

# The Effects of Polyphasic Sleep on Academic Success

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## Abstract

Sleep has been shown to play an important role in human health, specifically cognitive function. Through a comparison of the different types of human sleep patterns, it was determined that polyphasic sleep is the best sleep pattern to use. Polyphasic sleep is a sleep pattern in which multiple short naps are taken throughout the day. 88 college students were asked to take a survey about sleep and its effects on their academic success. It was determined through statistical analysis that polyphasic sleep is the best sleep pattern. However, more research should be done to further corroborate these results.

## Introduction

Many college students feel overwhelmed by the amount of stress that daily classes can bring. This causes many to reduce the amount of time spent sleeping in order to study harder for classes. However, research has shown that the decline of mental performance throughout the day can be attributed to nighttime sleep deprivation. There are three types of sleep patterns that humans tend to take on to fight the affects of sleep deprivation: monophasic, biphasic, and polyphasic. A monophasic sleep pattern is when a person sleeps once for more than 6 hours a day (Saeed 2015). Biphasic sleep can be described as a pattern in which two naps are taken throughout a 24-hour period (Saeed 2015). Polyphasic sleep is a pattern in which multiple naps are taken in intervals throughout the day and when "less than 50% of total sleep time is obtained in one continuous episode" (Porcú 1997). It has been found that polyphasic sleep is the best method to replenish lost hours of sleep since it consists of taking short, scheduled naps throughout the day.

The focus of this study is to determine how a polyphasic sleep schedule affects the academic performance of college students. My null hypothesis for this study is that polyphasic sleep has no effect on the academic performance of college students. My alternative hypothesis is that polyphasic sleep increases the academic performance of college students. By replenishing lost nighttime sleep through naps, students will be more alert in class, thus improving their academic performance.

## Literature Review

Sleep is an important part of the everyday lives of humans. Research has shown that sleep is an important part of what keeps the human mind running at its maximum potential. It has been proven that sleep

deprivation can cause decreased efficiency, lower motivation to come to work, and a decline in working relations (Gaines, 2016). Due to cultural norms and the demands of daily life, many believe that sleep is only a nighttime activity. However, studies have shown that polyphasic sleepers can perform just as well or even better in the classroom than monophasic sleepers (Porcú, 1997). Research in the medical field has shown that polyphasic sleep can boost academic performance by fighting the negative effects of sleep deprivation, improving memory retention, and increasing alertness.

## Sleep Deprivation

Polyphasic sleep can help reduce the negative affects of sleep deprivation by replenishing lost nighttime sleep hours, allowing for better academic performance. Studies done in the area of medicine have proven that lack of sleep can have adverse affects on humans. A 2006 study stated that "30% of the pediatric population has sleep problems, which are frequently associated with significant psychological and social consequences" (Jenni, 2006). This information shows the importance of sleep and the negative affects sleep deprivation can cause. Research done on adult sleep patterns can back the claim that lack of sleep causes both mental and physiological problems. A recent study done on college students stated that "[a] lack of adequate sleep can affect mood, the ability to learn and retain information, and increases the risk of serious accidents and injuries" (Carter 2016). These results showed that sleep deprivation is found throughout the age spectrum and can cause issues in children as well as adults.

Carter (2016) believed that the hectic schedules students face could reduce the hours of nighttime sleep received and in turn, lower their academic performance. In a study done on medical students, it was stated that "the burden of [an] extensive curriculum often results in the development of non-recuperative sleeping patterns, which can, in turn, affect their overall academic performance" (Saeed, 2015). These results not only prove Carter's (2016) belief, they also show that the sleep pattern a person uses ultimately affects their performance in the classroom. This is an important finding because many students tend to make sleep and maintaining a consistent sleep pattern less of a priority due to their hectic daytime schedules. However, studies have shown that it would behoove students to make sleep a high priority due to its positive affects on performance and health.

