

EFFECTS OF SLEEP DEPRIVATION

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ABSTRACT

This causal analysis deals with determining the effects of sleep deprivation on a college student's performance in school. The following discusses the causes of sleep deprivation and how the lack of sleep affected the participant's performance on the battery of tests that were administered. Thus, illustrating the following point: when the mind is revitalized and well rested, individuals can improve their academic performance levels.

INTRODUCTION

Many students do not sleep enough. Therefore these students suffer the consequences of fatigue, a condition that may affect their academic performance. Sleep is a natural process and is especially important in young adults. How much deprivation of sleep is needed before functions such as memory or reaction time are influenced? The relationship between student performance in school and the effects of sleep are hypothesized to be proportionally related and will be studied in an attempt to support the correlation or hypothesis.

Background

Both cultural and lifestyle factors contribute to insufficient sleep. A combination of schoolwork, demands, part-time jobs, extracurricular activities, and late-night socializing may also contribute to sleep deprivation. Not getting enough sleep for more than a day or two can lead to what is called "sleep debt." Sleep debt is defined as the difference between the hours of sleep people need and the hours they actually get. Many people believe that because they are able to function well the next day with as little as five hours of sleep, they have rested themselves adequately. But five hours of sleep may have only been enough rest for their bodies. Their brains may require more sleep. The effects of sleep loss are cumulative. Regularly losing 1 to 2 hours of sleep a night can create a "sleep debt" and eventually lead to chronic sleepiness over time. Only one thing can reduce a sleep debt... sleep.

Many studies have been performed to date focusing on both driving while drowsy and the sleep cycles of young people. The studies for driving are generally conducted in simulation driving machines and will measure such information as brain waves and eye movement. Ways in which scientists measure the sleep cycle of young adults include interviewing young adults and studying their brain patterns. Some of these studies show that the sleep patterns of young adults do not necessarily follow the cycles of day and night.

Sleep deprivation may also lead to many other harms, including poor moods, decreased memory formation, decreased attention span, and/or illness. An area of sleep deprivation that has not been focused upon as much pertains to performance of students depending on the amount of sleep attained.

Problem

Rather than focusing on sleep cycles of students or why they are unable to stay awake during school hours, this experiment will be focusing on the motor skills and aptitude of students relating to learning performance. How much deprivation of sleep is needed before functions such as memory or reaction time are influenced? Cognitive skills are highly affected by the amount of quality sleep one receives over a certain period of time. The relationship between student performance in school and the effects of sleep are believed to be proportionally related to each other. This will be studied to support the hypothesis of this correlation.

Scope of Report

The following research will inform readers of the study conducted and the methods employed to analyze the data and conclusions.

METHODS

Research Approach

Before the study began, initial steps were taken to compose ethical research consent forms for the participants. These consent forms stated the purpose of the study, what participants would be doing in the study, and that experimental participation was voluntary. The next action dealt with submitting the consent forms along with documentation detailing the experimental design and scope. The forms were submitted to the Human Subjects Review Committee at the University of South Dakota. After approval by the committee the study was then conducted.

Equipment & Tests

Participants were asked to record the amount of sleep received each night for a three-week period. Over the course of the three-week period, each participant was given a battery of tests to examine the following performance details: dexterity, manual control pursuit task, reaction time, and short-term memory. Before testing was conducted, participants were asked a few simple questions relating to stress and daily activities encountered over the last few days.

- The dexterity test was administered using a grooved pegboard consisting of 25 holes with randomly positioned slots. Pegs with a key along one side must be rotated to match the hole before they can be inserted. A picture of the grooved pegboard test can be seen in figure 1. Testing was done by having participants use one hand at a time to complete the test while being timed. The test was given twice for each hand on each testing date.



Figure 1. Grooved pegboard

- A software program called “Perception and Prototype” measured manual control pursuit task. This program was used on a Macintosh Performa 6300 D to test the ability of the participant. Each participant followed a randomly moving square box for thirty seconds with a crosshair controlled by the mouse. After completion, the computer generates a percent based on how much of the cross hair was on the box. This test was conducted twice on each testing day.
- Testing participant reaction time was achieved by using a board with four differently colored light bulbs, each of which was connected to a switch with a timer. The experimenter randomly lit up one of the light bulbs; the participant was timed on how long it took to hit the button to shut off the light. This test was given ten times on each test date.
- The widely used Folstein *Mini-Mental Status Examination* (MMSE) aided the assessment of cognitive mental status. “The MMSE represents a brief, standardized method by which to grade cognitive mental status. It assesses orientation, attention, immediate and short-term recall, language, and the ability to follow simple verbal and written commands. Furthermore, it provides a total score that places the individual on a scale of cognitive function” (1). The memory test used in the MMSE is widely known as serial 7’s memory test. This memory test is a large scoring portion of the MMSE. Doing well on this portion of the test was important in order to score well. This test was given at the beginning of each test date and can be seen in the appendices.

RESULTS

Table 1. Results of Participant Testing

Three day avg. of sleep (hours)	MMSE	Dexterity Dominant Hand (sec.)	Dexterity Non- Dominant Hand (sec/)	Reaction Time (sec.)	Pursuit Task (%)
Participant 6					
8	29	63.44	61.62	0.451	34.5
7.66	29	48.32	56.94	0.409	32.5
Participant 7					
6.16	30	51.82	53.88	0.466	31.5
7.83	28	42.50	47.50	0.437	37.0
5.83	30	44.28	56.57	0.474	39.0
Participant 8					
6.66	30	59.46	71.36	0.409	39.5
8	30	48.44	63.14	0.378	37.5
Participant 2					
6.33	30	57.24	58.53	0.392	43.5
6	29	47.50	53.10	0.400	38.0
6.5	29	47.68	51.35	0.431	34.0
6.66	30	46.70	51.71	0.351	39.0
Participant 3					
5.33	29	53.79	59.50	0.439	40.0
7.83	30	49.64	54.48	0.448	41.5
8.5	30	45.36	53.90	0.437	43.0
8.33	29	49.49	51.92	0.370	43.0

DISCUSSION

All participants were administered the battery of tests on a practice day to ensure the learning curve would not be so large during actual testing. The results of the practice day were not recorded.

