

RUNNING HEAD: Perceived Alertness

HIGH SCHOOL STUDENTS' PERCEIVED ALERTNESS IN AFTERNOON CLASSES  
FOLLOWING A SHORT POST-LUNCH NAP

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Submitted to

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Submitted in Fulfillment for the Requirements for  
61-683 Research Paper

Summer 2013

May 14, 2014

## ABSTRACT

This study was completed to determine whether a 15-minute post-lunch nap would be of benefit to students in grades 9-12 in a small, rural town. Specifically, the study measured students' perceptions of their level of subjective sleepiness during their afternoon classes. Current research shows that adolescents are not getting adequate sleep during the school week, on average missing the recommended mark by 2 hours. This lack of rejuvenation has serious detrimental affects on students' physical and mental wellbeing. While some schools across the nation are adopting later start times to combat this phenomenon, the school participating in this study is not in a position to consider that option. However, these students do have a short period of time around lunch that is not utilized productively. The present study was conducted by surveying nine randomly selected students in each of their four afternoon classes, both during a no-nap control week and during a week where they were allowed a 15-minute post-lunch nap. The students were asked to use the Stanford Sleepiness Scale in rating their level of perceived sleepiness in each class, each week. The results of this study showed that a post-lunch nap did not change students' level of perceived sleepiness in their afternoon classes.

## INTRODUCTION

### *Background, Issues and Concerns*

The investigator in this study has been teaching for five years at a school district in rural Northeast Missouri. This school district has a high population of Free or Reduced Lunch students (70%), as well as Hispanic students (62%). The current lunch schedule at the school cycles all grades 9-12 students through one cafeteria on a staggered schedule from approximately 11:30 to 12:10. Students who are not in the cafeteria are in 'homeroom.' Because of this staggered schedule, some students have 15 -20 minutes of down time in their classrooms either before or after lunch. In general, the educators within the school frequently criticize students' afternoon performance in classes. Overall, teachers have seen a definitive "slump" in the students' abilities to stay awake and pay attention in post-lunch classes. The teachers typically look to physical attributes of their classroom for the culprit behind this phenomenon: classroom too hot, not enough natural light, etc. While these classroom environments are sporadically present in the school (classroom temperatures fluctuate with the seasons, natural light is not present on overcast or stormy days), none are ever-present; however, the students' inability to pay attention after lunch is an everyday occurrence. This project will investigate this phenomenon from a different perspective: that of students' sleep habits. Current research suggests that while a short post-lunch nap will not take the place of a good night's rest, it may help students stay engaged in their afternoon classes by giving them an increased level of alertness.

### *Practice under Investigation*

The practice under investigation is whether a short nap will help adolescent students to get the most out of their afternoon classes and activities in high school.

*School Policy to be Informed by Study*

Many school districts in the United States are recognizing that teens' sleep habits today are being affected by early start times, increased access to technology, after-school job and family responsibilities, homework, etc. In response to this phenomenon, school districts are choosing to delay start times. However, the high school involved in the present study is tied to several other school districts in the area because of the connected EPN system, which provides dual-credit classes through a fiber optic network. With this connection, the school is not in a position to delay the beginning of the school day. Therefore, this study will seek to discover an alternate way for the school's students to get the most out of their day, by using an otherwise 'down time' in the day (homeroom) to take a short nap. If this study is successful, the high school should consider a broader implementation of short after-lunch naps for students.

*Conceptual Underpinning*

The Centers for Disease Control and Prevention (CDC) conducted a study that determined approximately 70% of teenagers in the United States are not getting the recommended eight-plus hours of sleep per night during the school week. The CDC found that factors contributing to teens' sleeplessness range from increased academic pressures, changes in recreational scheduling, after-school employment, early school start times, and an increased use of and access to technology. Many people may believe that a lack of sleep is simply a part of life. However, the phenomenon is not simply a matter of not getting enough shut-eye. According to the CDC study, lack of sleep in teenagers has also been linked to a number of other unhealthy activities, including physical aggression, cigarette/alcohol/marijuana use, and attempted suicide. This is a dangerous spiral for teenagers to get into – and one that is especially harmful to the already at-risk population at the school involved in the present study. Many schools in the U.S.

are working to help teens get the sleep they need by delaying start times by an hour or even two. Schools in Japan are going a different direction and implementing short nap times into the students' daily schedules.

With this CDC study in mind, it is reasonable to posit the theory that with an increase in students' school-week rest time, there should be a correlative increase in academic achievement and afternoon alertness.