A 2015 study done on college students found that taking naps allows students to replenish lost nighttime sleep as well as deal with drowsiness during the day (Ye, 2015). These results illustrate how polyphasic sleep can improve performance. Ye (2015) mentioned that "[t]he benefits of napping for waking performance such as improved neurobehavioral performance and alertness have been systematically reviewed in healthy adults," showing that polyphasic sleep has been proven to boost

brain function and overall performance. In order to back these claims, Ye (2015) surveyed 440 undergraduate students in order to determine the optimal napping frequency in healthy adults. The study found that multiple short naps could improve academic performance by enhancing brain functionality (Ye, 2015).

Although these studies all focus on different aspects of sleep deprivation, all agree that sleep deprivation causes problems in humans both mentally and physically. The mentally exhausting nature of school can enhance the issues that sleep deprivation can cause. However, students can replenish lost nighttime sleep by following a polyphasic sleep schedule. By taking short naps throughout the day, students would not only be able to regain lost hours of sleep, but also improve their cognitive function. Thus, boosting brain function and activity can lead students to perform better in the classroom, leading to academic success. Medical research on polyphasic sleep has shown that this sleep pattern does not only reduce the affects of sleep deprivation, but also improves alertness.

#### Alertness

Prior research has found evidence that polyphasic sleep can improve alertness, allowing for better academic performance. As mentioned in the previous section, nighttime sleep deprivation has many negative consequences, one of them being a loss of concentration and alertness. A 2016 article stated that people who neglect sleep have "increased risks of accidents, strained relationship and impaired concentration (Kadam, 2016). Due to these results, Kadam (2016) believed that sleep and sleep pattern could play a role mental ability. To back this claim, a 2015 study researched the affects of changing sleep patterns in college students (Saeed, 2015). It was discovered that small changes in a student's sleep pattern could cause "effects such as dullness or lethargy, lack of attention, problems in focusing, and low performance caliber" (Saeed, 2015). This study proved Kadam's (2016) results to be true by showing how important sleep pattern is to mental performance. Studies have also shown how alertness can improve performance in both the workplace, as well as in school.

Research has shown that a person's performance can be affected by their level of alertness. For example, one study looked at the affect of alertness and sleep pattern on performance (Bermudez, 2016). Bermudez (2016) believed that people determine their ability to perform a task based on how alert they feel. In order to back this claim, the article mentions that "[s]ubjective ratings of alertness plateau within a few days of chronic sleep restriction, whereas cognitive performance continues to decline across weeks" (Bermudez, 2016). This statement shows how a small decline in alertness can cause long-term performance consequences. Studies have proven that alertness can affect performance in different ways. However, there has also been research

to show how polyphasic sleep plays an important role in alertness.

The nature of polyphasic sleep has been shown to increase alertness in humans. A recent article stated that "napping can dramatically increase alertness and stamina, heighten creativity, improve memory and motor skills, prevent burnout, improve glucose control, reduce stress/anxiety, decrease heart attack risk, enhance sexual function, stimulate weight loss, and improve overall health" (Gaines, 2014). Gaines (2014) believed that the nature of polyphasic sleep could improve both bodily functions and mental functions. In order to back this claim, a study was done in adult women to see the affects of napping on alertness and cognitive function (Lamarche, 2010). Prior to the study being done, Lamarche (2010) mentioned that research had already been done to prove that napping had a positive affect on brain function and alertness. However, Lamarche (2010) took her research to the next level by hypothesizing that napping could reduce PMS symptoms due to the positive affects mapping had on cognitive function. The study found that "Napping improved sleepiness, alertness, mood, and some aspects of cognitive performance. Improvements were maintained for at least 30 minutes and up to 6 hours after napping" (Lamarche, 2010). This proves Gaines' (2014) theory that polyphasic sleep could improve cognitive function and therefore, improve alertness.

Although each of the studies took a different path in identifying the positive affects of polyphasic sleep, all agree that the nature of polyphasic sleep can increase alertness in humans. Studies have shown the positive affects of napping and sleep pattern to brain function and health. Using a polyphasic sleep pattern, students would be able to increase their cognitive ability as well as improve their alertness in the classroom. This is an important finding because one of the main ways to succeed in academia is to stay focused and to always be alert. By improving their alertness, students will be able to pay better attention during classes and ultimately gain more from their education. Although studies have found that napping can improve alertness, other studies have found that polyphasic sleep can also increase memory retention.

