Relationship between Playing Video Games and Happiness

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Abstract

The purpose of this study is to determine whether playing video games is associated with happiness - both in short and longer terms. Previous studies have identified mixed results of video games on mental health. For this study, data was obtained through an online survey sent to teenage students in online and brick-and-mortar schools. Three variables were collected: hours spent playing video games per week, hours of sleep per week (as a confounding variable), and "happiness" ranked on a scale of 1-10. There was an overall, undefined happiness and a "happiness" broken into satisfaction in three categories: academics, relationships, and extracurriculars. Because it was inferred that the average of the satisfaction in the three different categories did not fit with the overall happiness, the averages were used going forward. There were no significant results showing that sleep or "happiness" were different for people who did and did not play video games. The final test of association only indicated that the "happiness" of an individual in a month was associated with hours of sleep. Though the results do not suggest that happiness is associated with playing video games, there was enough evidence that happiness was associated with sleep in a month.

Keywords
Happiness, video games, sleep, statistics

1. Introduction
In the age of rapidly developing technologies, the Internet and video game industries have experienced rapid growth. As the new technologies are developed, many studies have researched the effects of 3C devices on individuals. Many studies focus on either side of the spectrum - researching the possible benefits of video games or the negative effects on cognitive skills.

Teenagers in the US spend an average of over 7 hours per day on screen media and entertainment, and this excludes the time spent using screens for school and homework. "Among teens, the amount of time dedicated to several individual screen activities inched up by 42 minutes per day since 2015" (Rogers 2019) and this time has certainly increased in the past years. Especially during COVID and lockdown, many individuals have turned to online sources of entertainment and the use of the internet in some areas have doubled. Researching the effects of internet use is more important than ever.

Concurrent with internet growth, video games have become more prevalent and accessible as well. Over half of the individuals were reported to have at least one gaming console in their homes and mobile games have also been rising in popularity (Yau et al. 2012).

With the increased amount of time spent playing video games, some people have defended the positive effects of playing video games and researchers have examined benefits. Some such benefits include improvement in attention, cognitive control (Green et al. 2012), and volumetric brain increase (Brilliant T. et al. 2019). However, these are typically not why teenagers decide to play video games. People play video games for fun and enjoyment, not because it improves certain cognitive skills. The cognitive skills are simply a side benefit.

On the other hand, the negative effects of gaming give more insight to playing video games and the happiness that comes with it. One notorious impact of playing video games is addiction. According to the paper *Brain activity and desire for internet video game play*, "the brain circuitry mediating cue induced desire for video games is similar to that elicited by cues related to drugs and alcohol" (Han et al. 2012). This similarity is supported by similar activations in the regions of the brain. In particular, the dorsolateral prefrontal (executive function and response selection),

orbitofrontal cortex (decision making), parahippocampal gyrus (memory encoding and retrieval), and thalamus (relaying sensory and motor signals) were associated with desire for internet video game play (Han et al. 2012). Furthermore, this connection between gaming and addiction is supported by an association between dopamine and reward systems in games. Dopamine is a hormone and neurotransmitter that is released when an individual is either anticipating or in a pleasurable situation and it stimulates the individual to seek out that pleasurable activity. Increased levels of dopamine and the fast rate that this neurotransmitter increases cause addiction. In regard to gaming, this means that an individual can feel happy and pleasure when they are playing video games, but the high dopamine levels (and other important neurotransmitters) can lead to addiction in the long term or gaming disorder.

Gaming disorder is a more serious term for gaming addiction. The DSM-5 issued by the American Psychiatric Association provided nine criteria and meeting five of the criteria would qualify as gaming disorder. One of the criteria provided was "loss of functioning in work, studies or social life due to gaming" (Wang et al. 2019). Even now, it is difficult to define what exactly gaming disorder is and whether it counts as a kind of mental disorder.