### *Statement of the Problem*

If there is a significant difference in students' ability to pay attention in afternoon classes after they take a short post-lunch nap, the school should make better use of the time around lunch to provide napping areas for students to use.

### *Purpose of the Study*

The purpose of the study is to ascertain whether a short power nap after lunch elevates high school students' level of alertness in their afternoon classes. If successful, the results of this study will allow the investigator to advise school administration of afternoon naptime as an alternative to a later start time for the school (which is not a possibility based on current school conditions).

### *Research Question*

RQ: Is there a significant difference in student alertness after lunch between students who take a short post-lunch nap compared to students who do not take a short post-lunch nap?

### *Null Hypothesis*

Ho: There is no significant difference in student alertness after lunch between students who take a short post-lunch nap compared to students who do not take a short post-lunch nap.

*Anticipated Benefits of the Study*

The results of this study will allow the investigator to advise school officials on whether their students are sleep-deprived, and what can be done about it. Sleep deprivation in teens can be a significant barrier to their academic success, and many schools are moving to later start times to combat this phenomenon. However, this is not an option for this high school. If the naps in this study prove successful, the investigator will be able to present this information to school administration as a viable – albeit unorthodox – alternative to a later school start time.

*Definition of Terms*

CDC – The Center for Disease Control and Prevention

Circadian biological clock – the body's internal clock that controls periods of sleepiness and wakefulness throughout the day

Circadian rhythms – the natural 24-hour sleep/wake cycle that the body's biological and physiological functions follow

NSF – National Sleep Foundation

*Summary*

High school students have many demands for their attention, resulting in a tug-of-war for a restful night of sleep. A study of high school students in rural Missouri will be conducted to see if there is a significant difference in their perceived and observed attention levels in afternoon classes with a 15-minute post-lunch nap, and without a nap. The students (grades 9-12) will be chosen at random and asked to participate in the study. If the study is successful, the results will be taken to school administration, and will perhaps influence the mid-day homeroom/lunch scheduling for the high school to make this time more beneficial to the students.

## REVIEW OF LITERATURE

Adolescence is a time of tumultuous change. Young people are learning how to handle increased social and financial responsibility, juggle multiple deadlines and tasks at the same time, and prioritize their daily lives. Unfortunately, it has been reported for decades that adolescents are not placing a high enough priority on sleep (Wolfson & Carskadon, 1998). In fact, according to Noland, Price, Dake, & Telljohann (2009), while most adolescents require a little over 9 hours of sleep every night, most are only getting around 7 hours on school nights.

While sleep may not seem as though it needs to be a priority in the life of a teenager, research has shown that those two hours of sleep loss can affect many aspects of life. Most importantly for a student, adequate sleep has been proven to improve learning, memory, and creative thinking (Harvard Health Letter, 2009; Mednick, Nakayama, & Stickgold, 2003). Conversely, two studies completed in the U.S. in 1995 indicated that students who struggle in school, earning C's, D's and F's on their grade reports also got less sleep, went to bed later, and had more irregular sleep/wake patterns than those students who maintain A's and B's (Wolfson & Carskadon, 1998). This correlation between sleep and academic performance is no wonder, given that a survey of school-aged children in Israel showed that, "less total sleep time was associated with daytime fatigue, inability to concentrate in school, and a tendency to doze off in class" (Wolfson & Carskadon, 1998, p. 877). These are some of the most important abilities to possess in an educational environment, and teens are unable to employ them because they are not sleeping enough at night. However, the side effects of too little sleep do not stop at academics. Other studies have shown that inadequate sleep time for adolescents increases the instances of depressed mood, obesity, and behavior problems, as well as lack of attention span during the day

(Wolfson & Carskadon, 1998; Noland, Price, Dake, & Telljohann, 2009). The negatives of sleep deprivation are troubling, given that high school-aged children are working toward high-stakes testing, scholarship opportunities, employment opportunities, and college – the very foundations of the rest of their lives.

With rigid school start times, academic and social demands, stress, and the lure of television and video games, how can today's teens be expected to make up those two hours of quality sleep each day? Recent research indicates this can be accomplished with a short, daytime nap. Mednick, Nakayama, and Stickgold (2003) report that, "Research on behavioral effects of napping has found improvement in alertness, productivity, and mood" (p. 1), clearly three of the most pressing needs for adolescents.