#### Memory

Polyphasic sleep can help improve academic performance by increasing memory retention. A recent study stated that "[g]iven that sleep is polyphasic in the early years, ... and children's word learning is gradual and strengthened slowly over time, it is highly plausible that sleep is a strong candidate in supporting children's memory for novel words" (Axelsson, 2016). The study showed that word retention was greatest when a nap was taken immediately after a novel word was introduced to a child (Axelsson, 2016). This evidence shows that the polyphasic sleep pattern children use

has a strong positive correlation to word retention. This brings up the theory that polyphasic sleep can positively affect the memory retention in not only children, but also in adults.

Studies have shown that a healthy amount of nighttime sleep can positively affect brain function; however, many researchers believe that daytime naps can also have the same affect. Lahl (2007) stated that after their study on this topic "memory performance was significantly enhanced after napping as opposed to waking but was not correlated with time spent in slow wave sleep or total sleep time within the napping condition." He believed that it was not the total amount of sleep that increased memory retention, it was the polyphasic sleep pattern that had the greatest effects. In order to back his claims, Lahl (2007) produced a second study in which a group would take naps no longer than six minutes long. The study found that those who had either long naps (35 minute) or ultra-short periods of sleep had better memory processing than those who were awake.

These studies show that the nature of polyphasic sleep in itself is enough to increase memory recollection. This can be important to academia because many aspects of school are based around memorization. By using a polyphasic sleep pattern, students would be able to retain important information for longer periods of time, allowing for better academic performance. While the different studies focus on different age groups, both agree that polyphasic sleep improves memory and brain function in humans.

Sleep is an important aspect to human biology as it helps to regulate both brain and body function. However, the importance of sleep pattern is a factor overlooked by many. With education being an important part of life in college, sleep can sometimes be a last priority. However, research has shown that polyphasic sleep can improve academic performance by fighting the negative consequences of sleep deprivation, increasing alertness, and improving memory retention. Studies have shown that a polyphasic sleep pattern can fight the negative effects of sleep deprivation by allowing for short naps throughout the day. These naps replenish lost nighttime sleep as well as boost brain function. Polyphasic sleep has also been found to increase alertness. This allows for students to pay better attention in class and ultimately, improve performance in the classroom. Research has found that polyphasic sleep can improve memory recollection by boosting cognitive function. While different studies state slightly different theories, all agree that polyphasic sleep can help improve academic performance by boosting memory recollection, improving alertness, and solving the issues sleep deprivation can cause.

## Methods

The study was conducted by surveying<sup>1</sup> 88 college students from varying college campuses using a population of convenience and snowball sampling. Snowball sampling is when "one subject gives the researcher the name of another, who in turn provides the name of a third, and so on" (Cohen, 2011). Students that took the survey would pass the survey on to their friends and followers, causing a snowballing affect. By using a snowball sampling method, there was increased potential for sample size. Also, it gave a larger spread of students from different campus and disciplines to study.

The population of convenience that was used for the study was classrooms of students and online social media followers. The population used was convenient for the study because student emails could be retrieved via Lulima and the survey could be distributed quickly and easily. Students in the classes sampled were emailed a link to the Google Form containing the survey. By using social media, a broader sample of students from different universities and different parts of the country were able to participate in the study. Also, simply posting the link to social media and having students share the link made the distribution of the survey effortless.

After collecting all of the data via Google Forms, multiple statistical tests were done to see if there was a significant difference between academic performance on monophasic, biphasic, and polyphasic sleep schedules. Using StatPlus, an ANOVA was done to determine if there is a statistical difference between the average amount of nighttime sleep students with grades A,B,C,D, and F receive. Grade lettering was determined based on the UH Hilo grade standards. Another ANOVA was run to test the difference in the average grades of students who used polyphasic, biphasic, and monophasic sleep patterns. Pie charts were used to show the percentage of students who believe that napping improves productivity and the amount of students who believe that napping helps to improve academic performance.

## Results

Table 1 describes the results of running an ANOVA on the average amount of nighttime sleep students with grades A,B,C,D, and F receive. From the ANOVA, a p-value of 0.63386 was determined. Since the p-value is above the significance level of 0.05, it can be stated that there is no statistical difference in the average hours of nighttime sleep that students with different letter grades receive. Although the bar graph that was created along side the ANOVA looks as though there is a difference between the hours of sleep received between students with "D" letter grades, statistical analysis shows that there is no difference (Figure 1).