It is safe to say that gaming addiction and disorders can affect everyday life. According to a research paper citing the World Health Organization (WHO), "For the diagnosis of gaming disorder, the game behaviour pattern must be serious enough for at least 12 months to cause significant damage in an individual's personal life, family, social, educational, professional, or other important areas of functioning" (Wang et al. 2019). One such important area of functioning is sleep. When an individual is absorbed into the world of gaming and addicted, it can lead to poor sleep quality or simply less sleeping time. In turn, the poor quality of sleep can affect other aspects of life (perhaps academics or other activities), which makes the individual want to escape reality and go back into the world of gaming. This could turn into a very bad cycle with the individual confusing pleasure, or immediate gratification, with happiness and even lead to depression (Gros et al. 2020).

However, not all people who game end up getting addicted. According to a paper that studies videogames and mental health, *Gaming well: links between videogames and flourishing mental health*, "depressed mood has been found to be significantly lower in moderate players of videogames compared to those who "never" play videogames and those who play videogames to excess (Durkin and Barber 2002), and time spent in gameplay is highlighted as the moderating factor" (Jones et al 2014). A moderating factor is one that provides a more insightful account to exactly how the dependent variable – the mental health and mood – is related to the independent variable – whether one plays video games or not. In other words, due to reward systems and an increase in dopamine, people who play video games at "just the right amount" are happier than those who do not play video games at all and those who spend too much time playing video games.

In summary, previous research has pointed out the positive cognitive effects of playing video games, but those benefits are not the main reason why teens play video games. Research regarding the negative effects of playing video games, namely addiction, has given insight to the fact that gaming does influence happiness. However, this relationship between gaming and happiness is not very clear. When is an individual playing "too much" and starting to be unhappy? How many hours a week is a good amount? Therefore, the main purpose of this project is to analyze the relationship between video games and happiness and determine whether these two variables are associated, with sleep as a confounding variable (for it can be influenced by time spent playing video games and influence happiness).

2. Methods

This portion of the project explains the initial hypotheses and the method of data collection. It was hypothesized that there would be a "sweet spot" or "just the right amount" for playing video games; if an individual played video games, they may be happier than those someone who does not. However, if the individual plays too much, they will be unhappier. An online survey was sent to middle and high school students from Stanford Online High School and Taipei American School. It was used to gather information about the hours spent on playing video games, hours of sleep, and "happiness" of an individual in two-time intervals - a week and a month.

2.1 Hypotheses

The initial hypothesis was that people who played video games at "just the right amount" may be happier than normal. According to the American Academy of Pediatrics, the maximum recommended time to play video games on weekdays is 30 minutes to 1 hour and 2 hours on weekends (American Academy of Pediatrics 2013). The hypothesized "right amount" would fall between 0 hours/week and the recommended values (from 30 minutes to 2 hours depending

on the day). If an individual plays too much, then their happiness would decrease because they might get less sleep or spend less time doing things that they should be doing like homework. The individual's happiness was collected over two-time intervals: a week (shorter amount of time) and a month (longer amount of time). This was because it was hypothesized that the impact of spending too much time playing video games may not be very obvious in a short amount of time, like a week. However, for longer intervals, their decreasing happiness may be observed more clearly, perhaps due to and reflected by poor grades, poor relationships, or less participation in extracurriculars.

2.2 Data Collection

The data was collected through a Google Form survey. This form was distributed through three social media platforms: Skype, Instagram, and Snapchat. Teenage students (middle schoolers and high schoolers) from Stanford Online High School and Taipei American School filled out the form. The reason for targeting people in this age range was that teenagers nowadays have access to better technologies and a lot more different games. It is hard to find statistics on exactly how much more prevalent video game addiction and gaming disorder really is, since the very definition of "addiction" is somewhat ambiguous and difficult to diagnose. Regardless, due to the increased exposure to digital media, more teenagers in general have been spending more time playing video games.

One variable collected was the average hours per week spent on playing video games. The following options were given on the Google Form: 0, 1-2, 2-3, 3-4, 4-5, 5-6, 6-7, 7 or more. The reason for choosing these values (and aggregated in this way) is because the American Academy of Pediatrics suggests that the time spent on gaming should be under 30-60 minutes on school days and 2 hours or less on non-school days (American Academy of Pediatrics 2013). Assuming students play 30 minutes on school days and the maximum 2 hours on non-school days gives a recommended playing time of 6.5 hours per week. Assuming 60 minutes on school days and the maximum 2 hours on non-school days gives a recommended playing time of 9 hours per week. It was decided that the form would specify up until 7 hours and include a 7 or more option. Seven hours per week (which is between 6.5 and 9) means that the average time spent playing per day is 1 hour. Additionally, the first option (0) was not aggregated because it shows that one does not play video games at all. If it were 0-1, it would be uncertain whether they play very little video games or none at all. The importance of this unaggregated value will come in later statistical tests.

