CAN SIMPLE MOVEMENTS PRIOR TO INSTRUCTION INCREASE LEARNING IN EARLY MORNING SECONDARY SCHOOL CLASSES?

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Abstract

Can Simple Movements Prior to Instruction Increase Learning in Early Morning Secondary School Classes?

The present study examined the effects of performing simple, early morning movements on students' memory. For week 1 of the study, students were shown a series of 20 images at the beginning of their first period class on Monday. They were asked to recall as many images as possible at three stages – immediately after viewing the images, at the end of first period, and at the beginning of first period on Friday. For week 2, students were randomly split into two groups on Monday. Group A performed the simple movements while Group B completed a sleep habit survey. The students were shown another set of 20 images and their recall was tested at the same three stages as in week 1. For week 3, the procedure was the same except Group A completed the survey and Group B performed the simple movements.

The students' individual recall scores were averaged to make the groups' mean scores for each stage of recall testing during week 1 and week 2. Group A's mean scores during week 2 were compared to Group B's mean scores during week 2. A t-test determined that the simple movements did not have a significant effect on the students' memory. However, when Group A's mean scores during week 1 were compared to Group A's mean scores during week 2, t-tests revealed that there were significant decreases in the mean scores for the end of period recall test and the delayed recall test. The same results were found when Group B's mean scores during week 1 were compared to Group B's mean scores during week 2.

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Introduction

Many high school students arrive at school without enough sleep. The changing of their circadian rhythms is causing their sleep phases to shift. Teens often suffer from poor sleep hygiene skills. Noland et al. (2009) defined sleep hygiene as "the practice of several behaviors that optimize and promote good sleep and daytime functioning" (p. 225) including "ensuring regular bedtimes and rise times, limiting napping during the day, avoiding lying in bed waiting to fall asleep, winding down before bed, being relaxed, restricting caffeine and nicotine throughout the day, avoiding alcohol and sleep aids, and providing for a favorable sleeping environment" (p. 225). Teens knowingly stay up later than they should due to social lives, the internet or homework. High schools generally start around 7:00am. All of these reasons combined make for sleepy students in early morning classes. Having students arrive at school awake and ready to learn would be beneficial not only to the students, but to the teachers and administration as well.

Some school districts realize that they cannot change the circadian rhythms of their students and that the typical school day needs to be more aligned with those rhythms. This has led school districts around the country to adopt later start times for their high schools. However, the decision to adopt a later start time is not without struggle. Transportation, before and after school activities, music programs, athletics, the impact on families, and the impact on the community are all areas of concern that need to be addressed and discussed. As a result of these discussions, many school districts decide to not adopt a later start time. High school students continue to come to school without having gotten enough sleep.

What can the teachers of early morning classes do to counteract their students' lack of sleep and increase learning in their classrooms? Many studies have touted the effects of physical activity on learning. However, encouraging sleepy teens to do push-ups, sit-ups, jumping jacks and run laps is futile. This study will explore the idea of simple movements performed by students prior to instruction and see if these movements can increase learning. This is important to education because trying to educate sleepy students is not an effective use of the short amount of class time that a teacher has. Learning is optimal when students are awake and perceptive.

Literature Review

Teens and Sleep

One of the main contributors to attention problems in early morning classes is the lack of sleep. In 2007, a sleep duration question was added to the Youth Risk Behavior Survey. Eaton et al. (2007) examined the results of this added question and found that 68.9% of the high school students that they surveyed reported getting insufficient sleep on the average school night. Insufficient sleep was considered less than or equal to seven hours, borderline sleep was considered eight hours, and optimal sleep was considered equal to or more than nine hours. Of the 12,154 students that responded to the sleep question, 38.7% reported getting six or less hours of sleep on an average school night. When broken down by grade, insufficient sleep was more prevalent as the students got older. These findings are representative of ninth through 12th-grade students attending public and private United States schools because a three-stage cluster design was used for the study of the survey. Also, student participation was anonymous and voluntary.

One reason that teens do not get enough sleep may be beyond anyone's control. Dawson (2005) notes, "With the onset of puberty, adolescents begin to experience a sleep-phase delay in their biological clock (i.e., circadian rhythms) and develop a natural tendency to fall asleep later in the evening and wake up later in the morning" (p. 45). Their bodies want to wake up later in the morning, but school schedules do not allow for this. Sleepiness, according to Dawson, is the most common result of insufficient sleep and it is "most problematic during periods of low stimulation, such as passive or monotonous classroom instruction" (2005, p. 46).

Dawson's points are supported by the current body of research, specifically the research of Amy Wolfson and Mary Carskadon. Wolfson and Carskadon (1998) use data from a large-scale survey to gain insight to the association between adolescents' sleep/wake habits and several daytime behaviors (sleepiness, grades and mood). The School Sleep Habit Survey was anonymously completed by 3,120 students from four Rhode Island high schools. The survey showed that as the students got older, lower amounts of total school-night sleep time were reported. The rise times remained about the same across the ages, but bedtimes were increasingly later in the older teens.

