

To Study the Effects of Video Games on Concentration, Attention and Reaction Time Among Undergraduate Students: A Randomised Controlled Trial

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Abstract

Objectives: This randomised controlled trial was conducted to determine the effects of video games on concentration, attention and reaction time among the students of Melaka Manipal Medical College. **Methodology:** 60 participants were randomly assigned into two groups, where 30 participants were assigned to video gaming while the other 30 participants were assigned to reading an article. After the participants had gone through the video games and reading respectively, the participants were administered a series of three tests, which were concentration, attention and reaction time. Test scores obtained from the two groups were then converted into percentages and were analysed using Epi Info™. **Results:** Based on the study, subjects in the intervention group had achieved a mean of 27.9% in concentration while the control group had achieved a mean of 30.8% in concentration. These results were slightly higher when compared to the intervention group. In terms of attention, the intervention group had attained a mean of 56.7% while the control group had achieved mean of 60.0% which were also higher when compared to the intervention group. In reaction time however, it was observed that the mean of intervention group was 364.3ms which was higher as compared to the control group that was 324.9ms. **Conclusion:** Non-video gamers performed slightly better than video gamers.

Keywords

Video Games, Concentration, Attention, Reaction Time

1. Introduction

Mental health is not mere absence of mental illness. A good mental health is the ability to respond to varied experiences of life with flexibility and sense of purpose. [1] In Mental Status Examination (MSE), the cognitive or higher mental functions is the main component to be assessed. [2] There are several factors that affect one's cognitive functions. In this research, an experimental study of association between videogames and cognitive abilities will be assessed.

Cognitive abilities such as concentration, alertness and reaction times are needed in playing videogames.

Based on previous studies, computer game research became so significant by 2004. Specifically, researchers have focused on the other factors causing increased in cognitive performance that could be produced by playing of videogames. In general, the research has examined concentration skills and selective attention. [3]

Selective attention is the ability to focus on a specific information that is required to the task, while filtering out the insignificant information. [4] Blumberg found that skilled

computer game players performed better on a popular computer game (Sonic the Hedgehog for Sega Genesis); because they were better able to concentrate on specific game features. This study suggests that those who play computer games frequently are able to focus their attention on relevant information that is crucial for completion at their specific task. [5] Similar results found that those who play computer games frequently have an increased attentional capacity and useful field of view. [6]

A study was done in University of Rochester, study found that by playing action videogames trains people to make right decision faster. The researchers also discovered that video game players develop a better sensitivity towards things going on around them, and this quality doesn't just make them better at playing video games, but improves a wide variety of general skills that help with everyday activities like multitasking, driving, reading small print, keeping track of friends in a crowd, and navigating around town. [7]

Playing video games was related to a significant improvement in the Sternberg reaction time task, and to a relative increase in self-reported well-being. The videogame-playing group had faster reaction times and felt a more positive sense of well-being compared to their nonplaying counterparts. Consistent with previous research on video games and the elderly, the present study finds the strongest effects on measures of reaction time. [8]

There are some risk factors affecting the cognitive function which are associated health, nutrition, and social factors. The WHO identifies these four main risk factors: stunting, inadequate cognitive stimulation, iodine deficiency, and iron deficiency anaemia. [9] Chronic tiredness that results from a number of different causes can cause a lack of concentration that continues for an extended period of time. Stress and anxiety can also be the culprits. [10] Any type of illness that affects the brain or head trauma can cause lack of concentration. Drugs can cause a lack of concentration for different periods after use depending on the specific drug and the half-lives of the drugs. [11]

In this research, questionnaires were included in which require participants' specific information. This is because there are cofounders that will effect one's cognitive abilities. This questionnaire will help to decide which participant is suitable according to the inclusion and exclusion criteria in order to participate in this study.

The objective of this study is to determine the effect of video games on concentration, to determine its effects on attention and also to determine its effects on reaction time. In this study.