Another variable collected was the average hours of sleep per week. The following options were given on the Google Form: 0-20, 20-30, 30-40, 40-50, 50-60, 60-70, 70 or more. The reason for the values is because the American Academy of Sleep Medicine has recommended that teenagers (between the ages of 13 and 18) should sleep 8-10 hours per day (Centers for Disease Control and Prevention 2020). The "70 or more" hours of sleep category corresponds to the maximum of the recommended hours of sleep per day – 10 hours. However, lower values were taken into consideration as well, because the study shows that 72.7% of teenagers did not get enough sleep on school nights. The reason for the uneven aggregation (from 0-20) is because there were very few people who slept less than 20 hours per week - only 1 out of the 67 people surveyed.

Lastly, the final variable was happiness, which was the hardest variable to define and collect. The three following categories were used to better define happiness: satisfaction in academics, relationship with friends and family, and extracurriculars. These three categories were chosen because academics and extracurriculars are a big part of teenage life, especially for high school students. The relationship with friends and family were asked because parental relationships and friendship quality have been identified as key variables to happiness (Holder and Coleman 2015). In conjunction, these three categories were predicted to define happiness. The three categories were asked to be ranked on a scale of 1-10 (1 being extremely unsatisfied). Then, the overall and undefined happiness was asked. The overall happiness refers to the individual's answer to the question "Rank your happiness" without any attempt to define what happiness meant.

After attempting to define happiness, happiness in the short-term versus long-term had to be differentiated. It is crucial to differentiate between short and long term happiness because in the moment (or the shorter term), people will likely find joy in playing video games. However, if people start playing too much, it may affect their performance in other areas, such as academic performance, relationship with others, and time spent in extracurricular activities. Therefore, the researcher asked the same set of questions for two different time intervals: a week and a month.

3. Data and Statistical Analysis

This section consists of a brief overview of some of the data and the statistical analysis. The statistical analysis involves three types of tests: the Chi-Square Test Goodness of Fit, the normal distribution in the Mann-Whitney test, and the Chi-Square Test of Association. The Chi-Square Goodness of Fit test determined that the average of the three categories – satisfaction in academics, relationships, and extracurriculars – did not fit the overall happiness. The normal distribution in the Mann-Whitney tests failed to detect that the average hours of sleep and "happiness" of people who do and do not play video games were from different populations. Lastly, the Chi-Square Test of Association showed that sleep and "happiness" could be associated in a month, but again, failed to yield results that suggest "happiness" and playing video games were associated.

3.1 Data Types

The "average hours spent playing video games in a week" variable is on the ratio scale because it is a numerical scale with an absolute zero value (you cannot play negative hours of video games). Though on the ratio scale, this variable is mostly organized and analyzed on the ordinal scale.

The total hours of sleep in a week is also on the ratio scale because it is a numerical scale with an absolute zero value. Though on the ratio scale, this variable is mostly organized and analyzed on the ordinal scale as well (as mentioned in the data collection section.)

The "happiness" variable is on an ordinal scale. In other words, it is a rank order scale and the numbers assigned to evaluate happiness are relative to one another (e.g., a "10" would mean that the individual is happier than a "9".)

3.2 Data Presentation

Figure 1 displays basic demographic information about the individuals in the sample. Full time online students take all of their classes online and do not attend a brick-and-mortar school. Part time students take 2-3 courses online, but may still go to a brick-and-mortar school. Single course students take only 1 course online and still go to a brick-and-mortar school. These three categories (full time, part time, and single course) only pertain to Stanford Online High School students. This demographic can be an important factor because students who go to Stanford Online High School full time will almost certainly be spending more time of their day on the laptop (and with access to games) than those who go to a brick-and-mortar school (and Stanford Online High School single-course or part-time). Most students who took the survey are full time online students, as expected.