When it came to grades, the students with higher grades (Bs or better) reported more total sleep and earlier bed times on school nights than those with lower grades (Cs and lower). Students who got more sleep and had similar sleep/wake patterns on weekdays and weekends have better grades because they are more able to pay attention and be alert in class (Wolfson & Carskadon, 1998). The sample for this study was four public high schools in three Rhode Island school districts. With a response rate of 88%, these findings can be considered representative of students enrolled in a moderate to large public high school, but only in the region of the study.

Noland, Price, Dake, and Telljohann (2009) surveyed 384 ninth through 12th grade students on their sleep behaviors and their perceptions of sleep. Of the sample, 96% reported getting fewer than nine hours of sleep on school nights. A majority of the students reported that not getting enough sleep led to three problems: being more tired during the school day (93.7%), having difficulty paying attention (83.6%), and having lower grades (60.8%) and increased stress (59%). However, the data did not produce a relationship between the lack of sleep and grades, even though more than half of the students reported that this was the case. These results were obtained with some limitations. Since surveys are inherently self-reporting, the amount of under reporting and/or over reporting cannot be determined. The external validity was compromised by convenience sampling and the fact that the survey was only given on one day so only those students in attendance that day, with the parental consent, could participate.

Many school districts across the country are aware of the research into adolescent sleep and some have started adopting later start times for their high schools, and in some cases, their middle schools. Wolfson, Spaulding, Dandrow and Baroni (2007) compared a late-starting middle school to an early-starting middle school in an urban, New England school district. Their goal was to analyze the impact of an early start time on sleep patterns, academic performance, attendance, and tardiness. The sample came from two middle schools with start times of 7:15am and 8:37am. The Sleep Habits Questionnaire was given to the 205 participants to assess their normal sleeping/waking behaviors and their sleep hygiene practices for the previous two weeks. Parents consented to the schools providing the official records of academic performance, attendance, and tardiness. The findings showed that the seventh graders had no school differences, but the eighth graders at the late-starting school had significantly higher average grades than the eighth graders at the early-starting school. Tardiness rates were four times higher at the early-starting school than the late-starting school. An attempt was made to isolate school start time by picking two schools that were similar in socioeconomic status, size, and ethnicity. The findings, however, cannot be generalized out to other populations because only two schools were used.

School Schedules

If the research about teen circadian rhythms is to be believed, then schools should consider it when planning school schedules. Klein (2004) researched academic achievement in relation to the time of learning among middle school students. The sample was 25 seventh to ninth grade classes in Israel which required intensive reading (i.e. literature and history) and these classes were held at different times of the day. For each class and subject, the following information was obtained: the day of the week, the time the lesson started, and the annual mean achievement of each student (the final grade point average, FGPA). The findings showed that "learning achievement in middle school varies with the time of day at which classes are held" (Klein, 2004, p. 446). There was a gradual increase in academic achievement from morning to noon. Klein stated that the gradual increase from morning to noon is due to the transition from night hours (little physical and cognitive function) to day hours (increased physical and cognitive function for school and study) (2004). The findings suggest that schools should plan courses that involve activity, such as technology and sports, for the hours that coincide with students' lower levels of alertness. This would mean scheduling active classes in the morning and sedentary classes in the afternoon. The validity of these results is threatened because there was no mention of how randomness in the selecting of the classes was achieved and there was no mention of the population from which the sample was drawn.

Instead of aligning certain classes to the times of day of students' higher levels of achievement, the Minneapolis Public Schools district changed the start times of seven high schools and seven middle schools. The high schools changed from a start time of 7:15am to 8:40am and the middle schools changed from 7:40am to 9:40am. Kubow, Wahlstrom, and Bemis (1999) held focus groups for teachers, students, and support/administrative staff members from three of the high schools and five of the middle schools. Once there was clarification on the issues, a questionnaire was developed for the groups to complete to assess the impact of the changed start times on education and the community. Of the high school teachers surveyed, 57% noticed that a greater number of students were more alert during the first two periods. Just over half of the teachers noticed fewer students sleeping at their desks. When the students were surveyed, almost all of them reported that they were more alert and rested in the first hour of class. They also noted that they were going to bed at, generally, the same time as when they had the earlier start time. This meant that they were getting about one hour more of sleep a night.

When Kubow et al. surveyed middle school personnel, the overall view of the later start time was negative. Many were dissatisfied with the later start time due to both student and teacher fatigue by the end of the day which led to discipline issues. The later dismissal time posed problems for students and their transportation home, as well as the transportation of students involved in after-school activities.

Adopting a later start time is a difficult decision because it affects many people in the school and in the community. Whalstrom (1999) summarized many of the questions that districts need to ask while considering this change:

- "What do we hope to gain by shifting our high school start time? And what might we lose in the process?" (p. 346)
- "What will it take to bring our school schedules into line with what research tells us about adolescent sleep needs?" (p. 346)
- "Are the data (research data on adolescent sleep needs) of sufficient quality and relevance to merit consideration?" (p. 346)
- "How late is late enough to help address the sleep needs of adolescents without changing school schedules more than is necessary?" (p. 347)

Because there is no single solution that satisfies all districts, many districts decide to keep their schools at the earlier start times.