In fact, much research has been done to prove the relationship of a daytime nap to increased alertness (Tietzel & Lack, 2002). And while extensive empirical evidence has not yet emerged to prove the most effective nap duration, studies have undertaken to measure the effectiveness of various nap lengths from ultra-brief (30 seconds) to longer (120 minutes), but have produced inconclusive results; presumably because of the vast number of variables that could affect test subjects (Tietzel & Lack, 2002). Nevertheless, research has produced at least "anecdotal evidence" that after a night of normal sleep or partial sleep deprivation, naps of shorter duration (less than 30 minutes) have more rejuvenating power for a person's alertness and cognitive performance, especially in the time directly following the nap. (Tietzel & Lack, 2000; Takahashi & Arito, 2000) In fact, researchers Brooks and Lack (2006) conducted a study to determine the most recuperative length of an afternoon nap in healthy college-aged test subjects who had experienced nighttime sleep restriction. Brooks and Lack (2006) determined that after a 10-minute nap, subjects showed immediate improvement in performance areas



including “sleep latency, subjective sleepiness, fatigue, vigor, and cognitive performance” (p. 831), and that those benefits stuck with the subjects for upwards of 155 minutes after the nap. Therefore, in applying this research to a high school student’s regular day, it is quite possible to imagine that a student might be able to find the time to accommodate a rejuvenating nap of 30 minutes or less, and have those benefits last for much of their afternoon classes.

In addition, further nap research that directly applies to adolescents who are at the mercy of a rigid school schedule, is the scientifically recognized “post-lunch dip” (Takahashi & Arito, 2000; Bes, Jobert, & Schulz, 2008). The internal clock that regulates many of a person’s daily physiological processes, is also in charge of the sleep and wakefulness schedule. This clock is more commonly known as a person’s circadian rhythm, and it has been shown to commonly go through a period of mid-afternoon sleepiness. (Harvard Health Letter, 2009) This period of time has been identified as occurring around 2 p.m., and, even in those who get adequate nighttime sleep, can be the cause of “decreased alertness, poor performance, and frequent errors” (Takahashi & Arito, 2000, p. 1). Combine this afternoon slump with the typical adolescent’s sleep-deficit, and it would take an iron will for a high school student to remain alert and fully functioning in an afternoon lecture class.

Takahashi and Arito (2000) investigated the effects of a 15-minute post-lunch nap in 22-year-olds. The authors specifically measured their sleep-deprived subjects’ alertness and performance after a nap from 12:30 to 12:45. They concluded that this brief opportunity allowed the students to experience significantly lower sleepiness levels, and significantly higher logical reasoning accuracy, especially at 1:15 and 2:45. (Takahashi & Arito, 2000) Interestingly, these times are correlative to the lunch and afternoon class schedule of high school students.

Alternatively, many students may try to get additional nighttime sleep, or use caffeine to combat the effects of sleep deprivation. However, a 2008 British study compared the benefits of additional nighttime sleep, taking a daytime nap, and using caffeine in combating the post-lunch dip. The researchers found the nap was the most effective. (Harvard Health Letter, 2009)

While the previously reviewed studies investigated post-nap benefits, there is also evidence to support the notion that sleep helps to solidify learning that occurs before the nap. Short-term memories are stored in the hippocampus, and according to Alger, Lau, and Fishbein (2010), it is generally accepted that sleep allows short-term memories to shift to the neocortex, where long-term memories are stored. Therefore, it is logical to assume that not only would a mid-day nap benefit teenagers in being able to remain alert in afternoon classes, but it would also help them to consolidate and store the information they learned in their morning classes.

## RESEARCH METHODS

### *Research Design*

A mixed method study was conducted in a rural Missouri high school, to ascertain whether a 15-minute post-lunch nap would help students' attention levels in their afternoon classes and activities. The independent variable being tested was nap versus no nap. The dependent variable being tested was students' perceived sleepiness level, based on the Stanford Sleepiness Scale. If the scores showed a significant level of improvement in afternoon classes, the information will be used to influence school administration regarding MHS students' homeroom and lunch scheduling, to make better use of that time.

### *Study Group Description*

Nine randomly selected male and female students in grades 9 through 12 were asked to participate in this study. There were four males and five females in the study group. Students' specific ages and grades were not collected or recorded. Overall, the high school involved in the study has 198 students, with 10% English as a Second Language (ESL) population, 8% of students with an Individualized Education Plan (IEP), and 71% eligibility for Free and Reduced Lunch.

### *Data Collection and Instrumentation*

Each of the nine study participants in grades 9-12 received a Stanford Sleepiness Scale worksheet at the beginning of the No Nap Control Week and at the beginning of the Nap Week. The students also received instruction on how to complete the worksheet after every afternoon class.

