

**The effect of video game play and sleep on reaction time**

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## **Abstract**

This project investigated the correlation between sleep and video gaming and how they may impact cognitive and physical abilities, specifically, reaction time. Other research suggests that sleep may or may not have a negative impact; gaming likely has a positive impact on cognitive tasks like reaction time. We hypothesized that the more sleep individuals got the night before, the better their performance would be on three tests. The second hypothesis was that the more people played video games, the better their performance would be on the tests. Our final hypothesis was that there was a multivariable relationship among sleep, gaming, and test scores. Thirty-nine participants were tested on three tests related to reaction time, and we also asked about their sleep and video gaming habits. It was found that sleep did not have an impact on cognitive performance, and it was seen that one bad night of sleep won't really matter and won't affect individuals that much. It was also found that individuals who gamed more had a better performance than those who were non-gamers in all three tests. Lastly, it was found that there is no multivariable relationship between sleep and gaming and the scores on the test; only gaming affects reaction time. Our data suggest that individuals who game more are more likely to have better cognitive abilities than those who don't.

## **The effect of video game play and sleep on reaction time**

The amount of sleep individuals get every night can affect their cognitive abilities and basic motor skills negatively. Nearly 75% of teens do not get the recommended amount of sleep, which suggests that many teens' cognitive abilities may be impaired (1, 2, 3, 4). Researchers have found that a lack of sleep may be caused by teens playing video games. However, research also suggests that video gamers may have better cognitive abilities than non-video gamers (5, 6, 3). In our research, we conducted experiments to measure the cognitive abilities of many teenagers who get less sleep versus those who get enough sleep, as well as see if this pattern holds true for frequent video gamers vs. nongamers. This is important because many teenagers get less sleep than is recommended, and if this negatively affects them, they should know so they can change their behavior.

### *Research on Video Gamers and Cognitive Abilities*

There is a common belief that gamers have excellent eye-hand coordination (5). Researchers hypothesized that gamers would score better on a variety of reaction tests. Forty-four high school students, 17 who were gamers, completed a ping pong ball catching test, a ruler drop test, and a screen reaction test. Gault and Scott found that gamers have a significant advantage in both physical and cognitive abilities, with gamers achieving significantly better results in 2 out of 3 tests (5). In the one test where there was not a significant difference, the gamers did catch more ping pong balls, but the difference was very small. The connection between our research and theirs is that I'm not just measuring the cognitive abilities between gamers and non-gamers; however, I will be using gaming as a factor in my research. I will use people who get adequate sleep vs people who don't, and people who tend not to go to sleep may tend to play video games, making gaming an important thing to consider.

One reason students might not sleep is that they play video games instead of sleeping. So, how do video game players' cognitive abilities compare to those of non-gamers? Latham et al. reported their findings that VGPs (Video Game players) have had a superior performance in hand-eye coordination over NGPS (Non-video Game Players) (6). They found that gamers have to pay attention to multiple things inside a video game, which increases their visuospatial attention. Researchers have also found that children who are VPGS are also more likely to have better reaction times. It has also been found that video game play affects individuals' cognitive abilities. It was examined by having participants play two games. Both of which measure your cognitive abilities: a puzzle game and an action game. The people who played the action video game had faster reaction times but lower accuracy. However, when they played the puzzle game, they had slower reaction time but higher accuracy. I'm going to conduct this experiment because video games are a big part of sleep deprivation, people get less sleep because of them, and many TNA students are avid video game players. Therefore, we asked people how much they play games as well as how much they sleep when we test their cognitive abilities.

We know that video game players have an advantage with reaction time, and sleep affects reaction time, but what about video gamers who don't sleep a lot? Peracchia and Curcio (3) conducted a systematic review of video gamers' sleep and cognitive abilities and found five big ideas. First, Total Sleep Time was reduced for video gamers. Second, Sleep Onset Latency was greater; gamers take longer to fall asleep. Third, slow-wave sleep was worse, so there was more fatigue when they woke up. Then, the next day, the gamer's sustained attention and verbal memory were impaired. Lastly, people who played violent video games like Call of Duty often felt less sleepy because their brains were in overdrive, producing more adrenaline. The researcher concluded the paper by saying that more research is needed because there isn't much research on this topic.

### *Research on Sleep and Ability*

Total sleep deprivation may cause many difficulties with one's dexterity. Khan et al tested 69 participants from Bangladesh, aged 18 to 40 years old (2). There were also two groups, which included 21 males and 8 females (control), and a group which included 8 males and 25 females (experimental). Researchers used a sleep tracker, sleep log, and the Crawford Small Parts Dexterity Test to measure one's psychomotor skills. It was found that the individuals who were totally sleep deprived (24 hours) performed significantly worse in the tests than those who slept more. The researchers concluded that sleep does affect your psychomotor skills and dexterity skills as well as cognitive abilities. This connects to my project because of the fact that I will be measuring cognitive abilities and dexterity based on sleep, although they will not be deprived for 24 hours, but instead we will survey people about their sleep.