Researchers are becoming aware that teachers need strategies to help their sleepy students in early morning classes. Hansen et al. experimented with bright light administration in an attempt to normalize the circadian sleep/wake cycles of high school students. Sixty incoming seniors started keeping sleep diaries in August. They kept the diaries through the first two weeks of school, for 1 month in November, and for 1 month in February. In the last 2 weeks of November and the last 2 weeks of February, early-morning light treatments were given to 19 of these students. Ultimately, it was found that exposure to bright light in the early morning did not alter the sleep/wake cycles of the students, nor did it improve their daytime performance during weekdays.

However, the sleep diaries provided supporting evidence that high school start times are not in alignment with high school student circadian rhythms. Hansen et al. found that during the week after the start of school, adolescents lost up to 120 minutes of sleep. Also, weekend sleep time was also significantly longer (about 30 minutes) than that seen before the beginning of school.

The students' performance and mood were measured using the Harvard Cognitive Battery. All students in this study exhibited a pattern of poor performance in the early morning compared to afternoon performance. All students also felt less vigorous in the morning than in the afternoon.

Benefits of Exercise

The proposed study will explore the impact of simple movements on learning. Research shows that physical exercise can improve both memory and learning. Labban and Etnier (2011) conducted a study into the effects on learning of exercise before exposure to the material to be learned, exercise after exposure, and no exercise. The sample was composed of 48 young adults (mean age of 22.02 years). There were 15 men and 33 women. They were randomly assigned to one of the three groups: exercise-prior, exercise-after, and control. The exercise consisted of 30 minutes of aerobic exercise on a cycle ergometer. The material to be learned was two paragraphs that were read to the participants. They were to recall each one as close to verbatim as possible. A coder recorded how many story units each participant recalled. There were two main findings from this study. First, both exercise groups recalled more story items than the control.

Second, the exercise-prior group recalled significantly more story items than the control group. "These results suggest that exercise can have a positive impact on long-term memory and that acute exercise exerts its greatest facilitative effect when it occurs prior to exposure and consolidation rather than during consolidation" (Labban & Etnier, 2011, p. 718).

Hill et al. (2010) moved the study of the effects of exercise into the classroom. They investigated whether physical exercise during the school day would influence cognitive performance in the classroom following the exercise. The participants consisted of 1,224 students from six primary schools in Scotland. They were eight to 11 years old which corresponded to grades four to seven. Two classes of similar size at each grade level were randomly designated into one of two groups: one that did the exercise program (group A) and one that did not (group B). The students then took six tests. The following week, the groups switched so group A did not exercise and group B did. Again, the students took the six tests. Both groups saw improvement on the tests after participating in the exercise program. The study also showed that the benefits of exercise were greatest when the students were least aroused because the test format was already familiar.

Previous studies have shown that students with higher physical activity levels have greater academic success, but does this academic success stem from the physical activity or the team association? Perhaps the greater academic success is due to the requirement of the student to maintain a certain GPA that team may impose. Fox, Barr-Anderson, Neumark-Sztainer & Wall (2012) did a study to see how team association and physical activity each relate independently to academic performance. It involved 4746 students from 31 middle schools and high schools in the Minneapolis/St. Paul area. The sample had an equal balance of males and females, it was ethnically diverse, and it had diverse socioeconomic status. The participants completed a survey about their eating habits and physical activity and self-reported their grades. The results showed that academic success did not stem from the team association. "Performing more hours of MVPA (moderate to vigorous physical activity) was associated with a higher GPA for girls and boys in middle school and high school" (Fox et al., 2012, p. 35).

Brain Gym

By far, the most impactful research to the proposed research project is that of Jennifer Richardson. Richardson (2011) did a study to determine if students would score higher on tests if they engaged in exercises designed to increase left brain and right brain connections. The exercises used were from the Brain Gym program. The study ran for six weeks over one summer school session of communication arts. There were 44 tenth grade students in two classes. The morning class of 22 students was the experimental group. The 22 afternoon students were the control group. At the beginning of the course, both groups took the same pre-test on the content. For the remaining instructional days of the course, the morning class did the exercises during the first three minutes of class and the afternoon class wrote in their journals for the first three minutes of class. At the end of the summer course, both groups took the same post-test. The post-test scores were analyzed to see if one class improved significantly more on the post-test. This study found that there was a correlation between the group doing the exercises that engaged the left and right sides of their brains and an improvement in their scores on a communication arts test. The generalizability of the findings is minimal since the sample size was very small and the population was mostly self-selected. Some threats to the validity of this study include the groups talking to each other about the exercises and some students possibly being involved in other communication arts classes.

The previous study shows a positive response to the Brain Gym exercises, but there is a substantial body of research that does not support that finding. The Brain Gym developers claim that their movements will enhance learning and they base that claim on theoretical bases and research findings. Hyatt (2007) reviewed those theoretical bases and research findings and attempted to determine if the movements were scientific and research-based. Brain Gym is based on three theoretical categories: neurological repatterning, cerebral dominance, and perceptual-motor training. Hyatt (2007) found that neurological repatterining is somewhat fraudulent, cerebral dominance has not been associated with learning, and there has been no rigorous scientific investigation into perceptual-motor training. Hyatt (2007) also reviewed research that has been conducted with the applications of the Brain Gym procedures. Only five peer-reviewed articles that dealt with the effectiveness of the program were found. One was disregarded because the author was a participant in the study. Three of the remaining four articles were all published in a journal where authors pay for publication. The four articles that were reviewed were found to have methodological flaws.