Analysis of Variance (One-Way)						
Summary						
Groups	Sample size	Sum	Mean	Variance		
A sleep	38	231.5	6.09211	1.76831		
B sleep	26	155	5.96154	1.63846		
C sleep	21	124.5	5.92857	2.60714		
D sleep	2	9	4.5	0.5		
F sleep	1	6	6	NaN		
ANOVA						
Source of Variation	SS	df	MS	F	p-level	F crit
Between Groups	4.92252	4	1.23063	0.64227	0.63386	2.48166
Within Groups	159.03203	83	1.91605			
Total	163.95455	87				

Table 1: Analysis of Variance of the average hours of nighttime sleep for different grades.

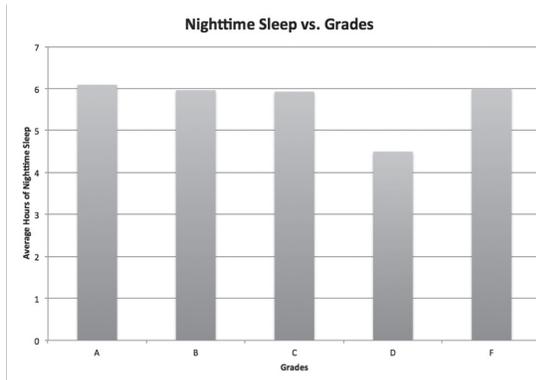


Figure 1: Bar graph showing visual comparison of the average hours of nighttime sleep for students with different grades.

Table 2 shows the results of the ANOVA that was used to test the different average grades of students who used polyphasic, biphasic, and monophasic sleep patterns. The ANOVA created a p-value of 0.03992, a value smaller than the significance level of 0.05. This means that one of the categories is statistically difference from the other two. In order to determine the difference, a box plot was created to visualize the three categories (Figure 2). The box plot showed that the group that had a positive statistical difference from the other categories was polyphasic sleep.

Analysis of Variance (One-Way)						
Summary						
Groups	Sample size	Sum	Mean	Variance		
Monophasic grades	33	114	3.45455	0.36506		
Biphasic grades	29	99	3.41379	0.30480		
Polyphasic grades	26	97.5	3.75	0.125		
ANOVA						
Source of Variation	SS	df	MS	F	p-level	F crit
Between Groups	1.83768	2	0.91884	3.34605	0.03992	3.10384
Within Groups	23.34130	85	0.27460			
Total	25.17898	87				

Table 2: Analysis of Variance of the average GPA of students who use polyphasic, biphasic and monophasic sleep patterns.

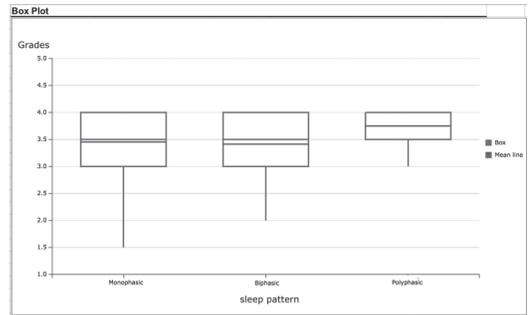


Figure 2: Box plot of the average GPA of students who use polyphasic, biphasic and monophasic sleep patterns.

Figure 3 is a pie chart that shows the percentage of students that believe napping improves their academic ability. 66.7% of students that took the survey believe that napping improves academic performance. Students in the "other" category wrote comments about how due to the fact they do not have time for naps, they are unable to formulate an opinion to answer the question properly. Figure 4 is a pie chart that shows the percentage of students that believe that napping improves productivity. According to the results of the survey, 71.3% of students who participated felt as though taking naps helped them to be more productive.

Do you feel napping helps you perform better academically?

