Reaction Time and Cognitive Abilities of Gamers and Non-Gamers

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Abstract

The purpose of this study was to examine the effects of video games on physical skills and cognitive abilities. Previous research has investigated how video games affect the body and brain, and studies have shown that video games can have both positive and negative effects. We hypothesized that frequent gamers have better reaction time, ruler drop scores, and ping-pong catch test scores. Forty-four high school students were involved in this experiment, 17 of whom were gamers. We found that gamers had better average scores than non-gamers on all three tests and were significantly higher on two of our tests. Our data suggest that video game players have a positive advantage in both physical and cognitive abilities, however, our data does not prove that the games caused these benefits.

Video games are a lot of fun, but what if they could be used to improve reaction time as well as physical abilities? Video games are a big part of our lives, over 3.32 billion people play video games on a regular basis (1). This is important because if so many people play video games, it is important to know their effects. Specifically, we are interested in whether video games improve eye-hand coordination and reaction time. These were measured with a ruler drop test, tennis ball test, and reaction-time test. We compared the results from gamers and nongamers to see if video games could improve one's physical and cognitive abilities.

Video Games and Cognitive Ability

Research suggests that first-person shooter games (FPS) can help a person's cognitive abilities (2). In one specific study, researchers investigated how playing video games can affect hand-eye coordination as well as multitasking abilities. An experiment was conducted on 50 people split into two groups: 25 frequent gamers and 25 nongamers. Group 1 (the gamer group) played games before and between each test while group 2, of all non-gamers, just took brief breaks in between their tests. The test simulated work on a computer to measure multitasking. The researchers' hypothesis was supported by the evidence, the test scores had a significant difference, suggesting that video games have a direct correlation to one's cognitive skills and abilities (2). While both groups saw their scores increase over time, the gaming group did much better overall. One challenge of this study is deciding if video games actually help increase these skills, or if people with higher multitasking abilities are also interested in games.

To address this shortcoming other researchers regarding the issue of cause and effect, Green and Bavelier trained non-gamers to play FPS games to see if games themselves cause increased scores or if people with better cognitive skills tend to play video games (3). Specifically, researchers were searching for if action video games affect selective attention. Everyone in this population played "Medal of Honor," a common FPS, for at least an hour for 10 days straight. Researchers found that there was an increase in visual attention (the ability to focus on a target while distractions are present), spatial distribution (the ability to be able to track more than one thing), and temporal resolution (the ability to be able to focus on things over time) (3). The conclusion of this project is that video games may actually cause skills to improve, not just that more talented people play games.

In a review article by Green & Bavelier, they argue that there are 5 positive effects of video games: selective attention in space, time, and objects, more efficient attentional control, and less impulsivity (4). Selective attention in space is the ability to focus on a target and ignore distractions. Selective attention in time is the ability to minimize the attentional blink, which is the lapse in attention after seeing a target. Selective attention to objects is when one can attend to multiple targets. Gamers are better at all of these attention skills (4). Also, gamers are better at ignoring irrelevant distractions and they are less impulsive when acting on targets. In our study, we looked for similar results.

Video Games and Kinesthetic Ability

In addition to the cognitive benefits of video games, some research suggests video games help with physical skills like reaction time and eye-hand coordination (5). Klicka tested 16 college football players, half of whom play video games while the others don't. Group 1 (the gamer group) played action video games for a week and took a test before and after the week while Group 2 (the nongamer group) didn't play any games at all. Results show that the group that played video games increased slightly but not significantly proving that video games can improve the hand-eye coordination for a person especially if using the right precautions for a longer period of time.

Evidence shows that games have an effect on psychological responses in children and adolescents. In a specific study, researchers examined how video games can help improve senses (6). The participants for this experiment are 62 children all from ages 9-14 they were conducted to do certain exercises before and after being in a competitive game against the people in the group. The exercises that were being practiced involved being on a treadmill solo then after being on a treadmill competing on a Kinect device, researchers would then compare the arousal of the children solo vs competing in the game. Results showed that kids were more stimulated when competing in this game, suggesting that games affect children and adolescents' physical abilities.

Can video games help the laparoscopic skills in surgeons? Studies have shown that the playing of video games could possibly help doctors and surgeons sharpen their skills (7). In a sample of 11 Medical students their surgical skills were recorded and split into 2 groups then one group was required to play video games for 2 weeks while the other did not. After the 2 weeks, their skills were then measured again. This source shows that there was a slight increase in skill for those who had played the video games, although this isn't enough evidence to prove that video games are directly proportional to video games it shows that video games could possibly increase surgical skills and can be proven with a bigger sample.