2. Methodology

A randomized control trial study was conducted to investigate if there is any impact of video gaming on concentration, attention and reaction time among medical students of MMMC (Muar campus), Malaysia. This study was set in a private medical college, Melaka Manipal Medical College in Muar, Johor, Malaysia where the student

population is around 300, comprising of two batches of 4th year students only. The study was held in January 2019. The inclusion criteria comprised of MBBS students aged between 20 and 25 from batch 37 and 38 irrespective of gender, race or posting. Exclusion criteria were those students who were unwilling to participate, or provide a written consent.

The sample size of this study was calculated using the formula below. [19]

$$n \geq \frac{(Z_{1-\alpha/2} + Z_{1-\beta})^2 (\sigma_1^2 + \sigma_2^2/r)}{(\mu_1 - \mu_2)^2}$$

The sample size was generated from the values of a previous research entitled, "The Effect of Violent and Non-violent Computer Games on Cognitive Performance" (2009) by Christopher P. Barlett. [3]

Where,

Type 1 error rate (α) = 0.05

Type 2 error rate (β) = 0.2

Mean in group 1 (μ_1) = -112.27

Standard Deviation in group 1 (σ_1) = 573.39

Mean in group 2 (μ_2) = -444.81

Standard Deviation in group 2 (σ_2) = 571.11

Sample size ratio group 1 / group 2 (r) = 1

From this formula,

Minimum sample size needed for group 1 = 47

Minimum sample size needed for group 2 = 47

Minimum total sample size needed = 94

Thus, n calculated = 94

The formula used to account for attrition was as follows:

$$n_{final} = \frac{n_{calculated}}{1 - (attrition\%)}$$

Where, the attrition% is set to 10%

Which results in, n final=104.44≈105

Hence, our total sample size is 105 participants.

However, because of the time limitation, we collected 60 participants for our studies.

Non-probability sampling method was used, which requires 60 volunteers from batches of 37 and 38. The participants were then further divided into two groups as "the ones who play video games" and "the ones who never play video games" after assessing the questionnaires previously given.

After sorting out the two groups, the volunteers were numbered and randomized using randomizer.org to be the control group who'd be getting reading materials and the experimental group who'd be asked to play video games (Temple Run 2) for 5 minutes.

Method of randomization used was stratified block randomization using <http://www.randomizer.org>.

All the participants were given an informed consent form to be filled in before participating in the study. The proper consent were obtained and the participants were informed that the participation in the study was optional. Participants will then be divided into 2 categories (play video game and

did not play videogames), then in both categories again will be randomized into control group and intervention group. For control group which consists of 30 students, reading materials will be provided to the participant to read for 5 minutes, while for the intervention group which consists of 30 students will have to play Temple Run 2 video game for 5 minutes. After that, all the participants will be assessed on their concentration, attention and reaction time. To ensure a non-biased result, our intervention was conducted in a conductive study environment and equal time was given to all the participants. We used the same mobile device, iPhone 6s with the same screen size and graphic and reading material given 8 pages of article from InfoMed Magazine Malaysia. [20]

The first test to assess concentration. A YouTube video owned by Sentis on ‘Concentration Challenge - Can you count the bounces?’ was used. [12] Participants is required to watch a 5 Minutes video which shows a series of balls bouncing. The second test was an attention test. YouTube video by Marissa Webb ‘Recreate of Simons and Chabris (1999) of the Monkey Business Illusion’ was used. [13] In this test, the participants watched a 5 Minutes video where a candy was placed under a cup and then shuffled between several other cups. At the end of both test, the participants need to answer a series of questions about the videos. From

these questions, the participants’ attention and concentration was scored. The third test required the participant to perform the reaction time test from the website, Human Benchmark reaction time test average out of 5 values was taken and recorded. All the data is then tabulated in Microsoft Excel.

Data was entered and summarized using Microsoft Excel. Data was analysed using Epi Info™ version 7 from Centres for disease control and prevention website (CDC). For categorical variables, proportions and frequency counts were calculated. For continuous variables, range, minimum, maximum values, mean and standard deviation were computed. Missing and extreme data were explored. Results will be depicted using bar graphs. Estimation of parameters using confidence interval (95% CI) and level of significance (5%)

An Informed consent form with all the important and relevant details of the study was given to the participants. The participants were not forced, but given the option of whether they wanted to participate or not in the study. Participants were notified that all data and information gained through the study would be kept confidential. The form also had a concise explanation about the study and its requirements, and the participants were told that they could choose to withdraw from the study whenever they needed to.