Sleep deprivation can be the cause of negative performance in gross motor abilities. Researchers hypothesized that partial sleep deprivation would affect basketball players' performance. Sears used 12 female subjects who were experienced basketball players. They were instructed to stay awake until 5:30 am and rest for 2.5 hours after, and this lasted for 2 days. Subjects were then instructed to fill out a sleepiness scale. Subjects were then put through a plethora of tests, including basketball free throws, passes, vertical jump, shooting, dribbling, and defensive movement. Sears found that there were no negative differences in any of the tests given(4). One reason they did not find a difference is that the activities were gross motor skills; these big movements tend to produce smaller changes. Also, these were highly rehearsed skills for experienced players, so they might rely on muscle memory when tired. This connects to my project because we will be measuring the abilities of individuals who may be sleep deprived, although the tasks will not be basketball-based, but quicker eye-hand coordination movements.

### *Research on Gender and Ability*

Boys and girls do have some physical differences, but do these extend to their cognitive abilities and motor skills? Researchers hypothesized that girls and boys would have different hand-eye coordination, attention, balance, and motor skills. Orhan et al studied 21 boys and 17 girls, who were third and fourth-grade students (7). Students completed a two-arm coordination test, the Cognitron attention test, the Flamingo balance test, and a ball throw test. Researchers found that boys and girls had no significant differences in hand-eye coordination in the tests,

even though the boys scored slightly higher than the girls; the difference wasn't statistically significant. The balance test was the same; however, the girls had fewer falls than the boys, but the difference wasn't significant either. The attention test and motor skills tests also had no differences. This is important to our study because we are confident we can use boys and girls in the study without affecting the results.

Overall, the research says that the lack of sleep may or may not affect reaction time and motor skills, and one of the factors that may affect sleep is playing video games (5, 6, 2, 4). Research also says that gamers get less sleep; however, they also have better reaction abilities than non-gamers (3). This study contributes to an understanding of how sleep and video game training interact to affect one's cognitive abilities. In this study, we will give a survey to high school students in order to find our gamers or non-gamers and how much they all sleep. Then we will have them do a series of three tests of reaction time: ruler drop test, drop stick challenge, keyboard reaction time test.

We hypothesized that the less a person sleeps, the lower their scores will be on the three tests. This is because some research suggests that the lack of sleep lowers reaction time (2). Second, we hypothesized that the more a person games (in hours per week), the better their scores will be on the three tests, and this is because research suggests that video gamers have an advantage with reaction time (5,6). Lastly, we hypothesized that there is a multivariable relationship between sleep and gaming and the score on the tests. This is because of the fact that gamers have better reaction time but sleep less so we think that both things might be important (3).

## **Materials and Method**

A total of 39 high school students and middle school students from the Neighborhood Academy participated in the study. We also included five faculty members. . t. The individuals who participated in the study were given a survey to complete before they started the tests. This survey measured things such as how much sleep they got last night, how many hours of games they played last night and in a week, and if they consider themselves a gamer or not. They were then given three tests: a ruler drop test, a keyboard reaction timed test, and a bar drop test. The ruler drop test was used to measure the reaction time of the individual by having them place their pointer finger and thumb in a parallel direction while their hand rested on the table. The ruler would then be dropped, and the participant would have to catch it as fast as they can; however, they wouldn't know when it would be dropped. The keyboard reaction timed test requires the person to press one button (space bar) on the computer as soon as they see a stop sign. This stop sign comes at random times while they seem to be strolling down a random road, and are distracted by other things while driving a car down the street. The bar drop test is a reaction-time game where foam bars fall at random at eye height, and a person has to catch them with one hand at their side. The ruler drop test is repeated three times, and the distance on the rulers in centimeters is averaged. For the reaction-time test, it is also repeated three times, and the average time in milliseconds is recorded. The bar-drop test is completed twice, so the person has the chance to catch up to 12 bars.

Relationships between sleep, gaming, and reaction times were calculated using a Pearson correlation coefficient r-test. The interaction between sleep and gaming time was investigated with a multivariate regression model. All tests were calculated using [vassarstats.net](http://vassarstats.net) with a 0.05 significance threshold.

## Results

The purpose of this study was to determine whether an individual's cognitive abilities, specifically reaction time, were negatively affected by the amount of sleep they get, and whether gamers had better cognitive abilities than non-gamers, even if they get less sleep.