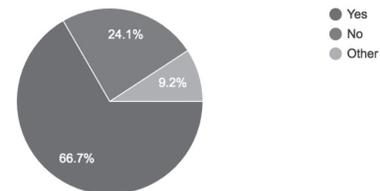


Figure 3: Pie chart showing the percentage of students who believe that napping improves academic performance

Does taking naps help you be more productive?

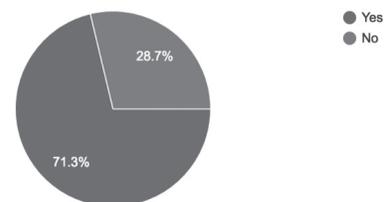


Figure 4: Pie chart showing the percentage of students that believe napping improves productivity.

## Findings

Based on the results of the experiment, polyphasic sleep is the best method to improve academic performance. It was found that students who take multiple naps throughout the day perform better in their classes than students who do not. The results allow us to reject the null hypothesis that polyphasic sleep has no effect on academic performance and accept the alternative as true. This allows us to state that polyphasic sleep increases the academic performance of college students.

The study also displayed that there is no statistical difference in the average amount of nighttime sleep received by students who have different letter grades. This implies that it is not the amount of nighttime sleep received, it is the sleep pattern that mainly affects the performance of the student. Small sample sizes could have contributed to the small p-value acquired, causing the results of this study to contradict the results of past experiments done in the field. Due to this, more research needs to be done on the affect of nighttime sleep on average grades.

Another interesting result from the study is that many students who stated that they did not take any naps mentioned in the comment section that they would like to take naps, but their schedule did not allow for it. Due to the high percentage of students who believed that naps improved their academic performance, it is interesting that many people do not make time for naps even though they believe that it could help them to do better in their classes. Although the experiment found that students who use a polyphasic sleep schedule have statistically higher grades, more research needs to be done in order to back these results.

## Discussion

Although this experiment found evidence to prove that polyphasic sleep improves academic performance, it came with many limitations. For one, the survey was completely voluntary, causing the sample size of the experiment to be small and not a good representation of all college students. Also, because it was on Google Forms, the only way for students to take the survey was by sending a link out via social media and email. Although it allows for the possibility of a large sample size, it is probable that people saw the link in their inbox and decided to simply delete the message. Another limitation of the study was running the statistical tests. After running an ANOVA on the grades vs. sleep pattern data set, a Tukeys pot-hoc test was to be run in order to determine which category was statistically different from the rest. However, the program was not able to run the test and a box plot had to be created instead.

The results of this study can have an impact on incoming and continuing college students. By being aware that sleep and sleep pattern plays an important role in cognitive function and academic performance, students can make time in their day to take a nap and allow their brains to get the rest it needs. Many of the students who took the survey believed that napping improves productivity and the statistical data shows that students who nap tend to have high grades than students who do not. These results could help students to understand how sleep works and inform them that it is not the amount of nighttime sleep that a person gets, it is the sleep pattern used that mainly impacts the academic performance of a student.

During the data collection process, certain questions arose that could serve as the basis for future research. One of the questions that arose was: do students in certain disciplines tend to take more naps than others? Although the survey used for this study contained a question related to academic major, it did not relate to the main question and was not used in statistical analysis. Another question that came up was: would these same results be reflected in students of different ages (i.e. high school students)? A possible future study could focus on specific majors and incorporate other questions into the survey, including but not limited to gender, home university, and if the student lives off or on campus. Also, a larger sample size for data collection would better represent the population as a whole.

## Conclusion

Previous studies have shown that sleep plays an important role on cognitive function and performance. However, many college students tend to push sleep to aside due to hectic daytime schedules. This causes many students to become sleep deprived and develop sleep patterns that can negatively affect their academic performance. From the results of this study, it can be said that the sleep pattern academic performance would most benefit from is a polyphasic sleep pattern.

Many students believe that the best way to improve grades is to get eight hours of nighttime sleep. However, for some students, eight hours of sleep at night is impossible. The results of the study show that the sleep pattern used is much more important than the amount of sleep received. It also showed that polyphasic sleep is the best way to replenish lost hours of nighttime sleep and to fight of the negative affects of sleep deprivation. Academic success is important, but staying healthy is the most important of all. By being aware of the importance of sleep, students will not only be able to take better care of their grades, but of themselves as well.