In conclusion, there is evidence showing that video games have a direct correlation to the improvement in abilities of humans both physically and cognitively. In this specific study we compared gamers vs non-gamers with 3 tests (ruler drop, reaction time, and a ping pong ball catching test) that measure reaction time, physical ability and overall eye-hand coordination. We hypothesize that gamers will score better in all three tests

Materials and Methods

In my experiment, there were a total of 44 high school students from The Neighborhood Academy who participated in the study. All subjects in my study are African American, 50% of which will be male while the remaining 50% will be female ranging from 15-18 between the grades of 9-12. A survey was given to all participants to measure how much they play video games, as well as their preferred games. This survey is to see if people are gamers or nongamers. Participants were categorized as gamers or nongamers by the amount of hours played a week.

This experiment has a total of three tests for each person, which measure one's reaction time, eye-hand coordination, and tracking skills. First, they did the ping pong ball test, which measures the ability to track multiple objects. Participants stood 8 feet away from the experimenter and 30 ping pong balls were thrown underhand into the air at a quick pace of one ball per second. The participant used a small box to catch the balls while also tracking the next ball already in the air. In the end, the number in the box was the score. Second, a ruler-drop test was used to measure eye-hand coordination and selective attention in space (5). Participants held their hands in a C shape, and then they had to concentrate on the ruler, which could be dropped at any time. They had to pinch to stop it. The score was the centimeter measurement on the top of the index finger. This was repeated three times and averaged. Last, a reaction-time test on a computer was used (8). A red screen was shown and the participant had to click when it flashes green. This was repeated three times and averaged. The test was always done on the experimenter's Chromebook. Participants were recruited randomly throughout the school over several weeks.

Differences in performance for gamers and nongamers were compared with a t-test. The abbreviation M is the mean. All tests were calculated using vassarstats.net with a 0.05 significant threshold.

Results

In this experiment, we expected that gamers would have an overall better performance than non-gamers.To carry out this project we had 44 high school students do a series of physical and mental tests after they completed a survey about their gaming habits. This experiment was conducted by doing 3 different tests that measured reaction time and hand-eye coordination.

People in the study were separated into two groups, gamers and nongamers. A survey was given out where the first question was if they considered themselves gamers or not. Four people's answers were changed from "no " to "yes" because they played 10+ hours a week, which makes them gamers even though they said "no ". On average, gamers tended to be male exclusively, playing 16.4 more hours per week, and 3.8 more days per week. Nearly half of the gamers were also athletes who played at least one sport, while non-gamers were more likely to be athletes **(Table 1)**.

	Gamers (n= 15)	Non-Gamers (n= 27)
Percent Male/Female	100%/0%	41%/59%
Avg Hours per Week	17.9	1.5
Average Days per Week	0.9 days	4.7 days
Percent who are Athletes	47%	67%

Table 1. Description of our participants

First, we expected the gamers to have lower ruler-drop scores, compared to non-gamers. The ruler-drop test measures reaction time and eye-hand coordination. Participants grab a ruler by pinching it when it is dropped at a random time. The measurement is the centimeters the ruler fell, so the lower the number, the better. A t-test for independent samples found a significant difference ($t(41)=1.7$, $p=0.048$). The gamers ($M=15.11$) had quicker reaction distances than the nongamers ($M=16.64$).