During the No Nap Control Week, students' regular schedules were not interrupted or altered. They filled out their worksheets as they went about a full week of classes and activities. Students then turned in their worksheets to the researcher at the end of the week.

During the Nap Week, students went to lunch at their usual time. After lunch, they gathered in a quiet classroom with the lights dimmed. They were instructed to lay their heads down on their desks and close their eyes for a period of 15 minutes. At the end of the allotted time, the bell rang and students attended their afternoon classes, indicating their sleepiness level on the worksheet. They turned in their worksheets to the researcher at the end of the week.

#### *Statistical Analysis Methods*

The Stanford Sleepiness Scale (Appendix 1) degree rating indicates that 1 is "Feeling active, vital, alert, or wide awake." As the number on the scale gets higher, the degree of sleepiness rises as well, with a 7 indicating "No longer fighting sleep, sleep onset soon; having dream-like thoughts," and "Asleep" indicated by an "X". However, in calculating the scores for this project, the X was scored as an 8. The scores were calculated for each individual student for the mean. Then, the mean scores were analyzed, using a t-test.

## FINDINGS

High school students' perceived alertness in their afternoon classes was assessed using the numerical Stanford Sleepiness Scale (1 is least sleepy, and 7 is most). Participants completed two SSS scales. During one school week, students were asked to remain awake in their homeroom class, then to record their level of post-lunch alertness in each of their afternoon classes. During a separate school week, students took a supervised short nap in their homeroom class, then recorded their alertness levels again. To determine the level of efficacy of the nap, the data was analyzed using a t-test.

Table 1  
Mean Average of Students' Stanford Sleepiness Scale Ratings

<b>Nap</b>	<b>No Nap</b>
1.20	3.20
2.73	2.00
3.00	1.25
1.70	4.65
3.31	4.10
1.13	2.25
1.25	1.35
2.58	4.20
1.81	3.60

The students' perceived degree of Nap and No Nap sleepiness scores were averaged for the mean, and analyzed using MiniTab 17 software to conduct a t-test. The information in Table 1 shows the mean averages of the students' Stanford Sleepiness Scale ratings for the Nap and No Nap weeks.

Table 2  
t-Test Analysis Results for Nap versus No Nap Scores

<b>Source</b>	<b>Mean</b>	<b>Mean D</b>	<b>t-Test</b>	<b>df</b>	<b>p-value</b>
Nap (n=9)	2.079				
No Nap (n=9)	2.96	-0.877	-1.72	13	0.109

Note: Significant when  $p \leq 0.05$

In running a standard t-test on the mean average of students' Nap versus No Nap scores, the alpha level was set at 0.05. As shown in Table 2, a statistically significant difference was not found between the Nap versus No Nap week (t-Test = -1.72; p-value = 0.109; Mean D = -0.877). Therefore, because the p-value of 0.109 is greater than the alpha level of 0.05, the null hypothesis is not rejected. From this information, it can be inferred that a 15-minute post-lunch nap does not affect students' attention levels in their afternoon classes.

## CONCLUSIONS AND RECOMMENDATIONS

The present investigation compared the sleepiness level of high school students in their afternoon classes with and without a 15-minute post-lunch nap, with a view to determining whether the homeroom section of the students' day could be used to help students pay attention better in the afternoon.

The Nap mean average (2.079) was lower than the No Nap mean average (2.96), meaning that on average, students were less tired during the Nap week. However, there was not a statistical significance between the two test weeks. The t-test conducted showed with 95% accuracy that the p-value was 0.109; therefore, the nap was not beneficial in helping the students remain alert in their afternoon classes. While the current study does not reject the null hypothesis, it has been widely reported in other scientific studies that short daytime naps of less than 30 minutes do help people to achieve higher levels of daytime alertness (Hayashi, Motoyoshi, & Hori; 2005). Therefore, while the indications of this study seem to negate the power of a post-lunch nap, there are certain caveats that should be discussed.

First, in the scientific studies used as the basis for this project, the researchers were able to standardize their test subjects and testing environments. These studies created highly rigorous conditions for their test subjects, including specific hours for sleep restriction, specific locations for their nighttime sleep and daytime naps, limitations on caffeine and consumption of other stimulants, alcohol consumption, etc. In addition, most of the researchers had access to highly technical equipment that was used to measure brain waves, eye movement, and minutes of actual nighttime and nap-time sleep for each of their test subjects. This level of standardization was not available for the present research study. Because of this lack of resources, the only measure used to indicate effectiveness was a subjective scale. Therefore, the variability of test subjects' sleep

restriction, actual sleep minutes during the nap, caffeine consumption, etc. is, unfortunately, unknown in the present study.