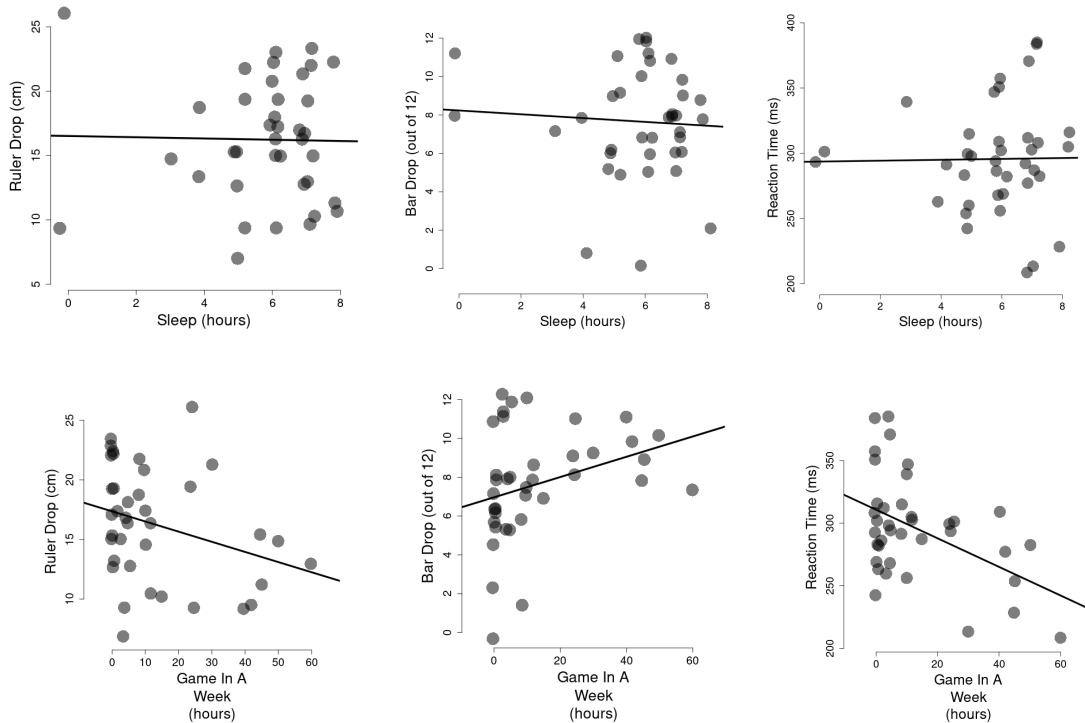
Our first hypothesis was that the less a person sleeps, the lower their scores would be on the three tests. A Pearson correlation coefficient r-test was run with sleep last night as the independent predictor and the score on the **ruler drop** test as the dependent variable. This did not have a significant model (p-one tail=0.45,  $r = -0.018$ ). Sleep did not affect the initial score of the ruler drop test. Another Pearson correlation coefficient r-test was run with sleep, but with the dependent variable being a **bar drop** test. This also did not have a significant model (p-one tail=0.35,  $r = -0.061$ ). Sleep did not have an effect on the initial score of the bar drop test as well. The last Pearson correlation coefficient r-test was run with sleep and the dependent variable being a **reaction time** test. This did not have a significant model as well (p-one tail=0.46,  $r = 0.014$ ). Sleep did not have a significant effect on the scores on the reaction time test.

Our second hypothesis was that the more individuals play games (in hours per week), the better their scores will be on the three tests. A Pearson correlation coefficient r-test was run with gaming in a week as the independent predictor and the score on the **ruler drop** test as the dependent variable. This was a significant effect (p-one tail=0.03,  $r = -0.30$ ). Gaming had a significant, but weak, effect for the ruler drop test. The more a person plays games, the quicker they catch the ruler. Another Pearson correlation coefficient r-test was run with gaming in a week as the independent predictor and the **bar drop** test as the dependent variable. This was a significant effect (p-one tail=0.03,  $r = 0.3$ ). Gaming had a significant effect on the bar drop test; the more a person games, the more bars they catch in the game. Finally, a Pearson correlation coefficient r-test was run with gaming in a week as the independent predictor and the score on the **reaction time** test as the dependent variable. The effect was significant (p-one tail=0.001,  $r = -0.46$ ). Gaming had a significant negative and moderate effect for the reaction time for the reaction time test. The more a person plays, the faster their reaction time.

Our third hypothesis was a multivariable relationship between sleep and gaming, and the scores on the tests. A multiple regression analysis was run with sleep last night and gaming in the last week as the independent predictors and the score on the **ruler drop** test as the dependent variable. This did not result in a significant model ( $F(2,35)=1.8$ ,  $p=0.18$ ). Sleep, with the effect of gaming controlled for, resulted in an unstandardized beta of  $\beta = -0.028$ , suggesting sleep had no effect on the reaction time. Gaming time, with the effect of sleep accounted for, resulted in an unstandardized beta of  $\beta = -0.31$ . For every additional hour of gaming, a person, on average, catches the ruler in 3mm less distance.