The amount of sleep measured was an average of the previous three nights of sleep. An average of three nights was used based on the belief that one night of little or no sleep would not affect the participant much assuming enough sleep had been attained in previous nights. Sleep debt occurring over a period of time influences performance. There was no set standards that the group could be measured against, such as if all participants received several nights of eight or more hours of sleep and then were administered the battery of tests to establish a control. So the

way to compare the results was to look at the average hours slept and the performances on each of the tests and whether or not performance was affected according to sleep.

A factor that had not been considered before the study began was the affects of drugs, such as alcohol, on the participant's sleep and abilities to perform on the battery of tests. Alcohol consumption affects the function of chemical messengers that appear to influence sleep (2). For instance if a person under the influence receives eight or more hours of sleep, this would be similar to a person not under the influence receiving five or more hours of sleep.

The dexterity test was administered with few variables. For instance, the test started and stopped when the hand was placed on the table next to the grooved pegboard. A variable that could of made a difference is whether or not the participants chose to pick up one grooved peg or many pegs at a time; because the participants were free to complete the task however they wanted. Also, more pegs than necessary were contained in the holding area to complete the task. These subtle variables could have been beneficial to participants, however may have been affected by the amount of rest one had received.

The manual pursuit task was administered with great consistency. The only variable would have been the pad that the mouse was used on, which remained constant for all tests.

According to Woodworth, the average reaction time to a four variable stimulus is about .440 seconds (3). All participants were around this average, with the fluctuation of personal abilities and their sleep record. The light bulb stimulus test had no clear directions as to how the hands should be placed or which fingers to use to push the buttons. These variables were left to the discretion of the participant. The experimenter should have stated to use both hands with a certain two fingers from each hand to push the buttons. Some participants used one hand while others used both hands, which affected how quickly they responded to the lights. The next error in the test was not having a set order that the lights were lit up. A set order to lighting the light bulbs would have demonstrated the ability of dominant and non-dominant hand response while also being able to measure finger response according to which fingers the participant was instructed to use. Having a set order and constant hand placement would have been another way to measure the effects of sleep deprivation of the participant.

Testing for the working memory was done in a round about way. The Mini Mental Status Examination had a working memory portion test in the exam. The experimenter decided it would be beneficial to test the participants overall alertness, rather than just the working memory. The working memory test in the MMSE consisted of attempting to remember a string of three words while the serial 7 test was administered.

Although the need for sleep varies among individuals, sleeping eight hours per every 24-hour period is common; seven to nine hours of sleep is needed to optimize performance. Regularly losing one to two hours of sleep a night can create a "sleep debt" and may lead to chronic sleepiness over time. Only sleep can reduce sleep debt. In a recent study, people whose sleep was restricted to four to five hours per night for one week needed two full nights of sleep to recover vigilance, performance, and normal mood (1). Loss of sleep insidiously affects sustained attention, cognitive speed and accuracy, working memory, reaction time, and overall behavioral capability. According to Dr. Dinges (4), these faults occur without the sleep-deprived person

being aware of the deficits. These deficits are especially supported in the reaction time test and the mental status exam. The participant's results in some tests support the hypothesis, while in other tests the correlation is not as high. As stated before, when deprived of sleep, cognitive tasks are more difficult to accomplish. This is why sleep deprivation is so detrimental to students. It has been shown that verbal learning is highly affected by lack of sleep. Recalling information is also more difficult, which is why it is important to have sufficient amounts of sleep before taking an exam. It has also been found that thinking and speech can be impaired as well. When you do not get enough sleep, it becomes more difficult to communicate to others. The problem occurs due to a lack in ability to find the right words to say what you are thinking. This suggests that access to long-term memory is impaired.

CONCLUSION

Overall the results seem to support the hypothesis of sleep effecting student's performance. There is some support of sleep deprivation affecting a student while some areas don't show much difference on the amount of sleep received. The findings of this experiment have exemplified the importance of sleep in the best interest of students; studying for a few hours with a little sleep is better than pulling an "all-nighter" in hopes of doing well on the test. Especially since the results show that the average amount of sleep received is less than the seven to eight hours of sleep needed. Hinting to the problem of not knowing the best the participants could score on the tests to establish a standard. The effects of the "all-nighter" on sleep loss are "negative effects on recall and working memory and on executive functions (4)." Try to recall the last time someone did not get enough sleep; remember how they may have had difficulty with communicating with other people at times. Finding the right words, speaking to them, and being able to concentrate was hard to do, which would be the same when taking a test.

Sleep deprivation doesn't only affect student performance; there is also the risk of affecting the immune system; therefore making it more susceptible to sickness and the possibility of diabetes. Sleep is a very important part of life, and a part that many people do not think is important. This study has shown the importance of sleep relating to student performance while also touching on other main topics related to sleep deprivation.

Overall this was a great study to perform and the experimenter has determined many problems with the study. If the opportunity to perform the study occurred again there would be fewer variables and more constants to obtain optimal results.

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