The literature review has shown the following:

- Teens are coming to school on insufficient sleep and it is due, in part, by their changing circadian rhythms.
- Traditional school schedules do not match these circadian rhythms.

- Some school districts have changed start times in the secondary schools to better align with the students' circadian rhythms, but since it is a difficult decision, many districts have not.
- Exercise and physical activity can improve memory and learning.
- Brain Gym exercises had a limited positive impact on learning, but it has been shown to be not scientifically based.

Teachers in the districts that do not adopt a later start time are ultimately left with sleepy students in their early morning classes. Physical activity has been shown to improve learning and memory but convincing sleepy students to run laps, do push-ups or do jumping-jacks is not likely. Perhaps sleepy students would be more willing to do exercises like those in the Brain Gym program because many of them can be done from their seats. This proposed research study seeks to determine if simple movements, prior to instruction, can increase learning in early morning secondary classes.

Research Question

My research question is can simple movements performed by students prior to instruction increase learning in early morning secondary classes?

Methodology

Method and Rationale

I conducted at quantitative study with a quasi-experimental design that ran for three consecutive weeks. The sampling was done through convenience sampling because my study involved students that were in pre-established classes.

This method was appropriate for my research question because I wanted to determine if a certain treatment had any effect on the group that received it. Using a pre-test gave me baseline data that I could compare post-test data to. Having a control group and a treatment group allowed me to control for the possibility that other factors not related to the treatment were responsible for the differences between the pre-tests and the post-tests.

Sample

The study was conducted in one first period class which started at 8:00am. There were 23 students in the class, all of which returned the required consent forms, so all students began the study. However, due to student absences, only 17 participated in all days of the study. Only the data from these 17 students were used.

My research question focused on students in early morning classes, and although 8:00am may not be considered early when another nearby district has a 7:10am start time, the class that I conducted my research in was the earliest that I could get. I did not also conduct my research in a 2nd period class as originally designed because 2nd period started at 9:00am and I did not consider that to be early in the context of school start times.

Instrumentation

On Monday of week one, a memory test was given to both groups as a pretest. At the beginning of class, 20 images (see Appendix A for Snodgrass-Vanderwart images) appeared, one after the other, on the board. Each image remained on the board for three seconds. After the last image was gone, recall sheets were passed out and students were asked to write down the images that they could remember. Their recall of the images was tested again at the end of the period on Monday and a third time at the beginning of the period on Friday of week one.

In preparation for week 2, I randomly split the class into two groups using my TI-83 calculator. I generated a random integer set to assign students by their number into Group A (treatment group). The remaining students were assigned to Group B (control group).

On Monday of week two, during the first three minutes of class, Group A (treatment) was led in a set of simple movements at their desks while group B (control) filled out a survey. The simple movements were the treatment and they consisted of one set of each of the following: Cross Crawls, Lazy Eights, Owl, and Finger-Thumb (see Appendix C for Simple Movements). The survey was just an activity to occupy Group B while Group A did the movements (see Appendix B for Sleep Survey Questionnaire). It provided no data for this study. When the surveys and the movements were completed, a memory test was administered. The procedure for this memory test was identical to the memory test done in week one with the exception that a new set of images was used. The students' recall of the images was tested at the same three stages as in week one. This served as the post-test.

On Monday of week three, the same procedure was followed as in weeks one and two, but Group B performed the movements and Group A completed the survey. This did not generate any useable data. Group B witnessed the movements as the control group in week two and, therefore, came into week three as the treatment group with unique knowledge that Group A did not have when they were the treatment group. However, having all students participate as both the control group and the experimental group gave all participants a feeling of equal involvement in the study.

The data collected consisted of the quantity of images remembered by each student at each of the three stages of recall testing – immediately after they viewed the images on Monday, at the end of the period on Monday, and at the beginning of the period on Friday (delayed). The data was collected for two weeks. Week 1 served as the baseline data and week 2 involved Group A doing the movements (treatment) while Group B answered a sleep survey (no treatment). The data was collected through the recall sheets that the students filled out. These sheets were scored based on the number of correct images recalled and recorded on the sheets.

This data was necessary because it quantified the students' ability to remember the images. This represented the students' recall memory. This data allowed me to compare Group A's ability to remember the images after performing the movements to Group B's ability to remember the images after not performing the movements. Any difference between Group A's and Group B's ability to recall images would be a difference in their memory.

This data also allowed me to analyze any difference in mean scores within each group. I was able to compare Group A's week 1 mean scores to their week 2 mean scores. I was able to do the same comparison with Group B.

Analysis/Validity

The null hypothesis was that the mean scores for both groups are the same for each of the three stages of recall testing. The alternate hypothesis was that the movements performed by Group A improved their memory and lead to more images recalled than Group B. The random assignment of the pre-established class in to the two groups was not enough to ensure that the groups were balanced. To determine if Group

A and Group B were equivalent groups, I used t-tests to compare their mean scores from week 1. These t-tests resulted in Group A and Group B being equivalent so I was able to use their mean scores for my analysis.