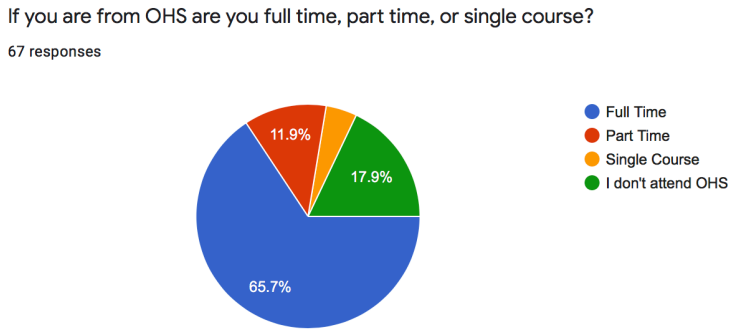

Figure 1. Pie Chart of Demographic Information

Figure 2 below shows the average hours of video games played per week. It was predicted that the majority of students would play video games (and not fall into the 0 hours per week category). However, a specific time interval was not predicted because many students can play from as little as 30 minutes per week up to more than 7 hours per week. An interesting and unexpected observation is that almost half of the people who took the survey did not play video games (0 hours per week). This may have been due to a sample that is not representative of the population, since data was collected through a survey and through volunteers. However, another likely explanation is response bias. Response bias is when participants respond falsely to questions. The people being surveyed may have been dishonest and inputted lower hours than they actually play.

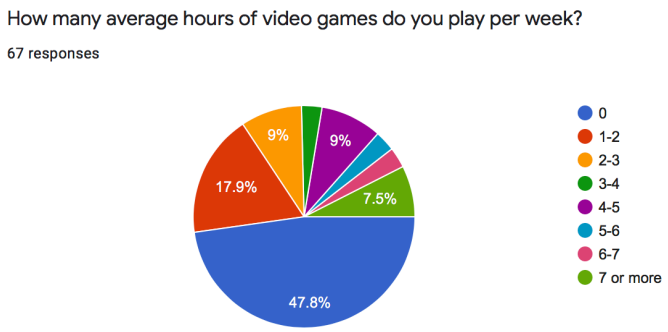

Figure 2. Pie Chart of Average Hours of Playing Video Games Per Week

Figure 3 displays the happiness of the individuals in the sample in a frequency bar graph. As seen below, students tended to avoid both sides of the extreme (1 being extremely unhappy and 10 being extremely happy). The median rank for happiness is 7 and the mean is approximately 5.91. Since the median is greater than the mean, the data is slightly negatively skewed. The shape of the distribution was expected to be roughly normal because it was predicted that few people would avoid either side of the extremes (which was found to be true).

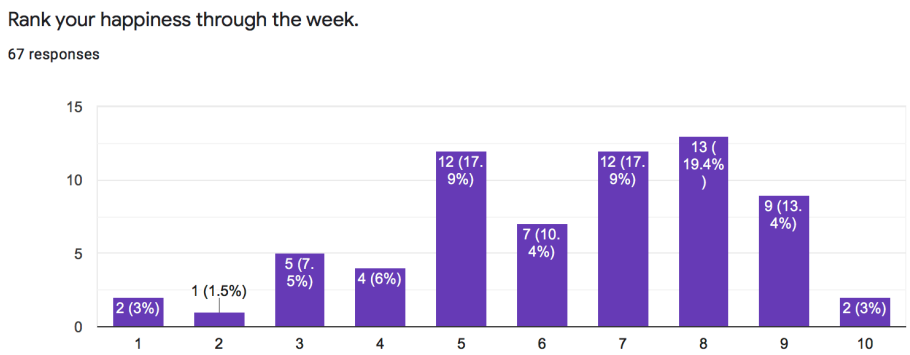

Figure 3. Frequency Table of the Happiness of Individuals in the Sample

3.3 Chi-Square Test Goodness of Fit

First, the Chi-Square Test: Goodness of Fit was used to observe whether the three categories used to define happiness (academics, relationship with friends and family, and extracurriculars) fit overall happiness (the happiness asked in a survey, without being defined or narrowed down). This test is used to check whether a distribution of data fits an expected pattern because it compares the expected and observed frequencies. The chi-square value is obtained using by taking the sum of squared difference of the observed value minus the expected value divided by the expected value.