3. Results

Table 1. Participant demographic (n=60).

Variables	Play Videogames (n=30)	Control (n=30)	Total
Age (years)	22.3 (1.06)	22.8 (1.4)	22.5 (1.24)
Gender (%)			
Male	9 (30)	10 (33.33)	19
Female	21 (70)	20 (66.67)	41
BMI (%)			
Underweight	4 (13.33)	2 (6.67)	6
Normal	18 (60)	17 (56.67)	35
Overweight	7 (23.33)	7 (23.33)	14
Obese	1 (3.33)	4 (13.33)	5
Race (%)			
Chinese	14 (46.67)	13 (43.33)	27
Indian	7 (23.33)	8 (26.67)	15
Malay	4 (13.33)	2 (6.67)	6
Others	5 (16.67)	7 (23.33)	12
Smoking (%)			
Yes	0 (0)	1 (3.33)	1
No	30 (100)	29 (96.67)	59
Sleep (%)			
Less than 3hrs	0 (0)	0 (0)	0
3-4hrs	2 (6.67)	3 (10)	5
4-5hrs	3 (10)	4 (13.33)	7
5-6hrs	16 (53.33)	14 (46.67)	30
More than 6hrs	9 (30)	9 (30)	18
Exercise (%)			
Yes	12 (40)	3 (10)	15
No	18 (60)	27 (90)	45
Meditation (%)			
Yes	2 (6.67)	4 (13.33)	6
No	28 (93.33)	26 (86.67)	54

The initial total participants was 60, consisting of intervention group (n=30) and control (n=30). Among the total of 60 participants, mean age in intervention and control groups is 22.3 and 22.8 respectively with standard deviation of 1.06 and 1.4 respectively. For gender, 30% of male and 70% of female are in the intervention group while 33.33 male and 66.67% female are in control group. For BMI,

intervention group consists 13.33% underweight, 60% normal, 23.33% overweight, 3.33% obese and control group consists 6.67% underweight, 56.67% normal, 23.33% overweight, 13.33% obese. For race, intervention group consists of majority of Chinese at 46.67% and Indian at 23.33% while Malays at 13.33% and others at 16.67% and control group is majority of Chinese at 43.33% while Indian

at 26.67%, Malays at 6.67% and others at 23.33%. There are no participants smoking in the intervention group while there is 1 participants smoke in control group. No one slept less than 3 hours in both group. For intervention group, 6.67% slept 3-4 hours, 10% slept 4-5 hours, 53.33% slept 5-6 hours, 30% slept more than 6 hours and for control group, 10% slept 3-4 hours, 13.33% slept 4-5 hours, 46.67% slept 5-6 hours,

30% slept more than 6 hours. For exercise, in intervention group consists of 40% people who exercise and 60% who don't while in control group consists of 10% who exercise and 90% who don't. For meditation, in intervention group only 6.67% who meditated and in control group only 13.33% who meditated.

Table 2. Data of participant with gaming history.

		Intervention n=13	Control n=9	N (%)
Hours spent	< 8 hours a week	4 (30.77%)	6 (66.67%)	10 (45.45%)
	8-12 hours	3 (23.08%)	2 (22.22%)	5 (22.73%)
	13-17 hours	3 (23.08%)	0 (0.00%)	3 (13.64%)
	18-22 hours	0 (0.00%)	1 (11.11%)	1 (4.55%)
	> 22 hours	3 (23.08%)	0 (0.00%)	3 (13.64%)
Videogame experience	<1 year	1 (7.69%)	1 (11.11%)	2 (9.09%)
	1-2 years	3 (23.08%)	1 (11.11%)	4 (18.18%)
	2-3 years	2 (15.38%)	0 (0.00%)	2 (9.09%)
	3-4 years	0 (0.00%)	0 (0.00%)	0 (0%)
	>4 years	7 (53.85%)	7 (77.78%)	14 (63.64%)
Prioritize Gaming over Schoolwork	Yes	10 (76.92%)	3 (23.08%)	14 (63.64%)
	No	4 (44.44%)	5 (55.56%)	8 (36.36%)