Independent, two-tailed t-tests were conducted using an online calculator at www.statisticslectures.com. T-tests were used to compare the week 2 mean scores of Group A and Group B, as well as to compare Group A's mean scores from week 1 to week 2 and Group B's mean scores from week 1 to week 2. This was done to assess whether any of the differences observed were significant. Corresponding p-values were calculated using an online calculator at www.graphpad.com. P-values were calculated to determine the probability of obtaining results as extreme as, or more extreme than, those that were actually observed.

As the researcher, I felt there was the possibility of bias when I was picking the images to be used for the memory tests. There were 244 Snodgrass-Vanderwart images available for free download from http://crl.ucsd.edu/experiments/ipnp/method/getpics/getpics.html. I numbered the images and used my TI-83 to pick random integers from 1 to 244 inclusive. The random integers picked were the images that I used for the memory tests.

There were quite a few internal threats to the validity of this study. One was instrumentation. I used different images for the pre-tests and the post-tests to avoid the threat to internal validity of testing (improvement on the post-test because subjects are familiar with the test due to the pre-test). However, students may have had an easier time remembering either the images from week 1 or the images from week 2. They may have had more personal connections with certain images or they may have been able to "link" images together to make them easier to remember. I attempted to control for this by having the images randomly picked.

A second threat to the internal validity of my study was experimental mortality. It was not guaranteed that all students in the class would be present on the days of the experiment. The number of participants dropped over the course of the study from 23 to 17. School calendars and schedules were consulted when planning this study but there was no way to control for student absences.

A third threat to the internal validity of this study was treatment diffusion. The students in Group B witnessed the students in Group A doing the simple movements during week 2 of the experiment. Isolating the groups was not an option for this study. To control for this, all participants were told on the first day that they would get to participate in both the control group and the treatment group for the study.

The main threat to external validity was the design of this study. Because the sample was chosen out of convenience and not randomly, the findings from this study cannot be generalized to any other populations. There was randomization in the forming of the two groups, but the sample was not representative of any other population.

Data

Table 1

Comparison of Group A's and Group B's Mean Recall Scores for Week 1 and Week 2

		Group A n = 10	Group B n = 7		
		M (SD)	*M (SD)*	t score	p value
Week 1	Immediate recall	8.4 (1.58)	9.29 (2.93)	0.81	0.43
	End of period recall	8 (1.89)	8.43 (3.99)	0.3	0.77
	Delayed recall	5 (2)	6.29 (2.36)	1.21	0.24
Week 2	Immediate recall	8.4 (1.26)	8.57 (3.26)	0.15	0.88
	End of period recall	4.4 (2.22)	3.29 (2.21)	1.02	0.32
	Delayed recall	3.3 (2.06)	3 (1.73)	0.31	0.76

Note. $^{*}p < .05$

Group B's mean recall scores were higher for all stages of recall testing in week 1 and for the immediate recall test in week 2. The differences seen in week 1 were not found to be significant. Therefore, Group A and Group B were determined to be equivalent. Group A's mean recall scores in week 2 were greater than Group B's in week 2 for the end of period recall (greater by 1.11) and the delayed recall (greater by .3).

Table 2

Mean Recall Scores for Group A

	Week 1 *M (SD)*	Week 2 *M (SD)*	*t*	*p*
Immediate recall	8.4 (1.58)	8.4 (1.26)	0	1
End of period recall	8 (1.89)	4.4 (2.22)	16.28	< .001
Delayed recall	5 (2)	3.3 (2.06)	4.64	< .001

Note. n = 10
$^{*}p < .05$

After being the same from week 1 to week 2 for the immediate recall, Group A's end of period recall mean score decreased by 3.6. Group A's delayed recall mean score decreased by 1.7.

Table 3

Mean Recall Scores for Group B

	Week 1 *M (SD)*	Week 2 *M (SD)*	*t*	*p*
Immediate recall	9.29 (2.93)	8.57 (3.26)	1.18	0.28
End of period recall	8.43 (3.99)	3.29 (2.21)	5.49	< .001
Delayed recall	6.29 (2.36)	3 (1.73)	11.5	< .001

Note. n = 7
*p < .05

Group B experienced a decrease of .72 in mean score for immediate recall from week 1 to week 2. There were greater decreases in mean scores for end of period and delayed recalls with decreases of 5.14 and 3.29 respectively.

Analysis

Analysis of the data shows a difference between the recall ability of Group A and that of Group B during week 2 when Group A performed the simple movements and Group B completed the sleep habit survey. This can be seen by comparing the data in Table 1. Group B's mean score for immediate recall was .17 greater than Group A's. Group A's mean score for end of period recall was 1.11 greater than Group B's. Group A's delayed recall mean score was also greater than Group B's by .3. However, given the t-scores for each of the three stages of recall testing, the differences that are noticeable are not statistically significant. With p-values of .88 for immediate recall mean score, .32 for end of period recall mean score, and .76 for delayed recall mean score, the null hypothesis was not rejected for each of these stages of recall testing. There is no evidence from this study that the simple movements performed by Group A improved their memory and led to more images recalled than Group B.