In this case, the observed values are the average of the three categories. The expected values are the overall happiness. This test was used for the data collected for a week and a month to determine whether the average of the three categories fit the overall happiness for both time intervals.

Regarding the data for a week, the Chi-Square Value is approximately 24.67. A contingency table (Table 1) is shown below and the sum of the Chi-Square values for each individual observation together yield the Chi-Square value (similar tables were created for each test). The degree of freedom is 10 columns - 1 = 9, which means that the critical values are 16.92 (for $p<0.05$) and 21.67 (for $p<0.01$). The Chi-Square Value is greater than both critical values, hence the result is highly statistically significant. This means that the null hypothesis (that the observed frequencies fit the

expected pattern) is rejected and it is inferred that the average of the three categories do not fit their overall happiness for a week.

Table 1. Chi-Square Goodness of Fit Test (Week)

Happiness Average of the 3 categories:	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10
Observed Frequencies				3	8	3	10	20	17	6
Expected Frequencies		2	1	5	4	12	7	12	13	11
Chi-Square Values (for each individual obs.)		2	1	0.8	4	6.75	1.285714286	5.333333333	1.230769231	2.272727273

Running the test for the data for a month, a test statistic of around 25.47 is obtained. The degrees of freedom is the same as above (10 columns - 1 = 9) and so are the critical values (16.92 and 21.67). Again, this result is highly statistically significant. This means that there is not sufficient evidence that suggests the average of the three categories fit their overall happiness for a month.

Because for both time intervals (week and month), the average of the three categories (academics, friends and family, and extracurriculars) did not fit their overall happiness (which were the expected values) in the sample, throughout the rest of the data analysis, the average of the three will be used. The average will instead be used because these three categories are clearly defined, whereas happiness is too broad. Therefore, the original question in the study (how do video games affect happiness?) will be changed to "How do video games affect one's satisfaction with academics, relationship with friends and family, and extracurriculars?" For simplicity, these three categories will be referred to in the rest of the report as "happiness."

3.4 Mann-Whitney Test Normal Approximation

The Mann-Whitney Test compares the medians of 2 unmatched samples, instead of means, because it is a nonparametric test (and can deal with ordinal data). This test was chosen because the data, though some of it on the ratio scale, was organized and analyzed on the ordinal scale. As aforementioned, hours of sleep is on the ratio scale, but aggregated into ranks (e.g., 0-20, 20-30) and hence it is organized on the ordinal scale. More generally, parametric data (in this case, the hours of sleep on the ratio scale) can be changed into nonparametric data (on the ordinal scale). This cannot happen vice versa; nonparametric data cannot be changed into parametric data. Because of this, an ordinal test was used instead of a ratio test because an ordinal test can deal with both parametric and nonparametric data.

In the Mann-Whitney test, a U statistic is calculated and can be compared to a critical value. If the U-value is larger, the null hypothesis can be rejected. While this method can be used for small samples, large samples (approximately n>20) have a different method. For large samples, U is approximately normally distributed and can be calculated using a standardized z-score. Since the sample in the study (n=67) qualifies as a large sample, a normal distribution was used to determine the p-value. The equation of the standardized value is shown below in Figure 4 along with the formula for the mean and standard deviation.

$$z = \frac{U - m_U}{\sigma_U}$$

$$m_U = \frac{n_1 n_2}{2}$$

$$\sigma_{\text{corr}} = \sqrt{\frac{n_1 n_2}{12}\left((n+1) - \sum_{i=1}^{k} \frac{{t_i}^3 - t_i}{n(n-1)}\right)}$$

where $n = n_1 + n_2$
t_i is the number of subjects sharing rank i
and k is the number of (distinct) ranks

Figure 4. Equations Used for Calculating the Standardized Z-Score

The normal distribution in the Mann-Whitney Test was used to measure the hours of sleep for people who do and do not play video games, the average "happiness" in a week for people who do and do not play video games, and the average "happiness" in a month for people who do and do not play video games.