There were 22 participants out of 60 who has video gaming history and 9 participants of them is in control group and 13 participants in intervention group. Regarding on hours spent on video games per week, 30.77% of the intervention group spent less than 8 hours, and 66.7% of the control group spent less than 8 hours. 23.08% from intervention group and 22.22% from control group spent 8-12 hours, 23.08% of the intervention group and 0% from control group spent 13-17 hours, 0% of intervention group and 11.11% of control group spent 18-22 hours, 23.08% of intervention and 0% of control group spent more than 22 hours a week. Regarding on years

in playing video games, 7.69% of intervention group and 11.11% of the control group play for less than 1 year, 23.08% of intervention group and 11.11% of the control group play for 1-2 years, 15.38% of intervention group and 0% of the control group play for 2-3 years, 53.85% of the intervention group and 77.78% of the control group play for less than 4 years. 76.92% of the intervention group and 23.08% of the control group feel themselves do prioritize games over schoolwork, 44.44% of the intervention group and 55.56% of the control group feel that they do not prioritize game over their school work.

Table 3. The effect of video games on concentration, attention, and reaction time.

Variable	Mean (SD)		Mean Difference (95%CI)	t-statistic (df)	P Value
	Play video games	Control			
Concentration (%)	27.9 (15.29)	30.8 (16.66)	-2.917 (-11.18, 5.34)	58	0.483
Attention (%)	56.7 (19.62)	60.0 (19.3)	-3.33 (-13.38, 6.71)	58	0.509
Reaction Time (ms)	364.3ms (91.59)	324.9ms (71.08)	39.40 (-2.97, 81.77)	58	0.068

Table 3 shows that intervention group achieved mean of 27.9% of concentration while in the control group achieved 30.8% of concentration. It was found that -2.917 of mean difference between the control and intervention. (95% CI: -11.178, 5.344), p value for concentration is 0.483. Therefore this result is not significant.

For attention, it shows that the intervention group attained

mean of 56.7% while control group achieved mean of 60.0%. The mean difference is -3.33 (95% CI: -13.38, 6.71), p value is found to be 0.509, which is not significant.

In reaction time, the mean of intervention group is 364.3ms while in control group is 324.9 ms. Mean difference is 39.40 (95% CI: -2.97, 81.77), p value is 0.068 and it is not significant.

Table 4. Perceived performance by participants.

	Mean (SD)	Intervention	Control	Mean difference (95% CI)	t-statistic (df)	P-value
Perceived Performance (Concentration) (SCORE /10)	TEST 1	4.5 (2.76)	5.0 (2.59)	-0.5 (-1.9, 0.9)	-0.67 (58)	0.503
Perceived Performance (Attention) (SCORE /10)	TEST 2	4.7 (2.38)	5.3 (2.65)	-0.6 (-1.9, 0.7)	-0.92 (58)	0.360
Perceived Performance (Attention) (SCORE /10)	TEST 1	8.5 (2.60)	9.3 (1.11)	-0.8 (-1.8, 0.3)	-1.49 (58)	0.143
Perceived Performance (Attention) (SCORE /10)	TEST 2	5.5 (2.30)	5.8 (3.01)	-0.4 (-1.8, 1.0)	-0.53 (58)	0.598

The feedback of all participants regarding their performance in the concentration, attention and reaction time

were collected. According to the intervention group, they perceived that they performed mean of 4.5 in test 1 and mean

of 4.7 in test 2 in concentration video. For attention test, they graded themselves mean of 8.5 in test 1 and mean of 5.5 in test 2.

In control group, they graded themselves mean of 5.0 in test 1 and mean of 5.3 in test 2 in concentration video. For attention test, they graded themselves mean of 9.3 in test 1 and mean of 5.8 in test 2.

The mean difference in concentration of test 1 is -0.5 (95% CI = -1.9, 0.9) and in test 2 is -0.6 (95% CI = -1.9, 0.7). The p value of test 1 is 0.503 and test 2 is 0.360. Hence, both shows no significant results.