Second, the students involved in this study did not all have the same daily schedule. Again, this presents a standardization issue, because some students might have had an early morning sports practice, causing afternoon sleepiness regardless of nap. Further, in their afternoon classes, some students could have truly stimulating or boring teachers, some could have classes that are inherently interesting to them, and some could have classes where they are required to be physically active (and therefore are much less likely to experience sleepiness). All of these elements could induce a reaction in students' sleepiness levels, regardless of whether they have taken a post-lunch nap.

Third, the diets of the test subjects were not monitored, leaving room for another large variance in sleepiness levels, regardless of the nap. Students who have not eaten all day will experience a dip in energy, bringing on a sleepy reaction. Students who have a diet that is not nutritionally balanced will have the same type of afternoon slump. Further, a lunch that is high in carbohydrates can also induce higher post-lunch sleepiness levels.

Finally, the nap environment was not ideal. Students returned from their lunch time and laid their heads down on their desks in a dimly lit classroom. While this is how all students at MHS would have to nap if the results of the study had been beneficial, it is still not an ideal situation, as it does not replicate the comfortable, prone posture indicative of good sleep. In addition, although the classroom door was always closed for the duration of the naps, there was occasional hallway noise that could have interrupted some students' nap cycle, decreasing the effectiveness of the nap.



While a more regulated approach to the test subjects and nap environment would produce more standardized results, it is not recommended that those restrictions be put on further research. The reasoning for this is because the lack of regulations creates a “real-world” test environment. Today’s high school students face a myriad of demands on their time, both in and out of school, and each teen deals with those demands in a different way. By allowing the test subjects to simply “live their lives” and include a post-lunch nap for a week, the results of the study would be indicative of the true benefits or detriments to the nap. That being said, further research is recommended, attempting to include all students at Milan High School. This would inherently create a more standardized nap environment, and a greater level of reliability in students’ reporting, and a more quantitative set of data to analyze.

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## Appendix A.

**Stanford Sleepiness Scale***Nap Week*

The Stanford Sleepiness Scale is a quick and easy way to assess how alert you are feeling. The degrees of sleepiness are each represented by a number of 1-7 or an "x", as shown in the chart below.

Degree of Sleepiness	Scale Rating
Feeling active, vital, alert, or wide awake	1
Functioning at high levels, but not fully alert	2
Awake, but relaxed; responsive but not fully alert	3
Somewhat foggy, let down	4
Foggy; losing interest in remaining awake; slowed down	5
Sleepy woozy, fighting sleep; prefer to lie down	6
No longer fighting sleep, sleep onset soon; having dream-like thoughts	7
Asleep	X

**Instructions:**

Student: Using the Degree of Sleepiness scale above, pick what best represents how you are feeling in each of your four afternoon classes and write the number in the corresponding box.

	Day 1 – Monday	Day 2 – Tuesday	Day 3 – Wednesday	Day 4 – Thursday	Day 5 – Friday
5 <sup>th</sup> Hour					
6 <sup>th</sup> Hour					
7 <sup>th</sup> Hour					
8 <sup>th</sup> Hour					

## Appendix B.

**Stanford Sleepiness Scale***No-Nap Week*

The Stanford Sleepiness Scale is a quick and easy way to assess how alert you are feeling. The degrees of sleepiness are each represented by a number of 1-7 or an "x", as shown in the chart below.

Degree of Sleepiness	Scale Rating
Feeling active, vital, alert, or wide awake	1
Functioning at high levels, but not fully alert	2
Awake, but relaxed; responsive but not fully alert	3
Somewhat foggy, let down	4
Foggy; losing interest in remaining awake; slowed down	5
Sleepy woozy, fighting sleep; prefer to lie down	6
No longer fighting sleep, sleep onset soon; having dream-like thoughts	7
Asleep	X

**Instructions:**

Student: Using the Degree of Sleepiness scale above, pick what best represents how you are feeling in each of your four afternoon classes and write the number in the corresponding box.

	Day 1 – Monday	Day 2 – Tuesday	Day 3 – Wednesday	Day 4 – Thursday	Day 5 – Friday
5 <sup>th</sup> Hour					
6 <sup>th</sup> Hour					
7 <sup>th</sup> Hour					
8 <sup>th</sup> Hour					