Firstly, it was to be determined whether the hours of sleep for people who do and do not play video came from different populations. After running the test, a U statistic of 441 was calculated. The number of people who did not play video games was 32 (n1=32) and the number of people who did play video games was 35 (n2=35). The sample sizes are the same for the other Mann-Whitney tests as well. Using the formula above, a mean of 560 and a standard deviation of 76.728 was calculated. The resulting z-score was -1.55, which corresponds to a p-value of 0.121. Since the p-value is greater than alpha (0.05), the null hypothesis is failed to be rejected: there is not sufficient evidence that the samples were taken from populations with different averages. Hence, using this specific sample, it is inferred that the hours of sleep for people who do and do not play video games have a similar average. This implies that people who do and do not play video games get the same amount of sleep. This result was not unexpected, for the people who do play video games could have only spent a little amount of time playing and it wouldn't have affected their sleep.

Next, the test was used to determine whether the average "happiness" in a week of people who played video games differed from those who did not. After running the test, a U statistic of 505 was obtained. A mean of 560 and a standard deviation of 79.473 were calculated, resulting in a z-score of -0.692. The corresponding p-value is 0.489. Since the p-value is greater than the significance level of 0.05, the null hypothesis failed to be rejected, and there is not enough evidence that the samples were taken from populations with different averages. More specifically, this means that based on this sample, it is assumed that "happiness" of people who do and do not play video games within a week have a similar average. In respect to the original hypothesis, this result was somewhat unexpected; it was hypothesized that the happiness of people who did and did not play video games were different. However, this may be due to the short period of time, which may mask a possible difference.

Similarly, the test was used to determine whether the average "happiness" in a month of people who played video games differed from those who did not. A U value of 522.5 was calculated. The mean was 560 and the standard deviation was 79.456. The z-score was -0.472 and the p-value was 0.637. Because the p-value is much greater than the significant level of 0.05, the null hypothesis failed to be rejected. This means that there is not sufficient evidence to suggest that the "happiness" of people who do and do not play video games in a month have different averages, hence a similar average is assumed based on the given sample data. This result was unexpected. Even during a longer period of time, there appeared to be no detectable difference between the happiness of individuals who played and did not play video games. The people who did play did not seem happier or less happy than the people who did not play.

3.5 Chi-Square Test of Association

The final kind of test used was the Chi-Square Test of Association. This test looks for an association between 2 variables. It was used to determine whether different variables are associated with one another (in other words, is there a relationship between the variables?). The Mann-Whitney tests were used as a simple tool to compare the averages for hours of sleep and "happiness" for people who do and do not play video games, but it does not incorporate the

many ranges for people who do play video games. The Chi-Square Test of association takes the different ranges into consideration. It can be used to determine whether an association exists even if there appears to be no difference in the averages of the sample, as the Mann-Whitney test might mask such results. Perhaps there appeared to be no detectable difference in the Mann-Whitney normal approximation because those who did play video games were either happier or unhappier and the data ended up cancelling each other out.

Similar to the Chi-Square Goodness of Fit test, the expected values are compared to the observed values through the same formula. In this case, the expected values specify what the values of each cell of the contingency table would be if there was NO association between the two variables. To calculate the expected value of a single cell in the table, the row total is multiplied by the column total and divided by the grand total.

By comparing the expected values to the observed values, the test is able to suggest whether two variables are associated or not. The test was run 5 times with two different variables for each time. Table 2 sums up the two variables involved for each test and the results of each of the tests.

Table 2. Chi-Square Test of Association Results Summary

Test Number	The two variables being tested for an association	P-value	Significance
1	Hours of sleep Hours of video games played	0.05216	Insignificant
2	"Happiness" in a week Hours of video games played	0.07920	Insignificant
3	"Happiness" in a month Hours of video games played	0.38006	Insignificant
4	"Happiness" in a week Hours of sleep	0.13350	Insignificant
5	"Happiness" in a month Hours of sleep	0.00001	Highly Significant

Firstly, the test was run to determine whether there was an association between hours of sleep and hours of video games played. After running the test, a value of 57.89 was obtained. The degree of freedom is (8 rows - 1) * (7 columns - 1) = 42. The critical value for $p<0.05$ is 58.12. Because the calculated value is less than the critical value, the null hypothesis failed to be rejected; there is not enough evidence to suggest an association between hours of sleep and hours of video games played. In other words, regardless of the hours of video games played, the hours of sleep did not change noticeably. It was originally predicted that when one becomes addicted and spends a lot of time playing video games, one's hours of sleep would be affected. After all, video game addiction can lead to "significant damage…in important areas of functioning" (Wang et al. 2019), sleep being one of them. The lack of association detected was an unexpected result.