Interestingly, both groups' mean scores decreased from week 1 to week 2, with the exception of Group A's immediate recall mean score which did not change. Analysis of the data in Table 2 shows a change in Group A's mean score from 8 in week 1 to 4.4 in week 2 for a decrease of 3.6. For end of period recall, Group A's mean score went from 5 in week 1 to 3.3 in week 2 for a decrease of 1.7. With t-scores of 16.28 and 4.64, plus p-values less than .001 for both stages of recall testing, the decreases encountered by Group A between week 1 and week 2 for end of period recall and delayed recall are statistically significant.

Group B also experienced decreases in all three stages of recall testing from week 1 to week 2. Table 3 shows that Group B's mean score decreased by .72 for immediate recall, by 5.14 for end of period recall, and by 3.29 for delayed recall. Just as with Group A, Group B's differences between week 1 and week 2 for end of period recall and delayed recall are statistically significant. The t-scores were 5.49 and 11.5, respectively. The p-values were less than .001 for both.

These results are interesting for two reasons. First, they went in the opposite direction than I expected. Second, both groups experienced significant decreases in mean scores for the same two stages of recall testing.

I believe the overall decreases in mean scores between week 1 and week 2 for both groups is due to a type of threat to external validity called testing and subject interaction. It occurs when subjects in a sample may react to the testing process in ways that are unpredictable. When I introduced myself and my experiment to the class, prior to beginning the study, the students were excited about the experiment and eager to take part. However, on Monday of week 1 when I collected the immediate recall test, many students complained that they didn't remember as many images as they thought they would. Because they did not perform as well as they imagined they would, the students may have developed negative attitudes towards the recall tests and the study in general. These negative attitudes could have impacted the students' level of commitment to the study, resulting in fewer images recalled.

The fact that both groups experienced statistically significant decreases in mean scores for end of period recall and delayed recall between week1 and week 2 is intriguing. Whatever caused this must be independent of the simple movements and the sleep survey because it affected both groups. Whatever caused this did not have the same effect on either group's mean scores for immediate recall. Perhaps the upcoming End Of Course (EOC) exams played a part in this. During week 2 of this study, students in this class, as well as the other Geometry classes at this high school, were given EOC review packets. The added stress of preparing for the EOC may have had an impact on the students' longer term recall while not affecting their short term recall. I have no other explanations for these results.

There were some unanticipated events that happened during the course of this experiment. I had anticipated being placed to student teach in a high school with an early start time between 7:00am and 7:30am. However, the school I was placed in has first period start at 8:00am. This may not have been as early has I had hoped, but some proponents for later high school start times are working for a 9:00am start time. Also, I had to make do with what other teachers were willing to do.

Some students used alternate names for the images that they recalled and I was prepared for ones that were synonymous (teeter-totter/see-saw, boat/canoe/kayak, board/plank/wood, rose/flower, rat/mouse). However, some students used names for images that were not synonymous. For example, a church was recalled as "house", an oven was recalled as "washing machine", a microscope was recalled as "telescope", a safety pin was recalled as "bobby pin", and a nail was recalled as "screw". I counted these names for recalled images as correct if they were consistent with their use.

When compiling the data and calculating the number of correct images recalled, I noticed that some students were recording images from the previous week during the Friday recall test when they should have only been recording the images from the current week that they recalled. These were not counted in their totals because images recalled from week 1 during week 2's recall tests would artificially inflate the number of images recalled for either group in week 2.

Implications/Recommendations

The implications of my data and analysis are that future studies need to be conducted into using these types of movements to improve the learning of sleepy students. A larger scaled study with more randomization, multiple weeks of treatment, and larger samples may yield more accurate results. However, future studies may benefit from altering some of the aspects of my study.

It may be necessary to commit more time to the movements at the beginning of class. To keep the loss of instruction time to a minimum, the students only performed one set of each of the movements. Perhaps more sets of all movements, or multiple sets of fewer movements, would yield different results.

These movements may not be a strong enough tool to counteract sleepiness. Sleepy students may need more traditional exercise to get their brains ready to learn.

Perhaps waking the brain needs to be done in conjunction with waking up the body.

Conclusion

Until the adoption of later start times for secondary schools becomes standard practice, teachers will have to develop strategies for dealing with sleepy students in early morning classes. This study explored a strategy that is of no monetary cost, is easily carried out at the students' desks, and doesn't take up much instruction time. However, the findings of this limited study were not statistically significant and the topic could use further investigation on a larger scale. If the use of simple movements prior to instruction is ultimately found to increase learning in the early morning classes, it may also be beneficial to teachers at other times of the school day when students are less aroused and attentive.