## Footnotes

<sup>1</sup>Refer to the Appendix for the survey used in the study.

## Reference

- Axelsson E, Williams S, Horst J, Sandhofer C, Mather E. The Effect of Sleep on Children's Word Retention and Generalization. *Front. Psychol* [serial online]. 2016;:1-9. Available from: Academic Search Complete, Ipswich, MA. Accessed September 16, 2016. doi: 10.3389/fpsyg.2016.01192
- Bermudez EB, Klerman EB, Czeisler CA, Cohen DA, Wyatt JK, Phillips AJK. 2016. Prediction of vigilant attention and cognitive performance using self-reported alertness, circadian phase, hours since awakening, and accumulated sleep loss. *Plos One* 11(3):1-18.
- Carter B, Chopak-Foss J, Punungwe FB. 2016. An analysis of the sleep quality of undergraduate students. *Coll Stud J* 50(3):315-22.
- Gaines K. 2014. A few thoughts: Get outside, slow down, take a nap, and don't forget to breathe. *Urologic Nursing* 34(2):61-.
- Gaines K. Sleepless in America: Burning the Candle at Both Ends? At What Cost?. *Urol Nurs* [serial online]. 2016;36(3):109-110. Ipswich, MA. Accessed September 29, 2016.
- Jenni OG, LeBourgeois MK. Understanding sleep-wake behavior and sleep disorders in children: the value of a model. *Curr Opin Psychiatry*. 2006;19(3):282-287. doi:10.1097/01.yco.0000218599.32969.03
- Kadam Y, Patil S, Waghachavare V, Gore A. Influence of Various Lifestyle and Psychosocial Factors on Sleep Disturbances among the College Students: A Cross-Sectional Study from an Urban Area of India. *JKIMSU* [serial online]. 2016;5(3):51-60. Available from: Academic Search Complete, Ipswich, MA. Accessed September 19, 2016.
- Lahl O, Wispel C, Willigens B, Pietrowsky R. An ultra short episode of sleep is sufficient to promote declarative memory performance. *J Sleep Res*. 2008;17(1):3-10. doi: 10.1111/j.1365-2869.2008.00622.x.
- Lamarche LJ, Driver HS, Forest G, de Koninck J. 2010. Napping during the late-luteal phase improves sleepiness, alertness, mood and cognitive performance in women with and without premenstrual symptoms. *Sleep & Biological Rhythms* 8(2):151-9.
- Porcú S, Casagrande M, Ferrara M, Bellatreccia A. Sleep and alertness during alternating monophasic and polyphasic rest-activity cycles. *Int J Neurosci*. 1998;95(1):43.
- Rowland Atkinson JF. Accessing hidden and hard-to-reach populations: Snowball research strategies. *social research UPDATE*. 2001:1.

Saeed Z, Hasan Z, Atif M. Sleep patterns of medical students; their relationship with academic performance: A cross sectional survey. *TPMJ*. 2015;22(7):919-923.

Ye L, Hutton Johnson S, Keane K, Manasia M, Gregas M. 2015. Napping in college students and its relationship with nighttime sleep. *J of ACH* 63(2):88-97.

## Appendix

### Sleep and Academic Success

This survey is for a research project on the affects of sleep and napping on academic success. Please answer each question as best and as accurately as possible. Thank you!

\* Required

On average, how many hours of nighttime sleep do you get? \* \_\_\_\_\_

On average, how many naps do you take per day? \* \_\_\_\_\_

Does taking naps help you be more productive? \*

Mark only one oval.

Yes

No

Does being tired affect your ability to pay attention in class? \*

Mark only one oval.

Yes

No

Do you feel napping helps you perform better academically? \*

Mark only one oval.

Yes

No

Other:

What is your major? \* \_\_\_\_\_

What is your class standing \* \_\_\_\_\_

Mark only one oval.

Freshman

Sophomore

Junior

Senior

Other:

What is your cumulative GPA? \*

Mark only one oval.

4.00-3.50

3.50-3.00

3.00-2.50

2.50-2.00

2.00-1.50

1.50 and below

Other:

Do you have any additional comments about sleep or napping?

\_\_\_\_\_