Next, it was to be determined whether there was an association between "happiness" in a week and hours of video games played. A chi-square value of 55.5 was obtained. The degree of freedom is (7 rows - 1) * (8 columns - 1) = 42, same as the previous test. Because the calculated value is less than the critical value of 58.12, the null hypothesis again failed to be rejected and based on this sample, it is inferred that there is no association between "happiness" in a week and hours of video games. This was also an unexpected result. The data from the study suggests that video games does not make one happier if they play at "the right amount" or make one less happy if they play too much, which goes against the initial hypothesis. Especially regarding this shorter time interval, it was expected to show that video games made one happier. This is an important result that challenges why the individuals in the study play video games in the first place if it does not lead to pleasure or greater enjoyment.

After that, a similar chi-square test was used, but this time using the data for a month instead of a week. A chi-square value of 44.17 was obtained. Since this is less than the critical value, the null hypothesis failed to be rejected: there is not sufficient evidence to show that there is an association between "happiness" in a month and hours of video games played. Similarly, to the previous test, this goes against the initial hypothesis. While the data in a week may not show obvious negative results (perhaps due to the fact that the negative effects have yet to surface and grow), a month was expected to be able to detect these possible negative effects. The lack of evidence showing the impact of video games on happiness does not question whether playing video games too much negatively influences mental health – that much was agreed upon by previous studies. However, it suggests crucial information about the sample itself: no one, based on their answers in the survey, had played video games enough to exhibit negative effects.

Next, it was to be determined whether there is an association between "happiness" in a week and hours of sleep. These two variables were tested for an association because it was originally hypothesized that hours spent playing video games may be related to hours of sleep, which in turn may relate to happiness. Hence, hours of sleep and "happiness" were to be tested for a possible association. After running the test, the Chi-Square Value of 45.49 was calculated. The degree of freedom is (7 rows - 1) * (7 columns - 1) = 36. The critical value for $p<0.05$ is 50.998. Because the statistic calculated is less than the critical value, the result is not significant, and the null hypothesis failed to be rejected. There is not enough evidence to suggest an association between "happiness" in a week and hours of sleep. This was not an unexpected result. While it was predicted that "happiness" and hours of sleep would be associated with one another, it was also noted that the short time period of a week may mask the results. An individual may not feel that lack of sleep in only one week influences his/her "happiness."

Next, another Chi-Square test was performed, but instead, this time using the data for "happiness" in a month and hours of sleep. A chi-square value of 84.03 was obtained. The degree of freedom is 36 (same as the previous test). Interestingly, this time the result is highly statistically significant because 84.03>50.998 (the test statistic is greater than the critical value for $p<0.01$). The null hypothesis is rejected, and we infer that there *is* an association between "happiness" in a month and hours of sleep. This is a significant result that suggests a positive relation between the two variables. Additionally, this result does fit in with the original hypothesis. However, regarding the larger picture and overall objective, this result by itself does not seem that crucial. The variable "hours of sleep" was originally collected because sleep may be a confounding variable that can be influenced by the time spent playing video games and affect "happiness." However, in the first Chi-Square Test of association, an association between sleep and playing video games was failed to be detected. Therefore, even though sleep is associated with "happiness," it is not related to the time spent playing video games.

4. Conclusions

The purpose of this study was to determine the relationship between hours spent playing video games and happiness. The hours of sleep was collected as a confounding variable. The Chi-Square Goodness of Fit Test determined that the average of the three categories of happiness (satisfaction in academics, relationships, and extracurriculars) did not fit the overall happiness. Because the average of the three categories was more specific and well-defined, it was a better measure of "happiness" in this study. This average was used for the other tests. In the study, the only significant result detected was that "happiness" in a month is associated with sleep; no results that suggested an association between "happiness" and video games were detected.