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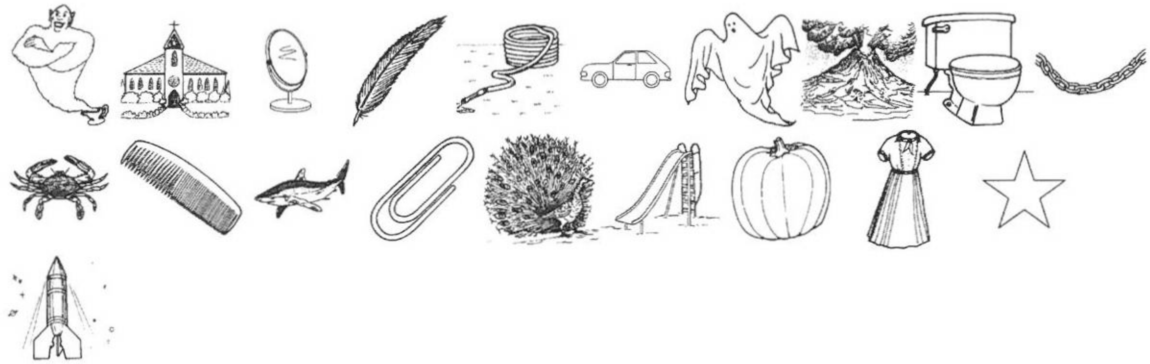
Appendix A

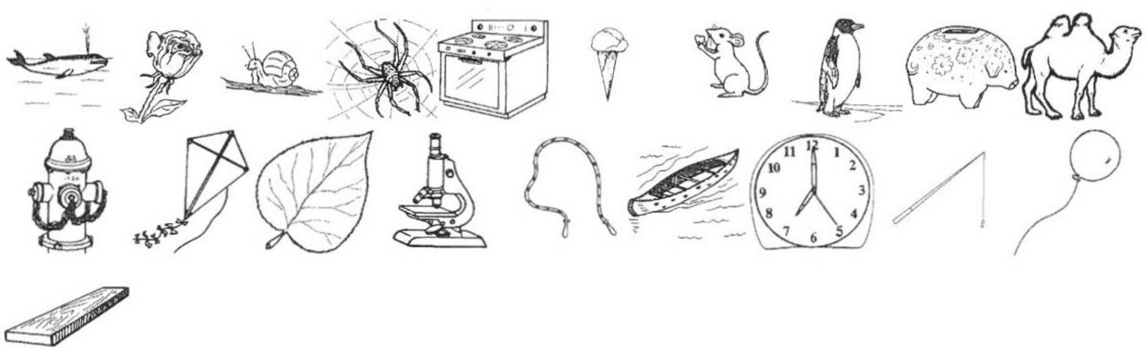
Snodgrass-Vanderwart Image Sets (UCSD Center for Research in Language, 2003)

http://crl.ucsd.edu/experiments/ipnp/method/getpics/getpics.html

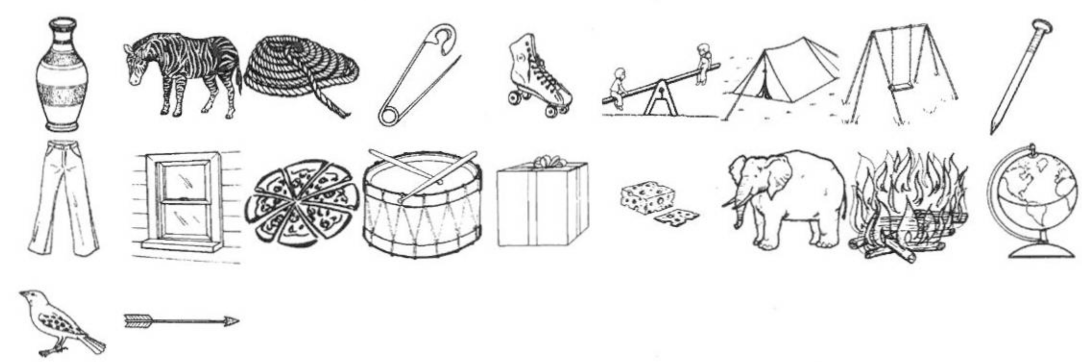
Set #1 – to be used week 1, Monday



Set #2 – to be used week 2, Monday



Set #3 – to be used week 3, Monday



Appendix B

Sleep Habit Questionnaire

Sleep Habit Questionnaire

There are no right or wrong answers. Be careful to choose the one answer that best describes the way your sleep has been in the last two school weeks (unless otherwise instructed).

The first set of questions has to do with your usual schedule on days when you have school.

1. What time do you usually go to bed on school days? List ONE time, not a range.
   ○ A.M.
   ○ P.M.
   ____

2. What is the main reason you usually go to bed at this time on school days? (mark one)
   ○ My parents have set my bedtime
   ○ I feel sleepy
   ○ I finish my homework
   ○ My TV shows are over
   ○ My brother(s) and/or sister(s) go to bed
   ○ I finish socializing
   ○ I get home from my job
   ○ Other: ______________

3. What time do you usually wake up on school days?
   ○ A.M.
   ○ P.M.
   ____

4. What is the main reason you usually wake up at this time on school days? (choose one)
   ○ Noises or my pet wakes me up
   ○ My alarm clock wakes me up
   ○ My parents or other family members wake me up
   ○ I need to go to the bathroom
   ○ I don't know, I just wake up
   ○ Other: ______________

5. What time do you usually leave home on school days?
   ○ A.M.
   ○ P.M.
   ____

6. How do you usually get to school?
   ○ Walk
   ○ Get a ride with friends
   ○ Take the bus
   ○ Drive my car
   ○ Get a ride with parent

7. On school days, after you go to bed at night, about how long does it usually take you to fall asleep?

   ______________ minutes

The next set of questions has to do with your usual schedule on days when you do not have school.