Another multiple regression analysis was run with sleep last night and gaming in the last week as the independent predictors and the score on the **bar drop** test as the dependent variable. This also did not result in a significant model ( $F(2,35)=1.86, p=0.17$ ). Sleep resulted in the unstandardized beta of  $\beta = -0.05$ , so sleep has no effect on the bar drop. Gaming had an unstandardized beta of  $\beta = -0.30$ . For approximately every 3 additional hours of gaming, a person could catch a whole bar.

The last multiple regression analysis was run with sleep last night as well as gaming in the last week being used as the independent predictors, and the score on the **reaction time** test being the dependent variable. This did result in a significant model ( $F(2,35)=4.79, p=0.01$ ). Sleep developed an unstandardized beta of  $\beta = 0.0004$ , so sleep has no effect on the bar drop. However, gaming had an unstandardized beta of  $\beta = -0.46$ . For approximately every 1 additional hour of gaming, a person's reaction time would go up by .46 milliseconds.



**Figure 1-6:** Figures 1 to 3 represent the correlation between sleep and the scores on the three tests, and figures 4 to 6 represent the correlation between gaming and the scores on the three tests.

## Discussion

In this experiment, we found out if gaming and sleep affected individuals' reaction time and hand-eye coordination. Our first hypothesis was that the less a person sleeps, the worse they would do on the three tests, which were the reaction time test, bar drop, and ruler drop test. This hypothesis was not supported because of the fact that individuals who got less sleep were still able to perform better than those who got more sleep. In most of the tests, the individuals who got less sleep did better than those who got more sleep (**Figure 1**). The second hypothesis was the more a person games (in hours per week), the better their scores will be on the three tests. This was supported because the individuals who played games performed better than individuals who were non-gamers. The people who are gamers performed better in the three tests (**Figure 6**). Our third hypothesis is that there is a multivariable relationship between sleep and gaming and the score on the tests. This was partially supported due to only one of the hypotheses being fully supported, which was that gaming affects individuals' cognitive abilities and sleep, not affecting their performance (**Figures 4 and 5**).

Our results are consistent with Sears's study, which found that sleep doesn't significantly affect cognitive performance during basketball drills (4). Players' passing accuracy was similar even when sleep-deprived. We found that less sleep had no effect on any of the three tests in this experiment. The experiment strengthens and supports the claim that sleep does not help individuals' cognitive performance. Sleep still is a factor if someone is totally deprived for long periods of time or if they have a long-running sleep deficit. However, if someone got poor sleep the night before, it wouldn't really affect their performance for otherwise healthy people.

The results concerning video gamers in this study are consistent with other research that took place at The Neighborhood Academy by Gault and Scott, which found that gamers had an advantage in 2 out of their 3 tests (5). Our results are also similar to Latham et al, who found that individuals who play video games have a superior performance over individuals who don't play video games (5). We found that individuals who game, in fact, do have an advantage over individuals who don't game, and it is represented in 3 out of 3 of the tests that were given. This is compelling evidence that individuals who game have better cognitive performance than individuals who don't game.

No other studies have looked at the multivariate relationship between sleep, gaming, and cognitive abilities. So we are unable to say if this research is reliable or consistent, but it does suggest that cognitive abilities can improve due to gaming, even if sleep is poor. This experiment also suggests that if people play video games, it's a more important factor because it permanently affects their abilities, so if they were to get some bad sleep, it wouldn't affect their performance.

One big limitation is the fact that my data was clustered around 4-8 hours of sleep, and there were a few outliers who were at 0. This could be bad because it had a big impact on my data, and 0 hours swayed the data more than those who slept more. Ideally it would have been better if there were individuals who slept in the range of 1 to 3 hours to fill in the gap. It was surprising that several students got 0 hours of sleep the night before a school day.

The improvements that could be taken in the future would be having a different variety of tests in the experiment. The tests could range from balancing to basketball drills to whole-body activities that involve their cognitive abilities. I can also improve my experiment by testing more people. Thirty-nine was a good spot, but the more people researchers have, the better their results will be. So in the future, more test subjects will be better for someone's results, especially in gaming vs. non-gaming experiments as well.

The big takeaway we had from this experiment were individuals who tend to have more of a gaming experience had better results than those who didn't game. There was more of a performance boost in 3 out of 3 of the tests for those individuals who were gamers. Another big takeaway is the fact that sleep wasn't an important factor in this experiment at all; it was just gaming that had a big impact on the individuals. We saw that sleep didn't have an impact because individuals who had less sleep did better than people who slept more. People should still sleep; however, one bad night of sleep wouldn't affect someone's cognitive functions too much. The results suggest video games might be an important factor for reaction time, and so people should give them a try.

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