From the normal distribution in the Mann-Whitney test, no significant results were obtained. Three inferences were drawn based on the sample: 1) the average hours of sleep for people who do and do not play video games were from similar populations, 2) the "happiness" in a week of people who do and do not play video games were from similar populations, and 3) the "happiness" in a month of people who do and do not play video games were also from similar populations. The first result was not unexpected, for there could be people who spent little time playing video games and it would not influence their hours of sleep. Whether one plays video games or not, their average hours of sleep and "happiness" in different time intervals were the same, indicating that video games do not appear to affect "happiness." These two results were unexpected and did not support the initial hypothesis that video games and "happiness" would be from populations with different averages.

From the Chi-square Test of Association, 5 inferences were drawn and only one result was significant - the test for "happiness" in a month and sleep. Firstly, there is not enough evidence to show that the hours of sleep and hours of video games are associated, which does not support the initial hypothesis that sleep is be a confounding variable that may be influenced by hours spent playing video games. Next, it was failed to be detected that the "happiness" of an

individual in both a week and a month and the hours of video games played were associated based on the sample in the study. Both these results also did not support the hypothesis that people who played games at a certain "right amount" (0 minutes - 30minutes to 2 hours) would be happier, but people who played too much would actually be less happy. Lastly, while the "happiness" of an individual in a week did not seem to be associated with the hours of sleep, these two variables are associated when the time interval is a month. These two variables were initially tested for an association because sleep may have been associated with playing video games and happiness. However, from the first Chi-Square Test of Association, no association was detected between sleep and video games. Therefore, even when sleep and "happiness" in a month do appear to be associated, it does not have to do with playing video games, as original hypothesized.

A possible explanation for these insignificant results that do not suggest a relationship between happiness and playing video games could be the small sample size. Perhaps the sample obtained was not representative of the population, which can be the case with samples consisted of volunteers. Additionally, because a survey was used to gather information, people may not have answered honestly. Even if the survey had reached people who actually had gaming addiction, they may have inputted lower times spent gaming or higher "happiness" than they were actually feeling. This would have led to inaccurate results.

Some of this data does not support the original hypothesis, which was that "happiness" would be affected by video games. When one plays "just the right amount" – greater than 0 hours per week but less than 2 hours of video games per week – it can make them happier. However, when one plays too much, it will affect the sleep they get, and hence make them unhappier. The statistical tests imply that happiness and sleep are mostly unaffected by video games. The only test that yields significant results other than the Chi-Square Test Goodness of Fit indicates that "happiness" in a month is associated with hours of sleep, but since sleep is not associated with video games, it does not really contribute to the overall objective of the study. Therefore, this study suggests that happiness and playing video games are not associated with one another, but happiness and sleep may be associated in the long term.

5. Future Research

For this study, three variables were analyzed: "happiness" of students in a week and month as well as their hours spent playing video games and hours of sleep. However, several possible factors may have impacted the accuracy of the results. Convenient sampling was used - the people who took the survey were volunteers. As a result, most individuals in the sample were Stanford Online High School students and few were from brick-and-mortar schools. Additionally, the survey indicated that approximately half of the online school students did not play video games, but this result seems inaccurate based on personal experience. Most of the researcher's friends and acquaintances who are full time online students do play video games and many call together while playing up to hours of video games. Further repetitions of the study could use random selection (specifically stratified random sampling) to obtain a more representative sample and minimize sampling error. Another way to mitigate confounding variables could be to select all students from the same school (because for example, the curriculum and academics at Stanford Online High School is more challenging).

An option for follow up studies would include analyzing causal relationships between these variables. Do video games cause less sleep? Does less sleep cause less happiness? Do video games impact the happiness of an individual (and in a positive or negative manner)? An experiment would be required instead of an observational study, since causation cannot be inferred from observational studies.

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Biography

Allie Lin is a student at Stanford Online High School. Her favorite subjects are chemistry and biology and statistics. She has taken AP Chemistry, AP Biology, AP Statistics, and is currently taking a university level class called Data Science. In addition to STEMS, she enjoys studying business and entrepreneurship and she is the founder and leader of the How to Start a business club.