8. What time to you usually go to bed on weekends?
   ○ A.M.
   ○ P.M.
   ____

9. What is the main reason you usually go to bed at this time on weekends? (choose one)
   ○ My parents have set my bedtime
   ○ I feel sleepy
   ○ I finish my homework
   ○ My TV shows are over
   ○ My brother(s) and/or sister(s) go to bed then
   ○ I finish socializing
   ○ I get home from my job
   ○ Other: ______________

10. What time do you usually wake up on weekends?

__________________ ○ A.M. ○ P.M.

11. What is the main reason you usually wake up at this time on weekends?
    - ○ Noises or my pet wakes me up
    - ○ My alarm clock wakes me up
    - ○ My parents or other family members wake me up
    - ○ I need to go to the bathroom
    - ○ I don't know, I just wake up
    - ○ Other: __________________

12. On weekends, after you go to bed at night, about how long does it usually take you to fall asleep?

__________________ minutes

13. Some people wake up during the night; others never do. How many times do you usually wake up at night?
    - ○ Never
    - ○ 1 time
    - ○ 2 or 3 times
    - ○ More than 3 times
    - ○ I have no idea

14. People sometimes feel sleepy during the daytime. During your daytime activities, how much of a problem do you have with sleepiness (feeling sleepy, struggling to stay awake)?
    - ○ No problem at all
    - ○ A little problem
    - ○ More than a little problem
    - ○ A big problem
    - ○ A very big problem

15. Some people take naps in the daytime every day; some never do. When do you nap (mark all that apply)?
    - ○ I never nap.
    - ○ I sometimes nap on school days.
    - ○ I sometimes nap on weekends.
    - ○ I never nap unless I am sick.

16. In general, do you feel you usually get....
    - ○ too much sleep?
    - ○ enough sleep?
    - ○ too little sleep?

17. Do you consider yourself to be....
    - ○ a good sleeper?
    - ○ a bad sleeper?

The next set of questions has to do with how you might organize the timing of various activities if you were free to plan your day according to when you feel your best. Please answer the questions based on your body's "feeling best" times.

18. Is it easy for you to get up in the morning?
    - ○ No way!
    - ○ Sort of
    - ○ Pretty easy
    - ○ Totally easy!

19. PE has been scheduled for 7:00 in the morning. How do you think you'll do?
    - ○ My best!
    - ○ Okay
    - ○ Worse than usual
    - ○ Awful!

20. The bad news: You have to take a two-hour test. The good news: You can take it when you think you'll do your best. What time is that?
    - ○ 8:00am to 10:00am
    - ○ 11:00am to 1:00pm
    - ○ 3:00pm to 5:00pm
    - ○ 7:00pm to 9:00pm

21. When do you have the most energy to do your favorite things?
- ○ Morning! I am tired in the evening.
- ○ Morning more than evening
- ○ Evening more than morning
- ○ Evening! I am tired in the morning.

22. Your parents have decided to let you set your own bedtime. What time would you pick? Between...
- ○ 8:00pm and 9:00pm
- ○ 9:00pm and 10:15pm
- ○ 10:15pm and 12:30am
- ○ 12:30am and 1:45am
- ○ 1:45am and 3:00am

23. How alert are you in the first half hour you're up?
- ○ Totally out of it
- ○ A little dazed
- ○ Okay
- ○ Ready to take on the world

24. When you wake up in the morning, how long does it take for you to be totally with it?
- ○ 0 to 10 minutes
- ○ 11 to 20 minutes
- ○ 21 to 40 minutes
- ○ More than 40 minutes

Appendix C

Simple Movements

Cross Crawls – Sit in a chair with your knees out in front of you and your hands at your sides. Raise your left knee and reach across your body with your right hand until it touches the outside of your lower left leg. Return to the starting position. Raise your right knee and reach across your body with your left hand until it touches the outside of your lower right leg. Return to the starting position. Repeat this process nine more times for a total of ten times in one set.

Finger/Thumb -- On one hand, hold up your index finger. On your other hand, hold up your thumb. Then, switch as fast as you can, so the hand that had the finger up now has the thumb up, and the hand that had the thumb up now has the index finger up. The goal is to make this switch simultaneously. This can be done sitting or standing. Do 10 switches for one set.

Owl – Sit in a chair and take your left hand and grasp your right shoulder while squeezing firmly. Turn your head slowly to the left and slowly to the right. Repeat this nine more times for a total of ten times in one set. Take your right hand, grasp your left shoulder and repeat. Do one set with each shoulder.

Lazy Eights – Sit in a chair and extend your left arm out in front of you with a closed fist and your thumb pointing up. Keep your head still and follow your thumb with only your eyes as you trace sideways eights with your thumb. Be sure to make big motions so that your eyes move all around their sockets. Do this five times with the left thumb, five times with the right thumb, and five times with both hands linked and both thumbs up for one set.