data. To make a large enough impact on the participant's sleep pattern it would need to be significantly less sleep than normal. Testing at consistent times each day should have been done for this study but schedule conflicts interfered. By having stricter control over the entire study it allows procedure to run smoother. Lastly, having a larger sample is not necessarily a necessity, because if the effects of napping are significant they will show with five participants or with one hundred. However, it can be beneficial in generalizing to the population.

In addition, researchers may also consider sticking with a multiple baseline design across subjects. Participants are measured over an extended period of time and the manipulation is introduced to them at different times. This will allow researchers to target only a few participants at a time, so only those who are manipulated should show an effect. Using this design will not only show the effect for each individual specifically but it also helps rule out coincidence or chance.

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Appendix 1

Sleepiness Scale

Please read the following questions and rate your responses honestly.

1. About how tired do you feel right now?

Very Tired		Neither Tired Nor Wide Awake		Wide Awake
1	**2**	**3**	**4**	**5**

2. How well were you able to follow/complete Abbie's instructions for today?

Not Very Well At All		Not Perfectly, But Not Bad		Followed Instructions Perfectly/Completely
1	**2**	**3**	**4**	**5**

3. How well do you expect to do on the upcoming memory task?

Not Very Well At All		Not Perfectly, But Not Bad		Very Well
1	**2**	**3**	**4**	**5**

4. About how many hours/minutes did you sleep last night? _____ Hours and _____ Minutes.

5. If you napped today, for how long did you sleep? _____ Hours and _____ Minutes.

Appendix 2

Short Term Memory Test

Instructions: Administer through Microsoft PowerPoint using a white background all uppercase Calibri 40-point black font. The test will begin by flashing 2 random numbers for 5 seconds, cleared for 5 seconds, and repeat, adding 2 numbers each time, up to 12 numbers.

EXAMPLE OF SHORT TERM MEMORY TEST												
SLIDE 1	8	4										
SLIDE 2	6	9	1	7								
SLIDE 3	1	4	6	3	9	7						
SLIDE 4	3	8	5	2	6	9	5	2				
SLIDE 5	6	5	7	4	6	4	9	5	1	3		
SLIDE 6	1	5	3	8	7	9	3	6	5	8	1	3