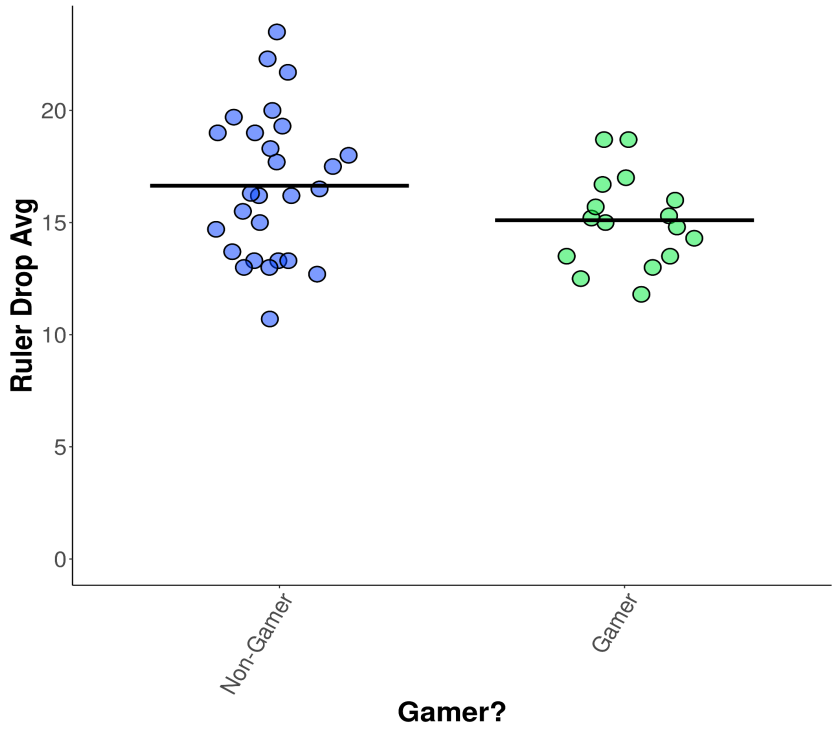

Figure 1. ***Gamers had a shorter Ruler Drop average than non-gamers.*** *This dot plot shows the average ruler drop speed (the black line) between gamers and non-gamers. A ruler was dropped and participants had to catch it as fast as they could with two fingers the data was collected using centimeters (the lower the number the better the score). A two-sample t-test was used $p<0.05$.*

Initially, we anticipated that the gamers would have faster reaction times compared to non-gamers. Data is the average of 3 attempts. The reaction time test measures how fast the participants' brains and bodies react to stimuli. Data is the average of 3 attempts of striking a key when instructed to by the computer and is measured in milliseconds. This means the shorter the time the faster the person's reaction ability. A t-test for independent samples found a significant difference (t(41)=2.3, p=0.013). The gamers (M=289.55) had a faster reaction time than the nongamers (M= 317.63).

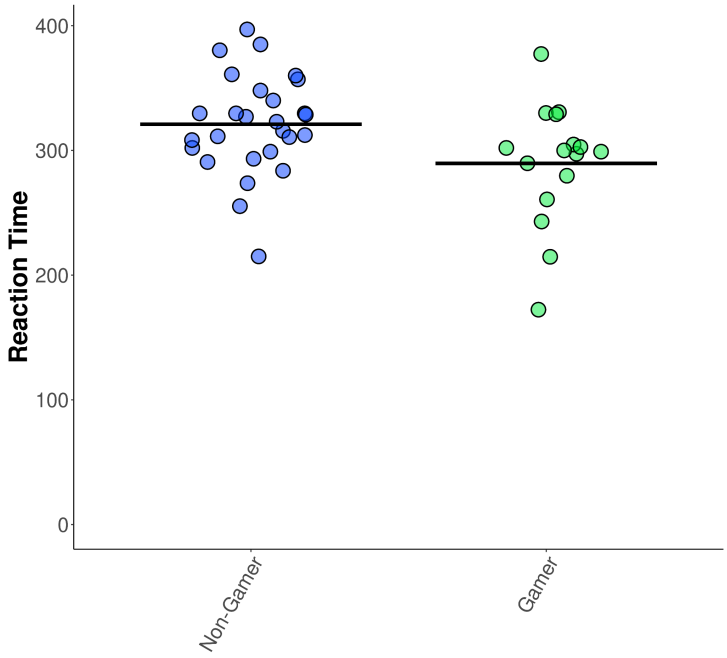

Figure 2. Gamers had a faster reaction time than non-gamers. *This dot plot shows the average reaction time (the black line) of non-gamers vs gamers. A reaction time test was conducted on a computer 3 times and was averaged between trials. A two-sample t-test was used p<0.05.*

Lastly, we expected that gamers would catch more ping pong balls compared to the non-gaming group. The Ping pong ball test measures how many balls the participant can catch in a box out of 30, the balls are thrown underhand about a second after the last one in a rhythm. After all balls are thrown we count how many balls the participants caught and the goal is to catch as many ping pong balls as possible. A t-test for independent samples found an insignificant difference (t(41)= -1.34,p=0.094), The gamers (M=16.4) caught more balls than the non-gamers (M =15.2) but there is not enough evidence to reject the null hypothesis.