The mean difference in attention test of test 1 is -0.8 (95% CI = -1.8, 0.3) and in test 2 is -0.4 (95% CI = -1.8, 1.0).. The p value of test 1 is 0.143 and test 2 is 0.598. Hence this shows test 1 and 2 are not significant.

4. Discussion

In the past few decades, interactive electronic media has grown from virtual non-existence to one of the primary means of entertainment for college students. In more recent years, the Internet has completely changed the landscape of electronic media from something individual and static into something with the potential to be interactive and social. [15]

A randomized controlled trial was conducted to determine the effect of video gaming on concentration, attention and reaction time amongst undergraduate medical students. The study has found that subjects in intervention group achieved mean of 27.9% of concentration while in the control group achieved 30.8% of concentration. It was found that -2.917 of mean difference between the control and intervention. (95% CI: -11.178, 5.344), p value for concentration is 0.483. Therefore this result is not significant. For attention, it shows that the intervention group attained mean of 56.7% while control group achieved mean of 60.0%. The mean difference is -3.33 (95% CI: -13.38, 6.71), p value is found to be 0.509, which is not significant. In reaction time, the mean of intervention group is 364.3ms while in control group is 324.9 ms. Mean difference is 39.40 (95% CI: -2.97, 81.77), p value is 0.068 and it is not significant.

There are a few studies that have been done regarding the effect of video gaming on concentration, attention and reaction time. Scientists have collected and summarized studies looking at how video games can shape our brains and behaviour. Research to date suggests that playing video games can change the brain regions responsible for attention and visuospatial skills and make them more efficient. The studies show that playing video games can change how our brains perform, and even their structure. For example, playing video games affects our attention, and some studies found that gamers show improvements in several types of attention, such as sustained attention or selective attention. [16]

The brain regions involved in attention are also more efficient in gamers and require less activation to sustain attention on demanding tasks. There is also evidence that video games can increase the size and efficiency of brain

regions related to visuospatial skills. For example, the right hippocampus was enlarged in both long-term gamers and volunteers following a video game training program. [17]

Video games can also be addictive, and this kind of addiction is called "Internet gaming disorder." Researchers have found functional and structural changes in the neural reward system in gaming addicts, in part by exposing them to gaming cues that cause cravings and monitoring their neural responses. These neural changes are basically the same as those seen in other addictive disorders. [18]

Implications and Recommendations

Gaming preferences may be a moderating or mediating variable that needs to be considered in future research. Although this study targeted college students, future studies with primary and secondary school students could further advance the understanding on the effects of video games, especially in relationship to developmental concerns.

Limitation

This study was carried out only on 4th year medical students of Melaka Manipal Medical College (MMMC). Therefore, generalization to other medical universities or any other educational institution is not possible. Another limitation included the fact that we researchers could not control the amount of sleep our participants had the day before or caffeine consumption, which may affect the subjects' concentration, attention or reaction time. Reduction of sample size was done in this study from 105 to 60 due to time limitation. For future studies on video gaming, a bigger sample size needs to be used.

5. Conclusion

The objective of this research was to study the effect of video gaming on concentration, attention and reaction time amongst undergraduate medical students in Melaka Manipal Medical College (MMMC). Based on this study, the relationship between video games and concentration, attention and reaction time are not significant. Non-video gamers performed slightly better than video gamers. More research in various settings should be done to understand the attitude towards video games among the society. This research can be used as reference for further researches to explore the effect of video games on daily performances. It is important to understand the positive and negative aspects of video games. Playing games socially as part of balanced lifestyle seems to have some positive effects. Some research has shown that video games may be one way to engage students more in the learning process. This seems especially true in areas involving analytical skills. They can contribute another way of learning in addition to the many other pedagogical methods which are currently popular. There is ongoing research on how to best leverage games in education, if they should be used at all. Students and educators need to be aware of the dangers of excessive gaming. It can have academic, social, and spiritual consequences. Balance needs to be emphasized as an important part of the healthy lifestyle, and video games are

no exception. [15]

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