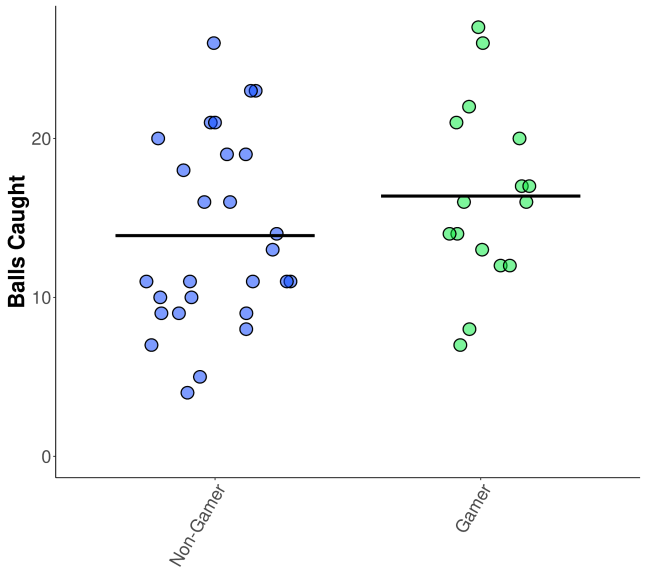

Figure 3. No significant difference in ping pong balls caught between the gamers and nongamers*. This Dot plot shows the average number of balls caught (the black line) between the two groups of people (Gamers and Nongamers). 30 balls were thrown at the participants at around 1 ball a second and participants had to catch as many as possible with a box. A two-sample t-test was used, p>0.05.*

Discussion

In this experiment, we determined if video games can increase a person's physical abilities and cognitive skills. Our first hypothesis was that gamers will have better results in our 3 tests compared to non-gamers. Results show that the gamers had better results on every phase of this experiment and 2 out of 3 tests the gamers were significantly better than the non-gamer group. Gamers had significantly better ruler drop test scores (Figure 1), and significantly faster reaction times (Figure 2), but did not catch significantly more ping pong balls (Figure 3).

Our results are partially consistent with other studies by Kearney (2). Kearney found that FPS games and cognitive abilities could be proportional, which was shown in the results of the multitasking tests participants performed. We found out that in our ping pong ball experiment, we did not find a significant difference, although gamers had better results it isn't enough to support our claim. These results together show that gamers can overall be better multitaskers. Our ping pong test was less reliable than Kearney's test because our test conditions were a bit inconsistent, but both results are in favor of gamers and could help our claim that video games are likely to benefit multitasking skills.

Similar to Kearney, we found that video games can stimulate your mind and benefit people's cognitive skills. In a prior study, Klicka measured the effect of video games on college football players (5). He found that video gamers had faster reaction times and therefore may improve hand-eye coordination for a person. This relates to our study because, in our experiment, the gaming group had significantly faster scores than the non-gaming group which supports my hypothesis. This suggests games might play a role in reaction time.

Our results from the ruler drop test are consistent with Bavelier and Green's findings on video games' benefits on selective attention, attentional blink, and impulsivity (3, 4). In our experiment, the gamers were able to control their impulses and correctly time their ruler drop test while also being significantly faster than the non-gaming group. We also found that because gamers had significantly better scores this suggests that they have little to no attentional blink, which would slow their response. Also, because of this they were able to solely focus on their target (selective attention) which brought about better results. We agree with other researchers that gamers are strong in these cognitive and attentional areas.

Our study had multiple limitations. The first limitation we experienced was our setting, being in a school doing tests during school hours there weren't consistent conditions. For example, some tests were taken from classrooms and gyms to cafeterias and hallways. Another limitation was our small sample size of 44 people, this isn't really enough people to make a final conclusion and there were also more non-gamers than gamers causing an unequal distribution and sample population.

For future researchers, we suggest experiments where the performance of extreme gamers (20+ hours a week) vs non-gamers (1 or fewer hours a week) are compared. This further would expose the difference between the two groups and lead me to a more confident conclusion. Another thing we suggest would be to advertise the experiment more and have an incentive for the people who complete it as well. This would bring more people to the experiment, which would create a larger sample population and motivate people to take the experiment seriously. It would also be interesting to have a group of non-gamers learn to play a game, so we could see if their scores would improve with training.

According to our research, gamers tend to have better cognitive skills and reaction times than nongamers. Because of this, we suggest that games aren't bad and could possibly be beneficial for those who choose to play. If people use them responsibly and in moderation, games could be an important and useful technology we use to improve our performance.

Works Cited

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